ODISHA BRIDGE & CONSTRUCTION CORPORATION LIMITED
(A Government of Odisha Undertaking)
VIKASH BHAWAN, NAYAPALLI, BHUBANESHWAR-751012
PHONE NO. 0674- 2394093, 2396309, 2390043 FAX-2396326

****

Bid Identification No. 32/Tender/OBCC/2026-27

NATIONAL COMPETITIVE BIDDING
(WORKS ON TURNKEY BASIS WITH ARCHITECTURAL PLANNING, DESIGN AND EXECUTION)

Request for Proposal
towards

Redevelopment of Maharaja Krishna Chandra Gajapati (MKCG) Medical College & Hospital, Brahmapur, Ganjam (Phase-I)

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(ଓଡ଼ିଶା ସରକାରଙ୍କ ପୂର୍ତ୍ତ ବିଭାଗ ଅଧିନସ୍ଥ ଏକ ଉଦ୍ୟୋଗ)

obcc

ODISHA BRIDGE & CONSTRUCTION CORPORATION LIMITED
(A Government of Odisha Undertaking under Works Department)

ବିକାଶ ଭବନ, ନୟାପଲ୍ଲୀ, ଭୁବନେଶ୍ୱର – ୭୫୧୦୧୨, ଦୂରଭାଷ – ୦୬୭୪ – ୨୩୯୦୦୪୩, CIN: U45203OR1983SGC001153
Vikash Bhavan, Nayapalli, Bhubaneshwar – 751012, Tel: 0674-2390043, Website: www.obcc.in, Email: md@obcc.in; info@obcc.in

No: 7498
File: SMT-2137

Date: 03.10.2026

CORRIGENDUM NO.- 1 to NIT

Name of the Work: **REDEVELOPMENT OF MAHARAJA KRISHNA CHANDRA GAJAPATI MEDICAL COLLAGE AND HOSPITAL, BRAHMAPUR**

Bid identification No. **32/Tender/OBCC/2026-27**

Sl. No.	Reference	As per NIT	As modified
1.	Sl No. 1 NIT	The Bid document shall be available in the website https://tendersodisha.gov.in , from dt. **20.08.2026 to 5.00 P.M.** of dt. **17.09.2026** for online bidding.	The Bid document shall be available in the website https://tendersodisha.gov.in , from dt. **03.10.2026 to 5.00 P.M.** of dt. **30.10.2026** for online bidding.
2.	Sl No. 3 NIT	Pre-bid queries will be received up to **05.00 P.M of 28.08.2026** through email queries@obcc.in and circle2@obcc.in	Pre-bid queries will be received up to **05.00 P.M of 12.10.2026** through email queries@obcc.in and circle2@obcc.in
3.	Sl No. 4 NIT	The Pre-bid meeting will be held on **29.08.2026 at 11.00 A.M** through video conferencing in the following link: https://meet.google.com/inp-zebt-ebp	The Pre-bid meeting will be held on **13.10.2026 at 12.00 P.M** through video conferencing in the following link: https://meet.google.com/osg-rxyt-mpa
4.	Sl No. 5 NIT	Pre-bid clarification shall be available in e-procurement portal on **03.09.2026**.	Pre-bid clarification shall be available in e-procurement portal on **23.10.2026**.
5.	Sl No. 6 NIT	The bids shall be received only on **"online"** on or before **5.00 P.M. of dt. 17.09.2026.**	The bids shall be received only on **"online"** on or before **5.00 P.M. of dt. 30.10.2026.**
6.	Sl No. 9 NIT	The technical bids received online shall be opened on **dt. 18.09.2026 at 11.30**	The technical bids received online shall be opened on **dt. 31.10.2026 at 11.30**

		AM in the office of the Managing Director, Odisha Bridge & Construction Cooperation Ltd, Vikash Bhavan, Bhubaneswar, Odisha in the presence of the bidders, who wish to attend. Bidders who participated in the bid can witness the opening of bids after logging on to the site through their DSC. If the office happens to be closed on the scheduled date of opening, then the bid will be opened on the next working day at the same time and venue.	**AM** in the office of the Managing Director, Odisha Bridge & Construction Cooperation Ltd, Vikash Bhavan, Bhubaneswar, Odisha in the presence of the bidders, who wish to attend. Bidders who participated in the bid can witness the opening of bids after logging on to the site through their DSC. If the office happens to be closed on the scheduled date of opening, then the bid will be opened on the next working day at the same time and venue.
7	Sl No. 10 NIT	The Design Basis Report (DBR) in Cover-III and the Original financial transaction receipts in support of the Bid Processing Fee and Bid Security in Cover-IV shall have to be submitted on or before **05.00 P.M** of **Dt. 22.09.2026** in the office of Managing Director, OB&CC Ltd. failing which the bid shall not be evaluated and liable for rejection.	The Design Basis Report (DBR) in Cover-III and the Original financial transaction receipts in support of the Bid Processing Fee and Bid Security in Cover-IV shall have to be submitted on or before **05.00 P.M** of **Dt. 03.11.2026** in the office of Managing Director, OB&CC Ltd. failing which the bid shall not be evaluated and liable for rejection.

8. The Corrigendum shall be the part of the RFP documents
9. All other terms & conditions remain unchanged.

3|10|26

Chief Engineer-II

ଓଡ଼ିଶା ସେତୁ ଓ ନିର୍ମାଣ ନିଗମ ଲିଃ
(ଓଡ଼ିଶା ସରକାରଙ୍କ ପୂର୍ତ୍ତ ବିଭାଗ ଅଧିନସ୍ଥ ଏକ ଉପକ୍ରମ)

ODISHA BRIDGE & CONSTRUCTION CORPORATION LIMITED
(A Government of Odisha Undertaking under Works Department)

ବିକାଶ ଭବନ, ନୟାପଲ୍ଲୀ, ଭୁବନେଶ୍ୱର – ୭୫୧୦୧୨, ଦୂରଭାଷ – ୦୬୭୪ – ୨୩୯୦୦୪୩, CIN: U45203OR1983SGC001153
Vikash Bhavan, Nayapalli, Bhubaneshwar – 751012, Tel: 0674-2390043, Website: www.obcc.in, Email: md@obcc.in; info@obcc.in

No: 6166 Date: 12.08.26
File: SMT-2137

NOTICE INVITING TENDER

Bid Identification: 32/Tender/OBCC/2026-27

The Chief Engineer-II Odisha Bridge & Construction Corporation Limited, Vikash Bhawan, Bhubaneshwar on behalf of the Governor of Odisha, invites bids from eligible bidders for the work mentioned below on a Turnkey basis at Bhubaneshwar, Odisha.

Sl. No.	Name of the Work	Concerned Nodal Officer with Headquarters	Bid Security Fee/ EMD	Bid Processing Fee	Class of Contractor	Time for completion
1	2	3	4	5	6	7
1	**REDEVELOPMENT OF MAHARAJA KRISHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLAGE AND HOSPITAL, BRAHMAPUR, GANJAM (PHASE-I)**	Chief Engineer-II	₹ 13,80,00,000.00	₹ 14,00,000.00 (Including GST)	Super Class	**30** (Thirty) Calendar Months

1. The Bid document shall be available in the website https://tendersodisha.gov.in, from **dt. 20.08.2026 to 5.00 P.M. of dt. 17.09.2026** for online bidding.
2. The bidder must possess compatible Digital Signature Certificate (DSC) of Class – III. The online bidding procedure is indicated in the document.
3. Pre-bid queries will be received up to **05.00 P.M of 28.08.2026** through email queries@obcc.in and circle2@obcc.in
4. The pre-bid meeting will be held on **29.08.2026 at 11.30 A.M** through video conferencing in the following link: https://meet.google.com/inp-zebt-ebp
5. Pre-bid clarification shall be available in e-procurement portal on **03.09.2026.**
6. The bids shall be received only on **"online"** on or before **05.00 P.M. of dt. 17.09.2026.**
7. The Bidders must submit the non-refundable Bid Processing Fee of required amount as stated in the above table at Column no 5. Scanned copy of Demand Draft for Bid Processing Fee shall have to be uploaded along with the Technical Bid failing which bid shall be summarily rejected.

8. The bidder must submit the bid security/ EMD of the required amount of **₹ 13,96,00,000.00.** Scanned copy transaction receipt of the Bank Guarantee of the Bid Security Fee shall have to be uploaded along with the Technical Bid failing which the bid shall be summarily rejected.

9. The technical bids received online shall be opened on **dt. 18.09.2026 at 11.30 A.M** in the office of the Managing Director, Odisha Bridge & Construction Cooperation Ltd, Vikash Bhavan, Bhubaneswar, Odisha in the presence of the bidders, who wish to attend. Bidders who participated in the bid can witness the opening of bids after logging on to the site through their DSC. If the office happens to be closed on the scheduled date of opening, then the bid will be opened on the next working day at the same time and venue.

10. The Design Basis Report (DBR) in Cover-III and the Original financial transaction receipts in support of the Bid Processing Fee and Bid Security in Cover-IV shall have to be submitted on or before **05.00 P.M** of **Dt. 22.09.2026** in the office of Managing Director, OB&CC Ltd. failing which the bid shall not be evaluated and liable for rejection

11. Bids submitted other than the e-procurement platform shall not be considered.

12. The authority reserves the right to cancel any or all bids without assigning any reason thereof.

13. Further details with any addendum, corrigendum, cancellation can be seen from the website https://tendersodisha.gov.in.

12/8/26

Chief Engineer-II

C.C. to:

1. The PS to The Hon'ble Minister, Law, Works, Excise Government of Odisha for kind information of Hon'ble Minister.
2. The PS to The Principal Secretary to Government of Odisha, Works Department, Bhubaneswar, for kind information of the Principal Secretary.
3. The Engineer-in–Chief (Civil), Odisha, Bhubaneswar
4. The Chief Engineer (Buildings), Odisha/ Chief Engineer (DPI & Roads), Odisha/ Chief Engineer (NHs), Odisha/ Chief Manager (Technical), State e-Procurement Cell, O/o E.I.C., Nirman Soudha, Bhubaneswar/ Chief Engineer, NIC office, Bhubaneshwar.
5. The Chief Finance Officer (CFO), OB & CC Ltd., Bhubaneswar
6. The General Manager, Bramhapur Division, OB & CC Ltd, Bhubaneswar.

PART-1

BIDDING PROCESS

INVITATION FOR BIDS

ODISHA BRIDGE & CONSTRUCTION CORPORATION LIMITED

(A Government of Odisha Undertaking)

VIKASH BHAVAN, NAYAPALLI, BHUBANESHWAR-751012

NATIONAL COMPETITIVE BIDDING

(WORKS ON TURNKEY BASIS WITH ARCHITECTURAL PLANNING, DESIGN AND EXECUTION)

NAME OF WORK	:	Redevelopment of Maharaja Krishna Chandra Gajapati (MKCG) Medical College & Hospital, Brahmapur, Ganjam (Phase-I)
PERIOD OF AVAILABILITY OF BID DOCUMENT	:	From 28.08.2026 to 5.00 P.M of 24.09.2026
LAST DATE OF RECEIPT OF PRE-BID QUERIES	:	Up to 05.00 P.M of 05.09.2026
PRE-BID MEETING	:	On 07.09.2026 at 11.30 A.M (Through Video Conferencing) Link: https://meet.google.com/inp-zebt-ebp
ISSUE OF PRE-BID CLARIFICATIONS	:	11.09.2026
LAST DATE AND TIME FOR RECEIPT OF BIDS	:	24.09.2026 till 05.00 P.M
TIME AND DATE OF OPENING TECHNICAL BIDS	:	25.09.2026 at 11.30 A.M
TIME AND DATE OF CONCEPT DRAWING PRESENTATION	:	TO BE ANNOUNCED
TIME AND DATE OF OPENING OF FINANCIAL BIDS	:	TO BE ANNOUNCED
PLACE OF OPENING OF BIDS	:	Office of the Managing Director, Odisha Bridge & Construction Cooperation Ltd., Vikash Bhawan, 2nd Floor Conference Hall, Nayapalli, Bhubaneshwar-751012.
OFFICER INVITING BIDS	:	Chief Engineer (Civil)- II, Odisha Bridge & Construction Corporation Ltd., Odisha.

SECTION 1
INSTRUCTION TO BIDDERS (ITB)

A. GENERAL INSTRUCTIONS

1. Scope of Bid:

1.1 The Employer [As mentioned in Bid Data Sheet at the end of Section-1] invites bids for the works namely [As mentioned in Bid Data Sheet at the end of Section-1] with design and execution (as defined in this document and referred to as "the works".

1.2 The successful bidder shall be expected to complete the works by the intended completion date specified in the Contract.

1.3. Throughout these bidding documents, the terms 'bid' and 'tender' and their derivatives (bidder, tender, bid/ tender, bidding/ tendering, etc.) are synonymous. Contractor means the selected bidder for the work.

2. Source of Funds:

The expenditure on this project shall be met from the budget of the Government of Odisha.

3. Eligible Bidders:

3.1. This Invitation for Bids is open to all bidders registered with the Government of Odisha or other State Governments / Government of India / MES / Railways for execution of Civil works in general and Building works in particular. Bidders are advised to note the minimum qualification criteria specified in the "Instruction to Bidders" to qualify for the award of contract.

3.2. All bidders shall provide in Section 2, Forms of Bid and Qualification Information.

3.3 Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices.

4. Qualification of the Bidder:

4.1 All bidders shall provide Forms of Bid and Qualification Information under Section 2, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary. The proposed methodology should include a program of construction backed with equipment planning and deployment duly supported with broad calculations and quality assurance procedures proposed to be adopted justifying their capability of execution and completion of work as per technical specifications, within stipulated period of completion.

4.2 All bidders shall include the following information and documents with their bids in Section 2- :

(a) Copies of original documents defining the constitution or legal status, place of registration, and principal place of business, written power of attorney of the signatory of the Bid to commit the Bidder;

(b) Financial Turnover of the bidder from civil construction works during last five financial years ending **31.03.2026**. [As mentioned in Bid Data Sheet at the end of Section-1]

(c) Experience in… [As mentioned in Bid Data Sheet at the end of Section-1] works and size for each of the last seven years ending last day of month previous to the one in which applications are invited, and details of works under way or contractually committed and clients who may be contacted for further information on those contracts;

(d) Major items of construction equipment proposed to carry out the Contract;

(e) Qualifications and experience of key site management and technical personnel proposed for the Contract.

(f) Reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past five financial years;

(g) Evidence of adequacy of working capital for this contract [access to line (s) of credit and availability of other financial resources];

(h) Authority to seek references from the Bidder's bankers;

(i) Information regarding any litigation or arbitration resulting from contracts executed by the bidder in the last five years or currently under execution. The information shall include the names of the parties concerned, the disputed amount, cause of litigation, and matter in dispute;

(j) Proposals for subcontracting components of the works amounting to more than …. [As mentioned in Bid Data Sheet at the end of Section-1] percent of the Bid Price (for each, the qualifications and experience of the identified sub-contractor in the relevant field should be annexed); and

(k) The proposed methodology and program of construction, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications within the stipulated period of completion as per milestones as mentioned in the Contract data. [As mentioned in Bid Data Sheet at the end of Section-1]

4.3 Bids from Joint ventures/association of firms: ……. [As mentioned in Bid Data Sheet at the end of Section 1].

4.4.A. To qualify for award of contract, each bidder in its name should have in the last five financial years immediately preceding the financial year in which the bids are received: -

(a) Achieved a minimum annual financial turnover[1] of .....[As mentioned in Bid Data Sheet at the end of Section-1].

(b) Satisfactorily completed, as a prime Bidder, at least one similar work / any major civil construction work of value not less than [As mentioned in Bid Data Sheet at the end of Section-1]. Bidder should submit completion certificate for Central / State Government projects. For private sectorprojects, completion certificates with TDS shall be submitted.

(c) Deleted

(d) Bidders must furnish their bid, a detailed construction planning and methodology supported with layout and necessary drawings and detailed calculations to allow the Employer to review their proposals.

[1] *Financial turnover and cost of completed works of previous financial years shall be given weightage of 10% (ten percent) per year based on rupee value to bring them to the price level upto the year of bid invitation.*

4.4.B. Each bidder should further demonstrate: -

(a) Availability (either owned or leased) of the following key and critical equipment for this work:

Sl. No.	List of plants and equipment [As mentioned in Bid Data Sheet at the end ofSection-1].	Requirement[2] [As mentioned in Bid Data Sheet at the endof Section-1].
1.		
2.		

(b) The bidders should, however, undertake their own studies and furnish with their bid, a detailed construction planning and methodology supported with layout and necessary drawings and detail calculations to allow the Employer to review their proposals. The numbers, types and capacities of each plant/equipment shall be shown in the proposals along with the cycle time for each operation for the given production capacity to match the requirements.

(c) Liquid assets and / or availability of credit facilities of not less than the amount of Rs..... [As mentioned in Bid Data Sheet at the end of Section-1]. crores *(Credit lines /letter of Credit / Certificate from banks for meeting the fund requirements etc. – usually the equivalent of the estimated cash flow for three months in peak construction period)*

4.4.C. To qualify for a package of contracts made up of this and other contracts for which bids are invited in the IFB, the bidder must demonstrate having experience and resources sufficient to meet the aggregate of the qualifying criteria for the individual contracts.

4.5 Sub-contractors' experience and resources shall not be taken into account in determining the bidder's compliance with the qualifying criteria. [Clarified in Bid Data Sheet at the end of Section-1]

4.6 Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity is more than the total bid value. The available bid capacity will be calculated as under:

Assessed Available Bid Capacity = (A x N x 2) -B

Where:

A = Maximum value of civil engineering works executed in any one financial year during the last five financial years (updated to bid invitation year .... [As mentioned in Bid Data Sheet at the end of Section-1] price level) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion for which the bid has been invited

B = Value (updated to the price level on the financial year in which bids are received) of existing commitments and on-going works[3] to be completed during the next..... [As mentioned in Bid Data Sheet at the end of Section-1]

[2]*An indicative list of major equipment and their quantity to attain the completion of works areshown in the Bid Data Sheet.*

[3]*The statements showing the value of existing commitments and on-going work as well as the stipulated period of completion remaining for each of the works listed should be countersigned bythe Engineer-in-charge, not below the rank of an Executive Engineer or equivalent.*

4.7 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

- Made any misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or

- Record of poor performance such as abandoning the work, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.; and / or

- Participated in the previous bidding for the same work and had quoted unreasonably high bid prices and could not furnish rational justification to the Employer.

5. One Bid per Bidder:

The E-Procurement procedure accepts only one bid from one bidder. Refer e-procurement procedure as annexed.

6. Cost of Bidding:

6.1 The bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible and liable for those costs.

7. Site visit and verification of information

7.1 The Bidder, at the Bidder's own responsibility and risk is encouraged to visit and examine the Site of

Works and its surroundings and obtain all information like site conditions, traffic, location, surroundings, climate, availability of power, water & other utilities for construction, access to site, handling and storageof materials, weather data, applicable laws and regulations, and any other matter considered relevant by them that may be necessary for preparing the Bid and entering into a contract for construction of the Works with in the stipulated time of submission of the Bid. No extension of time is likely to be considered for submission of Bids. The costs of visiting the Site shall be at the Bidder's own expense.

7.2 The Geotechnical and other related data provided by the Employer are based on the investigation conducted by Employer and are for reference purposes only. The Bidder should satisfy himself with the data furnished and make his own investigations if required for submitting his offer.

7.3 It shall be deemed that by submitting a BID, the Bidder has:

(a) made a complete and careful examination of the Bidding Documents, Schedules of the RFP Document.

(b) received all relevant information requested from the Employer.

(c) accepted the risk of inadequacy, error or mistake in the information provided in the Bidding Documents or furnished by or on behalf of the Authority relating to any of the matters referred to in Clause 7.1 above. No claim shall be admissible at any stage on this account.

(d) satisfied itself about all matters, things and information including matters referred to in Clause 7.1 hereinabove necessary and required for submitting an informed BID, execution of the Project in accordance with the Bidding Documents and performance of all its obligations thereunder.

(e) acknowledged and agreed that inadequacy, lack of completeness or incorrectness of information provided in the Bidding Documents or ignorance of any of the matters referred to in Clause 7.1 hereinabove shall not be a basis for any claim for compensation, damages, extension of time for performance of its obligations, loss of profits etc. from the Employer, or a ground for termination of the Agreement by the Contractor;

(f) acknowledged that it does not have a Conflict of Interest; and

(g) agreed to be bound by the undertakings provided by it under and in terms hereof.

7.4 The Employer shall not be liable for any omission, mistake or error in respect of any of the above or on account of any matter or thing arising out of or concerning or relating to RFP, including any error or mistake therein or in any information or data given by the Employer/ any of his Representatives.

B. BIDDING DOCUMENTS

8. Content of Bidding Documents:

8.1 The set of bidding documents comprises the documents listed below, and addenda issued in accordance with Clause 10:

Section	Particulars	Volume No.
	Invitation for Bids	I
1	Instructions to Bidders	
2	Form of bid, Qualification Information, and other forms	
3	Conditions of Contract	
4	Contract data	
5	Technical Specifications	II
6	Securities and other forms	III
7	Conceptual and Indicative Drawings	IV
8	Terms of Reference, Design Brief & Scope of Work, Geotechnical Investigation Report	
9	Payment Schedule	
10	Documents to be furnished by Bidder	V

8.2. The Bidder shall download the above listed documents as listed under Volume I, II, III, IV and V shall submit his bid online after preparing the same in compliance to Section-2 (refer clause 12).

8.3. The bidder shall be expected to examine carefully all instructions, conditions of contract, contract data, forms, terms, technical specifications, annexures and drawings in the Bid Document. Failure to comply with the requirements of Bid Documents shall be at the bidder's own risk. Pursuant to Clause 26 hereof, bids, which are not substantially responsive to the requirements of the Bid Documents, shall be rejected.

9. Clarification of Bidding Documents:

9.1 A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by cable (hereinafter "cable" includes telex, facsimile and e-mail) at the Employer's address indicated in the invitation to bid. The Employer will respond to any request for clarification, which he received earlier than 15 days prior to the deadline for submission of bids. Employer's response will be uploaded to the e-procurement site in shape of corrigendum / addendum if required.

9.2 Pre-bid meeting:

9.2.1 The bidder or his official representative is invited to attend a pre-bid meeting which shall be held through video conferencing as mentioned in Bid Data Sheet at the end of Section-1].

9.2.2 The purpose of this meeting will be to clarify issues and to answer questions on any matter that may be raised at this stage.

9.2.3 The bidder is requested to submit any questions in writing to reach the Employer not later than the date as mentioned in the Bid Data sheet.

9.2.4 Minutes of the meeting/ response to queries, including the text of the questions raised (without identifying the source of enquiry) and the responses given will be uploaded in the e-procurement portal. Any modification of the bidding documents listed in Sub-Clause 8.1 which may become necessary as a result of the pre-bid meeting/ queries shall be made by the Employer exclusively through the issue of an addendum/ corrigendum pursuant to Clause 10 and not through the minutes of the pre-bid meeting.

9.2.5 Non-attendance at the pre-bid meeting or non-submission of pre-bid query will not be a cause for disqualification of a bidder.

10. Amendment of Bidding Documents:

10.1 Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing addendum/ corrigendum.

10.2 Any addendum/ corrigendum thus issued shall be part of the bidding documents and shall be uploaded on the e- procurement site in shape of corrigendum / addendum if required.

10.3 To give prospective bidders reasonable time [As mentioned in Bid Data Sheet at the end of Section-1] in which to take an addendum into account in preparing their bids, the Employer may extend as necessary the deadline for submission of bids, in accordance with Sub-Clause 20.2 below.

10.4 The addendum/ corrigendum shall also be available on the official website [As mentioned in Bid Data Sheet at the end of Section-1].

C. PREPARATION OF BIDS

11. Language of the Bid:

11.1 All documents relating to the bid shall be in the English language.

12. Documents comprising the Bid:

12.1 The bid to be submitted by the bidder shall be in two separate parts (refer Clause 8.1):

Cover-I: Shall be named "***Technical Bid***" and shall comprise (to be submitted online): -

(i) Technical Bid (in the format indicated at Section 2).

(ii) Scanned copy of Transaction receipt of the Bid Processing fee & Scanned copy of Transaction receipt / Bank Guarantee of Bid Security/ EMD

(iii) Qualification Information and supporting documents as specified in Section -2

(iv) Certificates, undertakings, affidavits as specified in Section 2,

(v) Undertaking that the bid shall remain valid for the period specified in Clause 15.1 of Bid Data Sheet

Cover –II: Shall be named "***Financial Bid***" and shall comprise (to be submitted online only)

(i) The Lump Sum Price Bid

Cover-III (both online as well as original hardcopy):

The Bidder shall furnish the Design Basis Report (DBR) in Cover-III as indicated in this Annexure. The intent of this DBR is to present the salient features of technical considerations and scope of work envisaged by the bidder for the project, based on which the bidder has made its financial offer.

The bidder shall make sure that the DBR should cover sections on Architectural, civil, structural, electrical, public health engineering, HVAC, fire protection system, elevator systems and other monitoring and control systems, landscaping aspects For Details Please refer Annexure-III to ITB.

Cover-IV (both online as well as original hardcopy):

Bidder shall furnish other documents

i. Transaction receipt of Bid Processing Fee

ii. Transaction receipt / Bank Guarantee of Bid Security / EMD.

13. Bid Price:

13.1 The contract shall be for the whole work as described in Sub-Clause 1.1, based on the Lump Sum PriceBid submitted by the Bidder.

13.2 The bidder shall fill in the total bid price as **Lump Sum Price** (both in figures and words) for all items of work as specified in the Bid document.

13.3 The prices tendered shall be accepted in so far as it is otherwise, provided under the contract, include all constructional plant, labour, supervision, materials, erection maintenance, insurance, profit, taxes and duties & other levies together with all general risks, liabilities and obligations set out or implied in the contract.

13.4 The lump sum bid price quoted by the bidder shall be fixed for the duration of the Contract and shall not be subject to adjustment on any account.

14. Currencies of Bid and Payment:

14.1 The currency of bid and payment shall be quoted by the bidder entirely in Indian Rupees. All payments shall be made in Indian Rupees.

15. Bid Validity:

15.1 Bids shall remain valid for a period.....[As mentioned in Bid Data Sheet at the end of Section-1] after the due date for bid submission specified in Clause 20. A bid valid for a shorter period shall be rejected by the Employer as non-responsive. In case of discrepancy in bid validity period between that given in the undertaking pursuant to Clause 12.1 (v) and the Form of Bid submitted by the bidder, the latter shall be deemed to stand corrected in accordance with the former and the bidder has to provide for any additional security that is required.

15.2. In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders and the bidder may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable / e-mail. A bidder may refuse the request without forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid but will be required to extend the validity of his bid security for a period of the extension, and in compliance with Clause 16 in all respects.

16. Bid Security:

16.1 The Bidder shall furnish, as part of his Bid, a Bid security of an amount as shown in IFB for this particular work. Bid security in the shape such as Deposit Receipt of Scheduled Bank (Term Deposit Receipt) / Post Office Savings Bank Account / National Savings Certificate / Postal Office Time Deposit Account duly pledged in favour of ....[As mentioned in 16.1 of Bid Data Sheet at the end

of Section-1] is acceptable**.** The bidder has the option of furnishing Bid Security in the form of Bank Guarantee from a Nationalized Bank of India, in the prescribed format at Section 2- Section V-Bid Security.

16.2. Any bid not accompanied by acceptable Bid Security and not secured as indicated insub-clauses 16.1 shall be rejected by the Employer as non-responsive.

16.3. The Bid Security of unsuccessful bidders shall be returned within 28 days of the end of the bid validity period specified in sub-clause 15.1.

16.4. The Bid Security of the successful bidder shall be discharged when the bidder has signed the Agreement and furnished the required Performance Security.

16.5 The Bid Security may be forfeited

(a) If the Bidder withdraws the Bid after Bid opening during the period of Bid validity;

(b) In the case of a successful Bidder, if the Bidder fails within the specified time limit to

(i) Sign the Agreement; or

(ii) Furnish the required Performance Security.

(iii) Deposit the required license fees with State Government to register itself as a Special/ Super Class Contractor with Government of Odisha within 15 (fifteen) days of issue of Letter of Acceptance of Bid.

17. Alternative Proposals by Bidders:

17.1 Bidders shall submit offers as per his own estimate based on his own design & drawing but complying with the requirements of the bidding documents, including the basic technical design parameters and as per regulations of concerned Urban Development Authority, OECBC, specifications relevant to MoRTH, IRC, IS Codes & NBC.

Conditional offers or alternative offers will not be considered further in the process of tender evaluation.

18. Format and Signing of Bid: Refer e-Procurement procedure at Annexed

D. SUBMISSION OF BIDS

Online submission as per Govt. of Odisha e-Procurement Procedure annexed

19. **Sealing and Marking of Bids –** Refer e-procurement procedure as annexed in Annexure-I to ITB for Cover-I and Cover-II of the bid (Clause-12.1).

20. **Deadline for Submission of the Bids**

20.1 Bid shall be received on or before [As mentioned in 20.1 of Bid Data Sheet at the end of Section-1] as notified in IFB.

20.2 The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

21. **Late Bids:** Not applicable as per e-Procurement procedure.

22. **Modification and Withdrawal of Bids:** Refer e-Procurement procedure as annexed.

E. BID OPENING AND EVALUATION

23. Bid Opening:

23.1 All the bids received shall be opened in the Office of the Employer on [As mentioned in Bid Data Sheet at the end of Section-1] in the presence of the Bidders or their representatives who choose to attend. In the event of the specified date of Bid opening being declared a holiday, the Bids will be opened at the appointed time and location on the next working day.

23.2 The Employer shall prepare minutes of the Bid opening.

24. Process to be Confidential:

24.1 Information relating to the examination, clarification, evaluation, and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award is successful and Bidder has been announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid.

25. Clarification of Financial Bids:

25.1. To assist in the examination, evaluation, and comparison of Bids, the Employer may, at his discretion, ask the lowest evaluated responsive bidder for clarification of his-Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by cable/e-mail, but no change in the price or substance of the Bid shall be sought, offered, or permitted.

25.2. Subject to Sub-Clause 24.1, no Bidder shall contact the Employer on any matter relating to his bid from the time of the bid opening to the time the contract is awarded. If the Bidder wishes to bring additional information to the notice of the Employer, it should do so writing.

25.3. Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in the rejection of the Bidders' bid.

26. Examination of Bids and Determination of Responsiveness:

The Employer reserves the right to verify all statements, information and documents submitted by the Bidder in response to the RFP. Any such verification or lack of such verification by the Employer shall not relieve the Bidder of its obligations or liabilities hereunder nor will it affect any rights of the Employer thereunder.

26.1 During the detailed evaluation of "Technical Bids", the Employer will determine whether each Bid

(a) Meets the eligibility criteria defined in Clause 3 and 4;

(b) Is accompanied by the required securities and;

(c) Is substantially responsive to the requirements of the Bidding documents.

(d) Is fulfilling the requirements of IFB.

(e) Is substantially responsive in accordance with the procedure as per Annexure-II and substantially responsive to the requirements of the Bidding documents. After Prequalification Evaluation (Phase-I), Technical Evaluation (Phase-II) and Power Point Presentation (Phase-III) the Bidder enter into Financial Evaluation. During the Financial evaluation of the "Financial Bid" of the lowest evaluated bidder, the responsiveness of the bids will be further determined with respect to the remaining bid conditions, i.e., priced bill of quantities, technical specifications, and drawings.

26.2 A substantially responsive "Financial Bid" is one which conforms to all the terms, conditions, and specifications of the Bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the works; (b) which limits in any substantial way, inconsistent with Bidding documents, the Employer's rights or the Bidder's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.

26.3 If a "Financial Bid" is not substantially responsive, it will be rejected by the Employer and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

27. Correction of Errors - Not applicable as per e-procurement procedure.

28. Evaluations and Comparison of Financial Bids

28.1. The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with the procedure as per **Annexure-II**.

28.2. The Employer reserves the right to accept or reject any variation arising out of change in scope of work. Such variations, which are in excess of the requirements of the Bidding documents, shall not be taken into account in Bid evaluation.

F. AWARD OF CONTRACT

29. Award Criteria:

29.1 Subject to Clause 30, the Employer will award the Contract to the Bidder whose Bid has been determined to be substantially responsive to the Bidding documents and who has offered the lowest evaluated Bid price, provided that such Bidder has been determined to be

(a) eligible in accordance with the provisions of Clause 3 and

(b) qualified in accordance with the provisions of Clause 4.

29.2 In no case, the contract shall be awarded to any bidder whose available bid capacity is less than the evaluated bid price, even if the said bid is the lowest evaluated bid. The contract will in such cases be awarded to the next lowest bidder at his evaluated bid price.

30. Employer's Right to accept any Bid and to reject any or all Bids:

30.1 Notwithstanding Clause 29, the Employer reserves the right to accept or reject any Bid and to cancel the Bidding process and reject all Bids at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the Employer's action.

30.2 The Employer reserves the right to reject any Application and/ or Bid if:

(a) at any time, a material misrepresentation is made or uncovered, or

(b) The Bidder does not provide, within the time specified by the Employer, the supplemental information sought by the Employer for evaluation of the Bid.

30.3 In case it is found during the evaluation or at any time before signing of the Agreement or after its execution and during the period of subsistence thereof, including the Defects Liability Period, that one or more of the bid conditions have not been met by the Bidder , or the Bidder has made material misrepresentation or has given any materially incorrect or false information, the Bidder shall be disqualified forthwith if not yet appointed as the Contractor either by issue of the LOA or entering into the Agreement , and if the Bidder has already been issued the LOA or has entered into the Agreement, as the case may be, the same shall, notwithstanding anything to the contrary contained therein or in this RFP, be liable to be terminated, by a communication in writing by the Employer to the Bidder , without the Employer being liable in any manner whatsoever to the Bidder and without prejudice to any other right or remedy which the Employer may have under this RFP, the Bidding Documents, the Agreement or under applicable law.

30.4 The Employer reserves the right to verify all statements, information and documents submitted by the Bidder in response to the RFP. Any such verification or lack of such verification by the Employer shall not relieve the Bidder of its obligations or liabilities hereunder nor will it affect any rights of the Employer thereunder.

31. Notification of Award and Signing of Agreement:

31.1 The Bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by cable, telex, facsimile or e-mail confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "***Letter of Acceptance***" will state the sum that the Employer will pay the Bidder in consideration of the design and execution the works on a Turnkey basis by the Bidder as prescribed by the Contract (hereinafter and by the Contract called the "***Contract Price***").

31.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Clause 32.

31.3 The Contract will incorporate all agreements between the Employer and the successful Bidder. The detailed work program and milestone-wise activity shall be finalized during contract negotiation with the successful bidder within 14 days after issue of Letter of Acceptance. The agreed work program/ milestone shall form part of the contract agreement. Within 21 days of receipt of Letter of Acceptance, the successful Bidder will sign the Agreement and deliver it to the Employer. The agreement will be signed by the Employer and sent to the successful Bidder, within 28 days following the notification of the award along with the Letter of Acceptance

31.4 Upon furnishing by the successful Bidder of the Performance Security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.

31.5 In the event of non-payment of the performance security by the L1 bidder, the successful bidders in sequence (L2, L3 ….) may be asked for negotiation for execution of the work with the bid price quoted by the L1 bidder.

32 Performance Security:

32.1 Within 21 days of receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a **Performance Security** [valid for a period as stipulated in Cl. 48 of Conditions of Contract & in the contract data] in any of the forms given below for an amount equivalent to **5 (five) % of the Contract price**:

- an **e-bank guarantee** issued by any bank indicated in Bid data sheet **payable at par by its branch at Bhubaneswar** in the form given in Section 6; or

- a deposit receipt of any Bank Schedule Bank (list indicated in Bid Data Sheet) / Post Office Savings Bank Account / National Savings Certificate / Post Office Time Deposit Account duly pledged in favour of the [As mentioned in Bid Data Sheet at the end of Section-1].

32.2 Deleted

32.3 Failure of the successful Bidder to comply with the requirements of Sub-Clause 32.1 and/or 32.2 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Bid Security.

33. Advance Payment and Security - - The Employer shall make advance payment to the Contractor of theamounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a Bank acceptable to the Employer in amounts and currencies equal to the **110 (Hundred & Ten) %** of the advance payment.

34. Corrupt or Fraudulent Practices:

34.1 It is required that the bidders / contractors observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, it is:

(a) Defined, for the purposes of this provision, the terms set forth below as follows:

(i) "Corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution and

(ii) "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Government of the benefits of free and open competition.

34.2 The Employer will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question and will declare the firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract, if it at anytime determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing the contract.

34.3 Furthermore, Bidders shall be aware of the provision stated in sub-clause 23.2 and sub-clause 54.2 of the Conditions of Contract.

ANNEXURE- I to ITB

Procedure to participate in online bidding- e-procurement (Refer clause-19 of ITB)

1. **PARTICIPATING IN THE BID IN THE E-PROCUREMENT PORTAL:** The Contractor/Bidder intending to participate in the bid is required to register in the Portal using his /her active personal/ official e-mail ID as his Login ID and attach his/her valid Digital Signature Certificate (DSC) to his/her unique Login ID. The DSC used must be of appropriate class (Class II or Class III) issued from a registered Certifying Authority such as n-Code, Sify, TCS, MTNL etc. He/ She has to submit the relevantinformation as asked for about the firm/ contractor. The portal registration of the bidder/ firm is to be authenticated by the State Procurement Cell after verification of original valid certificates/ documents such as (i) PAN and (II) Registration Certificate (RC)/ GST Registration Certificate and GSTIN (for procurement of goods) of the concerned bidder. The time period of validity in the portal is at par with the validity of RC/ GST Registration Certificate and GSTIN. Any change of information by the bidder is to be re-authenticated by the State Procurement Cell. After successful authentication, the bidder can participatedin the online bidding process.

   Contractor not registered with Government of Odisha, can participate in the e-procurement after necessary enrollment in the portal but have to subsequently register themselves with the appropriate registering authority of the State Government before award of the work as per prevalent registration norms of the State.

   a. To log on to the portal, the Contractor/Bidder is required to type his/her username andpassword. The system will again ask to select the DSC and confirm it with the password of DSC. For each login, a user's DSC will be validated against its date of validity and also against the Certificate Revocation List (CRL) of respective CAs stored in system database. The system checks the unique ID, password and DSC combination and authenticates the login process for use of portal.

   b. The tender documents uploaded by the Tender Inviting Officer in the websitehttps://tendersodisha.gov.in will appear at the "Active Tenders" Section of the homepage. Only a small notification will be published in the newspaper specifying the work details along with mention of the specific website for details. The publication of the tender will be for specific period of time till the last date of submission of bids as mentioned in the 'Invitation for Bid' after which the same will be removed from the list of Active tenders. Any bidder can view or download the bid documents from the web site.

   c. Contractors exempted from payment of EMD will be able to participate in the tender directly by uploading documentary evidence towards his eligibility for such exemption.

   d. The software application has the provision of payment of cost of tender document through payment gateways of authorized bankers by directly debiting the account of the bidders.

1.1 Furnishing scanned copy of such documents is mandatory along with the tender documents otherwise his/her bid shall be declared as non-responsive and thus liable for rejection. Bidders participating through Joint Venture shall declare the authorized signatory through Memorandum of Understanding duly registered and enroll in the portal in the name and style of the joint venture company. It is mandatory that the DSC issued in the name of the authorized signatory is used in the portal.

1.2 In the case of any failure, malfunction, or breakdown of the electronic system used during the e-procurement process, the tender inviting officer shall not accept any responsibility for failures or breakdown other than in those systems strictly within their own control.

1.3 Any third party/company/person under a service contract for operation of e-procurement system in the State or his/their subsidiaries or their parent companies shall be ineligible to participate in the procurement processes that are undertaken through the e-procurement system irrespective of who operates the system.

1.4 For submission of Bids through the E-Procurement Portal, the bidder shall upload the scanned copy/copies of document in prescribed format wherever warranted in support of eligibility criteria and qualification information. The online bidder shall have to produce the original documents in support of the scanned copies and statements uploaded in the portal before the specified date as per DTCN.

1.5 Each bidder shall submit only one bid for one package. A bid is said to be complete if accompanied by cost of bid document and appropriate bid security. The system shall consider only the last bid submitted through the E-Procurement portal.

1.6 The bidder may ask questions related to tender online in the e-procurement portal using his/her DSC, provided the questions are raised within the period of seeking clarification as mentioned intender call notice/Bid. The Officer inviting the Bid/ Procurement Officer-Publisher will clarify quarries related to the tender.

1.7 The details of drawings and documents pertaining to the works available with the officer invitingthe Bid as well as in the office of the Superintending Engineer and Engineer as mentioned in the Contract Data will be open for inspection by the bidders. The bidder is required to download all the documents for preparation of his bid. It is not necessary for the part of the Bidder to up-load other Bid documents (after signing) while up-loading his bid. He is required to upload documents related to his eligibility criteria and qualification information and Bill of Quantities duly filled in. It is assumed that while participating in the bid, the bidder has referred all the drawings and documents. Seeking any revision of rates or backing out of the bid claiming fornot having referred to any or all documents provided in the Bid by the Officer Inviting the Bid will be construed as plea to disrupt the bidding process and in such cases the bid security shallbe forfeited.

1.8 Any addendum / corrigendum/ cancellation of tender shall be published in the website https://tendersodisha.gov.in, notice board and through paper publication and such notice shall form part of the bidding documents.

1.9 The system generates a mail to those bidders who have already uploaded their tenders and those bidders if they wish can modify their tenders. The bidders are required to which the website till last date and time of bid submission for any addendum/ corrigendum/ cancellation thereof. Tender inviting authority is not responsible for communication failure of system generated mail. All the volumes/documents shall be uploaded / provided in the portal by the Officer inviting the bid. The bidder shall carefully go through the document and prepare the required documents and upload the scanned documents in Portable Document Format to the portal in the designated locations of Technical Bid. He will fill up the rates of items or percentage in the BOQ downloaded for the work in designated Cell and up loads the same in designated locations ofFinancial Bid. Bidders are to submit only the original BoQ uploaded by publisher after entering the relevant fields without any alteration/deletion/modification. Multiple BoQ submission shall lead to cancellation of bid. In case of item rate tender, bidders shall fill in their rates other than Zero value in the specified cells. In the percentage rate tender, the bidder quoting Zero value is valid and will be taken as Schedule of Rates. Submission of documents shall be affected by using DSC of appropriate class.

2. PAYMENT OF EMD/ BID SECURITY AND COST OF BID DOCUMENTS: The Bidder shall furnish, as part of his Bid, a Bid security for the amount mentioned under NIT/Contract Data in online mode. Non-submission of bid security within the designated period shall debar the bidder from participating in the on-line bidding system and his portal registration shall be cancelled. His name shall also be informed to the registering authority for cancellation of his registration.

2.1 Deleted.

2.2 Deleted.

2.3 The tender accepting authority will verify the originals of all the scanned documents of the successful lowest bidder only within 5 days of opening of the tender (price bid). In the eventuality of failure on the part of the lowest successful bidder to procedure the original documents, he will be debarred in future from participating in tender for 3 years and will be blacklisted by the competent authority. In such a situation, successful L-2 bidder will be required to produce his original documents for consideration of his tender at the negotiated rate equal to L1 bidder.

2.4 Contractors exempted from payment of EMD will be able to participate in the tender directly by uploading documentary evidence towards his eligibility for such exemption.

2.5 Government of Odisha has introduced e-payment gateway into the portal for payment of cost of Bid and Bid Security/ Earnest Money Deposit. The process of using e-payment gateway is mentioned in the "Procedure for Electronic receipt, accounting and reporting of Cost of Tender Paper and Earnest Money Deposit on submission of bids".

3. **FORMAT AND SIGNING OF BID:** (Logging to the Portal)-The Contractor/ Bidder is required to type his/her Login ID and Password. The system will again ask to select the DSC and confirm it with the password of DSC as a second stage authentication. For each login, a user's DSC will be validated against its date of validity and also against the Certificate Revocation List (CRL) of respective CAs stored in system database. The system checks the unique Login ID, Password and DSC combination and authenticates the login process for use of portal.

The bidder can download the tender of his choice and save it in his system and undertake the necessary preparatory work off-line and upload the completed tender at his convenience within the final date and time of submission. The bidder shall only submit a single copy of the required documents and Price Bid in the portal. In the Financial bid, the bidder cannot leave any figure blank. He has to only write the figures; the words will be self-generated. The Bidders are advised to upload the completed Bid documentwell ahead of the last date & time of receipt to avoid any last moment problem of power failures etc.

3.1 The Bidder shall go through the Bid carefully and list the documents those are asked for submission. He shall prepare all documents including Declaration form, price bid etc and storein the system.

3.2 The bidder shall log on to the portal with his DSC and move to the desired tender for up loading the documents in appropriate place one by one simultaneously checking the documents. Once the Bidder makes sure that all the documents have been up-loaded in appropriate place he clicks the submit button to submit the bid to the portal.

3.3 The bids once submitted cannot be retrieved or corrected. Tender cannot be pre-opened and cannot be submitted after due date and time. Therefore, only after satisfying that all the documents have been uploaded, the Bidder should activate submit button.

3.4 In the e-procurement process each process are time stamped. The system can identify each individual who has entered into the portal for any bid and the time of entering in to the portal.

3.5 The Bidder should ensure clarity of the document uploaded by him to the portal, especially the scanned documents by taking out sample printing. Non-submission of legible documents may render the bid non-responsive. However, the Officer inviting the Bid if so desires can ask for legible copies or original copies for verification with in a stipulated period provided such document in no way alters the Bidder's price bid. If the Bidder fails to submit the original documents with in the stipulated date, his bid security shall be forfeited.

4. **SUBMISSION OF BIDS: -**

4.1 The bidder shall carefully go through the tender and prepare the required documents. The bid shall have a Technical Bid and a Financial Bid. The Technical bid generally consists of GSTIN, PAN, Registration

Certificate, Affidavits, Profit Loss statement, Joint venture agreement, List of similar nature of works, work in hand, list of machineries and any other information required by OIT. The Financial Bid shall consist of the Bill of Quantities (BOQ) and any other price related information/ undertaking including rebates.

4.2 Bidders are to submit only the original BOQ (in .xls format) uploaded by Procurement Officer Publisher (Officer Inviting Tender) after entering the relevant fields without any alteration/ deletion/ modification. Multiple BOQ submission by bidder shall lead to cancellation of bid. In case of items rate tender, bidders shall fill in their rates other than zero value in the specified cells without keeping it blank. In the percentage rate tender the bidder quoting zero percentage isvalid and will be taken at par with the estimated rate of the work put to tender.

4.3 The bidder shall upload the scanned copy/ copies of document in support of eligibility criteria and qualification information in prescribed format in Portable Document Format (PDF) to the portal in the designated locations of Technical Bid.

4.4 The bidder shall write his name in the space provided in the specified location in the Protected Bill of Quantities (BOQ) published by the Officer Inviting Tender. The bidder shall type ratesin figure only in the rate column of respective items(s) without any blank cell in the rate columnin case of item rate tender and type percentage excess or less up to two decimal place only in case of percentage rate tender.

4.5 The bidder shall log to the portal with his/ her DSC and move to the desired tender for uploading the documents in appropriate place one by one simultaneously checking the documents.

4.6 Bids cannot be submitted after due date and time. The bids once submitted cannot be viewed, retrieved or corrected. The Bidder should ensure correctness of the Bid prior to uploading and take print out of the system generated summery of submission to confirm successful uploadingof bid. The bids cannot be opened even by the OIT or the Procurement Officer Publisher/ opener before the due date and time of opening.

4.7 Each process in the e-procurement is time stamped and the system can defect the time of log in of each user including the Bidder.

4.8 The Bidder should ensure clarity/ legibility of the document uploaded by him to the portal.

4.9 The system shall require all the mandatory forms and fields filled up by the Contractor during the process of submission of the bid/ tender.

4.10 The bidder should check the system generated confirmation statement on the status of the submission.

4.11 The bidder should upload sufficiently ahead of the bid closure time to avoid traffic rush and failure in the network.

4.12 The Tender Inviting Officer is not responsible for any failure, malfunction or breakdown of the electronic system used during the e-procurement process.

4.13 The Bidder is required to upload documents related to his eligibility criteria and qualification information and Bill of Quantity duly filled in. It is not necessary for the part of the bidder to upload the drawing and the other Bid documents (after signing) while uploading his bid. It is assumed that the bidder has referred all the drawings and documents uploaded by the Officer Inviting the Bid.

4.14 The Bidder will not be able to submit his bid after expiry of the date and time of submission of bid (server time). The date and time of bid submission shall remain unaltered even if the specified date for the submission of bids declared as a holiday for the Officer Inviting the Bid.

4.15 The 'Online bidder' shall digitally sign on all statements documents, certificates uploaded by him, owning responsibility for their correctness/ authenticity as per IT ACT 2000. If any of the information furnished by the bidder is found to be false/ fabricated/ bogus, his EMD/BID Security shall stand forfeited and his registration in the portal shall be blocked and the bidder is liable to be blacklisted.

5. SECURITY OF BID SUBMISSION:

5.1 All bid data uploaded by the Bidder to the portal will be encrypted by the DSC of the opener(s). The system shall require all the mandatory forms and fields filled up by the Contractor during the process of submission of the bid/tender.

5.2 The Bid shall be received in encrypted format by the system which can only be decrypted / openedby the authorized openers only on or after the due date and time.

6. DEADLINE FOR SUBMISSION OF THE BIDS:

6.1 The online bidding will remain active till the last date and time of the bid submission. Once the date and time (Server date and time) is over, the bidder will not be able to submit the bid. The date & time of bid submission shall remain unaltered even if the specified date for the submission of bids declared as a holiday for the Officer inviting the Bid.

7. RESUBMISSION AND WITHDRAWAL OF BIDS:

7.1 Resubmission of bid by the Bidders for any number of times before the final date and time of submission is allowed.

7.2 Resubmission of bid shall require uploading of all documents including price bid afresh.

7.3 If the bidder fails to submit his modified bids within the pre-defined time of receipt, the system shall consider only the last bid submitted.

8. LATE BIDS:

8.1 The system shall reject submission of any bid through portal after closure of the receipt time.For all purpose the server time displayed in the e-procurement portal shall be the time to be followed by the bidder and concerned officers.

9. MODIFICATION AND WITHDRAWAL OF BIDS:

9.1 In the E-Procurement Portal, it is allowed to modify the bid any number of times before the final date and time of submission. The bidder shall have to log on to the system and resubmit the documents as asked for by the system including the price bid. In doing so, the bids already submitted by the bidder will be removed automatically from the system and the latest bid only will be admitted. But the bidder should avoid modification of bid at the last moment to avoid system failure or malfunction of internet or traffic jam or power failure. If the bidder fails to submit his modified bids within the designated time of receipt, the bid already in the system shall be taken for evaluation.

9.2 In the E-Procurement Portal, withdrawal of bid is allowed. But in such case he has to write a letter with appropriate reasons for his withdrawal addressed to the Officer inviting the bid and upload the scanned document to portal in the respective bid before the closure date and time of receipt of the bid. The system shall not allow any withdrawal after expiry of the closure time of the bid.

10. OPENING OF THE BID:

10.1 Bid opening date is specified during tender creation or can be extended with corrigendum. This date is available in IFB, tender document as well as the home page of portal. Bid opening can be done by the authorized users which are defined during the tender publication / approval stage. The bids are encrypted using their public keys and can be decrypted only on or after the Bid Opening due date and time. The bid openers private key will be required to open the bids and all the openers have to log on to the portal during that time.

10.1.1 The bidders who participated in the online bidding can witness opening of the bid fromany system logging on to the portal with the DSC away from opening place. Contractors are not required to be present during the bid opening at the opening location if they so desire.

10.1.2 Each activity is date and time stamped with user details. For time stamping, server timeis taken as the reference.

10.2 In the event of the specified date of bid opening being declared a holiday for the Officer inviting the Bid/Engineer-in-Charge, the bids will be opened at the appointed time on the next working day.

10.3 In case bids are invited for more than one package, the order for opening of the "Bid" shall be that in which they appear in the "Invitation for Bid".

10.4 The Bid openers; who have been pre-defined shall log on to the portal with their respective DSC. Unless all the Officers who have been declared as Opening officers, log on the portal with their DSC the Tender cannot be opened.

10.5 In case of non-responsive tender, the officer Inviting tender should complete the e-Procurement process by uploading the official letter for cancellation/ re-tender.

11. EVALUATION OF BIDS: -

11.1 All the opened bids shall be downloaded and printed for taking up evaluation. The officer authorized to open the tender shall sign and number on each page of the documents downloaded and furnish a certificate that "the documents as available in the portal containing nos. of
pages".

11.2 After opening of technical bid, the bidder may be asked in writing / online (in their registered e- mail ID) to clarify on the uploaded documents provided in the Technical Bid, if necessary, with respect to any doubts or illegible documents required for Technical Evaluation. The Officer Inviting Tender may ask for any other document of historical nature during Technical Evaluation of the tender. Provided in all such cases, furnishing of any document in no way altersthe bidders price bid. Non submission of legible documents may render the bid non-responsive. The authority inviting bid may reserve the right to accept any additional document.

11.3 The bidders will respond in not more than 7 days of issue of the clarification letter, failing which the bid of the bidder will be evaluated on its own merit

11.4 Immediately, on receipt of these clarifications, the Evaluating Officers; predefined in the system for the bid, will finalize the list of responsive bidders. They will log on to the site with their DSC and record their comments on the Technical evaluation page in the system. The Officer Inviting the Bid if also the accepting

authority, shall log on to the system with his digital signature and check the technical evaluation. He can either accept or pass on to the evaluating officers for re-evaluation. Upon acceptance of technical evaluation by the Accepting authority in the system, the system shall automatically generate letter to all the responsive bidders and the system shall forward the letter to all the responsive bidder that their technical bid has been evaluated responsive with respect to the data/information furnished by him and the letter shall also intimate him the date & time of opening of financial bid. The system shall also inform the non-responsive bidders in their e-mail ID that their bid has been found non-responsive.

11.5 The Technical evaluation of all the bids shall be carried out as per the information furnished by the Bidders. But evaluation of the bid does not exonerate the bidders from checking their original documents and if at a later date the bidder is found to have misled the evaluation through wrong information, action as per relevant clause of DTCN shall be taken against the bidder/contractor.

11.6 The Procurement Officer-Evaluators will evaluate bid and finalize list of responsive bidders.

11.7 Opening of price bid and evaluation of lowest bidder is subject to satisfaction of other qualification information.

11.8 The financial bids of the technically responsive bidders shall be opened on the due date of opening. The Procurement Officer-Openers shall log on to the system in sequence and open the financial bids.

11.9 The Financial Bid will be opened on the notified date & time in the presence of bidders or their authorized representative who wish to be present.

11.10 At the time of opening of "Financial Bid", the names of the bidders whose technical bids were found responsive will be announced and the bids of only those bidders will be opened. The remaining bids will be rejected.

11.11 The responsive bidders' name, the bid prices, the item wise rates, the total amount of each item in case the item rate tender and percentage above or less in case of percentage rate tenders will be announced. any discounts and withdrawals, and such other details as the officer inviting the tender may consider appropriate, will be announced by him or his authorized representatives at the time of opening.

11.12 Rebate/discount offer if any uploaded to the system shall be declared and recorded first.

11.13 The Financial bid of the bidders shall be opened one by one by the designated officers. The system shall auto-generate the Comparative statement.

11.14 The Bidder can witness the principal activities and view the documents/summary reports for that particular work by logging on to the portal with his DSC from anywhere.

11.15 Procurement Officer-Openers shall sign on each page of the download BOQ and the Comparative Statement and furnish a certificate to that respect.

11.16 System provides an option to Procurement Officer Publisher for reconsidering the rejected bid with the approval of concern Chief Engineer/ Head of Department.

12. CLARIFICATION AND NEGOTIATION OF BIDS:

12.1 For examination, evaluation, and comparison of bids, the officer inviting the bid may, at his discretion, ask the lowest bidder for clarification of his rates including reduction of rate on negotiation and breakdowns of unit rates.

12.2 On opening of the price bid the system shall arrange the financial bids in order of their value (L1 first, followed by L2, L3 ….) for subsequent evaluation. The evaluation status (Sheet) will be visible to all the participating bidders after opening on their respective logins. Each activity is recorded in the system with date and time stamping.

13. NOTIFICATION OF AWARD AND SIGNING OF AGREEMENT:

13.1 In the E-Procurement Portal, the system shall generate the template of award letter and the Officer Inviting the Bid shall mention the amount of Performance Security and additional security required to be furnished in the letter and intimate the bidders in his e-mail ID.

13.2 The Employer/ Engineer-in-Charge shall notify acceptance of the work prior to expiry of the validity period by cable, telex or facsimile or e-mail confirmed by registered letter. This letter of Acceptance will state the sum that the Engineer-in-Charge will pay the Contractor in consideration of execution and completion of the works by the Contractor as prescribed by the contract and the amount of performance security and Additional Performance Security required to be furnished. The issue of the letter of Acceptance shall be treated as closure of the Bid process and commencement of the contract.

13.3 The Contractor after furnishing the required acceptable Performance Security and Additional Performance Security, " Letter of Proceed" or "Work Order" shall be issued by the Engineer-in- Charge with copy thereof to the Procurement Officer-Publisher. The Procurement Officer- Publisher shall upload the summery and declare the process as complete.

13.4 If the L1 bidder does not turn up for agreement after finalization of the tender then he shall be debarred from participation in bidding for three years and action will be taken to blacklist the Contractor. Besides the consortium/ JV/firm where such an agency/ firm already happens to be or is going to be a partner/ member/ proprietor, he/ they shall neither be allowed for participation in bidding for three years nor his/ their application will be considered for registration and action will be initiated to blacklist him/ them. In that case, the L2 bidder, if fulfils other required criteria would be called for drawing agreement for execution of work subject to condition that the L2 bidder negotiates at par with the quoted by the L1 bidder, otherwise the tender will be cancelled.

14. BLOCKING OF PORTAL REGISTRATION

14.1 If the registration Certificate of the Contractor is cancelled/ suspended by the registering authority/ blacklisted by the competent authority his portal registration shall be blocked automatically on receipt of information to that effect.

14.2 The portal registration blocked in the ground mentioned in the above Para- 11.1 shall be unblocked automatically in receipt of revocation order of cancellation/ suspension/ blacklisting from the concerned authority.

14.3 The Officer Inviting Tender shall make due inquiry and issue show cause notice to the concerned Contractor who in turn shall furnish his reply, if any, within a fortnight from the date of issue of show cause notice. Thereafter the Officer Inviting Tender is required to issue an intimation to the defaulting bidder about his unsatisfactory reply and recommend to the Chief Manager (Tech) for blocking of portal registration within 10 days of intimation to the defaulting bidder regarding his unsatisfactory reply with intimation to the Registering Authority and concerned Chief Engineer/ Heads of Office if any of the following provisions are violated.

14.4 Fails to furnish original Technical Documents before the designated officer within the stipulated date and time.

14.5 Backs out from the bid on any day after the last date of receipt of tender till expiry of the bid validity period (including till the extended bid validity period)

14.6 Fails to execute the agreement within the stipulated date.

14.7 If any of the information furnished by the bidder is found to be false/ fabricated/ bogus.

14.8 Accordingly, the officer Inviting Tender shall have recommended to the Chief Manager (Tech) State Procurement Cell, Odisha for blocking of portal registration of bidder and simultaneously action shall also

be initiated by OFFICER INVITING TENDER for blacklisting as per Appendix- XXXIV of OPWD code Volume-II.

14.9 The minimum period of blocking of Portal Registration shall in no case be less than 180 days.

ANNEXURE-II to ITB

1. EVALUATION CRITERIA (Clause-26.1 of ITB)

1.1 INTRODUCTION

Evaluation Criteria contains the broad criteria based on which the applicants shall be evaluated.

1.2 EVALUATION OF TECHNICAL BID (To be submitted in Cover-I)

Technical Bid will be evaluated based on financial standing, technical and organizational capability, experience and track record of the bidder. The bidder is required to submit all the necessary details including certificates from the client agencies in support of their qualification information.

CRITERIA FOR EVALUATION OF THE BIDDER FOR ELIGIBILITY

Sl. No	Attributes	Marks	Evaluation
(a)	**Financial strength** (i) Minimum annual financial Turnover 4.4 A (a) of the BID DATA SHEET	**15 Marks**	60% marks for minimum eligibility criteria. 100% marks for twice the minimum eligibility criteria or more; in between (i) & (ii) – on pro-rata basis.
	(ii) Liquid Asset as per clause-4.4 B (c) of the BID DATA SHEET	**5 Marks**	60% marks for minimum eligibility criteria. 100% marks for twice the minimum eligibility criteria or more; in between (i) & (ii) – on pro-rata basis.
(b)	**Experience in similar project work** Refer to clause 4.4 A.(b) of the BID DATASHEET	**25 Marks**	60% marks for minimum eligibility criteria 100% marks for twice the minimum eligibility criteria or more; in between (i) & (ii) – on pro-rata basis.
(c)	**DBR** Design Basis Report should be as per Section – 8 and Annexure-III to ITB	**15 Marks**	Drawings: 3 Marks Design Approach: 4 Marks Work Programme: 2 Marks Quality Plan: 3 Marks Safety Plan: 3 Marks
(d)	**Personnel and Establishment** Refer to clause 4.2 (e) of ITB	**20 Marks**	Minimum Eligibility The below-mentioned CVs are to be submitted by the bidder in their technical proposal for evaluation. The need for adequate technical staff to execute the works is to be assessed by the bidder and deployed as per requirement

Sl. No	Attributes	Marks	Evaluation
	Type of Personnel	**Maximum Marks- 20 (To be prorated out of 100 as indicated below)** **Qualifications and Experience**	
(i)	Project Director / Project Manager– 1 No	8	• B.E./B.Tech in Civil Engineering -1.6 Marks • 20 years overall experience-2.4 Marks • At least 10 years in leading and managing large Healthcare projects-4 Marks.
(ii)	Deputy Project Manager / Construction Manager – 2 Nos	10 **(5 each)**	• B.E./B.Tech in Civil Engineering -1 Mark • years overall experience- 1.5 Marks • At least 10 years in construction of multistorey institutional/hospital buildings projects -2.5 Marks
(iii)	Structural Engineer- 2 Nos	10 **(5 each)**	• B.E./B.Tech in Civil with ME/ M-Tech in Structures -1 Mark • years overall experience- 1.5 Marks • At least 12 years in designing RCC and High-rise Building Projects -2.5 Marks
(iv)	Hospital Equipment Planner / Biomedical Equipment Specialist- 1 No	5	• Graduation in Biomedical Engineering-1 Mark • 15 years overall experience- 1.5 Marks • 10 years of experience in planning, specification, procurement support, installation and commissioning of medical equipment for hospitals having minimum 300 beds -2.5 Marks
(v)	Planning & Scheduling Engineer- 2 Nos	8 **(4 each)**	• B.E./B.Tech in Civil with PGD/master's in construction management or equivalent -0.8 Mark • 15 years overall experience- 1.2 Marks • At least 10 years in Planning & Scheduling of Institutional/ Hospital Building Projects -2 Marks

Sl. No	Attributes	Marks	Evaluation
(vi)	Architectural / Finishing Engineer- 2 Nos	8 **(4 each)**	• B.Arch -0.8 Mark • 15 years overall experience- 1.2 Marks • At least 10 years in experience of Institutional/ Hospital Building Projects -2 Marks
(vii)	MEP Coordinator- 2 Nos	6 **(3 each)**	• B.E./B.Tech in Mechanical/Electrical Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 10 years in coordination of HVAC, Electrical, Fire Fighting, Plumbing and Medical Gas Systems -1.5 Marks
(viii)	Electrical Engineer- 2 Nos	6 **(3 each)**	• B.E./B.Tech Electrical Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 10 years in HT/LT systems, substations and institutional buildings -1.5 Marks
(ix)	Mechanical Engineer (HVAC & Fire Fighting)- 2 Nos	6 **(3 each)**	• B.E./B.Tech Mechanical Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 10 years in HVAC, Fire Fighting and Building Services -1.5 Marks
(x)	Public Health Engineer- 2 Nos	6 **(3 each)**	• B.E./B.Tech Civil Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 8 years in Water Supply, Sewerage, STP and Plumbing Systems -1.5 Marks
(xi)	Quality Control Engineer- 2 Nos	6 **(3 each)**	• B.E./B.Tech Civil Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 8 years in quality assurance and quality control of major building projects -1.5 Marks
(xii)	Health, Safety & Environment (HSE) Manager- 2 Nos	6 **(3 each)**	• Degree/Diploma in Engineering with recognized Safety Certification -0.6 Mark • 12 years overall experience- 0.9 Mark

Sl. No	Attributes	Marks	Evaluation
			• At least 8 years in construction safety management of major building projects - 1.5 Marks
(xiii)	Survey Engineer- 2 Nos	6 **(3 each)**	• Degree/Diploma in Civil Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 8 years in construction industry as survey Engineer -1.5 Marks
(xiv)	Quantity Surveyor / Billing Engineer- 2 Nos	6 **(3 each)**	• Degree/Diploma in Civil Engineering -0.6 Mark • 12 years overall experience- 0.9 Mark • At least 8 years in construction industry as QS/Billing Engineer -1.5 Marks
(xv)	BIM Coordinator - 1 No	3	• B.E./B.Tech / B.Arch. with BIM expertise -0.6 Mark • 10 years overall experience- 0.9 Mark • At least 6 years in construction industry as BIM Coordinator -1.5 Marks

Notes: **The Key personnel mentioned above in Personnel and Establishment head are the minimum requirements for obtaining the marks for evaluation; however, more key personnel may be engaged as per the requirement for executing the projects.**

(e)	**Plant & Equipment[5]** **Refer clause 4.4 B (a) of ITB**	**Maximum Mark- 20**	
		Numbers	**Marks**
1	Concrete Batching Plant (min 100-120 Cum/hr capacity)	2	2 (1 mark each)
2	Truck/Tipper	10	2 (0.2 mark each)
3	Piling set (Hydraulic Rigs)	10	2 (0.2 mark each)
4	Transit Mixer (6 Cum or higher)	8	2 (0.25 mark each)
5	Concrete Boom Placer / Boom Pump (minimum 36 m boom)	3	1.5 (0.5 mark each)
6	Tower Crane (Minimum 60 M Height)	5	2.5 (0.5 mark each)
7	Passenger cum Material Hoist (Minimum 60 M Height)	10	2 (0.2 mark each)
8	Hydraulic Excavator (0.9 Cum bucket or higher)	4	2 (0.5 mark each)

(e)	Plant & Equipment[5] Refer clause 4.4 B (a) of ITB	Maximum Mark- 20	
		Numbers	Marks
9	Vibratory Soil Compactor (10–12 Ton)	2	1 (0.5 mark each)
10	Diesel Generator Set (125 kVA or above for construction activities)	6	1 Mark
11	Centering and Shuttering	50,000 Sqm	1 Mark
12	Dewatering Pump Set	10	1 Mark
		Total	**20 Marks**

[4] Qualification and Experience shall be on the respective branch of engineering/discipline only

[5] The bidder is to provide their own estimate of the number of equipment, commensurate with their work plan and methodology. The bidder to fill up the table based on its assessment of requirement of the project to be completed within the stipulated time period.

The bidders qualifying the initial criteria as set out will be evaluated for following criteria by scoring method based on details furnished by them.

S. No.	Criteria	Maximum Marks
a	Financial Strength	20
b	Experience in Similar Nature of work	25
c	DBR	15
d	Personnel and Establishment	20
e	Plant & Equipmen	20
	Total Marks	**100**

1.2.1 The bidders who qualify as per Clause 1 above, securing minimum **60% marks** in each category as stated in above table with overall minimum of **70 marks out of 100** only will be asked to make a technical presentation regarding the contents of Cover-III (DBR) & parameters in Technical Presentations as mentioned in Clause 1.3 of Annexure-II to ITB, before a Committee on the scheduled date and time (to be intimated to the qualified bidders by post / E-mail).

1.3 CRITERIA FOR EVALUATION OF THE BIDDER FOR TECHNICAL PRESENTATION (Submitted in Cover – III)

Post-Qualification Criteria for Technical Presentation Evaluation

The bidders shall ensure that the minimum development obligations (floor area) are fulfilled in their proposed concept design and plan to be eligible for Technical Presentation. Detail area statement of all the Hospital buildings shall be scrutinized based on minimum requirements on items below and as specified in Section-8. Any bidder not achieving the same, **shall not be considered**.

a) Clinical requirement(s)- No. of Clinic/beds accommodated in each floor

b) Common area statement in sqm (Lobby area with lifts and staircases, fire escape staircase, toilets, and other common facilities)

c) Service Area under utilities in sqm (DG Room, BMS Room, Security room, Control room,Panel room and transformer etc)

d) Ground coverage in percentage (%).

e) FAR achieved (FAR excludes the parking floor).

f) Statement of use of Energy conserving materials in walls, roofing, parapets, compound wall, relief works.

g) Building wise parking area in sq.

Sl. No	Parameters	Maximum Marks
1	**Experience in Similar Works** Details of Similar works done with status. Similar experience should include list of all Completed/ Substantially completed (90%) projects (The bidder shall have to present maximum of 10 slides during the presentation to committee members in order to ascertain their relevant design experience as per the terms and conditions mentioned in the RFP)	20
2	Design Basis Report (To be presented by the Bidder)	50
3	Technologies to be adopted, Type of materials envisaged to be used, Working Methodology, aspects of Planning & Scheduling (including software's) likely to be used, IGBC rating etc.	30
	Total Marks	**100**

1.3.1 The Bidder shall score a minimum of 60% marks in each category of the above table and 70% in total toqualify for financial proposal opening.

1.3.2 Evaluation of the bid will be based on the qualification of bidder in the criteria as mentioned in Sl.1.2 and 1.3 above, taken together.

1.3.3 The results of evaluation of technical bid and technical presentation shall be published in the e-Procurement portal.

ANNEXURE-III to ITB

Design Basis Report (DBR)

The Bidder shall furnish the Design Basis Report (DBR) in Cover-III as indicated in this Annexure. The intent of this DBR is to present the salient features of technical considerations and scope of work envisaged by the bidder for the project, based on which the bidder has made its financial offer. The bidder shall make sure that the DBR should cover sections on Architectural, civil, structural, electrical, public health engineering, fire protection system, elevator systems etc and other monitoring and control systems, landscaping aspects. The individual report shall contain, but not limited to, the following:

This part shall deal with the **DBR** for the Hospital Block building.

Drawings:

- **i.** Conceptual drawings of all Buildings
- **ii.** Typical Hospital Building floor wise arrangements
- **iii.** Master Plan & Circulation
- **iv.** Sections & Elevation of the building
- **v.** Rendered images of the Building Exterior

Design Approach:

- **i.** Floor-wise building design approach for civil, electrical and PHE items; fire fighting
- **ii.** Area Statement with detail break-up
- **iii.** Design considerations vis-à-vis Statutory Compliances
- **iv.** Use of new Technology in the project
- **v.** Use of concepts of Energy Conservations-IGBC Gold Rating & Sustainability
- **vi.** Material details and makes proposed for different architectural, structural and non-structural members, electrical, ELV items, HVAC, PHE, Fire Protection System, elevator and all other systems
- **vii.** Emphasis shall be given by the bidder with respect to the following items:
  - (a) Adoption of New Technology for Faster Construction.
  - (b) Extent of use of energy conservation materials for the works
- **viii.** Details of maintenance till completion of the project
- **ix.** Building Information Model (BIM) Modelling 4D level with LOD 350
- **x.** Assumptions and Exclusions

Work Programme:

- **i.** Detailed construction planning of complete Project.
- **ii.** Software Tool proposed Primavera P6 (latest version) for monitoring construction
- **iii.** Write up on proposed Project Planning, Scheduling, Monitoring & Control system and close out.

Progress Measurement Methodology with details of weightages, milestones etc. Both WBS and CBS to be shared.

iv. Contractors Personnel/**Key resources of the Design consultant**.

v. Equipment, Manpower, Material, Cost, Machinery planning

vi. Contractor Proposal for Sub-Contractor with credentials for Design verification

vii. Procurement Management Plan in line with proposed program for the works

viii. Schedule of material requirements, both source, quantity and availability

Quality Plan:

i. Quality management mechanism proposed to be adopted

ii. Methodology for implementation in the execution of the project

iii. Process control mechanisms

Safety Plan:

i. Safety management mechanism proposed to be adopted

ii. Methodology for implementation in the execution of the project

iii. Process control mechanisms

BID DATA SHEET

DATA SHEET

Clause No.	Item	Description / Clarification
	A. General Instructions	
1.1	Employer	**Managing Director,** Odisha Bridge & Construction Corporation Ltd, OdishaAddress: Vikash Bhavan, Nayapalli, Bhubaneswar-751012 Phone No. 0674-2394093/6309/0043 Fax: 0674-2396326 Email: md@obcc.in ; tenders@obcc.in ; queries@obcc.in Official website: www.obcc.in ; www.tendersodisha.gov.in
1.1	Scope of Bid	**Redevelopment of Maharaja Krishna Chandra Gajapati (MKCG) Medical College & Hospital, Brahmapur, Ganjam (Phase-I)**
2	Source of Funds	The expenditure on this project shall be met from the Budget of Government of Odisha.
3.1	Eligible Bidders	Only Reputed Indian firms [It is meant for the Indian Firm having reputation in the specific area of operation for which tender is being invited] are allowed to apply for this Project. Class of Contractor: **"Super" Class** (Government of Odisha Registration) or equivalent of other State Governments / Government of India / MES / Railways for execution of Civil works in general and Road, Bridge work in particular. In case of successful bidders being not registered in **"Super" Class** under Government of Odisha, shall have to be registered as **"Super" Class** Contractor under Odisha PWD within 3 months' time from execution of agreement failing which no payment shall be released till registration process is completed.
4.2 (b)	Qualification of the Bidder	Financial Turnover from civil engineering works shall only be considered, as mentioned in Cl. 4.4. A (a) of Bid Data
4.2 (c)	Qualification of the Bidder	Experience of successful completion of works / substantial completion of works of Similar projects (*90% of the value of the contract to be considered as substantial completion*) as referred in Bid Data Sheet Cl. 4.4.A(b).

Clause No.	Item	Description / Clarification
		"Similar Project" mean "Construction of Hospital Building Campus with Clinical & Allied Infrastructure under Turnkey/ EPC Contract, executed under a single contract." The bidder must furnish the list of such works in the proforma stated inCl. 1.3.1. in Section 2 (Qualification Information).
4.2 (j)	Sub-Contracting	Subcontracting components of the works shall be limited to **30%** of the Contract Price. The maximum number of Sub-Contractors allowed is **TWO**. Work Experience, Equipment and Personnel of these specified Sub-Contractors shall Not be considered while evaluating the proposal of the Bidder under Cl. 4.4. The total limit of Sub-Contracting under the Contract is specified in Clause 7 of Conditions of Contract in Section 3 read with Contract Data in Section 4.
4.2 (k)	Methodology and Programme	Bidder shall provide these details in the Cover - III as mentioned inCl.12.1 of this Section-I.
4.3	Bids from Joint ventures	Bids from Joint ventures / Consortiums / Association of Parties are not acceptable
4.4. A (a)	Minimum Annual Financial Turnover	i. Shall have an **annual minimum turnover of ₹ 1103.00 Crores** *in Civil Construction works* certified by a chartered accountant during any year in the last five financial years ending 31.3.2026. {*Please note that stand-alone financial figures of the Applicant only shall be considered for evaluation*} Financial turnover of previous financial years shall be given weightage of 10% (ten percent) per year based on rupee value to bring them to the price level up to the year of bid invitation.[6] ii. The Firm should demonstrate making profit in any three (3) years out of preceding five (5) financial years, ending 31.3.2026. iii. Should have valid PAN and GSTIN.
4.4. A (b)	**Experience in similar project works**	Experience of successful completion of Work: (a) Experience of having successfully completed works / substantial completion of works of Similar projects (*90% of the value of the contract to be considered as substantial completion*) during the last 10 years prior to the bid invitation date. The cost of completed

Clause No.	Item	Description / Clarification
		works of previous financial years shall be given weightage of 10% (ten percent) per year based on rupee value to bring them to the price level up to theyear of bid invitation.[7] **One** similar project has a contract value not less than**₹ 1103.00 Cr.** Or **Two** similar projects have a contract value not less than **₹ 690.00 Cr. each.** Or **Three** similar projectshave a contract value not less than **₹ 552.00 Cr. each.** (b) In addition to meeting the requirements under Clause (a), the bidder must have successfully completed at least one building project having a configuration of **Basement + with 10 Floors.** If any of the projects submitted under Clause (a) satisfies the above requirement, no separate project experience shall be required for compliance with this clause. *Please note that: -* *(i) Further, contractor shall have to mandatorily sign a MOU with a consulting firm having experience in Designing and commissioning of Hospital Projects as mentioned in Clause No.4.4. (A) (b) The design consulting firm shall provide consultancy to the bidder during the project period from Design to Commissioning stage. The Employer reserves the right to ask for replacement on account of non-performance and maintaining adequate quality in Design by the Design consultant. Such replacement shall be entirely at the risk of the contractor and no time and cost claim, whatsoever, shall be liable on same account.* *(ii) Experience of holding companies, associate companies, subsidiaries, and sister concerns shall not be considered for evaluation.* *(iii) All work orders with completion certificates submitted*

Clause No.	Item	Description / Clarification
		shouldbe in the name of the Applicant. (iv) *For private sector projects, completion certificate with TDS shall be submitted.* (v) *Work experiences as a Subcontractor shall not be considered as Experiences of Similar Projects.* *(vi) For Bidder having In-House design capability is exempted from submitting MOU with a design firm. However, it is mandatory to submit the following CVs to illustrate their competency in executing work of similar nature:* • *Urban Planner* • *Healthcare Planner cum Architect* • *Biomedical Engineer* • *Structural Engineer* • *BIM Expert* *The CVs of above position must specify the minimum experience of 15 Yrs. and 5 yrs. minimum with the bidding firm. Further their relevant experience should also match with the minimum eligibility requirement as mentioned in Clause 4.4 A(b).* *i. Contractor who does not have In-house design capability and intend to engage a separate reputed design firm for the project shall have to mandatorily sign a MOU with a consulting firm having experience in Designing and commissioning of Hospital Projects as mentioned in Clause No.4.4. (A) (b). The design consulting firm shall provide consultancy to the bidder during the project period from Design to Commissioning stage. The Employer reserves the right to ask for replacement on account of non-performance and maintaining adequate quality in Design by the Design consultant. Such replacement shall be entirely at the risk of the contractor and no time and cost claim, whatsoever, shall be liable on same account.*

<table>
<tr><th>Clause No.</th><th>Item</th><th>Description / Clarification</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>4.4. A (c)</td><td>Minimum Quantities</td><td>Not Applicable</td></tr>
<tr><td>4.4 A (d)</td><td>Construction, Planning and Methodology</td><td>Bidder shall provide these relevant details in the Cover - III as mentioned in Cl.12.1 of this Section-I.</td></tr>
<tr><td>4.4B. (a)</td><td>Equipment</td><td>
<table>
<tr><th>Equipment List</th><th>Numbers</th></tr>
<tr><td>Concrete Batching Plant (minimum 100-120 Cum/hr capacity)</td><td>2 Nos.</td></tr>
<tr><td>Truck/Tipper</td><td>10 Nos.</td></tr>
<tr><td>Pilling Rig (Hydraulic)</td><td>10 Nos.</td></tr>
<tr><td>Transit Mixer (6 Cum or higher)</td><td>8 Nos.</td></tr>
<tr><td>Concrete Boom Placer / Boom Pump (minimum 36 m boom)</td><td>3 Nos.</td></tr>
<tr><td>Tower Crane (Minimum 60 M Height)</td><td>5 Nos.</td></tr>
<tr><td>Passenger cum Material Hoist (Minimum 60 M Height)</td><td>10 Nos.</td></tr>
<tr><td>Hydraulic Excavator (0.9 Cum bucket or higher)</td><td>4 Nos.</td></tr>
<tr><td>Vibratory Soil Compactor (10–12 Ton)</td><td>2 Nos.</td></tr>
<tr><td>Diesel Generator Set (125 kVA or above for construction activities)</td><td>6 Nos.</td></tr>
<tr><td>centering and shuttering</td><td>50,000 Sqm</td></tr>
<tr><td>Dewatering Pump Set</td><td>10 Nos.</td></tr>
</table>
</td></tr>
<tr><td>4.4. B. (b)</td><td>Non-Availability of Equipment</td><td>In case of non-availability of any of the plants and equipment the bidders should submit a lease deed/ hire deed/ agreement (notarized) from the rightful owner.</td></tr>
<tr><td>4.4. B. (c)</td><td>Liquid Assets</td><td>Liquid assets and/or availability of credit facilities of not less than the amount of ₹ 138.00 Crore (One Hundred Thirty Eight Crore)</td></tr>
<tr><td>4.5</td><td>Sub-contractors' experience and resources:</td><td>Please replace the existing paragraph 4.5 as below:
Sub-contractors' experience and resources shall NOT be considered indetermining the bidder's compliance with the qualifying criteria.</td></tr>
<tr><td>4.6</td><td>Bid Invitation Year</td><td>2026-27</td></tr>
<tr><td>4.6</td><td>Period of Project</td><td>30 Calendar Months [N = 2.5 Years]</td></tr>
</table>

Clause No.	Item	Description / Clarification
B. Bidding Documents		
9.2	Pre-Bid Meeting	Pre-bid meeting shall be held on 07.09.2026 at 11.30 AM through video conferencing in the link provided in Bid Data Sheet. The bidder shall make the queries through email on or before 05.09.2026 by 5.00 P.M. Responses to the queries, including the text of the questions raised (without disclosing the source of enquiry) will be uploaded in the official website. Any modification of the bidding documents listed in Sub-Clause 8.1 which may become necessary as a result of the pre-bid queries shall be made by the Employer exclusively through the issue ofan Addendum/ Corrigendum pursuant to Clause 10. Clarifications to the above will be uploaded on the tender portal of govt of Odisha https://tendersodisha.gov.in
10.2	Amendment of Bidding Documents	Any addendum / corrigendum/ cancellation of tender shall be published in the website https://tendersodisha.gov.in only and such notice shall form part of the bidding documents.
10.3	Amendment of Bidding Documents	Employer may extend as necessary the deadline for submission of bids
10.4	Amendment of Bidding Documents	Addendum shall be available in the Official website.
C. Preparation of Bids		
12.1	Documents Comprising the Bid	In addition to online submission of Cover-I and Cover-II, the bidders shall also submit online the soft copies (pdf format) of the documents to be furnished in Cover –III & Cover-IV. A set of hard copies of the documents and original financial instruments furnished in Cover –III & Cover-IV shall be submitted to the Employer, either by post / courier or in person by the date and time mentioned in this section. The bidder shall furnish the **Design Basis Report (DBR)** in Cover-III, as per the details provided at Annexure I to ITB, at the end of this Section-I. The Bidder shall furnish the following documents in Cover-IV: i. Cover -IV should be comprised of scanned copy of Bid Processing Fee and EMD (Original BG / Scanned copy of EMD in case of Online submission).

Clause No.	Item	Description / Clarification
13.2	Bid Price	Replace the contents of the Clause with the following. ***The bidder shall fill the total bid price in figures online as Lump Sum Price.*** The total bid price shall be excluding GST on Works Contract. GST onWorks Contract shall be paid by the Employer extra as applicable. **No price variation on any account is payable under this contract**.
15.1	Bid Validity	Bids shall remain valid for a period of **120 days** after the due date for bid submission
15.2	Bid Validity	In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders and the bidder may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable / e-mail. A bidder may refuse the request. A bidder agreeing to the request will not be required or permitted to modify his bid.
16	Bid Security	The paragraph is replaced with the following: The Bidder shall furnish, as part of his Bid, a **Bid security as Earnest Money Deposit (EMD) for an amount of ₹ 13,80,00,000.00/-**(*Thirteen Crore Eighty Lakh*) for this particular work in shape of irrevocable e-Bank Guarantee from any Nationalized Schedule Bank in India counter guaranteed by its local branch at Bhubaneswar / Insurance Surety Bond issued by Insurance Company authorized by Insurance regulatory and development authority of India (IRDAI). Bid Processing Fee: The Bidder shall furnish a non-refundable Bid Processing Fee amounting to **₹ 14,00,000/-** (amount inclusive of GST) through Demand Draft in favor of the Managing Director, OB & CC Ltd, as per e-procurement portal of Govt. of Odisha
18	Format and Signing of Bid	Refer e-Procurement procedure
D. Submission of Bids		
19	Sealing and Making of Bids	In addition to online submission of Cover-I and Cover-II, the bidder shall also submit online the soft copies (pdf format) of the documents to be furnished in Cover –III & Cover-IV. A set of hard copies of the documents and original financial instruments furnished in Cover –III & Cover-IV shall be submitted to the Employer in sealed covers, either by post / courier or in person by the date and time mentioned in this section. The hard copies of Cover-III & Cover-IV shall be addressed to the Employer in the address provided in the Clause-1.1 of the ITB, bear

Clause No.	Item	Description / Clarification
		the name and identification number provided in of IFB and superscripted "COVER-…….. (NOT TO BE OPENED BEFORE……Hours[TIME] on …. /…/….. [DATE])".
20.1	Bid Submission	In addition to online submission of Cover-I and Cover-II, the bidder shall also submit online the soft copies (pdf format) of the documents to be furnished in Cover –III & Cover-IV. Time and date of online submission is on or before 5:00 PM on **24.09.2026** For Cover-III & Cover-IV, time and date of offline submission is on orbefore **05.00 PM** of **28.09.2026** * in the office of the Employer. The sealed covers (Cover-III & Cover-IV) sent through post / courier / in person, must physically reach the Employer by the stipulated date and time. ***The Employer shall bear no liability for any delay or loss or damage of the above documents during transit and in such event the bid shall stand rejected summarily and no request in any form from any Bidder shall be entertained on this ground.***
E. Bid Opening & Evaluation		
23.1	Bid Opening	All the bids received shall be opened in the Office of the Managing Director, Odisha Bridge & Construction Corporation Ltd, Vikash Bhawan, Nayapalli, Bhubaneswar-751012 on **dates as mentioned Bid Data Sheet.**
26.1 (b)	Bid Security and Bid Processing Fee	Read the Sub-Clause as: Is accompanied by the required bid processing fee & bidsecurity /EMD
26.1 (c)	Substantial Responsiveness (Technical Evaluation)	Read the Sub-Clause as: Is substantially responsive to the requirements of the bidding documents and qualified in the evaluation procedure set-forth in Annexure – II to ITB. (Eligibility and Technical Presentation) If there is a discrepancy between the information provided in the soft copy submitted in online mode and the hard copies submitted by the Bidder relating to Cover -III, the information provided in online mode shall prevail and the bidders qualification shall be evaluated accordingly. However, if in the opinion of the Employer there is an obvious misplacement or omission of information relating to Cover -III in the online mode, the Employer may consider such information provided

<table>
<tr><th>Clause No.</th><th>Item</th><th>Description / Clarification</th></tr>
<tr><td></td><td></td><td>in the offline mode for the purpose of evaluation, subject to written confirmation from the bidder.</td></tr>
<tr><td>6.1 (e)</td><td>Financial Evaluation (Negotiation)</td><td>Read the Sub-Clause as:
The “Financial Bids” of the responsive bidders shall be opened online. During detail evaluation of the “Financial Bid” of the lowest evaluated bidder, the responsiveness of the bid will be further examined and if required, the bidder shall be asked to clarify its offer through further negotiation.</td></tr>
<tr><td colspan="3">F. Award of Contract</td></tr>
<tr><td>31.3</td><td>Notification of Award & Signing of Agreement</td><td>Add the following below the paragraph:
The Bidder shall submit a detail resource based work program using standard software (Primavera) and a ‘S’ Curve showing monthly cash flow forecast for the Works, within 14 days of issue of the Letter of Acceptance of tender which shall form part of the contract.
The Project Completion Schedule must contain the Project Milestones mentioned in Cl. 45.1 of Contract Data.</td></tr>
<tr><td>32.1</td><td>Performance Security</td><td>The Bidder shall furnish, Performance Security of the amount stated in the Contract Data, for this particular work in the form of e-Bank Guarantee from any nationalized scheduled bank in India counter guaranteed by its local branch at Bhubaneswar, in favour of the Managing Director, OB & CC Ltd, Payable at Bhubaneswar in the form given in Section 6. or in the form of insurance surety bond issued by an insurance company authorised by IRDAI. Being a Turnkey assignment no additional Performance security shall be required to be deposited by the selected bidder.
<table>
<tr><th>Name of Banks</th><th>Name of Banks</th></tr>
<tr><td>1. Canara Bank
2. Punjab National Bank
3. State Bank of India
4. Union Bank of India
5. Bank of India
6. Bank of Baroda
7. UCO Bank
8. Indian Bank
9. Indian Overseas Bank
10. Central Bank of India</td><td>11. Bank Of Maharashtra
12. IDBI Bank
13. Odisha Grameen Bank
14. Odisha State Co-operative Bank</td></tr>
</table></td></tr>
<tr><td>32.3</td><td>Performance Security</td><td>Replace the paragraph as under:
Failure of the successful Bidder to comply with the requirements of</td></tr>
</table>

Clause No.	Item	Description / Clarification
		Sub-Clause 32.1 and/or 32.2 shall constitute sufficient grounds for cancellation of the award and disqualification of bidder from bidding for any contract with the Bidder for a period of one year from the date of notification on breach of obligation under the bid conditions.
33	Advance Payment and Security	Replace the paragraph as under: The Employer shall make advance payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a Bank acceptable to the Employer in amounts and currencies equal to 110% of the advance payment. The advance shall carry 10% (Ten) interest
	Up-dation Factor	**Year before** — **Up-dation Factor** One — 1.10 Two — 1.21 Three — 1.33 Four — 1.46 Five — 1.61 Six — 1.77 Seven — 1.94 Eight — 2.14 Nine — 2.35 Ten — 2.59

SECTION 2
FORMS OF BID

TABLE OF FORMS:

1. **CONTRACTOR'S BID**
2. **QUALIFICATION INFORMATION**
3. **BANK CERTIFICATE**
4. **AFFIDAVIT**
5. **CERTIFICATE OF NO RELATIONSHIP**
6. **INFORMATION REGARDING ANY CONFLICTING ACTIVITIES AND DECLARATION THEREOF**
7. **CV FORMAT**
8. **LETTER OF ACCEPTANCE**
9. **NOTICE TO PROCEED WITH THE WORK**
10. **AGREEMENT FORM**
11. **FORMAT FOR INSURANCE SURETY BOND FOR BID SECURITY/ EMD**
12. **FORMAT FOR INSURANCE SURETY BOND FOR PERFORMANCE SECURITY**

1. CONTRACTOR'S BID

[This is a mandatory form to be submitted by the bidder on their letterhead, failing which the bid is liable for rejection]

DESCRIPTION OF THE WORKS: "Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)"

To:

The Chief Engineer- II
Odisha Bridge & Construction Corporation
Ltd. Vikas Bhawan, Nayapalli
Bhubaneswar-751012

Gentlemen,

Having examined the bidding documents including addendum/corrigendum, I / we offer to execute the Works described above in accordance with the conditions of contract, specifications, accepted tendered drawing, and Payment schedule accompanying this Bid for the Contract Price as tendered in our price bid document separately.

This Bid and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We undertake that, in competing for (and if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988".

We hereby confirm that this Bid complies with the Bid Validity and Bid Security required by the

Bidding documents. We attach herewith our current income-tax clearance certificate.

Yours faithfully,

_____

Authorized Signature:
Name & Title of
Signatory: Name of
Bidder:
Address:
Email-id:
Contact No:
Stamp:

2. QUALIFICATION INFORMATION

[This is a mandatory form to be submitted by the bidder on their letterhead, failing which the bid is liable for rejection]

The information to be filled in by the Bidder in the following pages will be used for purposes of qualification as provided for in Clause 4 of the Instructions to Bidders. This information will not be incorporated in the Contract.

1. **Information of the Bidder**

1.1 Constitution or legal status of Bidder *as per ITB Clause 4.2 (a)*
[Attach copy]

Place of registration: _____

Principal place of business: _____

Power of attorney of signatory of Bid
[Attach]

1.2 Financial Turnover of the bidder during the last five financial years duly certified by the registered chartered accountant. (in **Rs. Crores**) *as per ITB Clause 4.2 (b)*

1.3.1 Work performed as prime contractor (in the same name) on project works over the last five financial years. ******

Project Name@	Name of the Employer*****	Description of work	Contract No.	Value of contract (In Rs. Crores)	Date of issue of work order	Stipulated period of completion	Actual date of completion*****	Remarks explaining reasons for delay and work completed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

******Attach certificate (s) from the Engineer(s)-in-Charge*

@The item of work for which data is requested should tally with that specified in ITB clause 4.2(c) read with Bid Data Sheet.

****** *Immediately preceding the financial year in which bids are received.*

1.1 Information on Bid Capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this bid.

(A) Existing commitments and on-going works:

Description	Place &	Contract	Name and	Value of	Stipulated	Value of	Anticipated

of Work	State	No. & Date	Address of Employer	Contract (In Rs. Crores)	period of completion	works* remaining to be completed (In Rs. Crores)	date of completion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(B) Works for which bids already submitted:

Description of Work	Place & State	Name and Address of Employer	Estimated value of works (In Rs Crores)	Stipulated period of completion	Date when decision is expected.	Remarks if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)

***** *Attach certificate(s) from the Engineer(s)-in-Charge.*

1.2 The following items of Contractor's Equipment are essential for carrying out the Works. The Bidder should list all the information requested below. Refer also to Sub Clause 4.2(d) read with 4.4 (B) of the Instructions to Bidders.

Item of Equipment	Requirement	Availability Proposals		Age/Condition	Remarks
	No.	Nos./Capacity	Owned/Leased		(From whom to be purchased

1.3 Qualifications and experience of key personnel proposed for administration and execution of the Contract. Attach biographical data. Refer also to 4.2(e) read with annexure of instructions to Bidders and Sub Clause 9.1 of the Conditions of Contract.

	Name	Years of experience in Qualifications (From DD-MM-YY to DD-MM-YY)	Years of experience in Position	the proposed position.
Project Manager etc.				

1.4 Proposed subcontracts and firms involved. [Refer ITB Clause 4.2 (j)]

Sections in of the works work	Value of Sub-contract	Sub-contractor (name and address)	Experience similar

1.5 Financial reports for the last five financial years: balance sheets, profit and loss statements, auditors' reports (in case of companies/corporation), etc. List them below and attach copies. [Refer ITB Clause 4.2 (f)]

1.6 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List them below and attach copies of support documents *[sample format attached]*. [Refer ITB Clause 4.2 (g)]

1.10. Name, address, and telephone, telex, and fax numbers of the Bidders' Bankers who may provide references if contacted by the Employer. [Refer ITB Clause 4.2 (h)]

1.11 Information on litigation, arbitration, debarment, termination, notice for recession of contract, abandonment of work history in which the Bidder is involved. [Refer ITB Clause 4.2 (i)]

Employer Name and Contact	Description of Work	Agreement No.	Status & matter of dispute and/or issues

1.12 Statement of compliance under the requirements of Sub Clause 3.2 of the instructions to Bidders.

1.13 The Bidder MUST SUBMIT THE DRAWINGS, DESIGN BRIEF REPORT, WORK PROGRAMME & QUALITY PLAN IN COVER-III as necessary for the works [As per the provisions of ITB Clause 4.1, 4.2 (k) and 4.4 A (d].

1.14 The Bidder shall furnish the Bid Security in shape of e-Bank Guarantee & Non-refundable Bid Processing Fee in shape of Demand Draft (as mentioned in Clause 16.1) in Cover-IV:

1.15 Affidavit by the bidder duly signed by the Notary Public

_____
Authorized Signature:
Name & Title of Signatory:
Name of Bidder :
Stamp:

3. BANK CERTIFICATE

[To be issued by bidder's bank on bank's letterhead and submitted by the bidder]

This is to certify that M/s.....is a reputable company with a good financial standing.

If the contract for the work, namely ***"[insert name of the work]"*** on turn-key basis involving design and execution of works is awarded to the above firm, we shall be able to provide overdraft/cash credit facilities to the extent of Rs. …… to meet their working capital requirements for executing the above contract.

Name of Bank:
Name of Senior Bank Manager: Address of the Bank:
e-mail id:

4. AFFIDAVIT

[To be submitted by the bidder in a non-judicial stamp paper duly signed by the Notary Public]

1. I, the undersigned, do hereby certify that all the statements made in the required attachments are true and correct.

2. The undersigned also hereby certifies that neither our firm M/s…..…… …..... have abandoned any work on building in India nor any contract awarded to us by the State of Odisha for such works have been rescinded during last five years prior to the date of this bid.

3. The undersigned hereby authorize(s) and request(s) any bank, person, firm or corporation to furnish pertinent information deemed necessary and requested by the Department to verify this statement or regarding my (our) competence and general reputation.

4. The undersigned understand and agrees that further qualifying information may be requested and agrees to furnish any such information at the request of the Department/ project implementing agency.

_____

Authorized Signature:
Name & Title of
Signatory: Name of
Bidder :
Stamp:

5. CERTIFICATE OF NO RELATIONSHIP

I/We hereby certify that I/We* am/are* related/not related(*) to any officer of OBCC and P.W.D of the rank of Assistant Executive Engineer & above and any officer of the rank of Under Secretary and above of the Works Department, Govt. of Orissa I/We* am/are* aware that, if the facts subsequently proved to be false, my/our* contract will be rescinded with forfeiture of E.M.D and security deposit and I/We* shall be liable to make good the loss or damage resulting from such cancellation.

I//We also note that, non-submission of this certificate will render my / our tender liable for rejection.

(*) - Strike out which is not applicable _____

Authorized Signature:
Name & Title of Signatory:
Name of Bidder :
Stamp:

Date: -

Please Note - The contractor shall furnish a certificate along with the tender to the effect that he is not related to any officer in the rank of an Assistant Executive Engineer & above in OBCC or the state P.W.D. or Under Secretary & above in the Works Department. If the fact subsequently proved to be false, the contract is liable to be rescinded. The earnest money & the total security will be forfeited & he shall be liable to make good the loss or damages resulting for such cancellations. The proforma for no relationship certificate is given above.

6 INFORMATION REGARDING ANY CONFLICTING ACTIVITIES AND DECLARATION THEREOF

Are there any activities carried out by your firm / company? If yes, please furnish details of any such activities.

If no, please certify,

IN BIDDER' S LETTER HEAD

I, hereby declare that our firm as Individual is not indulged in any such activities which can be termed as the conflicting activities.

I, also acknowledge that in case of misrepresentation of any of the information, our proposal / contract shall be rejected / terminated by the Client which shall be binding on us.

Authorized Signatory [*In full initials with Date and Seal*]: _____

Communication Address of the Bidder: _____

Conflicting activities means*- The existence of any potential conflict of interest on the part of the bidder due to prior, current, or proposed agreements, engagements, or affiliations with the Client.*

7. CV FORMAT

Position Title	
Name of Expert:	

Employment and Education record relevant to the assignment:

Total Years of Experience	**Relevant years of Experience**	**Education Qualification with Name of the Institution and year of passing**	**Name of the Project with duration and activities performed relevant to the Assignment.**		
			Name of project	**Duration (From DD-MM- YY to DD-MM-YY)**	**Brief description of project and nature of responsibility**

* Bidders need to provide educational qualification certificates to support the qualification criteria.

8 LETTER OF ACCEPTANCE

[To be issued to successful bidder on Letterhead of OBCC]

_____[date]

To: _____[name and address of the Contractor]_____

Dear Sir(s)

This is to notify you that your Bid dated _____ for execution of the work ***"[insert name of the work]"*** on turn key basis involving design ~~and execution of works~~ ***[Name of the contract and identification number, as given in the Instructions to Bidders]*** for the Contract Price of Rupees _____ (_____) [amount in words and figures], as corrected and modified[1] in accordance with the Instructions to Bidders[1] is hereby accepted by our Agency.

We note that as per bid, you do not intend to subcontract any

component of work. (Or)

We note that as per bid, you propose to employ _____ as sub-contractor for executing _____

(Delete whichever is not applicable)

You are requested to furnish the detailed Work Program and milestone wise activity as per Para 31.3 of ITB to complete the contract negotiation within 14 days of this Letter of Award. Further, you are hereby requested to furnish Performance Security in the form detailed in Para 32.1 of ITB for an amount of Rs ..... within **21** days of the

receipt of this Letter of Acceptance and sign the contract failing which action as stated in Para 31.5 and Para 32.3 of ITB will be taken.

Yours faithfully,

_____

Authorized Signature
Name and Title of
Signatory Name of Agency

[1] Delete "corrected and" or "and modified" if only one of these actions applies. Delete "as corrected and modified in accordance with the Instructions to Bidders" if corrections or modifications have not been effected.

9 NOTICE TO PROCEED WITH THE WORK

[To be issued on Letterhead of OBCC]

———— (date)

To

——————————————— (name and address of the Contractor)

_____

_____

Dear Sirs:

Pursuant to your furnishing the requisite security as stipulated in ITB clause 32.1 and signing of the contract agreement for the work ***"[insert name of the work]"*** on turnkey basis involving design and execution of works @ a Bid Price of Rs. ____, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

Authorized Signature
Name and Title of
Signatory Name of Agency

10. AGREEMENT FORM

[To be executed on stamp paper of appropriate value]

Agreement

This agreement, made the _____ day of _____2023 between _____

_____[name and address of Employer]
(hereinafter called "the Employer)" of the one part and _____
_____

_____ [name and address of contractor] (hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor "[insert name of the work], [name and identification number of Contract] (hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein, at a contract price of Rs.....

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:

   i) Letter of Acceptance
   ii) Notice to proceed with the works
   iii) RFP and Corrigenda
   iv) Contractor's Bid
   v) Contract Data
   vi) Conditions of contract (including Special Conditions of Contract)
   vii) Specifications
   viii) Drawings
   ix) Bill of Quantities (Optional)
   x) Payment Schedule and

xi) Any other document listed in the Contract Data as forming part of the contract.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____
was hereunto affixed in the presence of:
Signed, Sealed and Delivered by the said _____
_____
_____

in the presence of:
Binding Signature of Employer _____
Binding Signature of Contract

11.FORMAT OF INSURANCE SURETY BOND FOR BID SECURITY / EARNEST MONEY DEPOSIT

(To be executed on Non-Judicial Stamp Paper/e-Stamp Paper of appropriate value in accordance with the applicable Stamp Act)

Insurance Surety Bond No.: _____
Date of Issue: _____
Bond Amount: ₹_____
Valid up to: _____
Claim Period up to: _____
To

The Managing Director
Odisha Bridge & Construction Corporation Limited (OBCC)
Bhubaneswar, Odisha

Subject: Insurance Surety Bond towards Bid Security / Earnest Money Deposit

Tender Reference No.: _____

Name of Work:
"_____"
Dear Sir,
WHEREAS, **M/s. _____**, having its Registered /Head Office at _____, hereinafter referred to as the **"Bidder"**, has submitted its Bid dated **_____** for the aforesaid work pursuant to the Tender Document issued by Odisha Bridge & Construction Corporation Limited (OBCC), hereinafter referred to as the **"Employer"**.
AND WHEREAS, in accordance with the provisions of the Tender Document, the Bidder is required to furnish a **Bid Security/Earnest Money Deposit of ₹_____ (Rupees _____ only)** as a condition for participation in the tender.
AND WHEREAS, at the request of the Bidder, **M/s. _____ Insurance Company Limited**, having its Registered Office at _____, hereinafter referred to as the **"Surety Insurer"**, has agreed to issue this Insurance Surety Bond in favour of the Employer.
NOW THEREFORE

We, **M/s. _____ Insurance Company Limited**, hereby irrevocably and unconditionally undertake and agree to pay to the Employer, on its **first written demand**, without demur, protest, contest or reference to the Bidder, any sum or sums not exceeding in aggregate **₹_____ (Rupees _____ only)**.

The Surety Insurer shall make payment to the Employer upon receipt of a written demand from the Employer stating that the Bidder has become liable to forfeiture of its Bid Security in accordance with the provisions of the Tender Document.

1. Irrevocable and Unconditional Obligation

The Surety Insurer hereby irrevocably and unconditionally guarantees payment to the Employer up to the maximum amount of this Insurance Surety Bond upon the Employer's first written demand.

The Employer shall not be required to establish or prove the actual amount of loss or damage suffered by it before making a claim under this Bond.

2. Circumstances for Invocation

The Bid Security may be invoked and the amount covered by this Bond shall become payable to the Employer upon occurrence of any event specified in the Tender Document, including but not limited to:

a. withdrawal or modification of the Bid by the Bidder during the period of Bid validity or any extended period accepted by the Bidder;

b. failure or refusal of the Bidder, if selected, to accept the Letter of Acceptance/Letter of Award in accordance with the Tender Conditions;

c. failure of the successful Bidder to sign the Contract Agreement within the period stipulated in the Tender Document;

d. failure of the successful Bidder to furnish the required Performance Security/Security Deposit within the prescribed period;

e. submission of false, incorrect, misleading or materially suppressed information/documents by the Bidder, where such action attracts forfeiture of Bid Security under the Tender Conditions;

f. any other circumstance expressly specified in the Tender Document under which the Bid Security is liable to be forfeited.

3. Payment on First Demand

The Surety Insurer shall pay the amount demanded by the Employer **forthwith and without demur, protest or contest**, upon receipt of the Employer's written demand.

The demand made by the Employer shall be conclusive as regards the amount payable by the Surety Insurer under this Insurance Surety Bond, subject to the maximum liability specified herein.

4. No Defence on Account of Dispute

The obligation of the Surety Insurer under this Bond shall not be affected or suspended by:

a. any dispute or difference between the Employer and the Bidder;

b. any arbitration, litigation or other proceedings pending between the Employer and the Bidder;

c. any objection or defence raised by the Bidder;

d. any amendment, modification, clarification or extension relating to the Bid or Tender Process; or

e. any other matter which may otherwise affect the liability of the Bidder towards the Employer.

The Surety Insurer shall not require the Employer to first proceed against or exhaust any remedy against the Bidder before invoking this Bond.

5. Validity of Insurance Surety Bond

This Insurance Surety Bond shall remain valid up to _____, which shall not be less than the period stipulated for Bid Security under the Tender Document.

The Surety Insurer shall remain liable under this Bond for any claim received within the prescribed claim period.

6. Claim Period

Unless otherwise specified in the Tender Document, any claim or demand under this Insurance Surety Bond shall be received by the Surety Insurer on or before _____.

Upon expiry of the aforesaid claim period, the Surety Insurer shall stand being discharged from all liabilities under this Bond, provided no valid claim has been received within the prescribed period.

7. Maximum Liability

The total liability of the Surety Insurer under this Bond shall not exceed:

₹_____ (Rupees _____ only).

8. No Revocation

The Surety Insurer shall not revoke or cancel this Insurance Surety Bond during its validity period except with the prior written consent of the Employer.

9. Extension

In case the Bid validity is extended in accordance with the provisions of the Tender Document, the Bidder shall arrange for corresponding extension of the validity of this Insurance Surety Bond within the period prescribed by the Employer.

Failure of the Bidder to extend the Bond, wherever required, shall be dealt with in accordance with the provisions of the Tender Document.

10. Change in Constitution

Any change in the constitution, ownership, management or legal status of the Bidder or the Surety Insurer shall not discharge or otherwise affect the liability of the Surety Insurer under this Bond.

11. No Requirement to Proceed Against Bidder First

The Employer shall have full liberty to invoke this Insurance Surety Bond directly without first proceeding against the Bidder or enforcing any other security available to the Employer.

12. Compliance with IRDAI Requirements

The Surety Insurer declares that this Insurance Surety Bond has been issued in accordance with the applicable laws, rules, regulations and guidelines of the **Insurance Regulatory and Development Authority of India (IRDAI)** and that the Surety Insurer is duly authorized to issue such Surety Insurance Bonds.

13. Stamp Duty

This Insurance Surety Bond shall be executed on Non-Judicial Stamp Paper/e-Stamp Paper of appropriate value as applicable under the relevant Stamp Act.

14. Governing Law and Jurisdiction

This Insurance Surety Bond shall be governed by and construed in accordance with the laws of India.

The courts having jurisdiction over **Bhubaneswar, Odisha** shall have jurisdiction in respect of matters arising out of or in connection with this Bond, subject to the provisions of the Tender Document.

15. Authority of Signatory

The person signing this Insurance Surety Bond on behalf of the Surety Insurer confirms that he/she is duly authorized to execute this Bond.

For and on behalf of
M/s. _____ Insurance Company Limited

Signature: _____
Name: _____
Designation: _____
Power of Attorney/Authorization No.: _____
Date: _____
Place: _____
Official Seal of the Surety Insurer

Registered Office:

_____

Branch Office:

_____

Telephone: _____

E-mail: _____

WITNESSES

1. Signature: _____
Name: _____
Address: _____

2. Signature: _____
Name: _____
Address: _____

INSTRUCTIONS FOR SUBMISSION OF INSURANCE SURETY BOND

1. The Insurance Surety Bond shall be issued only by an **Insurance Company authorized by IRDAI to issue Surety Insurance Bonds**.

2. The Insurance Surety Bond shall be executed on Non-Judicial Stamp Paper/e-Stamp Paper of appropriate value in accordance with the applicable Stamp Act.

3. The Bond shall be furnished strictly in the prescribed format.

4. The Bond shall be **irrevocable and unconditional** and shall provide for payment to OBCC on its **first written demand**.

5. The Bond shall not contain any conditions requiring OBCC to first obtain a decree, award or order from any Court, Tribunal or Arbitrator before invocation.

6. The Bond shall clearly indicate the **Tender Reference Number, Name of Work, Bidder's Name, Bond Amount, Validity Date and Claim Period**.

7. The Bid Security shall remain valid for the period stipulated in the Tender Document, including any additional claim period specified therein.

8. In case the Bid validity is extended, the Bidder shall extend the validity of the Insurance Surety Bond within the prescribed period.

9. Any amendment, alteration, overwriting or deviation from the prescribed format shall require prior written approval of OBCC.

10. The Surety Insurer shall provide confirmation/authentication of the Insurance Surety Bond through its authorized official communication channel, as prescribed by OBCC.

11. The original Insurance Surety Bond shall be submitted within the time and in the manner prescribed in the Tender Document. Where the e-procurement system permits electronic submission, the scanned copy shall be uploaded as prescribed and the original shall be submitted wherever required.

12. The Insurance Surety Bond shall be released/returned in accordance with the provisions of the Tender Document after the Bidder's obligations relating to Bid Security have ceased.

Note: In the event of any conflict between this format and the provisions of the Tender Document, the provisions of the Tender Document shall prevail.

12.FORMAT OF INSURANCE SURETY BOND FOR PERFORMANCE SECURITY

(To be executed on Non-Judicial Stamp Paper/e-Stamp Paper of appropriate value as applicable under the relevant Stamp Act)

INSURANCE SURETY BOND NO.: _____

Date of Issue: _____

Bond Amount: ₹_____
Validity up to: _____
Claim Period up to: _____

TO

The Managing Director
Odisha Bridge & Construction Corporation Limited (OBCC)
Bhubaneswar, Odisha

hereinafter referred to as the "Employer"

SUB:

Insurance Surety Bond towards Performance Security

Tender Reference No.: _____
Name of Work:
"_____"
Letter of Acceptance No.: _____ dated _____
Agreement No.: _____ dated _____
Contract Price: ₹_____
Performance Security Amount: ₹_____

WHEREAS

A. Odisha Bridge & Construction Corporation Limited (OBCC), having its office at Bhubaneswar, Odisha, hereinafter referred to as the **"Employer"**, has invited bids for the aforesaid work and has awarded the work to **M/s. _____**, having its Registered/Head Office at **_____**, hereinafter referred to as the **"Contractor"**, pursuant to Letter of Acceptance No. **_____ dated _____**.

B. The Contractor has entered into / is required to enter into an Agreement with the Employer for execution and completion of the aforesaid work in accordance with the terms and conditions of the Contract.
C. The total Contract Price of the aforesaid work is ₹**_____** (Rupees **_____ only**).
D. In accordance with the provisions of the Contract, the Contractor is required to furnish a Performance Security for an amount of ₹**_____** (Rupees **_____ only**) for the due and faithful performance of all its obligations under the Contract.
E. At the request of the Contractor, **M/s. _____ Insurance Company Limited**, having its Registered/Head Office at **_____**, hereinafter referred to as the **"Surety Insurer"**, has agreed to furnish this Insurance Surety Bond in favour of the Employer as Performance Security.

NOW, THEREFORE

We, **M/s. _____ Insurance Company Limited**, hereby **unconditionally and irrevocably guarantee and undertake** to pay to the Employer, upon its **first written demand**, without demur, reservation, recourse, contest or protest and without any reference to the Contractor, such sum or sums up to an aggregate maximum amount of:

₹_____
(Rupees _____ only)

being the amount of this Insurance Surety Bond.

1. Unconditional and Irrevocable Undertaking

The Surety Insurer hereby **unconditionally and irrevocably guarantees the due and faithful performance** by the Contractor of all its obligations under the Contract.

In the event of any default, breach, non-performance or failure by the Contractor to duly perform its contractual obligations, the Surety Insurer shall, upon receipt of the Employer's first written demand, pay to the Employer such amount as may be demanded, subject to the maximum liability under this Bond.
The Employer shall **not be required to prove or establish the actual loss, damage or liability suffered by it**, or to provide detailed evidence of such loss, before invoking this Bond.

2. Scope of Security

This Insurance Surety Bond shall secure the due and faithful performance by the Contractor of all obligations under the Contract, including but not limited to:

f. execution and completion of the Works in accordance with the Contract;

g. compliance with the specifications, drawings, designs, approved methodology and other requirements of the Contract;

h. compliance with the time schedule and milestones stipulated under the Contract;

i. rectification of defects and deficiencies where the Performance Security is required to remain valid for such obligations;

j. compliance with directions and instructions issued by the Employer/Engineer in accordance with the Contract;

k. payment/recovery of amounts due from the Contractor where such recovery is permissible from the Performance Security under the Contract; and

l. any other contractual obligation for which the Performance Security is liable to be invoked under the Contract.

3. Payment on First Written Demand

The Surety Insurer shall **forthwith and immediately pay** to the Employer any amount demanded under this Bond, up to the maximum amount guaranteed herein.

Any demand made by the Employer under this Bond shall be sufficient and conclusive evidence of the amount due and payable by the Surety Insurer, subject to the maximum liability specified herein.
The Employer shall not be required to first proceed against the Contractor or any other security before making a demand under this Bond.

4. No Demur, Protest, Contest or Reference

The Surety Insurer shall make payment under this Bond:

- without demur;
- without reservation;
- without protest;
- without contest;
- without recourse; and
- without reference to the Contractor.

No objection raised by the Contractor shall constitute a valid ground for withholding or delaying payment by the Surety Insurer.

5. Liability Notwithstanding Disputes

The Surety Insurer undertakes to pay the amount demanded by the Employer notwithstanding any dispute or disputes raised by the Contractor in any suit, arbitration, proceeding before any Court, Tribunal, Arbitrator, Statutory Authority or any other forum.

The liability of the Surety Insurer under this Bond shall remain **absolute, unconditional and unequivocal**.

6. No Requirement to Proceed Against Contractor

The Employer shall have full liberty to invoke this Insurance Surety Bond directly without first proceeding against the Contractor or enforcing any other remedy/security available against the Contractor.

The Surety Insurer shall not require the Employer to exhaust any remedy against the Contractor before invoking this Bond.

7. Performance During Construction Period

This Insurance Surety Bond shall remain valid and enforceable during the entire period required for due and faithful performance of the Contract, including the **Construction/Execution Period**, as specified in the Contract.

8. Defects Liability / Maintenance Period

Where the Contract provides that the Performance Security shall remain valid during the **Defects Liability Period and/or Maintenance Period**, this Insurance Surety Bond shall remain valid and enforceable for such period as specified in the Contract.

The applicable period shall be:
Construction/Execution Period: _____
Defects Liability Period: _____
Maintenance Period, if applicable: _____
Additional period/claim period: _____
The exact validity requirement shall be governed by the relevant provisions of the Contract.

9. Validity of Insurance Surety Bond

This Insurance Surety Bond shall remain valid up to **_____**.

The Contractor shall ensure that the Bond remains valid for the entire period stipulated under the Contract.
Where the Contract period is extended and continuation of Performance Security is required, the Contractor shall arrange for extension of this Bond before its expiry.

10. Extension of Bond

In the event of extension of the Contract period, extension of the Defects Liability/Maintenance Period or any other circumstance requiring continuation of Performance Security, the Contractor shall obtain and submit an appropriate extension of this Insurance Surety Bond within the period prescribed by the Employer.

Failure to extend the Bond within the prescribed period shall be dealt with in accordance with the provisions of the Contract.

11. Claim Period

The Employer shall be entitled to invoke this Insurance Surety Bond by making a written claim on the Surety Insurer on or before:

_____

Any demand received by the Surety Insurer within the aforesaid claim period shall be honoured notwithstanding expiry of the validity period of this Bond.

12. Maximum Liability

The total liability of the Surety Insurer under this Bond shall in no event exceed:

₹_____
(Rupees _____ only).

13. Partial Invocation

The Employer shall be entitled to invoke this Insurance Surety Bond **in whole or in part and from time to time**, subject to the maximum aggregate liability of the Surety Insurer under this Bond.

Any amount paid by the Surety Insurer pursuant to invocation shall reduce the remaining liability under this Bond by the amount so paid.

14. Effect of Extension / Modification of Contract

Any extension of time, amendment, modification, variation, alteration, change in scope or other modification of the Contract shall not discharge or otherwise affect the liability of the Surety Insurer under this Bond.

However, the maximum liability of the Surety Insurer shall remain limited to the amount specified herein unless the Bond is formally amended.

15. Change in Constitution of Contractor

Any change in the constitution, ownership, management, partnership, status or legal structure of the Contractor shall not discharge or otherwise affect the liability of the Surety Insurer under this Bond.

16. Additional Performance Security

Where the Contractor is required to furnish **Additional Performance Security** in accordance with the provisions of the Tender Document/Contract, such Additional Performance Security shall be furnished separately in the form and manner prescribed by the Employer.

A separate Insurance Surety Bond may be furnished towards Additional Performance Security where permitted under the Contract.

17. Release / Discharge of Bond

The liability of the Surety Insurer under this Bond shall cease upon:

m. expiry of the validity and claim period specified herein, provided that no valid claim has been received within the claim period; or

n. written discharge/release of this Bond by the Employer,

whichever is applicable in accordance with the Contract.

18. Compliance with Applicable Laws and IRDAI Regulations

The Surety Insurer declares and confirms that:

a. it is duly authorized by the **Insurance Regulatory and Development Authority of India (IRDAI)** to issue Surety Insurance Bonds;

b. this Insurance Surety Bond has been issued in accordance with all applicable laws, rules, regulations and guidelines governing Surety Insurance in India; and

c. the person executing this Bond on behalf of the Surety Insurer is duly authorized to execute and bind the Surety Insurer.

19. Stamp Duty

This Insurance Surety Bond shall be executed on Non-Judicial Stamp Paper/e-Stamp Paper of appropriate value in accordance with the applicable provisions of the relevant Stamp Act.

20. Governing Law

This Insurance Surety Bond shall be governed by and construed in accordance with the laws of India.

21. Jurisdiction

Subject to the provisions of the Contract, the courts having jurisdiction over **Bhubaneswar, Odisha**, shall have jurisdiction in respect of matters arising out of or in connection with this Insurance Surety Bond.

22. Authority of Signatory

The person signing this Insurance Surety Bond on behalf of the Surety Insurer confirms that he/she is duly authorized to execute this Bond and bind the Surety Insurer.

IN WITNESS WHEREOF

The Surety Insurer has executed this Insurance Surety Bond through its duly authorized representative on this _____ day of _____, 20____.

For and on behalf of

M/s. _____ Insurance Company Limited

Signature: _____
Name: _____
Designation: _____
Power of Attorney/Authorization No.: _____
Date: _____
Place: _____
Official Seal of the Surety Insurer
Registered Office:

_____

Branch Office:

_____

Telephone: _____

E-mail: _____

WITNESSES
1.

Signature: _____

Name: _____
Address: _____

2.

Signature: _____

Name: _____
Address: _____

INSTRUCTIONS FOR FURNISHING PERFORMANCE INSURANCE SURETY BOND

1. The Performance Insurance Surety Bond shall be issued only by an **Insurance Company authorized by IRDAI to issue Surety Insurance Bonds**.

2. The Insurance Surety Bond shall be furnished **strictly in the prescribed format**.

3. The Bond shall be **unconditional and irrevocable** and shall provide for payment to OBCC on its **first written demand**.

4. The Bond shall not contain any conditions requiring OBCC to first obtain a decree, award or order from any Court, Tribunal or Arbitrator before invocation.

5. The Bond shall clearly indicate the:

    - Tender Reference Number;
    - Name of Work;
    - Letter of Acceptance Number and Date;
    - Agreement Number and Date;

- Contract Price;
- Performance Security Amount;
- Date of Issue;
- Validity Date; and
- Claim Period.

6. The Performance Insurance Surety Bond shall remain valid for the period specified under the Contract.
7. Where the Contract period is extended and the Performance Security is required to remain valid, the Contractor shall arrange extension of the Bond before its expiry.
8. Any amendment, alteration, overwriting or deviation from the prescribed format shall require the **prior written approval of OBCC**.
9. The Surety Insurer shall provide confirmation/authentication of the Insurance Surety Bond through its authorized official communication channel as prescribed by OBCC.
10. The original Insurance Surety Bond shall be submitted within the period and in the manner prescribed in the Tender Document.
11. The Contractor shall ensure that the Bond remains valid and enforceable throughout the period for which Performance Security is required under the Contract.
12. The Insurance Surety Bond shall be released/discharged in accordance with the provisions of the Contract after the Contractor has duly fulfilled its obligations and OBCC has no further claim under the Bond.

Note: In case of any conflict between this format and the provisions of the Tender Document/Contract Agreement, **the provisions of the Tender Document/Contract Agreement shall prevail**.

SECTION 3:
CONDITIONS OF CONTRACT

Conditions of Contract

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CONDITIONS OF CONTRACT

A. GENERAL

1. Definition

1.1. Terms which are defined in the Contract Data and not defined in the Conditions of Contract shall keep their defined meanings. Capital initials are used to identify defined terms.

1.1.1 **Bill of Quantities** means the priced and completed Bill of Quantities.

1.1.2 **Compensation Events** are those defined in Clause 41 hereunder.

1.1.3 The **Completion Date** is the date of completion of the Works as certified by the Engineer in accordance with clause 50.

1.1.4 The **Contract** is the contract between the Employer and the Contractor to execute, complete and maintain the Works. It consists of the documents listed in Clause 2.3 below.

1.1.5 The **Contract Data** defines the documents and other information which comprise the Contract.

1.1.6 The **Contractor** is a person or corporate body whose Bid to carry out the Works has been accepted by the Employer [obligations of the Contractor mentioned in the Contract Data].

1.1.7 The **Contractor's Bid** is the complete Bidding document submitted by the Contractor to the Employer and includes Technical and Financial bids.

1.1.8 The **Contract Price** is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

1.1.9 **Days** are calendar days; months are calendar months.

1.1.10 A **Defect** is any part of the Works not completed in accordance with the Contract.

1.1.11 The **Defects Liability Period** is the period named in the Contract Data and calculated from the Completion Date.

1.1.12 The **Employer** is the party who will employ the Contractor to carry out the Works; [As mentioned in the Contract Data].

1.1.13 **The Engineer** is the person named in the Contract Data (or any other competent person appointed and notified to the contractor to act in replacement of the Engineer) who is responsible for supervising the Contractor’s work, administering the Contract, certifying payments due to the Contractor, issuing and valuing Variations to the Contract, recommending extensions of time, and valuing the Compensation Events.

1.1.14 **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

1.1.15 **Initial Contract Price** is the Contract Price listed in the Employer's Letter of Acceptance.

1.1.16 **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Employer by issuing an extension of time.

1.1.17 **Materials** are all supplies, including consumables, used by the contractor for incorporation in the Works.

1.1.18 **Plant** is any integral part of the Works, which is to have a mechanical, electrical, electronic or chemical or biological function.

1.1.19 The **Site** is the area defined as such in the Contract Data.

1.1.20 **Site Investigation Reports** are those which were included in the Bidding documents and are factual interpretative reports about the surface and sub-surface conditions at the site.

1.1.21 **Specification** means the Specification of the works included in the Contract and any modification or addition made or approved by the Employer.

1.1.22 The **Start Date / Date of Commencement** is given in. the Contract Data. It is the date when the Contractor shall commence execution of the works. It does not necessarily coincide with any of the Site Possession Dates.

1.1.23 A **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.

1.1.24 **Temporary Works** are works designed, constructed, installed, and removed by the Contractor, which are needed for construction or installation of the Works.

1.1.25 A **Variation or Change in Scope** is an instruction given by the Employer, which varies and changes the scope of Works.

1.1.26 **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

1.1.27 Year may be understood as financial year.

1.1.28 **"Approved Make"** means makes of items as specified in the "List of Approved Makes/Approved Manufacturers" in Section 8 of this RFP. However, a higher or equivalent make can be utilized after obtaining prior approval of "Engineer-In-Charge" in writing.

2. Interpretation

2.1. In interpreting the Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their general meaning under the language of the Contract unless specifically defined. The Employer will provide instructions clarifying queries about the Conditions of Contract.

2.2 If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion date for the whole of the Works).

2.3 The documents forming the Contract shall be interpreted in the following order of priority:

(a) Agreement
(b) Letter of Acceptance, notice to proceed with the works.
(c) Contractor's Bid
(d) Contract Data
(e) Conditions of Contract including Special Conditions of Contract
(f) Specifications
(g) Drawings
(h) Bill of quantities (optional) and
(i) Any other document listed in the Contract Data as forming part of the Contract.

3. Languages and Law

The language of the Contract and the law governing the Contract are stated in the Contract Data.

4. Engineer's Decisions:

Except where otherwise specifically stated, the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer as per the provision of the contract.

5. Delegation:

The Engineer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

6. Communications:

Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

7. Sub-contracting:

The Contractor may sub-contract any portion of work, up to a limit specified in Contract Data, with the approval of the Engineer but may not assign the Contract without the approval of the Employer in writing. Sub-contracting does not alter the Contractor's obligations.

8. Other Contractors:

The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of other Contractors. The Contractor shall, as refer to in the Contract Data, also provide facilities and services for them as described in the Schedule. The employer may modify the schedule of other contractors and shall notify the contractor of any such modification.

9. Personnel:

9.1. The Contractor shall employ the key personnel named in the Schedule of Key Personnel as referred to in the Contract Data besides those as listed at section-8 and Section-9 to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities, and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

9.2. If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. Employer's and Contractor's Risks:

The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Employer's Risks:

The Employer is responsible for the excepted risks which are in so far as they directly affect the execution of the Works in India, the risks of war, hostilities, invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war, riot commotion or disorder (unless restricted to the Contractor's employees), and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive.

12. Contractor's Risks:

All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the excepted risks are the responsibility of the Contractor.

13. Insurance:

13.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover ***for the period as stated below against the events and*** in the amounts and deductibles stated in the Contract Data for the following events, which are due to the Contractor's risks:

A) From the starting date to the end of defect liability period:

(a) Loss of or damage to the works

B) From the start date till completion of the work as per agreement:

(a) Loss of or damage to plant, materials and equipment,

(b) Loss of or damage of property (except the works, plant, materials and equipment) in connection with the contract, and

(c) Personal injury or death.

13.2 If all the items as listed at Cl.13.1(B) can be combined / grouped under one insurance cover like Contractor's, All Risks (CAR) Policy **covering all-natural calamities as per local conditions.**

13.3 Prior to seven days before the start date, the Contractor shall furnish to the Engineer notarized true copies of the certificates of insurance, copies of insurance polices and premia payment receipts in respect of such insurance for the Employer's approval. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

13.4 If the contractor does not provide any of the policies and certificates required, the Employer may affect the insurance which the contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the contractor or, if no payment is due, the payment of the premiums shall be a debt due.

13.5 Alterations to the terms of insurance shall not be made without the approval of the Employer.

13.6 Both parties shall comply with any conditions of the insurance policies.

14. Site Investigation Reports:

14.1 The Contractor, in preparing the Bid, may rely on any site Investigation Reports referred to in the Contract Data, which are indicative and not exhaustive. The Employer shall provide all available details to the Contractor (Bidder) for his information, if requested by him at least one week prior to the bid submission date. The bidder shall be responsible for interpreting all such data. After award of work, the Contractor shall carry out detail survey and investigation for preparation of detail designs as per the scope of work and time period stipulated at Section-8.

To the extent which was practicable (taking account of cost and time), the Contractor (Bidder) shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Tender or Works. To the same extent, the Contractor (Bidder) shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Tender as to all relevant matters, including (without limitation):

(a) the form and nature of the Site, including sub-surface conditions,
(b) the climatic conditions,
(c) the extent and nature of the work and Goods necessary for the execution and

completion of the Works and the remedying of any defects,

(d) the Laws, procedures and labour practices of the Country, and

(e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

(f) availability of required materials

15. Queries about the Contract Data:

15.1 The Employer will clarify queries on the Contract Data if any during the Pre-bid references.

16. Contractor to Construct the Works:

16.1 The Contractor shall construct and install the Works in accordance with the approved specification and drawings. All designs, drawings, and specifications to be furnished by the contractor shall be approved by the Employer before execution in accordance with Cl. 18.

17. The Works to be completed by the Intended Completion Date:

The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the programme submitted by the Contractor, as updated with the approval of the Engineer, and complete them by the Intended Completion Date.

18. Approval by the Engineer:

18.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer, who is to approve them if they comply with the Specifications and Drawings.

18.2 The Contractor shall be responsible for the design of Temporary Works.

18.3 The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.

18.4 The Contractor shall obtain approval to the design, drawings, and specifications of all components of the building and all allied infrastructure works, except those for the temporary works as stated at Cl. 18.1, from any National Institute of Repute / State Govt. Engineering College of repute in Odisha at its own cost. Such approved documents need to be furnished to the Employer within the stipulated date as mentioned in the contract data and at Section-8

18.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Employer / Engineer before their use.

19. Safety:

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. Discoveries:

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site is the property of the Employer. The Contractor is to notify the Engineer of such discoveries and carry out the Engineer's instructions for dealing with them.

21. Possession of the Site:

21.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the Contract Data, the Employer is deemed to have delayed the start of the relevant activities and this will be Compensation Event.

22. Access to the Site:

22.1 The Contractor shall allow the Employer and any person authorized by the Employer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured / fabricated / assembled for the works.

23. Instructions:

23.1 The Contractor shall carry out all instructions of the Engineer pertaining to works, which comply with the applicable laws where the Site is located.

23.2 The Contractor shall permit the Employer to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Employer, if so, required by the Employer.

24. Disputes:

That for the purpose of jurisdiction in the event of disputes if any of the Contract would be deemed to have been entered in to within the State of Odisha and it is agreed that neither party to the Contract will be competent to bring a suit in regard to the matter by this Contract at any place outside the State of Odisha.

25. Deleted.

26. Replacement of Adjudicator: Not applicable

B. TIME CONTROL

27. Programme:

27.1 Within **14 days of issue of letter of award**, the successful bidder shall submit to the Employer detail work programme for approval showing the general methods, arrangements, order and timing for all the activities in the Works along with monthly cash flow forecast. The agreed work programme / milestones during such contract negotiation shall form part of the agreement.

27.2 An update of the Programme shall be a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

27.3 The contractor shall submit to the Employer, for approval, an updated Programme at intervals no longer than the period stated in the Contract Data. If the Contractor does not submit an updated Programme within this period, the Engineer may withhold the amount stated in the Contract Data from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue programme has been submitted.

27.4 The Employer's approval of the Programme shall not alter the Contractor's obligations. The Contractor may revise the Programme and submit it to the Employer again at any time. A revised Programme is to show the effect of Variations and Compensation Events.

27.5 Contractor has to facilitate themselves to update the project reporting in client PMIS portal.

28. Extension of the Intended Completion Date:

28.1 The Employer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the intended Completion Date without the Contractor taking steps to accelerate the remaining work and which would cause the Contractor to incur additional cost.

28.2. The Employer shall decide whether and by how much to extend the Intended Completion Date within 35 days of the Contractor asking the Engineer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

28.3. The Engineer shall, within 14 days of receiving full justification from the contractor for extension of Intended Completion Date refer to the Employer his recommendation. The Employer shall in not more than 21 days communicate to the Engineer the Employer's decision.

29. Delays Ordered by the Engineer:

The Engineer may instruct the Contractor to delay the start or progress of any activity within the Works.

30. Management Meetings:

30.1 Either the Engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

30.2 The Engineer shall record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

31. Early Warning:

31.1 The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the work resulting delay in the execution. The Engineer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Completion Date.

31.2 The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer.

C. QUALITY CONTROL

32. Identifying Defects:

The Engineer shall check the Contractor's work regularly and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for defects and to uncover and test any work that the Engineer considers may have a Defect.

33. Tests:

If the Engineer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect the test shall be a Compensation Event.

34. Correction of Defects:

34.1 The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

34.2 Every time notice of a Defect is given; the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice.

35. Uncorrected Defects:

If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

D. COST CONTROL

36. Changes in the Quantities: (OPTIONAL)

37. Change of Scope (Variations) and Procedure for change of Scope:

37.1 The Employer may, require the Contractor to make modifications/alterations to the construction works before the issue of the completion certificate either by giving an instruction or by requesting the contractor to submit a proposal for change of scope involving additional cost or reduction in cost. Any such change of scope shall be made and valued in accordance with the provisions of this contract and the contractor, in that event, will have no further claim on the ground that had it been known / disclosed earlier he would have made such charges in other connected work in their design, construction which would have saved him some cost and given him other consequential benefits.

37.2 Change in scope may include.

(a) Change in specifications of any item of works

(b) omission/ deletion of any item of work from the scope of work

(c) any additional work (such as addition of extra plinth area) which are not included in the scope of work including any additional test on completion

37.3 In the event of the Employer determining that a change of scope is necessary, it shall issue notice to the contractor a notice specifying in reasonable detail the works contemplated there under ("Change in scope notice")

37.4 Upon receipt of change in scope notice, the contractor shall with due diligence, provide to the Employer through the Engineer within seven days time such information as is necessary together with documentation in support of;

(a) the impact, of any, which the change in scope is likely to have on the completion of the work

(b) the options for implementing the proposed change of scope and the effect, if any, each on the cost and time thereof m including the following details;

i. break down of quantities, unit rates and cost for different items of work

ii. proposed design for the change of scope

iii. proposed modifications, if any, to the construction period with updated work programs (all Variations shall be included in updated programs produced by the Contractor).

37.5 The contractor's quotation for change of scope shall be based on the detail design and rates for various item of works as derived on the basis of his original bid price (in case of repetition of similar item as per original contract) or MoRTH Standard Data Book and prevailing market rates (in case of new item not envisaged in the original contract.)

37.6 The total value of all change of scope of work shall not exceed 5% of total contract price for the construction work.

38. Payments for Change of Scope (Variations):

38.1 The Employer shall assess the change in scope proposal and Contractor's quotation and upon reaching an agreement; the Employer shall issue the Change of Scope Order requiring the contractor to proceed with the performance thereof.

38.2 If the Contractor's quotation is unreasonable, the Employer may order the Variation and make a change to the Contract Price which shall be based on Employer's own forecast of the effects of the Variation on the Contractor's costs.

38.3 If the Employer decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event, subject to condition that such variation shall not exceed 5% of the total contract price for the contract work.

38.4 The Contractor shall not be entitled to additional payment for costs, which could have been avoided by giving early warning.

38.5 Deleted

39. Payment Certificates:

39.1 The Contractor shall submit to the Engineer statements of the value of the work completed.

39.2 The Engineer shall check the Contractor's statement within 14 days and certify the amount to be paid to the Contractor as per contract payment schedule after taking into account any credit or - debit for the month in question in respect of materials for the works in the relevant amounts and under conditions set forth in sub-clause 47.3 of the Contract Data (Secured Advance).

39.3 The value of work executed shall be determined by the Engineer.

39.4 The value of work executed shall comprise the value of the quantities of the items as per the milestone and work programme attached to the contract.

39.5 The value of work executed shall include the valuation of Change in Scope (Variation) and Compensation Events, if any.

39.6 The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

40. Payments:

Payments shall be adjusted for deductions for retention, other recoveries in terms of the contract and taxes at source, as applicable under the law. The Engineer shall pay the Contractor the amounts as per the payment schedule attached to the contract.

41. Compensation Events:

41.1.1 The following are Compensation Events unless they are caused by the Contractor:

(a) The Employer does not give access to a part of the Site by the Site Possession Date stated in the Contract Data.

(b) Other contractors, public authorities of utilities or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

41.2 If a Compensation Event would prevent the work being completed before the Intended Completion Date, the Intended Completion Date shall be extended. The Contractor will react competently and promptly to the event and shall submit information demonstrating the effect of the Compensation Event and the required extended time period for completion.

41.3 The Engineer shall examine the information furnished by the Contractor and shall recommend to the Employer by how much time the Intended Completion Date shall be extended. The Employer shall decide / sanction the required extension of time due to such compensation event.

41.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Engineer.

42. Tax:

42.1 The rates quoted by the Contractor shall be deemed to be exclusive of the GST and inclusive of Royalty, Income Tax, Labour CESS and all other statutory taxes that the Contractor will have to pay for the performance of this Contract. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

43. Currencies:

All payments shall be made-in Indian Rupees.

44. Retention:

44.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the Contract Data until Completion of the whole of the works or settlement of final payment.

44.2 On completion of the whole of the works half the total amount retained is repaid to the contractor and half when the Defects Liability Period has passed and the Engineer has certified that all defects notified by the Engineer to the contractor before the end of the period have been corrected.

45. Liquidated Damages:

45.1 The Contractor shall pay liquidated damages to the Employer at the rate per week stated in the Contract Data for each week that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the contract data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not relieve the contractor from his / her / their obligation to complete the works or from any other duties, obligations or responsibilities which he / she / they may have under the contract.

45.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate.

45.3 If the contractor fails to comply with the time for completion as stipulated in the tender, then the contractor shall pay to the employer the relevant sum stated in the Contract Data as Liquidated damages for such default and not as penalty for every week or part of week which shall elapse between relevant time for completion and the date stated in the taking over certificate of the whole of the works on the relevant section, subject to the limit stated in the contract data.

The employer may, without prejudice to any other method *of* recovery deduct the amount of such damages from any money due or to become due to the contractor. The payment or deduction of such damages shall not relieve the contractor from his obligation to complete the works or from any other of his obligations and liabilities under the contract.

45.4 If, before the Time for Completion of the whole of the Works or, if applicable, any Section, a Taking - Over Certificate has been issued for any part of the Works or of a Section, the liquidated damages for delay in completion of the remainder of the Works or of that Section shall, for any period of delay after the date stated in such Taking-Over Certificate, and in the absence of alternative provisions in the Contract, be reduced in the proportion which the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The provisions of this Sub-Clause shall only apply to the rate of liquidated damages and shall not affect the limit thereof.

46. Bonus Payment:

46.1 The procedure for payment of bonus (incentive) shall be as per the latest amendment to Para 3.5.5 of OPWD code.

46.2 If the contractor achieves completion of the whole of the works prior to the Intended Completion Date prescribed in Contract Data the Employer shall pay to the contractor a sum stated in Contract Data as bonus (incentive) for every completed month which shall elapse between the date of completion of all items of works as stipulated in the Contract and the time prescribed in Clause 17.

46.3 For the purpose of calculating bonus payments, the time given in the Bid for completion of the whole of the works is fixed and unless otherwise agreed, no adjustments of the time by reason of granting an extension of time pursuant to Clause 28 or any other clause of these conditions will be allowed. Any period falling short of a complete month shall be ignored for the purpose of computing the period relevant for the payment of bonus.

47. Advance Payment:

47.1 The Engineer shall make advance payment to the Contractor for mobilization and cash flow support of the amounts stated in the Contract Data by the date stated in the Contract Data, only against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a Bank acceptable to the Engineer in amounts and currencies equal to 110% of the advance payment.

47.2 An interest @ 10% per annum shall be charged on the advance payment.

47.3 The Advance Payment shall not be released until the basic design & architectural drawings is finalized and establishment of camp at work site is completed.

47.4 The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. The contractor shall ensure that the Bank Guarantee remains enforceable until the advance payment has been fully repaid and accordingly renew it, from time to time, until the advance payment has been fully repaid.

47.5 If the terms of guarantee specify its expiry date, and the advance payment has not been re-paid by the date then 28 days prior to the expiry date, the contractor shall extend the validity of the guarantee until the advance payment has been fully repaid.

47.6 The advance payment shall be repaid through percentage deductions from the interim payments as follows:

(a) Deductions shall commence from the 1st interim payment.

(b) Deductions shall be made in proportions of the advance payment until such time as the advance payment has been repaid provided that the advance payment shall be completely repaid prior to the time when 90 percent of the accepted contract amount has been repaid.

47.7 If the advance payment has not been repaid prior to the issue of the Taking over Certificate for the work or prior to termination under Section – 3 Clause -54 of (termination by employer), the balance advance is payable by the contractor to the employer.

48. Securities:

The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank or surety acceptable to the Employee and denominated in Indian Rupees. The Performance Security shall remain valid up to the period as defined in the Contract Data.

49. Cost of Repairs:

Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions including the situation as stipulated at Cl. 12.

E. FINISHING THE CONTRACT

50. Completion:

50.1 The Contractor shall request the Engineer to issue a Certificate of Completion of the Works and the Engineer will do so upon deciding that the Work is completed.

51. Taking Over:

51.1 The Employer shall take over the Site and the Works within seven days of the Engineer issuing a certificate of Completion.

52. Final Account:

52.1 The Contractor shall supply the Engineer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Engineer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Employer shall decide on the amount payable to the Contractor and issue a payment certificate, within 56 days of receiving the Contractor's revised account.

53. Operating and Maintenance Manuals:

53.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

53.2 If the Contractor does not supply the Drawings and/or manuals by the dates stated in the Contract Data, or they do not receive the Employer's approval, the Engineer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

54. Termination:

54.1 The Employer may terminate the Contract if the other party causes a fundamental breach of the Contract.

54.2 Fundamental breaches of Contract include, but shall not be limited to the following:

(a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Programme and the stoppage has not been authorized by the Engineer;

(b) the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(c) the Engineer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;

(d) the Contractor does not maintain a security which is required;

(e) the Contractor has delayed the completion of works by the number of days for which the maximum number of liquidated damages can be paid as defined in the Contract data; and

(f) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this paragraph: "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition."

54.3 When either party to the Contract gives notice of a breach of contract to the Engineer for a cause other than those listed under Sub Clause 54.2 above, the Engineer shall decide whether the breach is fundamental or not.

54.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

54.5 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site, as soon as reasonably possible.

55. Payment upon Termination:

55.1 If the-Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done fewer advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.

55.2 If the Contract is terminated at the Employer's convenience, the Engineer shall issue a certificate for the value of the work done, less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract and less taxes due to be deducted at source as per applicable law. No extra cost will be paid by the employer for expenditure towards removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works and the Contractor's costs of protecting and securing the Works.

56. Property:

56.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a contractor’s default.

57. Release from Performance:

57.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made.

F. SPECIAL CONDITIONS OF CONTRACT

1. LABOUR:

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Engineer may require.

2. COMPLIANCE WITH LABOUR REGULATIONS:

During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all existing labour enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to the construction industry are given below. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the Contractor including his amount of performance security. The Employer/Engineer shall also have the right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK.

a) Workmen Compensation Act 1923: - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) Payment of Gratuity Act 1972: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

c) Employees P.F. and Miscellaneous Provision Act 1952: - The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:

(i) Pension or family pension on retirement or death, as the case may be.

(ii) Deposit linked insurance on the death in harness of the worker.

(iii) Payment of P.F. accumulation on retirement/death etc.

d) Maternity Benefit Act 1951: -The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) Contract Labour (Regulation & Abolition) Act 1970: - The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

f) The Code on Wages, 2019: This code consolidates the Laws relating to Wages and Bonus and matters connected therewith or incidental thereto.

g) Industrial Disputes Act 1947: - The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

h) Industrial Employment (Standing Orders) Act 1946: - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

i) Trade Unions Act 1926: - The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

j) Child Labour (Prohibition & Regulation) Act 1986: - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

k) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: - The Act is applicable to an establishment which employs 5 or more inter- state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc.

l) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996: - All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer

of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the workplace etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

m) Factories Act 1948: -The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

3. SUB-CONTRACTING (GCC Clause 7):

Please add the following as Clause 7.2:

The contractor shall not be required to obtain any consent from the employer for:

a) the Sub-contracting of any part of the works for which the sub-contractor is named in the contract.

b) the provision of labour; and

c) the purchase of materials which are in accordance with the standards specified in the Contract.

d) Beyond this if the contractor proposes sub-contracting any part of the work during execution of works, because of some unforeseen circumstances to enable him to complete the work as per terms of the contract, the Engineer / Employer will consider the following before according approval:

- The contractor shall not sub-contract the whole of the works.
- The contractor shall not sub-contract any part of the work without prior consent of the Engineer. Any such consent shall not relieve at the contractor from any liability or obligations under the contract and he shall be responsible for the acts, defaults and neglects
  of any sub-contractor, his agents or workmen as fully as if they were the acts, defaults or neglects of the contractor, his agents or workmen.
- The Engineer should satisfy whether (a) the circumstances warrant such sub-contracting; and (b) the sub-contractors so proposed for the work possess the experience, qualification and equipment necessary for the job proposed to be entrusted to them in proportion to the
  quantum of work to be sub-contracted.
- If payments are proposed to be made directly to that sub-contractor, this should be subject to specific authorization by the prime contractor so that this arrangement does not alter the contractor's liability or obligations under the contract.

Note: All bidders are expected to indicate clearly in the bid, if they propose sub-contracting elements of the works along with proposed value of such works [as mentioned in Contract Data]. For each such proposal the qualification and the experience of the identified sub-contractor in the relevant field should be furnished along with the bid to enable the employer to satisfy himself about their qualifications before agreeing for such sub-contracting and

include it in the contract.

In view of the above, normally no additional sub-contracting should arise during execution of the contract.

4. PROTECTION OF ENVIRONMENT:

Add the following as Conditions of Contract Clause 16.2:

The Contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or other resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, by-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority. The contractor shall also abide by the requirements as per Attachment-X of the Bid Document.

Salient features of some of the major laws that are applicable are given below:

The Water (Prevention and Control of Pollution) Act, 1974: This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health or animals or plants or of aquatic organisms.

The Air (Prevention and Control of Pollution) Act, 1981: This provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

The Environment (Protection) Act, 1986: This provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human being, other living creatures, plants, micro- organism and property.

The Public Liability Insurance Act, 1991: This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

ENVIRONMENTAL MITIGATION MEASURES DURING CONSTRUCTION

	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
			Implementation	Supervision
1.	Removal of Trees	Trees will be removed from the corridor of impact (or, site) before the commencement of construction with prior clearance from the Forest Department.	Contractor	Department
2.	Generation of Debris	Debris generated due to the dismantling of the existing pavement structure shall be suitably reused in the proposed construction, subject to the suitability of the material and the approval of the Engineer. Unutilisable debris material shall be suitably disposed off by the contractor, either for the filling up of borrow areas created for the project or at pre-designated dump locations.	Contractor	Department.
3.	Loss of Topsoil	(a) The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles (maximum slope 1:2, and maximum height 2m). To retail soil and to allow percolation of water, the edges of the stockpile shall be protected by slit fencing (b)Stockpiles will not be surcharges or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. (c) Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on adjoining/proximate barren/rocky areas as identified by the Engineer in a layer of thickness of 75 – 150 mm. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes, medians, incidental spaces etc.	Contractor	Department.
4.	Borrowing of Earth	The borrowing shall not be carried out in cultivable lands, unless agreed upon by the Engineer. Borrowing of earth shall be carried out as per the IRC Guidelines.	Contractor	Department.

5.	Degradation of Borrow Areas	The location, shape and size of the designated borrow areas shall be as approved by the Engineer and in accordance to the IRC recommended practice for borrow pits for road embankments. Borrow pits shall be re-developed, spoils shall be dumped with an overly of stockpiled topsoil. Redevelopment of borrow areas shall be taken up in accordance with the plans approved by the Engineer.	Contractor	Department.

	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
			Implementation	Supervision
6.	Soil Erosion	Along sections abutting water bodies, stone pitching needs to be carried out for slopes between 1:4 and 1:2 Gabion structures/ Grass turfing shall be provided for slopes steeper than 1 vertical to 2 horizontals. The work shall consist of measures as per design or as directed by the Engineer to control soil erosion, sedimentation and water pollution, through use of berms, dikes, sediment basins, fiber mats, mulches, grasses, slope drains and other devices.	Contractor	Department.
7.	Construction Wastes & their disposal	Spoil from excavation of riverbed shall be managed and disposed off as directed by the Engineer. No new disposal site shall be created as part of the project, which is not redeveloped. All waste material shall be completely disposed as desired and the site shall be fully cleaned before handing over.	Contractor	Department.
8.	Quarry Operations	The Contractor shall open and use quarries, as per the Odisha Mining Rules. Alternatively, the Contractor shall acquire the required material from quarries licensed by the OSPCB and having an approved redevelopment plan.	Contractor	Department.

	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
9.	Loss of Water Bodies	a. Filling of surface water bodies shall be compensated by digging an equal volume of soil for water storage. Such dug-up soil shall be use4d for spreading as topsoil.	Contractor	Department.

		b. Wherever earthwork is undertaken, the banks shall be protected by means as designed or as approved by the Engineer. Construction shall be carried out in a manner so that the side slopes are no steeper than 1:4, otherwise slope protection work shall be provided, as approved by the Engineer and as pr item 6 of these specifications. For drains carrying run-off from the highways entering, into surface water bodies/channels, with a fall exceeding 1.5 m cascading or sedimentation traps shall be provided.		
10.	Loss of Other Water Sources	The replacement shall be ready prior to demolition / dismantling of the existing source. Any damage to the existing sources of water (hand pump, tube well etc.) shall be made good by the Contractor at his expense.	Contractor	Department.
11.	Flooding	In addition to the design requirements, the contractor shall take all desired measures as directed by the Engineer to prevent temporary or permanent flooding of the site or any adjacent area.	Contractor	Department.
	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
			Implementation	Supervision
12.	Alteration of Drainage	a. In sections along water courses, and close to cross-drainage channels, earth, stone or any other construction materials or appendage shall be properly disposed off so as not to block the flow of water. b. All necessary measures shall be taken to prevent earthwork, stonework, materials and appendage as well as the method of operation from impending cross-drainage at rivers, streams, water canals and existing and existing irrigation and drainage systems.	Contractor	Department.
13.	Contamination from Construction Wastes, fuel, and Lubricants	At construction vehicle parking locations and at fuel/lubricant storage sites, oil and grease traps shall be provided. Fuel storage shall be in proper bunded areas. The discharge standards promulgated under the Environmental Protection Act, 1986 shall be strictly adhered to.	Contractor	Department.

14.	Sanitation and Waste disposal in construction camps	Construction laborer's camps shall be located at least 200 m away from the nearest habitation and as approved by the Engineer. The sewage system for a construction laborer's camp shall be designed, built and as per the Factories Act, 1948 and the building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.	Contractor	Department.
15.	Generation of Dust	All vehicles delivering materials to the site shall be covered to avoid spillage of materials. Clearance shall be affected by manual sweeping and removal of debris, or, if so, directed by the Engineer, by mechanical sweeping and cleaning equipment, an all dust, mud and other debris shall be removed completely.	Contractor	Department.
16.	Emission from	Hot mix plants and batching plants shall be located sufficiently away from habitation, agricultural operations or industrial establishments. Where possible such plants will be located at least 1000 m downwind from the nearest habitation. The exhaust gases, and operation of the plants shall comply with the requirements of the relevant current emission control rules (as per OSPCB).	Contractor	Department.
	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
17.	Emission and noise from Vehicles & Equipment	All vehicles, equipment and machinery used for construction shall conform to the relevant Bureau of Indian Standard (BIS) norms. All vehicles, equipment and machinery used for construction shall be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of OSPCB.	Contractor	Department.
	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
			Implementation	Supervision
18.	Pollution from Crusher	All crushers used in construction shall conform to relevant dust emission control rules. Clearance for siting shall be obtained from the OSPCB. Alternatively, only crushers already licensed by the OSPCB shall be used.	Contractor	Department.
19.	Loss, Damage or Disruption of/to Fauna.	All works are to be carried out in such a fashion that the damage and disruption to fauna is minimum. Construction workers shall be instructed to protect natural resources and fauna, including wild animals and aquatic life.	Contractor	Department.

		Hunting and unauthorized fishing are prohibited.		
20.	Chance-found important Flora/Fauna.	If a rare/endangered/threatened flora/fauna species is spotted, the contractor shall make all arrangements to intimate the Forest/Wildlife authorities without delay, and measures will be taken for its conservation. Work would be suspended, until the relevant authorities are consulted, unless specifically directly by the Engineer.	Contractor	Department.
21.	Traffic Control and Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the road under improvement.	Contractor	Department.
22.	Risk from Construction Operations	The contractor is required to comply with all the precautions as required for the safety of the workmen as per the international Labour Organisation (ILO) Convention No. 62 as far as those are applicable to this contract. The contractor shall also comply with the national Building Code for this purpose.	Contractor	Department.
23.	Potable Water and Hygiene	Potable water supply will be provided, at every workplace, as per the Factory Rules of Odisha. All requirements as per standards set by the building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 shall be fulfilled.	Contractor	Department.
24.	Protection of Cultural Heritage / Property	All the necessary and adequate care shall be taken to minimize impact on cultural properties (which includes cultural sites and remains, places of worship, graveyards, monuments and any other important properties/sites/remains notified under the Ancient Sites and Remains Act)	Contractor	Department.
25.	Chance found Archaeological property	All fossils, coins, articles of value of antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government. The contractor	Contractor	Department.

	Environmental Impact/Issue	Mitigation / Management Measures	Responsibility	
			Implementation	Supervision
		shall work within 100 m in all directions from the site. The Engineer shall seek direction from the Archaeological Society of India (ASI) before instructing the Contractor to recommence work on the site.		
26.	Risk from explosives	Except as may be provided in the contract or ordered or authorized by the Engineer, the contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the contractor shall comply with the requirements of the explosives Act. First aid and medical care shall be provided, as per the factory Rules of Odisha.	Contractor	Department.

5. POSSESSION OF SITE:

The Contractor will facilitate acquisition of land and shifting of utilities including provision of manpower and vehicle for liaison with District Administration, Land Acquisition Authority, P.W.D & other concerned stakeholders for shifting of utilities. However, the final responsibility of land acquisition lies with the employer

SECTION 4:
CONTRACT DATA

Contract Data

Items marked "N/A" do not apply in this contract.

Clause Reference	Conditions	Data
1.1.5& 2.3	**Contract Data** (Documents also to form part of the Contract)	i. The Schedule of Operating and Maintenance Manuals (Date to be Notified) [Cl. No.53] ii. The Schedule of Other Contractors (To be Notified later) [Cl. No.8] iii. The Schedule of Key Personnel [Cl No.9] iv. The Methodology and Program of construction [Cl No.27] v. The Schedule of Key and Critical equipment to be deployed on the work as per agreed program of construction [Cl No.27] vi. Site Investigation reports [Cl No.14] vii. Notice inviting bid including all corrigendum's / addendum / additional conditions / specifications / drawings etc. if any issued at the time of invitation of bid and acceptance thereof. viii. Bid document. ix. Performance security
1.1.6	**Contractor**	Contractors Name and Address (for correspondence, e-mail id, mobile & landline number) Name of Contractor's Representative and authorized letter thereof **Contractor's obligations shall be, but not limited to the following:** I. The Contractor shall design, execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works. II. The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects. III. The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the

		Contractor. IV. The Contractor shall be responsible for all Contractor's Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract. V. The Contractor shall also be responsible engineering design of the all Temporary & Permanent Works complying to Section 8. VI. The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer. VII. Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to: a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract, b) remove and re-execute any work which is not in accordance with the Contract, and c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise. VIII. The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified as under sub-paragraph (c) or as Instructed by Employer/Engineer. IX. If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall pay to the Employer all costs arising from this failure. X. Contractor shall coordinate with suppliers of various materials and equipment to be procured by him for use in works and provide all required details with respect to their manufacturing facilities; raw materials etc. as per requirements of IGBC Gold Certification guidelines. XI. The Contractor shall comply with all Applicable Laws and Applicable Permits (including renewals as required) in the performance of its obligations under this Agreement. XII. The Contractor shall undertake and perform all such acts, deeds and things as may be necessary or required for the Works under and in accordance with this Agreement, the Applicable Laws and Applicable Permits. XIII. The Contractor shall directly perform the minimum following activities and not to be sub- contracted: -

a) Overall Project Management

b) Planning, Scheduling, Monitoring

c) Procurement Services

d) Quality Control

e) Health, Safety & Environment, Labour Camps.

f) Construction Management

g) Performance Guarantee Test Run.

The Contractor shall for the entire duration of the contract, no later than 10 (ten) days afterthe close of each month, furnish to the Employer and the Employer's Engineer a monthly report on progress of the Works and shall promptly give such other relevant information as may be required by the Employer's Engineer. The Contractor shall submit daily progress report and weekly progress report as per the directions of the Engineer

(xv) The Contractor shall take photographs/videos including Drone during various stages of construction, and submitted to the Engineer-In-charge, showing details of Special requirements / measures being taken by the Contractor towards above for documentary compliance and records.

(xvi) The Contractor shall provide and maintain furnished Office Accommodation & other facility for the use of Employer and Engineer for the entire duration of the project (as specified in the **SCC**)

(xvii) The Contractor shall remedy any and all loss or damage to the roads and services/ utilities in and around the battery limits which get damaged during the Defects Liability Period at the Contractor's cost to the extent that such loss or damage shall have arisen out of the performance of the contractor's obligation. The Contractor shall undertake and perform all such acts, deeds and things as may be necessary or required for the Works under and in accordance with this Agreement,the Applicable Laws and Applicable Permits.

Contractor's Care for Works:

(i) The Contractor shall take full responsibility for care of the Works and Goods from the Commencement Date until the Completion Certificate is issued for the Works.

(ii) After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the date stated in a Provisional Certificate, until this outstanding work has been completed.

(iii) If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

(iv) The Contractor shall also be liable for any loss or damage which occurs after a Completion Certificate has been issued and which arose from a previous event for which the Contractor was liable.

Clause Reference	Conditions	Data
1.1.11	**Defects Liability Period**	1. **Civil Works:** The Defects Liability Period is **5 (Five) Years** from the date notified in the Completion certificate of the work. I. In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Liability Period or as soon as practicable thereafter, the Contractor shall: a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Engineer, and b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Liability Period for the Works or Section (as the case may be). II. If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer. III. All work referred to as completion of outstanding work and remedying defects shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to: a) any design for which the Contractor is responsible, b) plant, materials, or workmanship not being in accordance with the Contract, or c) failure by the Contractor to comply with any other obligation.
1.1.12	**Employer's name and address**	**Managing Director,** **Odisha Bridge & Construction Corporation Ltd,** Vikash Bhavan, Nayapalli, Bhubaneswar-751012, Odisha. Email id: md@obcc.in Phone number: 0674-, 2394093, 2396309, 2390043. FAX - 2396326
	Name of the Authorized Representative	**General Manager, Brahmapur Division, Brahmapur, OB&CC Ltd.** He/she shall act as representative of the Employer for all purposes.

1.1.13	**Engineer's name and address**	**To be notified**
1.1.16	**Intended Completion Date**	Thirty (30) Calendar months from the date of commencement. However, any delay accountable due to contractor performance shall invite penalty.
1.1.19	**Site**	The Site is located in District-Ganjam**,** Odisha. Details of the Site: As provided in Section 7 and Section 8
1.1.22	**Start Date / Date of Commencement**	Date of issue of notice to proceed with the work. (To be notified later).
1.1.26	Works	**Work Details:** The government of Odisha has decided to execute the work of "Redevelopment of Maharaja Krishna Chandra Gajapati (MKCG) Medical College & Hospital, Brahmapur, Ganjam (Phase-I)" shall be executed in a Turnkey Contract, where the Contractor assumes single sole responsibility for on-time project delivery, to a specified performance level inclusive of the design and construction of the project components, in return for a payment on a fixed price Details of these works have been mentioned in Section-8, Drawings at Section- 7 and Technical Specifications at Section-5. The rates and prices quoted by the bidder shall remain fixed for the duration of the contract and shall not be subject to any price adjustment.
2.2	Sectional Completion	N/A.
2.3	Order of priority	The documents forming the Contract shall be interpreted in the following order of priority: • Agreement • Letter of Acceptance, notice to proceed with the works. • Contractor's Bid • Contract Data • Conditions of Contract including Special Conditions of Contract • Terms of Reference, Design Brief & Scope of Work (Section 8 of Bid Document) • Specifications • Drawings • Bill of quantities (optional) and • Any other document listed in the Contract Data as forming part of the Contract In case of ambiguities or discrepancies within this Agreement, the following shall apply: a) between two or more Clauses of this Agreement, the provisions of a specific Clause relevant to the issue under consideration shall prevail over those in other Clauses;

<table>
<tr><td></td><td></td><td>b) between the Clauses of this Agreement and the Schedules, the Clauses of agreement shall prevail and between Schedules and Annexures, the Schedules shall prevail;
c) between any two Schedules/Annexures/Appendices, the Schedules/Annexures/Appendices relevant to the issue shall prevail;
d) between the written description on the Drawings and the Specifications and Standards, the specifications shall prevail;
e) between the dimension scaled from the Drawing and its specific written dimension, the later shall prevail; and
f) between any value written in numerals and that in words, the latershall prevail.</td></tr>
<tr><td>3</td><td>Language & Law</td><td>The language of the Contract documents is English. The law, which applies to the Contract, is the laws of Union of India.</td></tr>
<tr><td>7</td><td>Sub-Contracting</td><td>Subcontracting components of the works shall be limited to 30 % of the Contract Price. The maximum number of Sub-Contractors allowed is TWO.

However, if any sub-contractor is proposed after award of contract, the qualification of the said Sub-Contractor shall be checked with respect to his technical and financial capability by the Engineer on proportionate to the criteria set forth in the bidding document.</td></tr>
<tr><td>13.1 & 13.2</td><td>Insurance</td><td>The Contractor shall provide the following policies within 28 days from the date of commencement.

a) Workmen Compensation Policy.

b) Contractor’s All Risks (CAR).

<table>
<tr><th>S.No</th><th>Item</th><th>Minimum Cover</th></tr>
<tr><td>(i)</td><td>Works and Plant and Materials</td><td>Full</td></tr>
<tr><td>(ii)</td><td>Loss of damage to Equipment</td><td>Full</td></tr>
<tr><td>(iii)</td><td>Other Property</td><td>Camp Cost</td></tr>
<tr><td>(iv)</td><td colspan="2">Personal injury or death insurance</td></tr>
<tr><td>a)</td><td>1. For other people - Death
2. For other people – Injury</td><td>Rs. 1,50,000/-

Maximum Rs. 1,50,000/-</td></tr>
<tr><td>b)</td><td>For Contractor’s Employees,
Operatives and Sub Contractor Operatives</td><td>In accordance with the

statutory requirements applicable to India</td></tr>
</table>
The maximum cover shall be as applicable to statutory requirements.</td></tr>
<tr><td>14</td><td>Site Investigation Reports</td><td>All reports are indicative and not exhaustive.</td></tr>
</table>

16	Contractor to Construct the Works	The Contractor shall do the Engineering, Procurement, Construction, Installation and Commissioning for all the Works as per Clause 1.1.26
18	Approval by the Engineer	(a) no review, comment or approval by the Employer or the Employer's Engineer of any Document or Drawing submitted by the Contractor nor any observation or inspection of the construction, or maintenance of the Project Works nor the failure to review, approve, comment, observe or inspect hereunder shall relieve or absolve the Contractor from its obligations, duties and liabilities under this Agreement, the Applicable Laws and Applicable Permits; and the Employer shall not be liable to the Contractor by reason of any review, comment, approval, observation or inspection referred to in (a) above.
18.4	Stipulated Datelines for Approvals	As mentioned in Section 8
19.1	Safety	The Contractor shall also appoint a team of safety consultants (the "Safety Consultant") to carry out safety audit at the **design stage, execution stage and post completion stage (during defect liability period)** of the Project Works in accordance with the Applicable Laws and Good Industry Practice. Any lapses on account of safety practices shall be liable for suitable penalty provisions.
21	Possession of the Site	The Site Possession Date shall be as follows: a) 60% of Site on the date of issuance of Notice to proceed with the Work. b) 85% of Site within 3 months of the date of issuance of Notice to proceed with the Work. c) Balance portion of the Site shall be handed over during execution of the Project.
24 & 25	Disputes	25.1: Amicable Settlement: Performance of the contract is governed by the terms & conditions of the contract, in case of dispute arises between the parties regarding any matter under the contract, Party of the contract may send a written Notice of Dispute to the other party. The Party receiving the Notice of Dispute will consider as Notice and respond to it in writing within 30 days after receipt. The same disputes will be settled amicably by both the parties in the interest of the work. If not settled amicably, both the parties will take the shelter of court of law at Bhubaneswar.
27.1	Programme	a. The Contractor shall submit a detail resource based work program using standard software (Primavera) and a 'S' Curve showing monthly cash flow forecast for the Works, within 14 days of issue of the Letter of Acceptance of tender which shall form part of the contract. b. The Programme shall complement with the Programme submittedin the Technical Presentation of Bidders Cover III.

		c. The Physical Progress should complement with financial progressat all times.
27.2& 27.3	Update of the Programme	The period between Program updates shall be **60** days. The amount to be withheld for late submission of an updated Program shall be 1% of the Contract Amount to be released upon submission of the next Work Programme.
31.1	Early Warning	The following is added after the paragraph: If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance. If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim.
34 & 35	Defects Liability Period	For Defects Liability Period Refer Cl. 1.1.11. The period for remedying Defects by the Contractor is 30 days from the date of Notice given by the Engineer, failing which the Employer shall make good the same at the cost and risk of the Contractor.
37.1	Change of Scope	The Change of Scope may also include work(s) under exigency which will facilitate smooth completion of the project and may not be directly related to the scope of works under this Contract
37.5	Change of Scope	(i) The contractor's quotation for change of scope shall be based on the detail design and rates for various item of works as derived on the basis of his original bid price (in case of repetition of similar item as per original contract). (ii) The Contractor's quotation for change of scope shall be determined by the Engineer as below in case of new item not envisaged in the original contract. a. For works where Schedule of Rates (SOR) of State's Public Works Department are available the same shall be applicable for determination of costs. b. For item of works not included in Schedule of Rates as mentioned in sub-para (a) above, the cost of same shall be derived on the basis of MORTH Standard Data Book / CPWD Analysis / DSR or the prevailing market rates

		whichever is less. The rates so arrived shall be approved by the Engineer which is binding on the Contractor. (iii) In case of partially execution of a line-item having multiple subcomponent as per SOP (Section-9), a. Entire item shall be descoped only if majority of the subcomponents are withdrawn and the determination will be done as per prevailing Clause 37.5. b. If majority of sub-components are not withdrawn then impact of the sub-component in isolation on the total item will only be determined as per prevailing Clause 37.5.
37.6	Change of Scope	The total value of all change of scope of work shall not exceed 10 % of total contract price for the construction work.
39.2	Payment Certificates	The Clause 39.2 of Section 3 is replaced as below: **39.2.1 Stage Payment Statement for Works** The Contractor shall submit a statement (the "Stage Payment Statement"), in 3 copies, by the 7th (seventh) day of the month to the Authority's Engineer showing the amount calculated basing on payment schedule of contract to which the Contractor considers himself entitlement for completed stage(s) of the Works. The Stage Payment Statement shall be accompanied with the progress reports and any other supporting documents. The Contractor shall notsubmit any claim for payment of incomplete stages of Work. **39.2.2 Stage Payment for Works** 39.2.2.1. Within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor the Authority's Engineer shall broadly determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined aspart payment against the Stage Payment Statement, pending issue of the Interim Payment Certificate by the Authority's Engineer. Within 10 (ten) days of the receipt of recommendation of the Authority's Engineer, the Authority shall make electronic payment directly to the Contractor's bank account. 39.2.2.2. Within 15 (fifteen) days of the receipt of the Stage Payment Statement referred to in Clause 39.2.1, the Authority's Engineer shall determine and shall deliver to the Authority and the Contractor an IPC certifying the amount due and payable to the Contractor, after adjusting the payments already released to the Contractor against the said statement. For the avoidance of doubt, the Parties agree that the IPC shall specify all the amounts that have been deducted from the Stage Payment Statement and the reasons therefor. 39.2.2.3. In case where there is a difference of opinion as to the value of any stage, the Authority's Engineer's view shall prevail, and interim payments shall be made to the Contractor on this basis;

		provided that the foregoing shall be without prejudice to the Contractor's right to raise a Dispute. 39.2.2.4. The Authority's Engineer may, for reasons to be recorded, withhold from payment: (a) the estimated value of work or obligation that the Contractor has failed to perform in accordance with this Agreement and the Authority's Engineer had notified the Contractor; and (b) the estimated cost of rectification of work done being not in accordance with this Agreement. 39.2.2.5. Payment by the Authority shall not be deemed to indicate the Authority's acceptance, approval, consent, or satisfaction with the work done.
40	Payments	Employer shall pay the Contractor **within 07 days** of certification of the Engineer as per Cl. 39.
42	Tax	Replace the existing Clause as below: The rates quoted by the Contractor shall be deemed to be inclusive the Royalty, Income Tax, Labour CESS, **Additional Charge along with EMF & DMF as per applicable notification from Government of Odisha** and all other statutory taxes that the Contractor will have to pay for the performance of this Contract but **excluding GST on Works Contract**. GST on Works Contract shall be paid by the Employer as applicable. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.
43	Currency	The currency of the Contract is Indian Rupees
44.1	Retention Money	Retention money - 10 % of gross value of each running bill is to be deducted after gross payment exceeds 10% of the Contract Amount and shall continue up to 60% of the Contract Amount. The limit of retention money shall be 5% of the Contract Amount. However, the Contractor may furnish Bank Guarantee(s) for an amount equal to 5% of the Contract Amount, in which case no deduction for Retention Money shall be made. The Bank Guarantee(s) amounting to 5% of Contract Amount must remain valid at-least up to completion of Works and the Bank Guarantee(s) amounting to at-least 2.5% of Contract Amount must remain valid up to 28 days beyond the defect liability period.
45.1	Liquidated Damages	**Project Completion Schedule** During Construction period, the Contractor shall comply with the requirements set forth for each of the Project Milestones and the Scheduled Completion Date. Within 15 (fifteen) days of the date of each Project Milestone, the Contractor shall notify the Engineer of such compliance along with necessary particulars thereof.

		Design Milestone-I All design activities as per the Scope of Project shall be completed within 120 days from the Notice to Proceed. **Construction Milestone** 1. Project Milestone-I Project Milestone-I shall occur on the date falling on the [**25% of the Scheduled/ Extended Construction Period**] day from the Commencement Date and the Contractor shall have **gross certified payment for an amount not less than 15% (Fifteen per cent) of the Contract Price**. 2. Project Milestone-II Project Milestone-II shall occur on the date falling on the [**50% of the Scheduled / Extended Construction Period]** day from the Commencement Date and the Contractor shall have **gross certified payment for an amount not less than 40% (Forty per cent) of the Contract Price**. 3. Project Milestone-III Project Milestone-III shall occur on the date falling on the [**75% of the Scheduled / Extended Construction Period**] day from the Commencement Date and the Contractor shall have **gross certified payment for an amount not less than 75% (Seventy Five per cent) of the Contract Price**. 4. Project Milestone-IV Project Milestone-III shall occur on the date falling on [**100% of the Scheduled / Extended Construction Period**] day from the Commencement Date and the Contractor shall have **gross certified payment for an amount not less than 100% (Hundred per cent) of the Contract Price**. Also Completion of 100 percent will include final approval from development authority on as built drawing, firefighting from fire officer, rating from IGBC, commissioning and installation of all lifts, electrical equipment's and HVAC equipment's including approval from competent electrical authority) of contract value on 100% time of execution stage. Note: All the milestones to be linked to Programme submitted in Technical Presentation Cover III by the bidder.

		The liquidated damages@ 0.05% of the balance work against the targeted achievement against the Milestone or completion per day subject to a maximum of 10% (ten percent) of the Contract Price, beyond which the Contract shall be **deemed to be terminated**. Provided further that in the event the Project Work is completed within or before the Scheduled Completion Date including any Time Extension, applicable for that work, the Damages paid under this Clause shall be refunded by the Employer to the Contractor, but without any interest thereon.
46	Bonus Payment	The Contractor shall be eligible for bonus payment as per the provisions of OPWD Code as on the date of signing of contract.
47	Advance payment	Advance Payment may be made upon request from the Contractor with the following conditions satisfied. (i) Maximum 10% (ten percent) of the contract amount for **mobilization**; and (ii) **90%** of the Paid Invoice amount subject to cumulatively maximum up to 35% of the Contract Amount as **Secured Advance** for non-perishable items of the Project. All advance payments shall be made against irrevocable bank guarantee(s) amounting to 110% of the Advance payment, from any Bank listed in Bid data sheet, payable at par by its branch at Bhubaneswar.
47.2	Interest on Advance payment	10 (ten) %
48	Performance Security	Within 21 days of receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security in any of the forms given below for an amount equivalent to **5 (Five) %** of the Contract price, Public Sector Bank of India, counter guaranteed by its branch at Bhubaneswar. The guarantee shall be valid 28 days from the date of expiry of the Defect Liability Period.
53 & 53.1	Operating and Maintenance Manual	As built drawings duly approved by the Engineer, operating and maintenance manuals of various fittings, machines, equipment and /or installations along with their warranties as provided by the OEMs are required by the Employer and the Contractor shall supply them **within 30 days** of handing over of the project, failing which 1% of the Contract amount shall be withhold by the Employer. *If the documents **are not submitted within 60 days** of handing over of the project, the above withhold amount shall be **forfeited** by the Employer.*

Clause Reference	Conditions	Data
54.2	Termination	The following is added after sub-para (f) [54.2] The Contractor has contravened Sub-clause 7 and Clause 9 of GCC. The Contractor does not adhere to the agreed construction program (Clause 27 of Conditions of Contract (CC) and also fails to take satisfactory remedial action as per agreements reached in the management meetings (Clause 30 of CC) for a period of 60 days.
55.1	Value of wok not completed.	The percentage to apply to the value of the work not completed representing the Employer's additional cost for completing the Works shall be 20 %.
56.1	Property	Contractor’s Default shall mean provisions under Cl. 54.2 (a), Cl. 54.2. (c) and Cl. 54.2.(e).

SECTION 5
TECHNICAL SPECIFICATIONS

OUTLINE SPECIFICATIONS- CIVIL.

5.1 General Specifications

The work shall in general conform to the Latest CPWD Specifications (corrected up to the lastdate of submission/uploading of bid) as mentioned in General Conditions of Contract (GCC). Work under this Contract shall consist of furnishing all labour, materials, equipment, tools & plants and appliances necessary and required.

The work shall be carried out in accordance with the Technical Specifications, Tender drawings and Scope Documents after approved by the Engineer-in-Charge. The Technical Specifications are to be read with and in general conforming to the Latest CPWD Specifications.

The Contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other Contractor(s) or by the Engineer-in-Charge and shall as far as possible arrange his work and shall place and dispose of the materials being used or removed, so as not to interfere with the operations of other Contractor simultaneously working or he shall arrange his work with that of the others in an acceptable and coordinated manner and shall perform it in proper sequence to the complete satisfaction of others.

Approved Makes - Specifications/brands names of materials to be used as per the scope of work are listed in the bid documents. The efforts should be made by the Contractor to use indigenous products wherever possible. The Contractor should also consider the availability of spares parts/ components for maintenance purposes while proposing any brand/ manufacturer. The materials of any other brand/manufacturer may be proposed for use by the Contractor in case the brands specified in the bid document are not available in the market and/or Contractor intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of Engineer-in-Charge.

The Contractor shall submit a 'Methods statement' for each important activity for the approval of the Engineer-in-charge soon after the award of work to him. The 'Methods statement' is a statement by which the construction procedures for any activity of construction are formulated and stated in chronological order. The 'Methods statement', should have a description of the item with elaborate procedures in steps to implement the same, the specifications of the materials involved, their testing and acceptance criteria, equipment to be used, Precautions to be taken, etc.

Setting Out-The Contractor shall carry out survey of the whole work area, setting out the layout of building in consultation with the Engineer -in-Charge & proceed further. Any discrepancy between the Tender drawings and actual layout at site shall be brought to the notice of the Engineer -in-charge. It shall be responsibility of the Contractor to ensure correct setting out of alignment. Total station survey instruments only shall be used for layout, fixing boundaries, and centre lines, etc.

The Contractor shall establish, maintain and assume responsibility for grades, lines, levels and benchmarks. He shall report any errors or inconsistencies shall be regarded as the Contractor’s acceptance of such grades, line, levels and dimensions regarding grades, lines, levels, dimensions etc. to the Engineer-in-Charge before commencing work. Commencement of work and no claim shall be entertained at a later date for any errors found.

If at any time, any error appears due to grades, lines, levels and benchmarks during the progress of the work, the Contractor shall, rectify such error, if so required, to the satisfaction of the Engineer -in-Charge.

Though the site levels are indicated in the drawings the Contractor shall ascertain and confirm the site levels with respect to benchmark from the concerned authorities. The Contractor shall protect and maintain temporary/ permanent benchmarks at the site of work throughout the execution of work. These benchmarks shall be got checked by the Engineer-in-Charge or his authorized representatives. The work at different stages shall be checked with reference to benchmarks maintained for the said purpose.

The approval by the Engineer-in-Charge, of the setting out by the Contractor, shall not relieve the Contractor of any of his responsibilities and obligation to rectify the errors/ defects, if any, which may be found at any stage during the progress of the work or after the completion of thework.

The Contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the Contractor to the entire satisfaction of the Engineer - in-Charge.

Before commencement of any item of work the Contractor shall correlate all the relevant Tender and structural drawings, and specifications etc. and satisfy himself that the information available is complete and unambiguous. The Contractor alone shall be responsible for any loss or damage occurring by the commencement of work based on any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.

Sample of building materials, fittings and other articles required for execution of work shall begot approved from the Engineer-in-Charge before use in the work. The Quality of samples brought by the Contractor shall be judged by standards laid down in the relevant CPWD/ BIS specifications. All materials and articles brought by the Contractor to the site for use shall conform to the samples approved by the Engineer-in-Charge which shall be preserved till the completion of the work.

BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the Engineer-in-Charge besides testing of other materials as per the specificationsdescribed for the item/material. Wherever BIS marked materials are brought to the site of work, the Contractor shall, if required, by the Engineer-in-Charge, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the material / procured by the Contractor for incorporation in the work satisfies the provisions of specifications / BIS codes relevant to the material and / or the work done.

The Contractor shall procure the required materials in advance so that there is sufficient time to testing of the materials and clearance of the same before use in the work. The Contractor shall provide at his own cost suitable weighing and measuring arrangements at site for checking the weight / dimensions as may be necessary for execution of work.

The Contractor shall allow access to Third Party Quality Assurance Agency (TPQAA) engaged by Client to have a control on quality and methodology of execution. Requisite number of Samples of materials including Cement Concrete Cubes shall be taken jointly by

Contractor, TPQAA and Engineer-in-charge or their authorized representative. All arrangements for transporting and getting them tested shall be made by the Contractor.

i. Welding tests shall be done as per applicable codal provisions.

ii. FAT(Factory Acceptance Tests) for Imported items shall be done by the Contractor and no extra cost shall be paid. Contractor to borne all costs for the FAT.

iii. Contractor to do their own due diligence for determination of foundation and strata. Contractor to deploy adequate No. of hydraulic rigs only for pile foundations if applicable.

iv. Contractor are responsible for the disposal of debris and construction waste at their own cost. No extra time and cost shall be granted in this account.

v. Prefabricated wall sections for partition work not allowed only solid block work shall be considered.

vi. All structural drawing and design shall be proof checked by any IIT. Due authorization for vetting personnel shall be made available by the institute.

vii. All windows shall be sliding window, no casement allowed.

viii. Integral crystalline admixture shall be used for water proofing treatment to RCC structures like basement raft, retaining walls, reservoir, sewage & water treatment plant, etc. at the time of transporting of concrete into the drum of the ready-mix truck , using integral crystalline admixture @0.80% (minimum) to the weight of cement content per cubic meter of concrete) or higher as recommended by the manufacturer's specification in reinforced cement concrete at site of work. The material shall meet the requirements as specified in ACI-212-3R-16(2016) i.e. by reducing permeability of concrete by more than 90%, compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure. The crystalline admixture shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the Engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.

5.2 Civil Finishes

(a) Indicative Architectural floor plan showing room wise layout for all the levels of 450 Bedded Hospital Block, Dental College, Pharmacy College and Allied Buildings, Hostels, Indoor Stadium, Guard room, boundary wall, UG tank, etc. are part of this tender document. Detail Architectural Plan for these floors has to be prepared by the Contractor. While detailing these floors plan there will be requirement of further partitioning of these rooms and cubicle in toilet blocks, along with additional doors as per functional requirement.

(b) The floors have to be divided in fire zone as per NBCS-2026 and fire rated walls and doorsneed to be planned and provided as per requirement of NBCS-2026.

The Finishing of the building will be as per schedule of finish which is part of this tender document. All works and finishing will be in accordance with the latest CPWD specifications and all details and requirements contained in annexures and These specifications are for work

to be performed, items to be supplied and materials to be used in the works as shown and defined in the drawings/finishes schedule and List of Approved Makes in the attached annexures and herein to the satisfaction of the Employer/ ENGINEER-IN -CHARGE.

(c) If specification for any item of work or material are not available either in CPWD Specifications or in these particular specifications, in such cases relevant IS specifications or National Building Code (NBC) 2026 shall be followed. If all of CPWD Specifications and IS codes are unavailable, then International Standards shall apply, and in case non-availability of those, prior approval of the Engineer will be taken before commencing work.

(d) The workmanship is to be the best possible and of a high standard. The contractor shall take all steps necessary to address deficiencies, if any, identified by the Engineer. Use must be made of special craftsmen / tradesmen in all aspects of the work and allowance must be made in the rates for the same. To ensure the same, the contractor shall implement a highly effective and comprehensive QA/QC program and shall adhere to the same.

(e) The materials to be provided by the contractor shall be in accordance with the samples already approved by the Engineer and conform to the specification and approved list of manufacture and brand, as per the attached annexures. The contractor shall produce all invoices, vouchers or receipts for any materials if called upon to do so by the Engineer.

(f) A sample of all materials along with technical specifications is to be submitted to the Engineer for their approval before the contractor orders or delivers the material to the site. Samples together with their packing are to be provided free of charge by the contractor and should any materials be rejected they will be removed from the site at the Contractor's expense. All samples will be retained by the Engineer for comparison with materials which will be delivered at site. Also, the contractor will be required to submit specimen finishes colours, glass, etc., for approval of the Engineer before proceeding with the works.

(g) All materials to be provided in subject contract shall be ISI marked. In cases where ISI marked materials are not available, materials superior or conforming to BIS standards and approved by the Engineer shall be used. Materials for which manufacturers names have been mentioned in contract, makes as approved from list of manufacturers mentioned in contract shall be provided by the contractor. Contractor can provide materials which are equivalent or superior then the ones specified in the list of makes after approval of the ENGINEER-IN -CHARGE. The manufacturers having ISI marked material shall be preferred.

(h) Contractor shall maintain uniform quality and consistency in workmanship throughout the execution of the work.

(i) The contractor shall provide, all materials, labour, maintenance, fixing, carrying, cleaning, and making good, etc. temporary canvas, plastics and any other requisite protection of the works, all the necessary equipment, labour and removal of the same at the completion of the work. The Engineer will be the sole judge in deciding as to the suitability of the tools or plants that may be brought on the works by the contractors, for the proper execution of the work.

(j) All floors, paving, staircase, etc. are to be scrubbed/cleaned, all glazing to be cleaned on both sides of windows/curtain wall including its members, screens, doors, sky-lights, roof lights, etc., all gulley, gutters, pipe heads, etc. to be cleaned out and the premises left clean,

perfect and water tight upon completion. However, proper care needs to be taken during such cleaning works so as to ensure no scratch/damage to the original finishing such as polishing, painting, anodizing, powder coating etc. In case of any suchdamage, the contractor shall have to reinstate the same as original as per the instructions of Engineer, without any cost to Employer.

(k) Templates, boxes and moulds shall be accurately set out and rigidly constructed so as toremain accurate during the time they are in use.

(l) All unexposed surfaces of timber e.g., backing fillets, backs of door frames, cupboard framing, grounds, etc., are to be treated with two coats of approved timber preservative before fixing or covering.

(m) Workmanship- All works shall be to true line, level; plumb and square corners and edges in all cases shall be unbroken and finished neat.

(n) The Engineer may order for the inspection of any finished work as he chooses and, in a manner, he decides, and the contractors shall bear all expenses in this connection. If the results of such inspection prove that the material used and/or workmanship is not of the standard required, the work will be rejected and removed forthwith and be replaced by works of the accepted standard of quality and material without any extra cost.

(o) The contractor shall produce all invoices vouchers or receipts for any materials if called upon to do so by the Employer.

5.3 Shop Drawings

(a) Shop/fabrication drawings shall be prepared by the contractor for all specialized items of work as indicated in the specifications before starting manufacturing of the items. These shall be carefully prepared in accordance with the specifications and drawings and best trade practices and shall contain all the relevant information required.

Unless otherwise mentioned, the engineer will take 21 working days for reviewing & comments or approving any drawings/ designs submitted by the contractor for approval. Before submission, the contractor shall check the shop drawings and ensure that these are correct, complete and drawn consultant with the engineer's designer for and clarifications on the drawing/ design documents submitted for design approval at engineer's designers to the required scale and fully coordinated with all relevant disciplines. Whenever required the contractor shall arrange a meeting of his design team/ place at his own cost.

(b) Shop drawings shall be prepared by the contractor at least for the following works unless specified otherwise: -

(i) Aluminum / UPVC Doors and Windows.

(ii) Curtain walls/façade Glazing system.

(iii) Tile works / Stonework.

(iv) Lift Machine Room

(v) Coordinated Panels in case of Cast in situ Concrete Panels.

(vi) Finishing drawings and details

(vii) Shaft/Duct Covering.

(viii) Fixed furniture

(ix) Modular Cabinets.

(x) Fire Doors.

(xi) Waterproofing.

(xii) Railings.

(xiii) Mild steel works/fabrications.

(xiv) Medical gas pipeline system

(xv) Modular operation theaters

(xvi) Lead lining doors.

(xvii) CSSD

(xviii) Laundry

(xix) PTS Waste & Laundry

(xx) Kitchen including Equipment's

(xxi) NCS (Nurse Call Stations)

(xxii) Other Medical Services

(xxiii) Signages

DETAILED SPECIFICATIONS CIVIL FINISHES

The latest CPWD Specifications and relevant IS codes applicable as on 30 days prior to submission of the bid, are to be followed for all purposes including workmanship, materials, finishing, warranty etc., unless mentioned otherwise. In case of multiple workmanship procedures or conflicting requirements, prior approval must be taken from the Engineer-in- charge before commencement of work. In case of additional/omitted items not mentioned here, latest CPWD Specifications or relevant IS codes to be followed. These specifications are to be read in conjunction with the Schedule of finishes and the List of Approved Makes in the attached annexures.

The latest CPWD Specifications will be applicable for the points mentioned below. The list given below is indicative and not exhaustive.

(a) External works

(b) RCC and block work superstructure

(c) Wall plaster.

(d) Flooring stone (includes internal, external, staircases and skirting of all stone flooring)

(e) Flooring Tile (including skirting)

(f) Paint works (internal, external, metal, wood)

(g) Sealants

(h) Wall cladding

(i) Stone counter tops

(j) Aluminum exterior doors

(k) Metal Fire doors (All fire doors shall be metal fire doors.)

(l) Wooden flooring (engineered wood / laminated wooden)

(m) Mild steel works

(n) Structural steel works

(o) Glass (windows, mirror and railings)

(p) False ceilings

(q) Bathroom fixtures

(r) Kitchen fixtures

(s) Woodwork - cabinetry and furniture

(t) Hardware / ironmongery

(u) Structural glazing

(v) Lifts

(w) Safety and Architectural railings

The following specifications will be taken in appendix to the CPWD specifications and IS Codes for specific conditions,

5.4 Earthwork in Excavation –

5.4.1 General Scope

This specification covers the general requirements for Excavation and Filling Works to be carried out at the site. Contractor shall be deemed to have visited the site prior to submitting his Bid and made all necessary inspection and investigations and to have decided for himself the means of access and working space, the nature of the ground and subsoil, if any, level of water table, extent of rock demolitions, alterations, support of neigh boring properties, etc.

The Contractor shall provide all labour, equipment, materials and any incidentals necessary to complete all aspects of work included in the drawings and specifications. Maintaining safety at site is the responsibility of the Contractor.

Clearing, grubbing and removing all vegetation from the site. Earthwork in excavation including disposal of the excavated material and necessary dressing to make surface ready to receive next course of work. Stacking of excavated earth within the site to make use of it for backfilling. Filling and back filling and compaction of fills.

Removal and disposal of surplus material.

Stone soling to roads and paving and necessary shoring to protect sliding of earth.

Dewatering works till the number of slabs as instructed by the Structural Engineer are constructed.

Codes and Standards:

The following standards shall be followed:

1 IS: 3764-1996 for Excavation Work Code of Safety

2 IS: 1498-1970 for Classification and identification of soils for general engineering purposes

3 IS: 1200-2002 for Part 1 Methods of Measurement of Building and Civil Engineering Works - Earthwork

4 SP27 for Handbook of method of measurement of building works

5 British Standard 1377 for Methods of test for Soils for Civil Engineering Purposes

6 British Standard 5930 for Code of Practice for Site Investigations

7 Local Building Regulations and Statutory Regulations

Definitions

Clear: The removal of trees, scrub and artificial obstructions including fences, concrete slabs, kerb and channel, remains of old buildings and the like. Grub: The removal of tree stumps and roots.

Topsoil: Topsoil is all surface soils which have sufficient humus to support plant growth without resort to artificial fertilization.

Fill: A general term for material spread and compacted over the ground to make up finished levels or levels to sub- may be used interchangeably.

Sub-Grade: The finished, trimmed and prepared surface of the earth works after thereof may be used interchangeably.

Sub-Base: A selected filling layer spread and compacted over the sub-grade to make up levels to the underside of the base course or floor slab.

Base course: A selected filling layer spread and compacted to levels immediately below road wearing course.

Spoil: Excess cut material remaining at the end of filling operations.

Bulk Earthworks: Earthwork excavation using earthmoving equipment or filling and compacting, building platforms, road formations, parking areas, reservoir, embankments, drainage canals or any other formation where the unimpeded use of large earthmoving equipment is possible. This is distinct from backfill of trenches, foundations or other earthworks immediately adjacent to completed or partially completed structures.

Site Inspection

Preamble

Any Site details or site information included in the Contract documents or Drawings are provided for the contractor or accurate description of conditions existing below the surface of the ground. The correctness of the information is not guaranteed, and the Contractor shall be responsible to make its own interpretation of sub-surface conditions.

Site Quality Control

The Contractor shall provide in his quality assurance programme information to show that a system will be used to ensure that all works carried out under this section (including any done by sub - contractor) will comply with all the requirements of this section.

Antiquities

Any ancient carvings, relics, coins or other curiosities discovered during the excavation or other work shall remain the property of the CLIENT and shall be handed over to the CLIENT as required under the General Conditions of Contract.

Setting Out and Clearing of The Site -

The Contractor shall check that the levels and lines in the field are in accordance with those shown on the survey drawings or site development drawings. The Contractor shall report to the ENGINEER-IN -CHARGE in writing all discrepancies with respect to the survey drawings or site development drawings prior to the commencement of work. The checking of any line or level by the ENGINEER-IN -CHARGE shall not in any way relieve the

Contractor of his responsibilities

The Contractor shall set out the centre line of the building or other involved works after clearing the site and get the same approved from ENGINEER-IN -CHARGE It shall be the responsibility of the Contractor to install substantial reference benchmarks and maintain them as long as required by the ENGINEER-IN -CHARGE .

The Contractor shall assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work by using Total Station.

Benchmarks and Setting Out

The Contractor shall engage a qualified surveyor or authorized third party to establish permanent benchmarks in suitable locations around the site. These benchmarks shall enable the Contractor to set out the location of all buildings, paths, roads, utility lines, storm water drains and all other portions of the Contract work.

If an error in setting out causes some portion of the work to be constructed in the wrong location, or to the wrong dimensions, the Contractor shall make good the incorrect work at his own expense to the satisfaction of the ENGINEER-IN -CHARGE the Contractor shall be liable for any consequential loss experienced by the owner.

All permanent benchmarks and setting out markers shall be constructed as permanent pillars so as to ensure no disturbance or shifting happens.

Excavation Classification

Excavation Classification Based on Type of Soil and Site Location. Excavations at the project site shall be broadly classified into two types based on type of soil as follows:

a) Excavation in Hard Rock

b) Excavation in Soft Soil / All kind of soils

Excavations at the project site shall be broadly classified into the following types based on its location at site:

a) Excavate foundation from existing ground level to the formation levels shown in drawing.

b) Excavation to pit working level.

c) Earthworks outside property line.

d) Excavation, compaction and backfill to plinth and service trenches.

Classification of Soil / Rocks:

a. All kinds of Soils: (Poclainable strata) Material such as sand, gravel, loam, clay, mud, black cotton, murrum, shingle, river or nullah bed boulders, disintegrated rock, soling of roads, paths, hardcore, macadam surface of any description (water bound, routed tarmac

etc.) lime concrete mud concrete or any combination of these. This class of material will yield to the application of picks, shovels, or any other manual digging implements.

b. Ordinary Rock (Poclainable strata): Material such as limestone, sandstone, laterite, hard conglomerate. This is any material that will not yield to manual implements but is capable of being excavated by conventional earthmoving plant applicable to the site and the distances that material has to be moved. The use of a pusher unit or small crawler tractor with ripper to facilitate excavation shall be considered as part of conventional plant.

c. Hard Rock (Unpoclainable strata): (Blasting prohibited): Hard rock in Unpoclainable strata the excavation has to be carried out by Chiseling, mechanical means, and all also breaking by use of approved Chemical such as Accusin or approved non explosive blasting chemicals and trimming to required level for foundation, trenches, rafts, plinths, levelling area etc. Wedging or any other method agreed to by the ENGINEER-IN - CHARGE . Contractor may resort to Controlled blasting only after getting written permission from competent authorities. For any damage caused by such blasting shall only be borne by the Contractor.

Classification of Soils:

Classification of excavated soil / material will be in accordance with the Section 302.1 of MoRTH or IS:1200 (Part I): 1992 as the case may be.

Excavation in all types of soil comprising any of the following:

Vegetable or Organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum.

Any mixture of soils in above, Mud concrete below ground level.

Generally, any material which yields to the ordinary application of excavation equipment.

Stiff heavy clay, hard shale, or compacted murrum requiring close application of excavation equipment.

Soft rock

Gravel and cobble stone usually rounded, having maximum dimension in one direction of 300mm.

Excavation in Hard Rock

Rock, which is in solid beds, which can only be removed either by controlled blasting or by wedging or chiseling or by using chemical compound, approved make and application as per Manufacturer's Specification, shall be treated as hard rock. A boulder or detached rock, measuring one cubic meter or more, shall also be treated as hard rock, if the same cannot be removed, without blasting, wedging or chiseling.

Where hard is met with, and blasting operations are considered necessary, the Contractor

shall intimate about the same to the PMC. The Contractor shall obtain license from district / public authorities, for carrying out blasting work, as well as for obtaining and storing explosives, as per 'explosive rules 1940' or as amended.

Blasting operations shall be carried out, under supervision of a responsible licensed operator of the contractor during certain specified hours, preferably during lunch break, as approved in writing by the ENGINEER-IN -CHARGE . The operator shall be conversant with the rules of blasting. The operator should have the valid blasting license.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted, and all people on work, except those, who light the fuses, shall be withdrawn, to a safe distance of not less than 300 meters, from the blast. Blasting shall not be done, within 100 meters of an existing masonry, or any other kind of structure, unless special precautions are taken by heavy blanketing etc. on the special approval of ENGINEER-IN -CHARGE .

Where blasting is not practicable or prohibited, excavation shall be done, by wedging or chiseling or by using chemical compound approved make and application as per

necessary foundation etc to be put in. In case, the dimension of trenches exceeds those shown in drawings, the excess quantity shall not be paid for.

Excavation in Soft / Ordinary Rock

In ordinary rock, excavation shall be carried out by crowbars, pickaxes or pneumatic drills. Blasting operations shall generally not be adopted for excavation works in this type of rock.

Where blasting operations are not prohibited, and it is practicable to resort to blasting for excavation in ordinary rock, the Contractor may do so with the permission of the ENGINEER-IN -CHARGE at no extra cost.

Method of Excavation -:

If the excavation is carried out to a greater depth than specified, extra depth shall be made up by filling with lean concrete in a ratio of 1:4:8 (1 cement: 4 coarse sand: 8 stone graded aggregate of 40 mm size) as directed by the ENGINEER-IN -CHARGE . The cost of such extra excavation and of the filling therein as specified shall be borne by the Contractor. No extra claims whatsoever will be entertained in this regard. The bottom of excavation shall be trimmed, levelled, rammed and sides dressed and trimmed in accordance with the drawings/directions of the ENGINEER-IN -CHARGE . The Contractor shall ensure that excavation is to be carried out as indicated on the drawings with sufficient working space to permit erection of forms, shoring, inspection of foundations and any other activity likely to be carried out below ground level. All ramps for excavation except one will be cleared before completion (unless specifically noted otherwise) and made good before final completion. One ramp as directed by the ENGINEER-IN -CHARGE will be left to enable

access for the other Contractor. Contractor shall advise ENGINEER-IN -CHARGE when excavation is ready to receive concrete. No concrete shall be placed in foundation until the Contractor has achieved ENGINEER-IN -CHARGE s approval that a secure foundation has been prepared.

The Contractor shall ensure proper methods are adopted to control the creation of Dust. Method adopted shall be approved by the ENGINEER-IN -CHARGE .

Excavation and Preparation for Concreting:

Excavation shall include removal of all materials of whatever nature at all depths and whether wet or dry necessary for the construction foundation and substructure (including mass excavation for underground reservoir where applicable) exactly in accordance with lines, levels grades and curves shown in the drawing or as directed by the ENGINEER-IN -CHARGE . The bottom of excavation shall be levelled both longitudinally and transversely or sloped as directed by the ENGINEER-IN -CHARGE . Softening of the bottom of excavation will not be allowed. If softening occurs due to weather or any other source, the Contractor shall remove the affected area and replace as specified and directed by the ENGINEER-IN -CHARGE at no extra cost.

Excavation shall be to the exact length, width and depth shown or figures in the drawing, or as directed by the PMC. If excavated to greater length, width or depth than shown or required, the depth shall be brought up by plain cement concrete filling 1:4:8 proportion, and extra length and width filled in by rammed earth or murrum or if the PMC thinks it necessary for stability of the work by 1:4:8 concrete as directed at contractor's cost. Water accumulated within the trenches, during the progress of work, from whatever causes, shall be bailed or pumped out at the contractor's own expenses. Foundations or trenches shall be kept, free of water, while masonry or concrete works are in progress. The lowermost 150mm layer thickness of soil / strata shall be removed with caution so as not to damage the founding strata

The Contractor shall report to the ENGINEER-IN -CHARGE when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the Contractor has obtained ENGINEER-IN -CHARGE approval in case, the excavation is done through different strata of soil and if the same is payable as per provision in the Bill of Quantities the Contractor shall get the dimensions of the strata decided by the ENGINEER-IN -CHARGE for payment. If no specific provisions are made in the Bill of Quantities, it will be presumed that excavation shall be in all types of soil and other material and the Contractor 's rate shall cover for the same.

After the excavation is passed by the ENGINEER-IN -CHARGE and before laying the concrete, the Contractor shall get the depth and dimensions of excavation and levels (and

nature of strata as applicable as per Bill of Quantities like hard rock, soft rock etc.) and measurements recorded from the ENGINEER-IN -CHARGE . Excavated pit should have adequate clearance from the face of concrete at all faces to have adequate working space.

Stacking of Excavated Materials:

All materials excavated will remain the property of the ENGINEER-IN -CHARGE and rate for excavation including sorting out of useful materials and stacking them on site as directed but with a safe distance from the edge of excavation to avoid collapse/ shielding of excavated area. Materials suitable and useful for back filling, plinth filling or levelling of the plot or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of men, animals and vehicles or encroach on the area required for constructional purposes.

Disposal / Carting of Surplus Earth -:

Top layer of hard soil free from vegetation, spoils, rocks, boulders for a quantity of approximately 15% of the total excavated earth quantity shall be stocked at locations as directed by the ENGINEER-IN -CHARGE for re-use up to a distance of 300m from the periphery of the buildings. The remaining excavated earth, except for the hard rock excavated, shall be disposed

- off including lifting out, transportation to locations approved by local bodies, Government agencies or as directed by the ENGINEER-IN -CHARGE , as the case may be.

The Contractor is responsible for finding suitable dumping yard approved by the local authorities at any distance and for the removal of all sub grade obstructions, whether indicated or not, wherever it is likely to interfere with execution and completion of the Project is deemed to be included in its rates.

All surplus and unusable earth shall be carted out and disposed - off outside the Site but at a location approved by local authority and confirming to their specifications. The Contractor shall quote its rate for disposing off or carting away the item considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed - off.

The Contractor shall indemnify the CLIENT against dumping in unauthorized areas and areas not allowed by the authorities.

Dewatering:

Rate for excavation shall include bailing or pumping out water which may accumulate in the excavation during the progress of work either from seepage, rain water or any other cause or for diverting surface flow, if any by bunds or other means. Pumping out water shall be done in such approved manner such as well point system as to preclude the possibility of any damage to the foundation trench, concrete or masonry or any adjacent structure inside

or outside the wall front. When water is met in foundation trenches or in tank excavation, pumping out water shall be from auxiliary pit of adequate size dug slightly outside the building excavations. The depth of auxiliary pit shall be more than the working foundation trenches / levels. The auxiliary pit shall be refilled with approved excavated materials after the dewatering is over.

The Contractor shall adopt an appropriate method of dewatering work and shall submit its proposal for carrying out the dewatering work for the approval of the ENGINEER-IN -CHARGE . The water shall be pumped continuously to keep the water level at a minimum of 60cm below the lowest point of excavation level. The operation shall be continued until the entire excavation has been completed so as to ensure the excavation is always dry.

Adequate number of pumps shall be deployed to ensure a continuous dewatering process.

Power / Fuel required for the operation of pumps etc shall be provided and paid for by the Contractor.

A log needs to be maintained if required.

Necessary grading, trenching and temporary sumps shall be made around excavations as required to prevent water runoff into excavation and to ensure proper protection to slopes from erosion.

The excavation shall be kept free from water:

During inspection and measurement.

From start to completion of concreting till they come above existing ground.

Dewatering may have to be continued till a suitable number of levels as instructed by the Structural Engineer are constructed to balance the possible uplift water pressure.

Till the ENGINEER-IN -CHARGE consider that the concrete is sufficiently set.

Till the underground reservoir is tested for water tightness.

Contractor shall ensure the bailing out of water continuously using number of pumps after makeshift arrangement.

Shoring and Strutting -:

The Contractor shall uphold the faces of excavation work to retain the earth, if required, at locations where considered necessary. Shoring and strutting shall be erected depending on nature of soil and the work. The arrangement of shoring and strutting including sizes and spacing of member used shall be approved by the ENGINEER-IN -CHARGE. All such necessary work, including but not limited to making / preserving / maintaining adequate slopes, necessary precautions, etc for ensuring safety of workmen below natural ground level shall be the responsibility of the Contractor. No extra charges shall be admissible on this account. Similarly, the Contractor shall be responsible to protect the bottom of excavation from weather.

Protection -

The excavated area shall be surrounded by strong barricaded safety barriers made of Steel barricade posts 75mm ,100mm (3 4 inches) diameter and cross planks/ runners shall be erected to a height of 1.2m all around the excavation with reflective tapes and necessary lighting at night all as shown on drawings. The barricade is such that no person can enter the area even by crawling below the same. The Contractor shall take all necessary measures for the safety of the excavation, persons working, tools and plants working in and near the excavation pits, property and people in the vicinity.

Protection and maintenance of all benchmarks axis points and other similar reference points if disturbed and/ or damaged, to be replaced by the Contractor at no extra cost to the Developer.

The Contractor shall survey the project site for any buried utilities or obstacles for excavation. Location of existing utility lines; if shown on the drawings, is only approximate and only for interpretation. The Contractor shall be responsible of the protection of all buried utilities (known or unknown prior to excavation) during the duration of the Contract without causing any damage, dislocation, injury and/ or interruption to these utility services. If so, the same shall be replaced/ restored to their original status at the Contractor

All the temporary roads, constructions etc shall be made and maintained according to the provisions of this Contract and as per the instructions of the ENGINEER-IN -CHARGE upon the completion of this Contract, the Contractor shall remove after getting the approval from the ENGINEER-IN -CHARGE all such temporary roads, structures, etc. and restore the area in its original condition without any extra cost.

5.5 Earthwork Fills

Methodology for Depositing Fills

5.5.1 General filling

Selected filling material as per turnkey design and build/design requirement from selected quarry after the approval of ENGINEER-IN -CHARGE shall be used.

Suitability of filling material from the excavated soil for filling or back filling shall be as decided by the ENGINEER-IN -CHARGE .

Deposit in horizontal layers not exceeding 300 mm thick before compaction.

Where material is dry, wet each layer to its optimum moisture content for compaction purposes.

Where material is wet, delay compaction and placement of additional fill until optimum moisture content is attained.

5.5.2 Structural filling:

Deposit in horizontal layers not exceeding 200 mm thick before compaction.

Each layer shall be uniformly moist and at the optimum moisture content for compaction

purposes.

Crushed stone:

Deposit in horizontal layers not exceeding 200 mm thick.

Deposit material so that it is free from lenses, pockets, streaks and other imperfections.

Consolidate using hand tamping, vibratory tampers or other approved methods.

Structural Fill:

a) Tests shall be executed by an independent testing agency.

b) In executing tests comply with the following IS Standards:

(i). Sampling

(ii). Sample preparation

(iii). Sieve analysis

(iv). Liquid limit

(v). Plastic limit and plasticity index

(vi). Moisture content

(vii). Moisture density relationship

(viii). Sand equivalent

(ix).Specific gravity

(x) Sand core density

(xi). Rubber balloon density

All tests not limited to the above shall be done by the Contractor as required for the project.

Classification

c) Carry out moisture density tests on representative samples prior to placing.

Carry out gradation of materials prior to placing as the work proceeds.

Carry out site density tests of materials as the work proceeds and as follows:

Frequency of Tests

Structural Fill:

a) One test for each 500 Cum. placed.

b) One test whenever there is a change of gradation or placement conditions.

General Fill:

c) One test for each 3000 Cum. placed.

d) One test required whenever there is a change of gradation or placement conditions.

e) Execute site density tests for compaction at a minimum depth of 100 mm below compacted surface.

f) Execute a full compaction test or a one-point compaction test in conjunction with each site density determination.

g) Execute a gradation test with each site density test and whenever there is an apparent change in material being placed.

h) Execute the following site density tests and laboratory moisture density tests to evaluate compaction achieved:

i) One test for every 200-400 cum of backfill in trenches or surrounding structures.

j) One test for every full shift of compaction operation on mass earthwork.

Filling Material for Foundation and Back Filling.

Contractor shall consider the following filling materials as required in the Bill of quantities.

Excavated material from within the site meeting the fill material standards

Approved Earth Brought from outside

Approved quality river sand brought from outside

Approved quality murrum brought from outside

Approved quality manufactured sand / ROBO Sand/ Rock sand brought from outside.

The procedure for filling shall be applicable for all the above filling materials as detailed in this specification. All the filling material shall comply with the relevant IS Codes and standards referred herein for all practical purposes. All the filling material so decided to use it to this site as per the BOQ shall be got approved by the ENGINEER-IN -CHARGE . Source of filling material shall be intimated by the Contractor to the client and after approval of the source the frequency of visit to such sources shall be as decided by the ENGINEER-IN -CHARGE .

Material Specifications for Fill and Water

General and Structural Fill:

To conform to gradation of well graded soil.

To be free from plastic fines and weakly elemental lumps of sand.

To be homogeneous and at the optimum moisture content for compaction purposes when placed.

Crushed stone:

To consist of either: Durable crushed rock comprising angular fragments obtained by breaking and crushing solid or shattered natural rock, or

Durable crushed gravel stone obtained by artificial crushing of gravel, boulders, or fieldstone.

Rubble soling 20 cm in height consisting of random granite stone/ available laterite stone

including filling in voids with durable crushed rock comprising angular fragments and consolidating with mechanical ramming.

5.5.3 Water

Water used for compacting fill or for washing crushed stone shall be clean and free from oil, grease, organic matter, suspended sediments and other deleterious substances.

5.5.4 Adjacent excavations:

Where an excavation encroaches below a line drawn at an angle of 60 Deg. from the horizontal from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto shall be completed before the higher excavation is done.

Excavated formations:

In made up ground, excavate foundations down to a natural bearing formation of undisturbed subsoil, unless otherwise instructed.

Obtain instructions if a natural bearing formation of undisturbed subsoil:

Is obtained at a lesser depth than shown on the Drawings

Is not obtained at the depth shown on the drawings.

If after inspection formation becomes unsuitable for any reason, excavate further and backfill

Treatment of Formations

Treatment of formations generally includes:

Trim excavations to required profiles and levels.

Remove all loose material.

5.5.5 Excess excavation:

Backfill any excavations taken wider or deeper than required with mass concrete.

Where such excess excavation is carried out without approval, necessary extra backfilling shall be at the contractor's expense.

Proof Rolling under Fill Embankments

After removal of topsoil, the existing natural ground that will be under fill embankments shall be scarified to a depth of not less than 150mm and compacted so that the criteria called for on the specification are met.

Compaction Requirement

The required compaction of fills which are deemed to be part of bulk earthworks shall be achieved by a minimum number of passes of compaction plant. This plant, unless the ENGINEER-IN - CHARGE specifically allows in writing, shall include the following types:

a) For primary compaction and may include either or both types.

b) Of the following listed types for the final compaction of the surface.

Vibratory roller of either double or single vibrating drum of not more than 3.2 tonnes mass per meter of roll width having a vibration frequency of not less than 37 Hz. Vibrating roller not exceeding the above weight limit but of frequency less than 37 Hz are approved providing the nominal amplitude does not exceed that shown relative to the weight in tones per meter roll width in figure1 any other vibrating roller specifically approved by the Project manager. Vibrating rollers of less than 1 ton per meter of roll width shall not be used to compact any layer of fill of more than 175mm of un-compacted thickness.

Three-wheel steel-tired rollers having rear rolls each at least 0.50m wide and having not less than 4.5 Tonnes per meter of roll width.

Pneumatic tired roller having a minimum weight when operating of not less than three tonnes, spread over at least seven pneumatic tired wheels.

For filling in inaccessible places or against structures, hand tamping or small vibratory compaction equipment may be used with the approval of the ENGINEER-IN -CHARGE .

Care must be taken during compaction to ensure that no gaps are formed between adjacent layers.

Fill material shall be compacted to attain the densities as called for in the specifications.

As filling proceeds, test to verify the compaction being achieved shall be conducted. Tests shall be done at a minimum frequency no less than one test per 150 cum. of fill volume. Testing locations shall be distributed evenly throughout the fill volume and each layer area. The locations shall be to the satisfaction of the ENGINEER-IN -CHARGE and copies of the results of all tests shall be submitted to them whether successful or not.

In the event that tests do not verify the minimum compaction requirements, the whole of the area for which the test is representative shall be reworked and retested, unless otherwise directed by the ENGINEER-IN -CHARGE .

Where the ENGINEER-IN -CHARGE is of the opinion that a specific area within an embankment cannot compact to the specified density, he shall order alternative improvement works.

The following references shall be used to confirm compliance:

Sampling BS 5930 (or as updated), IS 2720

Field Dry Density: BS 1377: 1975 Clause 4.4 Test 15 (or as updated) soil on the site. Standard Maximum BS 1377: 1975 Clause 4.1 Test 12 (or as updated) Dry Density Moisture Content: BS 1377: 1975 Clause 2.1 Test 1 (or as updated) Determination of the moisture content Standard Remove all suitable and excess material from areas to be filled.

Surface of ground with a gradient exceeding 1 in 5, which is to receive filling must have horizontal benches cut to match the depths of compacted layers of filling.

Do not place fill until the formation has been inspected by the ENGINEER-IN -CHARGE .

Give the ENGINEER-IN -CHARGE ready for inspection. Compact filling after grading and levelling surfaces. Compact filling in layers, adding any necessary extra fill and water, to attain the minimum dry densities as tabulated in the table appended at the end of this Section.

Backfilling and compaction shall be undertaken under full- Supervisor, and each layer shall be got checked by the ENGINEER-IN -CHARGE. Further layers are not to be placed without the approval of the ENGINEER-IN -CHARGE .

Compact filling using vibratory plate, roller or other approved (mechanical) equipment, making the required number of passes with the equipment to obtain specified densities. Each trip of equipment shall overlap the previous trip by 500mm.

If selected earth kept aside is not sufficient for the back filling, the Contractor, with its own cost, shall bring in good quality earth, murrum etc. from borrow pits, either approved at the site and/ or elsewhere by the ENGINEER-IN -CHARGE . The cost of developing and reinstating the same after use as per the directions of the ENGINEER-IN -CHARGE and/or local laws prevailing for such borrow pits, loading, transporting and re-handling of earth/ murrum etc. deemed to have been included in its rates by the Contractor.

The Contractor at its own cost rectify and / or restore the damage (s) occurred due to improper backfill and compaction done by it.

If any settlement occurs due to improper backfill and compaction and/ or cracks developing in the sub-structure/ super structure works due to the same, the Contractor shall make good its damages/ defects at no extra cost to the Developer.

The contractor at its own cost protect by bracing the basement walls till the proper back filling and compaction are completed with the satisfaction of the ENGINEER-IN -CHARGE and complying with the conditions of the Contract and Technical Specifications. The Contractor shall also undertake and execute the patching of the basement wall after removal of such bracing at no extra cost.

All the back filling and compaction works shall be of acceptable standard to both of the ENGINEER-IN -CHARGE and the Structural Engineer.

The Contractor shall include in its rates the cost of removal of debris/ rubbish etc. from the bottom of the basement wall prior to back filling.

Notes:

Forces applied for compaction shall be dynamic or impact loads.

Specified percentages of compaction shall be related to the maximum dry density at the optimum moisture content as established by and verified on site by.

Correct field density to account for stone material larger than 19 mm in accordance with suggested methods.

Excavation Items

Apart from other factors mentioned elsewhere in this Contract, rates for the item of excavation shall also include for the following:

a. Clearing site.

b. Setting out works as required.

c. Providing shoring and shuttering to avoid sliding of soil and to protect adjacent structures and subsequently by removing the same.

d. Collection of excavated soil and sorting out useful excavated materials and conveying beyond the structure and stacking them neatly on the site for back filling or re-use as directed.

e. Bailing and pumping out water as required and directed.

f.. Excavation at all depth and removal of all materials of whatever nature wet or dry and necessary for the construction of foundation underground reservoir etc. and preparing bed for laying concrete.

g. Necessary protection including labour, materials, and equipment to ensure safety and protection against risk or accident.

h. Drilling of small holes as directed to explore the nature of substratum if necessary.

Backfilling the trenches alongside masonry or concrete with approved excavated materials up to the natural ground level in layers as specified including watering and ramming.

Earth filling in plinth: If there is approved surplus earth after backfilling the sides of excavations, the same will be used for plinth filling if required. Any additional approved earth if required for plinth filling the same shall be brought on the site, by the Contractor from outside. No borrow pits shall be opened on the Site; Filling in plinth shall be done in layers of 15cm thick each layer being consolidated by ramming and watering. The payment of back filling item shall be made on measurement of finished consolidated quantity.

5.5.6 Soling Used as Sub-Base

Location

Soling shall be constructed under floors and other areas where shown in the drawings.

Soling Materials

The size of stones to used soling shall not be more than 120mm, nor less than 50 mm when measured in any direction, and their height shall be equal to the proposed soling course depth of 75mm +/-25mm.

Preparation of the Sub-grade before laying soling

The top level of the sub-grade shall be lower than the level of the underside of the floor or other structure, to be built over it, by a distance equal to the combine depth of soling and metalling (due allowance being made for consolidation). The depth of the soling shall be 75mm but to achieve this finished depth, an initial loose layer of approximately 100mm will be necessary.

Laying and packing the soling stones

A layer of sand or small size gravel 50mm thick shall be spread and consolidated on the sub-grade surface prepared.

The stones for soling shall be of a height equal to the required thickness of soling. Their length

or breadth shall not be greater than twice the soling thickness. This means that the stones would pass through a ring 180mm in diameter but not a ring 100mm in diameter.

Soling stone shall be hand packed as close as possible with their broadest side downward and greatest length across the road. Gauge pegs shall be driven at close intervals to indicate the required thickness of the soling. The joints between stones shall be placed at the edges of the area to be covered. All interstices between stones shall be wedged in with smaller stones, well driven into achieve tight packing and complete filling of the interstices.

Consolidation of the soling

The soling shall be thoroughly consolidated with mechanical rollers of 8 to 10 tonnes weight starting at the edges and working towards the centre. If the soling is to have a cross fall the rolling shall commence at the lowest edge and work over and up to the upper edge. Rollers shall pass over the same surface at least 8 times to ensure that the soling is well consolidated. The top surface shall be checked frequently to make sure that it conforms to the design grade and level.

Vibratory compactors may be used, if approved by ENGINEER-IN -CHARGE instead of mechanical rollers. For areas where access is difficult or restricted heavy hand rammers and hand rollers may be used if approval for this has been obtained from ENGINEER-IN -CHARGE .

5.6 Anti-Termite Treatment

The Contractor must take special care in performing anti-termite treatment since the construction site / project location is prone to termite infestation**.**

Chemicals

Chemicals concentration: **Imidacloprid 30.50 SC** (by weight) .

The quantity of all chemicals will be as per CPWD specifications or as per manufacturer’s specifications.

Further, the Anti termite treatment work shall be done strictly as per CPWD specifications following IS 6313 and IS 16131.

necessary action.

5.6.1 Treatment of column pits, wall trenches and basement excavations

The bottom surface and sides (up to a height of 30 cm from the bottom) of the excavations made for column pits and trenches shall be treated with the chemical emulsion mentioned above at 5 liters / sqm of surface area.

5.6.2 Treatment to Backfill Earth

After the column foundations and wall foundations come up, the backfill in immediate contact with the foundation structure shall be treated with the chemical emulsion at the rate of 15 liters/ Sqm of the vertical surface of the sub-structure for each side. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

5.6.3 Treatment for R.C.C Framed Structures

The treatment described above applies essentially to masonry foundations where there are voidsin the joints through which termites can seek entry into the superstructure. Hence the foundations require to be completely enveloped by a chemical barrier. In the case of RCC framed structures with columns and plinth beams, the concrete mix is rich and dense (being 1:2:4 or richer), it is unnecessary to start the treatment from the bottom excavations for columns, plinth beams and basement walls. The treatment shall start at depth of 50cm below ground level. From this depth, the backfill around the columns, beams and RCC basement walls shall be treated at the rate of 15-liters/ Sqm. of the vertical surface. The other details of the treatment shall be as laid down above.

5.6.4 Treatment of Top Surface of Plinth Filling

After the earth filling is completed in the plinth area and before the dry rubble packing or sub grade is laid, the entire surface of the filled earth shall be treated with the chemical emulsion at the rate of the 5 liters per Sqm. Light rodding may be carried out in the soil surface to facilitate absorption of the emulsion.

5.6.5 Treatment at Junction of Walls and Floor

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surface from the ground level up to the level of the filled earth surface. To achieve this, a small channel 3 x 3 cm shall be made at all the junctions of wall and columns with floor (before laying the sub grade) and rod holes made in the channel up to the ground level 15 cm apart and the rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 15 litre/ Sq.m of the area of the vertical surface of the wall surface of the sub-structure so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.

5.6.6 Treatment to Soil along External Perimeter of Building

Finally, the earth around the external perimeter of the building up to a depth of 30cm shall be treated at the rate of 4.5 litres per running meter of plinth wall. To facilitate this treatment, solid M.S. rods should be driven into the soil as close as possible to plinth wall at intervals of 15 cm and up to a depth of 30 cm and the rods moved backwards and forwards in a direction parallel to the wall to break up the earth so that the chemical emulsion mixes intimately with soil.

5.6.7 Treatment of Soil Surrounding Pipes, Wastes and Conduits

When pipes, wastes and conduits enter the soil inside the area of the foundation, the soil surrounding the point of entry must be loosened around each such pipe waste or conduit for a distance of 15 cm and up to a depth of 7.5 cm before the treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 7.5 cm for a distance of over 30 cm.

5.6.8 Termite Proof Course or DPC (PCC) in Plinth

Where there is the provision of a damp-proof course in the construction, it is located just below the level of the filled earth. Although this acts as an effective barrier impervious to termite entry the PCC surface should be treated at 5 litres per Sq.m immediately after the course is laid and the concrete is green. Where there is no provision for a DPC, the top surface of the masonry course just below the level of plinth filling mentioned above should be soaked with the chemical

emulsion at the rateof 5 litres per Sq.m. of the surface. The application should be carried out slowly to enable the masonry surface to absorb the emulsion.

5.6.9 Anti-Termite Treatment at Points of Contact of Woodwork

Refer to CPWD Specifications

5.6.10 Guarantee

The Contractor shall guarantee the anti-termite work for a period of 10 years from date of completion. The guarantee will cover the surfaces treated and will bind the Contractor to perform remedial measures, at his expense including but not limited to repeat of anti-termite work in the affected area/zone.

Contractors must ensure that the work is done through a professional pest control operator whois a member of Indian Pest Control Association or other recognized professional body. A list of termite control jobs successfully undertaken for Government Departments, Statutory bodies or large private organizations are to be provided to prove that they are capable of handling anti-termite work.

Anti-termite work for the RCC-Raft bottom, RCC Plinth /Wood etc. shall be done by the Contractor including the 10-year guarantee period without any additional cost and time to the Contractor.

5.7 Concrete (Non-Structural)

- Lightweight aggregate concrete shall be proportioned, mixed and placed as required by the ENGINEER-IN -CHARGE . Unless otherwise shown, the mixes shall be one of the following, the type to be directed by the ENGINEER-IN -CHARGE .

a) Breeze Concrete

1 Part cement to 6 Parts of coke breeze aggregate by volume

b) Polystyrene aggregate concrete

i. 1:2:4 mix (913 kg.m3): 45 kg. Cement and 0.056m3 sand to 2.25 kg. Expanded polystyrene particles.

ii. 1:3:6 mix (800 kg.m3): 45 kg. Cement and 0.084m3 sand to 3.06 kg. Expanded

c) polystyrene particles.

i. 1:1:4 mix (640 kg.m3): 45 kg. Cement and 0.028m3 sand to 2.155 kg.

ii. Expanded polystyrene articles.

iii. Vermiculite aggregate concrete 1 Part cement to 6 Part vermiculite by volume

- Lightweight “air entrained” concrete to be proportioned and mixed according to the manufacturer’s instructions and placed as required by the ENGINEER-IN -CHARGE .

5.8 RCC Works

(a) Concrete work shall be done with Design Mix Concrete or Ready Mixed Concrete from reputed and approved suppliers approved by ENGINEER-IN -CHARGE. If procured from RMC their design mix shall be approved prior to procurement.

(b) The Design Mix Concrete will be designated based on the principles given in Indian standards. The contractor shall design mixes for each class of concrete such that the concrete ingredients and proportions will result in concrete mix meeting specified requirements. In case of admixtures and or white cement, the mix shall be designed withthese ingredients as well. The specification mentioned herein below shall be followed for Design Mix Concrete.

(c) Source approval for the ingredients shall be done by the Contractor prior to Construction. The design mix shall be verified by any IIT before start of construction.

5.8.1 Ingredients

All ingredients selected should be as per relevant Indian Standards and CPWD specifications.

(a) Coarse Aggregate

(b) Fine Aggregate

(c) Water: It shall conform to requirements laid down as per standards.

(d) Cement: Cement arranged by the contractor will be slag or Portland Pozzolana Cement (PPC). Cement of grade lower than that used for mix design shall not be allowed to be used in the work. The Indian standards for PPC Cement are as follows and is highly recommended;

(i) IS 1489 (Part 1) 1991, Portland Pozzolana Cement specification (fly ash based).

(ii) IS 1489 (Part 2) 1991, Portland Pozzolana Cement specification (Calcined claybased)

IS 3812 1981 specification for fly-ash as pozzolana and admixture IS 1344 1981

5.8.2 Admixtures

Wherever required, admixtures of approved quality shall only be mixed with concrete as specified. The admixtures shall conform to relevant Indian Standards along with the approval of client representative.

(a) Grade of Concrete & Reinforcement:

The Characteristic compressive strength of various grades of concrete shall be M20 Grade in the case of plain concrete, M30, M35 and above in case of reinforced concrete.

(i) Special attention shall be given to the design of the mix to obtain the densest possible concrete: slag, broken brick, soft lime stone, soft sandstone, or other porous or weak aggregates shall not be used.

(ii) In reinforced concrete structures, care shall be taken to protect the reinforcement from exposure to saline atmosphere during storage, fabrication and use. It may beachieved by treating the surface of reinforcement with cement wash or by suitablemethods.

(iii) Reinforcement for RCC work shall be high yield strength ribbed cold twisted torsteel (HYSD) Fe 550D bar of various diameters and grade of steel at all levels conforming to IS specification including transporting from yard, decoiling, straightening, cutting, bending, hoisting, fabricating, and placing in position according to drawings and binding the reinforcement with GI annealed binding wire of double fold of 18 gauge and providing PVC cover blocks, for placing the reinforcements in position and for maintaining the cover specified and/or according to relevant IS codes.

5.8.3 Laying concrete

(i) Surfaces on which concrete is to be placed should be free from debris and standing water.

(ii) Pre-moist the base material prior to placing concrete. Timing: Place as soon as practicable after mixing and while sufficiently plastic for fullcompaction. After discharge from the mixer do not add water or re-temper. Temperature of concrete at point of delivery. In hot weather (maximum): 30°C.

(iii) In cold weather (minimum): 5°C.

(iv) Do not use frozen materials.

(v) Do not place concrete against frozen or frost covered surfaces.

(vi) Do not place concrete when air temperature is below 3°C on a falling thermometer. Do not resume placing until rising air temperature has reached 3°C.

Placing in final position. Place in one continuous operation up to construction joints.

Do not place concrete simultaneously on both sides of movement joints.

Spreading

Spread and strike off with surcharge sufficient to obtain required compacted thickness.

Joints

Cracking of concrete takes place when curing takes place and secondly when concrete shrinks with change in temperature. There are four different types of joints which are introduced depending on structural requirement of the concrete slab.

(a) Contraction joints:

These are intended to create weakened planes in the concrete and regulate the locationwhere cracks, resulting from dimensional changes, will occur.

(b) Isolation or expansion joints:

Separate or isolate slabs from other parts of the structure, such as walls, footings,columns, driveways and patios from sidewalks, stairs, light poles, other point of restraint.

(c) Construction joints:

Are surfaces where two successive placements of concrete meet. The location ofconstruction joint should be planned.

Guidelines for executing joints

(a) Refer relevant standards and structural consultant guidelines before executing joints in concrete slabs.

(b) The maximum joint spacing should be 24 to 36 times the thickness of the slab as basic thumb rule. Consult structural consultant for technical details.

(c) For contraction joints, the joint groove should have minimum depth of ¼ the thickness of the slab as basic thumb rule.

(d) Tooled joints must be run early in the finishing process and rerun later to ensure groovebond has not occurred.

(e) Early-entry-dry-cut joints are generally run 1 to 4 hours after completion of finishing of concrete setting.

(f) Conventional saw-cut joints should be run within 4 to 12 hours after the concrete has been finished.

(g) Use pre-molded joint filler such as compressible foam strips for isolation joints to separate slabs from building wall or footings. At least 50mm of sand over the top of a footing will also prevent bond to the footing.

(h) If the slab contains wire mesh as reinforcement, cut out alternate wires, or preferably discontinue the mesh, across contraction joints.

(i) For construction joints, use Connelly joints https://www.connollykeyjoint.com / or similar approved at all joints keying the two edges of the slab together.

(j) Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

(k) Concrete shall be deposited on the base as near the joints as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure anddeposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directlyupon or against the joints.

Compaction of Concrete

Concrete shall be compacted during placing so that:

(a) A monolithic mass is created between the ends of the member, planned joints or both;

(b) The formwork is completely filled to the intended level;

(c) The entrapped air is expelled;

(d) All reinforcement, tendons, ducts, anchorages and are completely surrounded;

(e) The specified finish to the formed surfaces of the member is provided;

(f) The required properties of the concrete can be achieved.

Compaction Methodology

(a) Hand compaction: this method is used for non-structural items. Workability should be decided

to minimize the chances of honey combing. Rodding and Tamping are two common methods which can be used for pathways and paved areas.

(b) Mechanical Compaction: Vibration is imparted to the concrete by mechanical means. It causes temporary liquefaction so that air bubbles come on the top and expelled ultimately.

Finishing of Concrete

(a) During compaction, any low or high spots shall be made up by adding or removing concrete.

(b) After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3 m straight edge.

(c) Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished.

(d) Adjacent work: Form neat junctions and prevent damage. Keep clean all channels, kerbs, inspection covers, etc to be installed and kept clean during the installation process.

5.9 RCC Retaining wall

Foundation

Design Mix Concrete M30 (minimum) by using 400 Kgs / Cum corresponding to IS 456 using weigh batcher / mixer with 20mm size graded machine crushed hard granite metal (coarse aggregate) from approved quarry. Actual quantity of cement will be as per approved mix design.

Wall material

Design Mix Concrete M30 (minimum) by using 400 Kgs / Cum corresponding to IS 456 using weigh batcher / mixer with 20mm size graded machine crushed hard granite metal (coarse aggregate) from approved quarry.

Reinforcement and Anchorage

(a) Reinforcing Steel: High strength deformed steel bars confirming to IS 1786.

(b) RCC Copings and Mullions: As per design and drawings

(c) Tie Beams: As per design and drawings

5.10 Concrete Mixes

General

Reference shall be made to concrete mixes Designed Mix concrete. Designed mix concrete is denoted by grade such as M-20, M-25, M-30, M-35 etc. where M refers to mix and the number to the characteristic strength of concrete in N/mm^2 to be established by 28 days of 15 cm works cube tests. The particular mix to be used shall be as described in the Contractor on the Drawings.

The characteristic strength of Designed Mix concrete with any type of cement shall be the 28 days cube strength below which not more than 5% of the test results are expected to fall.

The quality and strength of concrete shall be determined by test on samples taken on Site from

the member during concreting and tested at an approved Laboratory as directed by the ENGINEER-IN -CHARGE .

The maximum size of aggregate for structural work shall generally be 20 mm. For thin sections and where reinforcement is congested, 10 mm aggregate may be approved or required. For large sections where the reinforcement is widely spaced and for mass concrete, 40 mm aggregate may be approved.

The free water / cement ratio will generally be chosen to suit strength and workability requirements but may be limited by the considerations of durability .

The cement content not including fly ash and blast furnace slag in excess of 450 kg/m3 should not be used unless special consideration has been given in design to the increased risk of cracking due to drying shrinkage in thin sections, or to early thermal cracking and to the increased risk of damage due to alkali silica reactions.

5.10.1 Nominal Mix Concrete

NOT ALLOWED.

5.10.2 Design Mix Concrete

Design mix shall be in accordance with IS: 456, IS: 10262 and SP: 23. The Contractor shall design the mix and submit for the approval of the ENGINEER-IN -CHARGE . No concreting works shall be commenced without the approval of the design mix of concrete. The Contractor is responsible for the design of the concrete mix. Grades of concrete lower than M-15 shall not be used in reinforced concrete.

Mixes for each class of Designed Mix concrete specified or shown on the Drawings shall be designed by the Contractor to achieve the specified minimum cube strength combined with high density and adequate workability for the purpose. In order to allow for unavoidable variation, the design strength shall exceed the specified characteristic strength by twice the expected standard deviation. In the absence of previous information, the value of standard deviation given in the following Table 8 may be assumed (conforming to Table 8 of IS 456 2000). Assumed values of standard deviation shall only be used until sufficient data are available to determine

the standard deviation. Prior approval of the ENGINEER-IN -CHARGE shall, however, be obtained in the event of use of higher grade of design mix concrete not covered herein.

Grade of Concrete	**Assumed Standard Deviation (N/mm2)**
M10	3.5
M15	3.5

M20	4.0
M25	4.0
M30	5.0
M35	5.0
M40	5.0
M45	5.0
M50	5.0
M60	5.0

Classes of Design Mix concrete will be referred to by the minimum 28 days Works cube strength and by the maximum size of aggregate. Classes of concrete shall meet the criteria. The maximum water / cement ratio is herein defined as the ratio of the weight of the *free* water to the weight of the cement. The *free* water is that quantity of water available to combine with thecement. Any water required to be absorbed by aggregate is excluded. To keep the water-cementratio to the designed value, allowance shall be made for the moisture contents in both fine and coarse aggregates and determination of the same in accordance with IS:2386 shall be made as frequently as directed by the ENGINEER-IN -CHARGE .

Details of any proposed mix design shall be forwarded to the ENGINEER-IN -CHARGE for his approval in principle well in advance before that class of concrete is required to be used on the works. The details shall include at least the following information:

(a) Source, nature and grading of coarse and fine aggregates

(b) Source of cement

(c) Nominal maximum size of aggregate

(d) Cément content

(e) Aggregate / cément ratio

(f) Water / cement ratio

(g) Design density

(h) Design slump or compacting factor

(i) Design strength

(j) Proposed admixtures

(k) Nominal grading details (tabular & graphical) of the combined aggregate together with details of the proportions in which the fine and coarse aggregates are combined.

(l) Type of plant to be used and location if ready-mixed off site.

The cement content of concrete shall be not less than the appropriate amount given in Table 5 of IS 456 2000. For water retaining structures, the minimum cement content shall be 320 kg/m^3. Minimum cement contents, from durability consideration, or different exposures and sulphate attack shall be as given in Table-4 of IS:456 2000. In case, higher value is obtained from trial mix from strength consideration, same shall be considered.

Where a Designed mix is to be used, the Contractor shall carry out trial mixes to determine the suitability of the proposed mix proportions for production of concrete of the required quality, workability and computability for the location specified. The Contractor shall prepare trial mixes on receipt of the ENGINEER-IN -CHARGE provisional approval of the mix design and complete well before commencement of concreting. Failure on the part of the Contractor to doso and the consequent delay in the completion of the works will not entitle him for any compensation whatsoever, either financially or by way of extension of time.

The proportions, once decided for different grades of concrete, shall be adhered to, during all concreting operations as long as the quality of the materials does not change.

Each batch of concrete shall be sampled and the following prepared.

(a) six 150 mm cubes three for test at 7 days, and three for test at 28 days

(b) three slump tests (for design slump greater than 25 mm) or

(c) Three compacting factor tests (for design slump less than 25mm).

Variations in the proportions and sources of materials or in the type, size and grading of aggregates for approved mixes shall not be made without the consent of the ENGINEER-IN -CHARGE .

Mixing and Transporting Concrete:

All materials for concrete shall be measured as per approved design mix by weight in approved weight batching equipment of adequate capacity. Such equipment shall be checked at weekly shall be submitted immediately to the ENGINEER-IN -CHARGE .

In case of space constraints, the Contractor shall arrange for procurement of Ready-Mix concrete of approved Design mix and from approved brand or plant of RMC with necessary written consent from ENGINEER-IN -CHARGE .

Concrete shall be mixed in a mechanical mixer. The mixer should comply with IS: 1791 and IS: 12119. The mixers shall be fitted with water measuring (metering) devices. The mixing shall be continued until there is a uniform distribution of the materials and the mass in uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete should be remixed. In case of an RMC, the Contractor shall ensure that the travel time for transportation of

concrete from source to site shall be limited to a maximum time of 30 minutes. The Contractor shall ensure that the concrete is discharged on the site within 30 minutes after arrival. Also, careshould be taken for limiting the usage of retarders. In case of site mixed concrete, no retarders shall be added.

A water / cement ratio shall be maintained to produce concrete of adequate workability. The workability of fresh concrete shall be at the discretion of the Contractor but subject to approvalby the ENGINEER-IN -CHARGE and shall be the minimum consistent with producing a dense, well compacted mass. Due regard shall be paid to the size and shape of the section together with any congestion of reinforcement. A guide to the degree of workability required for various typesof work is shown in Table 10 (below).

The slump for concrete as determined by slump tests as per IS: 1199 shall not exceed the maximum slumps indicated in Table 9 below for each type of construction using high frequency vibration unless otherwise approved or directed by the ENGINEER-IN -CHARGE . The Contractor shall not place concrete having a slump outside the limits specified without the approval of the ENGINEER-IN -CHARGE . At least one slump test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in job conditions, or if required by the ENGINEER-IN -CHARGE

All materials shall be thoroughly mixed dry before water is added and the mixing of each batch shall continue for a period of not less than two minutes after the water is added or such longer period as recommended by the manufacturer of the mixer. The mixture shall be of uniform colour and distribution on discharge and the entire contents of the mixer shall be discharged without segregation before recharging. The volume of mixed material shall not exceed the ratedcapacity of the mixer.

Prior to the first mix each day being agitated in the mixer a rich cement / sand mix shall be usedto coat the inside of the drum, the surplus material being emptied away and not used in the works. Each time if the work stops for more than 30 minutes, the mixer shall be thoroughly cleaned and when the next mixing commences the first batch shall have 10% additional cement.

Volume batching of materials and hand mixing of concrete will be allowed only at the discretionof the ENGINEER-IN -CHARGE . Where approved, hand mixing of concrete shall be done on a clean close boarded platform. The materials shall be turned over not less than three times dry, water shall then be sprayed on through a hose and the materials again turned over not less than three times in a set condition and worked together until a mixture of uniform consistency is obtained.

For hand mixed or volume batched concrete the specified quantities of cement shall be increased by 10 per cent and not more than 0.5 cubic metre shall be mixed at one time. The Contractor shall not be entitled to any additional payment in respect of any extra cost of hand mixing by reason of the additional cement or otherwise. However, the extra cement shall be considered for reconciliation purposes.

Workability of Concrete

The concrete mix proportions chosen should be such that the concrete is of adequate workability for the placing conditions and can properly be compacted with the means available. Suggested ranges of workability of concrete measured in accordance with IS 1199 are given below.

The moisture content of the coarse and fine aggregates shall be checked by the Contractor at frequent intervals and the amount of water added to the mix shall be adjusted to maintain the design workability. For the determination of moisture content in the aggregates IS: 2386 shall be referred to.

Concrete shall be discharged from the mixer directly into the works or onto a clean, level, watertight platform or into a clean watertight container. It shall be transported as rapidly as practicable in a manner which ensures that it is of the correct quality and consistency at the point of deposition. Normally, not more than 30 minutes shall laps between mixing and consolidation in position. All platforms and containers shall be cleaned of the old concrete before the fresh concrete is discharged onto them.

Conveying equipment for concrete shall be mortar tight, well maintained and thoroughly cleaned before commencement of concrete mixing. Concrete shall be transported by transit mixers.

Concrete shall not be dropped from a height, thrown or otherwise treated so that segregation, un-desirable finishes, or defective structural quality results. The maximum drop shall be 2.1m unless otherwise approved by the ENGINEER-IN -CHARGE .

No extra water shall be added to the concrete mix after it has left the batching plant.

The Contractor shall take adequate precautions to protect concrete in transit from the effects of the weather.

Pumping of concrete, which will require a special Design Mix, will only be permitted with the approval of the ENGINEER-IN -CHARGE shall also review the entire scheme for which comprehensive details shall be furnished by the Contractor.

Pumping operation whenever commenced shall proceed continuously so as to prevent "cold" joints between placed sec

The delivery line of the pump shall be of 100 mm diameter or greater and the pump shall be capable of pumping concrete containing a 20 mm nom. Size aggregate.

The pump shall have a receiving hopper and pumping chamber capable of displacing at least 15

cu. Metres of concrete per hour against a horizontal delivery head of at least 90 metres and/or a vertical delivery head of 20 metres.

Pumping lines shall be of approved metallic type laid to avoid bends.

The Joints in pumping lines shall be sealed tight to prevent leakages.

Pulsating lines shall be isolated from the structure and shall be supported from the deckon stands.

The feet of such stands shall be placed on timbers or similar material to prevent movement of the line and stand scuffing the deck. Timbers shall not be embedded in finished work. Stands shall be kept clear of reinforcement.

All equipment, pump chamber, hoppers, lines and rubber hoses shall be kept clean at alltimes. Any build-up in the lines of material from previous operations shall be cleaned outpreparatory to pumping.

In the event of a breakdown in the equipment causing delay not exceeding twenty (20) minutes, during which time concrete cannot be placed, the following procedures shall becarried out with the approval of the ENGINEER-IN -CHARGE at site the concrete already in place shall have the "wet edges" maintained by depositing small quantities of hand mixed concrete placed by hand against the "wet edge" and vibrated into the mass.

Where atmospheric temperature exceeds 30 degrees C, the receiving hopper and lines shall be cleaned out and the concrete contained

therein discarded and immediately removed from the site.

The concrete shall be discarded if initial setting of the concrete has begun in the hopperor discharge lines.

All lines shall be cleaned free of concrete prior to resumption of pumping after eachbreakdown

Concrete in the lines shall be pumped at approximately eight (8) minute intervals to ensure the concrete in the line is live, whenever delivery of concrete to the pump is delayed. This pumping interval shall be reduced to five (5) minutes during extra hot weather conditions.

Delivery lines were exposed to hot sun, shall be protected by covering with bags, wetHessian or other approved means.

Should the concreting be stopped due to mechanical malfunction, accident, or other similar cause then the Contractor shall inform the ENGINEER-IN -CHARGE immediately so that necessary measures and precautions can be taken. The cost of any additional work caused by these stoppages shall be the responsibility of the Contractor.

No concreting shall be commenced until the form work and reinforcement and all other preparations for the pour have been inspected by the ENGINEER-IN -CHARGE who shall be given a minimum 24 .

Placing and Compacting Concrete

The pouring of concrete at various heights shall be at 0.00m to 4.50m, 4.50m to 7.00m and 7.00m to 12.50m.

Concrete shall be transported and placed by an approved method which ensures that there shallbe no contamination, segregation or loss of the constituent materials.

If concrete is placed by pumping, the consistency shall be the minimum necessary for such conveyance of concrete. Before commencement of regular pumping, the pipeline shall be lubricated by cement mortar (1:2), and once pumping commences, stoppages shall be avoided.

All areas where concrete is to be placed shall be clean and rendered free from standing water immediately before the placing of concrete, except for concrete placed under water.

Concrete shall not be placed in foundations on soft areas or where there is standing water or debris. Such soft areas shall be removed and filled with 1:4:8/1:3:6 nominal mix concrete, as directed by the ENGINEER-IN -CHARGE

For rock surfaces, it shall be ensured that the rock is not unsound. On sloping rock faces, rough steps or benches shall be formed and concrete shall not be placed on a sloping rock surface. Prior to pouring concrete, the rock surface shall be cleaned with a high-pressure water and air jet and kept wet for three hours. Also, before placing concrete, water shall be removed from depressions, the rock surface shall be dried and a 10 mm thick cement sand mortar (1:6) layer shall be placed and worked into all crevices, cracks, depression, etc. Pouring of foundation concrete on rock surfaces where required, shall be done with rebar rock anchoring for the calculated depth as per the standard drawings to meet the structural requirement and fixing the rebar with approved grouting compound.

Concrete shall not be placed in any part of the structure until approval has been given, and if concreting is not started within 24 hours of that approval being given, approval shall be obtained again. Approval by the ENGINEER-IN -CHARGE of any of the materials and / or work as required herein shall not relieve the Contractor of his obligation to produce finished concrete in accordance with the drawings and specifications.

Concreting shall proceed continuously between predetermined construction joints and shall rise uniformly in the form work at a rate of not less than 2m per hour. Concrete shall not be placed directly against a vertical form face but shall be caused to flow to this surface during the

compaction process. Unless the ENGINEER-IN -CHARGE agrees otherwise, fresh concrete shall not be placed against in-situ concrete which has been in position for more than 30 minutes unless the in-situ concrete has been kept damp with a layer of wet hessian and protected from the weather.

When in-situ concrete has been in place for 4 hours or in the opinion of the ENGINEER-IN -CHARGE the concrete has stiffened to such an extent that it no longer responds to the action of an internal vibrator, no further fresh concrete shall be placed against it for a further 20 hours and a construction joint shall be formed.

Concrete shall be compacted in its final position within 30 minutes of discharge from the mixer unless it is carried in continuously operating purpose made agitators when the applicable time shall be within 2 hours of the introduction of water to the mix and within 30 minutes of discharge from the agitator. Concrete, which in the opinion of the ENGINEER-IN -CHARGE no longer sufficiently workable, shall be rejected.

All concrete shall be vibrated unless otherwise specified. Experienced operatives using immersion type vibrators to the ENGINEER-IN -CHARGE satisfaction shall carry out the vibration.

Internal vibrators shall operate at not less than 10000 cycles per minute and external vibrators not less than 3000 cycles per minutes. Vibrating tables operating at a minimum of 5000 oscillations per minute may be used for pre-cast elements subject to approval. Do not use external clamp-on type vibrators without prior approval.

Placing of concrete shall be carried out in layers not exceeding 600 mm deep and in sequence from one end of the form to the other.

Placing of concrete shall be carried out in lifts not exceeding 3m in height. This restriction maybe reduced to 2 m or less when casting thin or congested sections at the discretion of the ENGINEER-IN -CHARGE . If directed, concreting of congested sections shall be done with self-level concrete without extra cost. Also, shutter vibrator shall be used to ensure uniform and honeycomb free concrete placement. For a single pour of above 3 M, column shuttering with suitably placed window openings shall be adopted for placement of concrete without separationof aggregate due to high level pour.

Concrete in foundations and other underground work shall be protected from contamination by falling earth or rock during and after placing

Sufficient vibrators shall be provided to correspond with the rate of placing of concrete. The vibration shall be continuous throughout the placing of the concrete. Standby vibrators shall beon Site during all concrete placing.

Vibration shall not be allowed to disturb any recently placed concrete that has begun set. Any water accumulating on the surface of newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed.

Concrete shall be placed and compacted in such a way as to avoid disturbance to the form work and reinforcement. Where sections of the Works are carried out in lifts, the reinforcement projecting above the lift being cast shall be supported to prevent movement of the bars during the casting and setting of concrete.

Vibration shall not be used as a means of distributing concrete into position, and concrete shall not be vibrated between 4 and 24 hours after placing.

The Contractor shall take special precautions when concreting in hot weather. Any form work made of concrete, metal or other material of high thermal capacity shall be cooled with water before concrete is placed against it. Curing of concrete shall commence immediately after compaction. Protection from direct radiation shall be in place within 30 minutes after final surface tamping

Suitable means shall be provided to ensure that the temperature of the concrete on placing does not exceed 30 deg. C. Concrete shall not be placed around reinforcement or against surfaces, which are at temperatures above 30 deg. C. All surfaces shall be thoroughly dampened immediately prior to placing fresh concrete to prevent excessive absorption of water by the form work.

Special care shall be taken in accordance with IS: 456 while laying concrete under extreme weather.

Under water concrete shall be placed in accordance with the recommendations given in BS 8004or corresponding IS Code.

While concreting, on opinion of the ENGINEER-IN -CHARGE , if it feels that the concreting and compaction found very difficult / inconvenience due to closer reinforcement, adequate vibrating system is to be followed, especially with shutter vibrator in order to achieve the

Testing of Concrete

Sampling

For all structural concrete the following representative samples shall be taken for each concreting day and shall be used and tested by an accredited laboratory.

a) 150 mm concrete test cubes

b) Two slump tests

c) Two compacting factor tests

The rate of sampling fresh concrete shall be at least that specified in Table 10 IS: 456 and at least one sample shall be taken from each grade of concrete produced on any oneday.

A technically competent person shall supervise the sampling of fresh concrete and themaking of concrete test cubes.

Additional test cubes of concretes shall be taken and placed near the area of concretingof slabs. These cubes shall be made to experience the same conditions of curing and environmental exposure as the slab they were cast with. These cubes shall be tested along with the laboratory samples to correlate with the strength of concrete obtained atsite.

The names and qualifications of the supervisory personnel representing the ENGINEER-IN -CHARGE and the Contractor respectively shall be entered into an inspection logbook. All inspections shall be clearly recorded with date, time and location of site activities. The logbook shall be provided by the Contractor and kept on site by the ENGINEER-IN -CHARGE .

The supervisory personnel shall mark and sign on the concrete test cubes a unique reference number and sufficient to allow the testing laboratory to identify clearly the date and time of casting and the position in which the batch of concrete (from which thecube was made) was placed.

Concrete Test Cubes

Make six cubes from a single sample taken from a batch of concrete selected at random.Taken the sample at the point of discharge from the mixer, or elsewhere as directed by the ENGINEER-IN -CHARGE . On completion of curing one set of three cubes is tested for 7 days strength and the remaining tested for 28 days strength. The average of the three results shall be taken as the test result.

The strength requirement shall be as per clause no 15.4 & 16.1 of IS: 456:2000.

Acceptance criteria shall be based on test results on 28 days strength only subject toclause 16.1 of IS: 456:2000.

The variation between the lowest and highest shall not be more than 15% of the meanof the three.

In addition to the water tank curing method specified in IS-516, cubes may be cured onSite or in the laboratory in approved mist rooms. Where mist rooms are used, they shall comply with ASTM C511-75 except that the temperature shall be maintained at 27 ºC +3 ºC.

If concrete represented by test cubes in any concreting day fails to meet the standard of acceptance specified in accordance with the IS codes, the ENGINEER-IN -CHARGE may order the taking of core samples from finished concrete work in same concreting day for by the ENGINEER-IN -CHARGE These cores shall be treated as below.

Concrete Test Cores: (Non-destructive testing on concrete will be carried out at the discretion of the ENGINEER-IN -CHARGE based on the cube test results and review of concrete executed).

Concrete core samples, from the finished concrete work, shall be taken in the locationsdirected by the ENGINEER-IN -CHARGE .

The diameter of the concrete cores should be 150 mm for 40 mm aggregate concrete, 100mm for 20 mm (or smaller) aggregate concrete and must not be less than 75 mm. The length of the test sample cut from the concrete core shall be at least 95% of the diameter.

All coring shall be completed within 7 working days of the date the instruction is givenby the ENGINEER-IN -CHARGE

All cores shall be drilled and tested by an accredited laboratory.

Cored holes shall be made good to the approval of the ENGINEER-IN -CHARGE withcement mortar or concrete of similar strength to that of the parent concrete.

Results of the cores for the same concreting day will be examined individually.

In assessing the results of compressive tests on cores the concrete represented by the core shall be deemed not to comply with the specification if the strength of the core whenadjusted for length / diameter ratio and converted to estimated cube strength as follows:

a) The average result of the cores is less than 85% of the specified gradestrength *or*

b) An individual result is less than 75% of the specified grade strength

Concrete cores should not show evidence of segregation of constituent materials

There should be no honeycombing in the cores and the extent of the voids in the cores.

Cores shall not be tested for strength at ages less than 28 days and no adjustment shall bemade to the measured strength in respect of the age of the core when tested.

Testing and Test Record

The concrete cubes tested at 7 days are intended to be **indicative only** and the target works strengths at 7 days are not mandatory. It should be noted however that it is unlikelythat cubes

failing the 7 days target will subsequently pass the 28 days cube strength.

The concrete cubes tested at 28 days shall be taken to represent the concrete placed in the works. The standard of acceptance for cube strength tests shall be calculated from the maximum load sustained by the cube at failure.

The appropriate compressive strength compliance requirement as given in Table 11 of IS: 456 2000 shall be considered to be satisfied if the test results comply with the acceptance criteria.

Workability

The standard of acceptance for the slump test during the production of concrete shall be the design slump $\pm$ 10 mm.

The standard of acceptance for the compacting factor test during the production of concrete shall be the design compacting factor (as specified in Table 10) $\pm$ 0.03.

Testing

The standard of acceptance of any preliminary tests will be similar to the standard for normal works cubes, cores, slump or compacting factor, except that the minimum cube strengths required shall be those given under minimum Preliminary Cube Strength at 28 days *in* Table 2 of IS: 456 - 2000.

The ENGINEER-IN -CHARGE , during the progress of the work, have the power to order tests, other than cube tests, including slump tests as far as practicable due to local conditions.

If the strength requirement is not satisfied the ENGINEER-IN -CHARGE may order such further testing, including chemical analysis of samples of hardened concrete in the structure, as he considers necessary.

Any concrete which fails to meet the above standards of acceptance shall he be either further tested or rejected at the discretion of the ENGINEER-IN -CHARGE The costs of any such tests or of the removal of rejected concrete and its replacement and associated costs shall be borne by the Contractor.

If the strengths required are not attained or maintained throughout the contract, the ENGINEER-IN -CHARGE may instruct the Contractor to take any one of the following steps or a combination thereof as the ENGINEER-IN -CHARGE considers appropriate.:

a) Adjust the mix proportion and carry out further trial mixes until a new mix proportion satisfying the requirements of the foregoing test is obtained and approved.

b) Improve the standard of quality control

c) Carryout, at the Contractor's expense, other tests as directed by the ENGINEER-IN -CHARGE

d) Replace any site concrete condemned as a result of failing to comply with the standards of acceptance specified and meet all costs arising from such replacement. Submit for approval the method statement for replacing the condemned concrete before the replacement is carried out. In certain cases, the ENGINEER-IN -CHARGE may require the method statement to be prepared and the remedial work to be supervised by a qualified ENGINEER-IN -CHARGE .

Curing and Protecting Concrete

 All freshly placed concrete surfaces shall be protected from damages by workmen equipment or any other cause.

 Newly placed concrete shall be protected by approved means from harmful effects of weather including rain, sun and wind. Concrete placed below ground level, shall be protected from falling earth, during and after placing. Concrete placed in ground containing any deleterious substances, shall be kept free from contact with such ground or with water draining from such ground, during placing of concrete and for a period of at least three days or as otherwise instructed by the ENGINEER-IN -CHARGE

 Steps, as approved by the ENGINEER-IN -CHARGE shall be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

 Immediately after compaction and for 7 days thereafter concrete shall be prevented from drying out too rapidly and protected against harmful effects of weather including rain, rapid temperature changes, and wind. This period may be extended, at the discretion of the ENGINEER-IN -CHARGE , up to 14 days. The methods of protection used shall be subject to the approval of the ENGINEER-IN -CHARGE . The method of curing used shall prevent loss of moisture from the concrete.

 During the curing period horizontal surfaces shall be protected by one or more of the following or other approved means.

a) Covering with damp hessian canvas sacks or similar absorbent materials kept constantly damp and wholly covering the exposed concrete surface.

b) Covering with impermeable materials raised approximately 50 mm over the surface so as to prevent loss of moisture.

c) an approved sprayed membrane curing compound

d) Flooding with water (potable water free from sediments of any kinds shall be used).

 During the curing period other surfaces shall be provided by the following or other approved means:

a) Form work in close contact with the concrete

b) covering as in 3.9.5 above

 All concrete faces or edges, particularly those, which are exposed without rendering in the final structure, shall be adequately protected from damage and discoloration at all times.

 Concrete structures shall not be loaded until the concrete is at least 21 days in the case of cantilevers. With the prior approval of the ENGINEER-IN -CHARGE the structure may be loaded after this time but in no case will loading greater than the final design loading be permitted.

Cleaning and Finishing of Concrete

 All concrete surfaces shall have an even and clean finish free from honeycombs, air bubbles, fins or other blemishes unmarred, reasonable smooth. The formwork joint marks on concrete work exposed to view shall be rubbed with carborandum stone and defects patched up with paste of cement sand mortar (1:1) and cured. The finish shall be made to the satisfaction of the ENGINEER-IN -CHARGE . Concrete surfaces to be subsequently plastered or where brick work is to be built against them, shall be adequately hacked as soon as the form is stripped off so that proper bond can develop.

 Immediately after removal of forms, the concrete shall be inspected, and defective areas as pointed out by the ENGINEER-IN -CHARGE shall be removed partially or entirely as directed. Holes, left by form bolts, etc. shall be filled-up and made good with cement sand mortar of approved mix. All superficial defects such as honeycombing, rough patches, etc. shall be similarly made good. If the defective area is at a vulnerable location, e.g. at the ends of beams & columns etc. then it may be necessary to cut out the member completely or in part and reconstruct as directed by the ENGINEER-IN -CHARGE If epoxies have to be used, the same shall be subject to the approval of the ENGINEER-IN -CHARGE Poured concrete affected by faulty form work shall be removed totally and replaced. If so directed, the Contractor shall have to resort to grouting / shotcreting.

 A smooth finish shall be obtained with the use of forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms, the joint marks shall be smoothened off and all blemishes, projections etc. removed leaving the surfaces reasonably smooth and unmarred.

 Where integral cement concrete finish is called for, the surface shall be compacted and then floated and treated with a straight edge and any high and low spots eliminated. The work shall be carried out as per IS: 2571.

Tolerances

 All other cast in place concrete work shall be dimensionally accurate to within the tolerances given in Table 11 (below), unless closer tolerances are further specified or shown on the drawings

 Closer tolerances will generally be specified for:

a) Pre-cast concrete

b) Measuring flume contours

c) Filter bed and drying bed floors

d) Machinery bases

Miscellaneous

Holes, chases, indentations and the like shall be provided where indicated on the drawings. All such shall be formed in the concrete and not cut after the concrete has hardened.

Should the Contractor or any subcontractor require additional case-in items, holes or the like these requirements shall be submitted to the ENGINEER-IN -CHARGE for his approval a minimum of 14 working days prior to concreting.

Pipes, conduits, fixing bolts and other such cast-in items shall be provided where indicated on the drawings.

Testing of Concrete shall be done as per codal provisions. Testing and Design Mix of Self compacting concrete shall be done as per codal provisions.

5.10.3 Cantilevered Canopies

 Construction joints for cantilevered canopy slabs must not be located along the external edge of the supporting beams or walls. Cantilevered canopy slabs shall be cast monolithically with supporting beams and walls.

 Adequate bar spacers shall be provided to maintain the position and alignment of the steel bar reinforcement.

 Effective water proofing should be provided on the top of the canopy slab.

 Upon the completion of the canopy structure, the Contractor shall submit a report including the following to the ENGINEER-IN -CHARGE for his approval and / or retention:

a) An as-built plan showing

i. Locations and dimensions of members

ii. Direction and gradient of falls

ii. Location of drainage outlets / down pipes

iv. The thickness of screed and finishes

iv. Locations and details of any construction joints for the canopy Structure

vi. Grades of concrete and steel

vii. Diameter and spacing of steel reinforcement in the canopy slab

viii. Date on which the concrete was cast

ix. Concrete cover to steel reinforcement at critical positions of the canopy slab as measured by cover meter and

b) Record photographs showing clearly and in detail.

i) Conditions and arrangement of the fabricated steel reinforcement in the canopy slab and all the supporting members prior to concreting and

ii) Condition of the canopy slab and the supporting members after concreting but before laying of the finishes and water proofing materials.

A statement confirming that the Contractor has inspected and supervised the construction of the canopy structure and that it has been constructed in accordance with the approved plans.

5.11 STEEL REINFORCEMENT

Related Works

- Concrete Formwork
- Cast in-situ Concrete

Applicable Standards

Sr	Code	Description
1	IS: 432	Specification for Mild steel and medium tensile bars and hard drawn steel wire.
2	IS: 1139	Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.
3	IS: 1566	Specification for plain hard drawn steel wire fabric for concrete reinforcement

4	IS: 1785	Specification for plain hard drawn steel wire for prestressed concrete.
5	IS: 1786	Specification for cold twisted steel high strength deformed bars for concrete reinforcement.
6	IS: 2080	Specification for high tensile steel bars used in prestressed concrete
7	IS: 2751	Code of practice for welding of mild steel structures are folded plates
8	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement

Steel Grades

Reinforcements for concrete may be from any of the "grades" of steel indicated below, conforming to the relevant Indian Standards and their latest amendments mentioned against each:

Grade	Description	Conforming to
Fe 250	Mild Steel	IS: 432 (Part I)
Fe 490	Hard drawn steel wire	IS: 432 (Part II)
Fe 415	High strength deformed/ ribbed	IS: 1786
Fe 500	High strength deformed / ribbed	IS: 1786
Fe 550	High strength deformed / ribbed	IS: 1786

Reinforcing steel may be any of the following types:

Type I	Plain round bars (PR)
Type II	Welded wire Fabrics (WWF)
Type III	Welded wire Fabrics (WWF)
Type IV	Thermo-Mechanically Treated Ribbon bars (TMT
Type V	Thermo-Mechanically Treated Ribbed Corrosion Resistant Bars- Copper Bearing (TMT-CR)

Type IV - TMT 550D is preferred option for this project. Use of 550MPa reinforcement shall be subject to approval from CLIENT/PMC and the Structural Engineer for compliance with the technical and design requirements.

BIS Certification

Material received at the Site shall have BIS Certification mark. Such bundle or coil containing the bars shall be suitably marked with BIS Certification mark. Bars shall also be marked to identify categories. This shall be done as per IS: 1387.

In case bars are without BIS Certification mark, the manufacturer shall give a certificate stating the process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the cart to which it applies, corresponding to the number or identification mark to be found on the material.

All reinforcements shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any other foreign deleterious material present on the surface. Cleaning should be done to the satisfaction of the PMC.

Each batch of steel brought to the Site shall be tested prior to use. Cost of all tests shall be borne by the Contractor.

Material acceptable as per IS Specifications will be allowed into the Project. All rejected material shall be removed from the Site by the Contractor within 30 days of its rejection. If the same is not done, the CLIENT/PMC can get work done by third party at the Contractor's risk and cost shall impose a penalty of Rs 500 (Rupees Five Hundred only) per metric ton per day.
This will be without any appeal and shall not be subjected to arbitration.

Storage

Reinforcement bars received at the Site shall be stored on hard, concreted platform and clear of the ground to a minimum of 500 mm with the use of concrete blocks or any other means. Reinforcements shall be kept covered by tarpaulins or plastic to avoid excessive corrosion or any other contamination. It is advised to follow storage methods as described in IS: 4082.

Reinforcement steel shall be stored in such a manner as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement no account any oily substance shall be used for removing the rust.

Quality Assurance

a. Supervisory staff shall have qualification and experience in the above field.

b. Welders qualified and having approved certificates for welding shall be employed.

Handling

a. Bend / re-bend test requirements shall conform to the following and shall be based on 1800 bends of full-size bars around pins.

Bar diameter (mm)	Pin diameter for test bend
10, 12,16	3.5 x bar dia.
20, 22, 25	5.0 x bar dia.
28, 30, 32	7.0 x bar dia.

a. Spacers of same dia. shall be used with any of the following:

- Wire

- Precast concrete
- Moulded plastic

Spacer material shall be of durable quality and shall not lead to corrosion of reinforcement or spilling of concrete.

Precast concrete spacers shall be of the same mix as that of surrounding concrete.

b. Tying wire shall be of 18 G black annealed mild steel wire or other approved type double fold to tie the reinforcements.

c. Cover blocks shall be non-corrosive material such as plastic, but not wooden or broken bricks or stone. Specially made concrete blocks shall be used. Such cover blocks shall be cast from concrete and not from cement mortar; strength of these blocks shall be equal to the concrete in use. Binding wire for fixing reinforcement shall be either no.16-gauge
soft Galvanised annealed iron wire, or no.18-gauge stainless steel wires.

Unit Weights:

Unit weights per meter shall be as follows:

6 mm	0.22 kg/ rm
8 mm	0.39 kg/ rm
10 mm	0.62 kg/ rm
12 mm	0.89 kg/ rm
14 mm	1.21 kg/ rm
16 mm	1.58 kg/ rm
18 mm	2.00 kg/ rm
20 mm	2.47 kg/ rm
22 mm	2.98 kg/ rm
25 mm	3.85 kg/ rm
28 mm	4.83 kg/ rm
32 mm	6.31 kg/ rm
36 mm	7.99 kg/ rm
40 mm	9.86 kg/rm

EXECUTION

Cutting and Bending

a. Flame cut and hot bending is absolutely forbidden.

b. Cut and bend reinforcement to approved shop drawings and details shall be used.

c. Bars to be cold bend, either mechanically or by hand, but to correct radius using proper tools, machine and platform and confirming to IS: 2502 latest code.

d. Do not re-bend without approval. In case of re bending, care shall be taken that the rating of bend is not less than 4 x bar dia. at construction joints for plain steel bars and 6 x bar dia. for high strength bars.

e. Reinforcement projecting from concrete shall not be bent without approval.

Bar bending schedule to be submitted for approval of the Structural Consultant to the CLIENT/PMC prior to commencement of any cutting, bending and binding of steel at site. f.

Cracked end of bars shall not be used on this Project.

g. Bars should be inspected for visible defects such as cracks, brittleness, excessive rust, loose mills scale, etc.

Welding

a. Do not weld reinforcement unless authorized by the Structural Consultant / CLIENT/PMC and recommended by the manufacturers.

b. Site welding shall be done with suitable safeguards and techniques.

c. Welding, if approved, may be used for the following and shall be carried out by an approved welder:

- Lapping reinforcement in position
- Fixing reinforcement to other steel members.

d. The length of run deposited in a single pass shall not exceed 5 x bar diameters. If a longer welded length is required divide into sections with the space between runs not less than 5 x bar diameters.

e. Welded joints:

- Shall not be made at bends in reinforcement.
- Stagger joints in parallel bars of principal reinforcement unless otherwise approved.
- The distance between staggered joints shall not be less than the end anchorage length joints.

Mechanical Splicing

a. To comply with IS: 456-2000, IS: 16700-2017, ACI 318 and ACI 439-3R

b. Use as indicated in structural drawings.

c. Structural Consultant has to approve mechanical splices before using it at site.

Inspection

a. Ensure that the reinforcement placing is checked by PMC.

b. Ensure that the Formwork to receive the reinforcement is clean and free from debris. c. Cracked end of bars to be cut out.

Anchoring

Anchoring of bars and stirrups shall be provided exactly as detailed in the structural drawings or as directed by Structural Consultant.

In case of reinforcement steel in tension, deformed bars may be used without end anchorage provided the development length requirement is satisfied. Hooks shall normally be provided for plain bars in tension. Development length of the bars shall be determined as per relevant clauses of IS: 456 - 2000.

The anchorage length of straight bar in compression shall be equal to the Development length of the bars in compression as specified in relevant clause of IS: 456 - 2000.

Lapping of Bars

Laps shall be strictly as per the structural drawing or as directed by the PMC/Structural Consultant. For general guidance the following principles shall be followed as given in IS: 456 - 2000

 As far as possible bars of the maximum length available shall be used.

 Laps shown on drawings or otherwise specified by the Structural Consultant will be based on the Contractor using bars of maximum length.

 In case Contractor wishes to use bars of shorter length, laps shall be provided at the Contractor's expense in the manner and the locations approved by the Structural Consultant.

 Splices shall be provided as far as possible away from the sections of maximum stress and be staggered.

 Not more than half of the bars shall be spliced at a section

 If more than half of the bars shall be spliced at a section, special case shall be ensured such as increasing length of lap or closer spacing of stirrups around the length of splice.

 Lap splice shall not be used for bars having diameter larger than 36 mm. For larger diameters bars it may be welded. Lap length including anchorage value of hooks in flexural tension shall be La (as defined in Article 25.2.1 of IS: 456-2000) or 30 times the diameter of the bar whichever is greater and for direct tension 2La or 30 times the diameter of the bar whichever is greater. The straight length of lap shall not be less than 15D or 20 cm, whereas D is the diameter of the bar.

 Lap length in compression shall be equal to the development length in compression calculated as described in relevant clause of IS: 456-2000 or as specified in the structural drawing

but not less than 24 times the diameter of the bar.

 Overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 1.25 times the maximum size of the coarse aggregate, whichever is greater.

 When above is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the diameter of such bars with two strands of annealed binding wire of 0.90mm to 1.6mm diameter twisted together tightly.

 As and when necessary welded laps shall be proved as specified by the Structural Consultant.

Securing Reinforcement

a. Adequately secure with tying wire or approved steel clips.

b. Bend the tying wires well back clear of forms.

Concrete Cover

a. Shall be in accordance with ISI: 456-2000 and as per the instructions in structural drawings.

 Footings, retaining walls and Similar members in contact with earth but not cast against earth - 50 mm

 Slabs - 20 mm

 Walls, ribs - 20 mm

 Beams:

For main bars - Min.25 mm or dia. of the bar

For stirrups - 15 mm

 Columns - 40 mm

Columns less than 20 cms -25 mm

 Water tanks:

In contact with water -40 mm

In contact with air -20 mm

 Walls in contact with water / Earth - 40mm

Spacers Chairs and Other Supports

a. Provide necessary supports to maintain reinforcement in its correct position.

b. Provide spacer bars of same diameter as longitudinal bars but not less than 25mm diameter between two layers at 1.5 mm centers except where bundled bars are detailed. Spacers, Chairs and other supports are not separately measured and paid for.

Precautionary Measures

a. Do not insert bars into placed concrete.

b. Do not damage forms and form linings, if any when fixing reinforcement.

Adjustment and Cleaning

a. Check reinforcement prior to and during placing concrete with particular attention to the top reinforcement in Cantilever sections.

b. Ensure that reinforcement is clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement concrete or the bond between the two.

c. Protect the projecting reinforcement from weather where the rust staining of exposed concrete surfaces may occur.

5.11 Form work

Form work shall include all temporary or permanent forming for the concrete, together with all temporary construction required for its support.

False work shall include any temporary structure used to support a permanent structure during its erection and until it becomes self-supporting.

The Contractor shall be responsible for the design, stability, supply, fixing, alignment and safe removal of all form work, false work and supports in accordance with IS: 14687, IS: 4990 and BS: 5975. Strutting shall be so arranged that it can be removed without undue shock to the concrete. The Contractor shall submit the design of false work and form work to the ENGINEER-IN -CHARGE for approval before construction. In the case of folded plates and shell roofs the Contractor should take approval for the pattern of centring and shuttering along with program for de-shuttering.

The Contractor shall construct form work and false work to support safely the worst combined effects of all loads as given below so that the final concrete structure is within the limits of acceptable dimensional tolerances and without causing bulging or deflection:

a) Total weight of form work, reinforcement and wet concrete

b) Construction loads, including dynamic effects of placing, compacting and construction traffic and

c) Wind loads

All form work shall be watertight and so constructed that there shall be no loss of material from the concrete. After the concrete has hardened and the form work has been removed, the concrete shall

be in the position and of the shape, dimensions, and surface finish described in this specification or on the drawings.

The form work shall so design and positioned that can be removed without damage to concrete. In the case of beams, slabs or like members the form work shall be so arranged that the sides oredges may be removed without disturbance to the soffit or propping system.

Form work shall compose of steel, best quality wood or non-absorbent type plywood. Timber shall be free from significant knots and shall be of medium grain as far as possible and hard woods shall be used as caps and wedges under or over posts. Timber shall be well seasoned free from sap, shakes, worm holes, warps or other surface defects and shall have smooth finish.

Staging, unless specified otherwise, shall generally be of mild steel tubes, steel beams and channels etc.

Plywood shall be used in exposed surfaces (fair faced finish specified) as shown on drawings or as directed by the ENGINEER-IN -CHARGE where a especially fair faced finish is required. Such surfaces shall be formed using approved brand of heavy quality water resistant plywood to produce a perfectly levelled, uniform and smooth surface.

Form work for Architectural shapes for columns, ring beams, circular or spherical walls, shell roofs or bottoms in the case of water reservoirs or any other structure shall be made from approved plywood or steel plates and frames.

Form work composed of steel and or approved good quality (seasoned) wood may be used in places where ordinary surface finish in required, plywood shuttering can also be used by the Contractor.

The staging shall be true and rigid and thoroughly braced in both directions as well as cross braced, strutted and propped such that it will not deform unduly under weight of concrete and other loads due to men, equipment, etc. Vertical member or props should not be supported on an un-propped lower suspended floor or beam unless it is ensured by the Contractor that the lower floor or beam can safely carry the loads. No propping shall take place until the ENGINEER-IN -CHARGE with supporting calculations.

To achieve the desired rigidity, ample studs, braces, bolts, spacer blocks, wires, clamps, ties, straps, shores, etc. shall be used to hold the form in proper position without undue distortion.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where these are necessary and as may be directed by the ENGINEER-IN -CHARGE . The temporary openings shall be so formed that they can be conveniently closed rigidly when required and must not leave any mark on the concrete.

Provision shall be made for traffic on form work not to bear directly on reinforcing steel.

The mould used for manufacturing precast components normally consist of two parts, (a) bottom mould and (b) side moulds. The bottom mould can be made out of timber, masonry, concrete, steel FRP, plastic or any other material acceptable to the ENGINEER-IN -CHARGE . The side moulds similarly can be of timber, steel FRP, or plastic. When using masonry or concrete moulds, the top surface shall be finished to the required accuracy and made smooth.

In case of masonry moulds, the use of chicken mesh or fibre reinforcements in the top surfaces will help in making the mould last longer for higher efficiency.

In the case of cored units can be created either by an extrusion process, by inflated tubes, Mild steel tubes, timber, cardboard / hard paper or any other materials.

Pre-cambering of Form work

In general, and unless otherwise shown or specified in the contract, all form work for beams and slabs shall be set with an upward camber at mid span of 2 mm per 1.0m of span for all spans in excess of 5.0 m. Cantilevers shall be set with an upward camber at end of span of 4mm per 1.0m. Pre-camber of 40 mm at mid span of flat slab shall be provided. Contractor has to evaluate the need for any additional camber as per his means and method of construction and present the same to the Structural Engineer for review.

Joints in Form work

All joints in form work shall be either horizontal or vertical, end form work being square across the mass of concrete. The design of the form work shall permit it to be struck and removed without injury to the concrete. The joints shall be sufficiently tight to prevent any leakage of mortar.

The Contractor shall use grout checks at all horizontal construction joints and shall adopt such other approved expedients, eg. foam rubber sealing strips, polyester crack filler in joints, or taping of joints, as may be necessary to obtain satisfactory results at joints in form work.

5.12 Brick Work:

Internal & External Walls:

Autoclaved Aerated concrete (AAC) blocks masonry with 150mm to 300 mm thick with Grade-I AAC blocks of density 551 to 650 kg/ cum conforming to IS: 2185 (Part 3) in super structure above plinth level with RCC band at sill level and lintel level with approved block laying polymer modified adhesive mortar all complete except wet area such as toilets as per direction of Engineer-in- Charge.

Mullion shall be designed accordingly by the Turnkey Contractor. The Door frame should be supported with mullion.

AAC Block work will be used for internal and external walls apart from theglazing and windows. The rooms with radiation equipment like CT Scan, Cath lab, ERCP, Fluoroscopy etc. will be provided with walls of adequate thickness and density to adhere the requirement of Radiation exposure as per requirement of AERB, along with walls the doors and control room windows should be lead lined as required by AERB and to prevent radiationexposure.

The Laying of block work should be done using polymer modified adhesive mortar complete as per direction of Engineer-in-Charge

Fly Ash Bricks.

Fly ash bricks will be used for foundation and wet area as per approval of Engineer-in charge.

Brickwork classification

Class 1 for exposed brick work and below plinth wall; Class 2 for compound wall and wet area with plastering.

(a) Strength: For class 1 - average compressive strength should not be less than 10.7 N/mm2For Class 2 - 75 which means average compressive strength should not be less than 7.5 N/mm2 and not more than 10 N/mm2.

(b) Manufacturer: From Suppliers Schedule provided or equivalent approved.

(i) Special shapes: The bricks shall have smooth rectangular faces with sharp cornerand shall be uniform in colour and emit clear ringing sound when struck

(ii) Size: (229 x 110 x 70) mm nominal size. –

Mortar

The mortar for the brick work shall be as specified and conform to accepted standards. Lime shall not be used where reinforcement is provided in brick work because it will allow corrosionof metal.

Samples of bricks shall be subjected to the following tests:

(a) Dimensional tolerance.

(b) Water absorption.

(c) Efflorescence.

(d) Compressive strength.

Soaking of Bricks

(a) Bricks shall be soaked in water before use for a period for the water to just penetrate thewhole depth of the bricks based on field test.

(b) Alternatively, bricks may be adequately soaked in stacks by profusely spraying withclean water at regular intervals for a period not less than six hours.

(c) The bricks required for masonry work using mud mortar shall not be soaked.

(d) When the bricks are soaked, they shall be removed from the tank sufficiently early sothat at the time of laying they are skin-dry.

Laying

(a) Bricks shall be laid in English bond unless otherwise specified.

(b) For brick work in half brick wall, bricks shall be laid in stretcher bond.

(c) All loose materials, dirt and set lumps of mortar which may be lying over the surface onwhich brick work is to be freshly started, shall be removed with a wire brush and surfacewetted.

(d) Bricks shall be laid on a full bed of mortar.

Joints

The thickness of all types of joints including brick wall joints and cross joints shall be such that four course and three joints taken consecutively not more than 31mm. Specified thickness of joints shall be of 1 cm. Deviation from the specified thickness of all joints shall not exceed one-fifth of specified thickness. Flushed joint. Plumb at every fifth cross joint.

Curing 7 days curing is must.

5.13 Finishing:

The rough surfaces of brick work, RCC, CC etc. shall be treated and finished in thefollowing manner:

Plaster Work

a. Internal Plaster.

(a) **:** Providing and applying 12 mm thick on even side and 15 mm on rough side wall (average) premixed formulated one coat gypsum lightweight plaster having additives and light weight aggregates as vermiculite/ perlite respectively conforming to IS: 2547 (Part - 1 & II) 1976, applied on hacked / uneven background such as bare brick/ block/

RCC work on walls at all floors and locations, finished in smooth line and level etc. complete.

(b) Ceiling plaster - Providing and applying 6 mm thick on Ceiling surface premixed formulated one coat gypsum lightweight plaster having additives and light weight aggregates as vermiculite/ perlite respectively conforming to IS: 2547 (Part - 1 & II) 1976, applied ceiling at all floors and locations, finished in smooth line and level etc. complete.

(c) (ii) **Wet areas** : Internal wall and exposed celling surfaces shall be finished with 12 mm thick (average) with CM 1:6 and **exposed ceiling** with ,6mm of CM 1:4 of cement plaster. The rough side wall shall be plastered 15mm thick of CM 1: 6 of in cement plaster.

b. EXTERIOR READY-MIX PLASTER for External and Wet area (toilets)

External Plaster

Providing and applying 18 mm thick premixed formulated Two coat readymade plaster having additives and aggregates produced at automated dry mixed plant mixed with cement, sand and polymers in ratio 1:4 (1 cement:4 sand and polymers in appropriate ratio) including applying Portland cement slurry on the under layer @0.40K9/5qm in two layers under layer 12mm thick and 6mm thick applied on hacked/uneven background such as bare brick/CC and Block/RCC work on walls and ceiling as per manufacturers specification finished in smooth line and level etc. complete:

General

Description of Work

The work covered under these specifications consists of supplying all materials and rendering all types of plaster/pointing finishes strictly in accordance with these specifications, applicable drawings etc.

Quality Assurance

Cement, sand and water required for the work shall, conform to specifications laid down herein before under section 'Cement concrete (plain and reinforced)', except that sand for plastering shall be conforming to IS: 1542.

Submittals

Product Data:

Submit manufacturer's product specifications and installation instructions for each material including products and other data as may be required to show compliance with these specifications.

Certificates:

Contractor shall submit test certificates for each material as may be required as per relevant IS codes. Samples:
Prepare and install sample plastering panel of not less than 2.0 m^2 area to demonstrate the specified plastering.

Water

Water conforming to IS: 456 and as approved by the Engineer shall be used.

Chicken Wire Mesh

All junctions of Masonry wall with R.C. structure e.g. column, beam, lintel etc. which are to be plastered, shall be reinforced by fixing strips of approved 22 SWG G.I. chicken wire mesh 250 mm wide with an overlapping of 100 mm centrally over the length of junction. G.I. chicken wire mesh of required width shall also be fixed over chasing for conduits, pipes, etc. on masonry walls before plastering is commenced.

EXECUTION

General

The surface to be plastered shall be raked out properly, dust and loose mortar shall be brushed out. The concrete surface shall be hacked before plastering if not already done. The surface shall be thoroughly wetted before commencement of plastering. Scaffolding required for facility of working shall be provided by the contractor at his own cost. This may be double or single according to the requirement and shall be approved by the Engineer. Stage scaffolding shall be erected when ceiling plastering is done. The contractor shall be responsible for accidents, if any, take place. The contractor shall co-operate with the other agencies also. Whenever electrical contractor / agency has to fix up switch boxes in walls, necessary 'Thiyyas', 'Tapanish' or 'Dhadas' shall be arranged to be given in advance of actual plastering process at these locations so that the boxes are fixed properly in line with finished plaster surface. All finishing in and around these boxes as also around the conduit boxes in ceiling shall be done by plastering contractor without any extra cost. The decision of the Engineer in this regard shall be final and binding on the contractor.

All junctions of Masonry wall with R.C. structure e.g. column, beam, etc. which are to be plastered, shall be reinforced by fixing strips of approved 22 SWG G.I. Chicken wire mesh 250 mm wide with an overlapping of 100 mm centrally over the length of junction. G.I. Chicken wire mesh of required width shall also be fixed over chasing for conduits, pipes, etc. on masonry walls before plastering is commenced. The mesh shall be nailed rigidly to the masonry with G.I. nails of suitable type at approx. 400 mm centres. The finished mesh shall be straight, rigid and laid without sagging. The contractor shall take into account the cost of G.I. chicken wire mesh while quoting for plastering work.

If the surface which is to be plastered either internally or externally is out of plumb and not in line and level and if the plastering to be done is more than specified thickness to bring the plastered surface to perfect line and levels, in such specific cases, chicken wire mesh is to be provided by the contractor at his own cost and the plaster should be done to required line and level with no extra cost whatsoever. Raking out of joints is expected to be carried out along with masonry but it should be checked thoroughly to receive good key. Walls should be sufficiently damp prior to plastering. Water from plastering mortar must not be absorbed by masonry under any condition. Thickness of one coat should not be more than 15mm and less than 8 mm for single coat finished plaster

No plastering work shall be started before all conduits, pipes, fittings and fixtures clamps, hooks, doors and window frames etc. are embedded, grouted and cured and all defects removed to the satisfaction of the Engineer. Special approval shall be taken from the Engineer before commencing each plastering work. No cutting of finished plaster shall be allowed under any circumstance. No portion shall be left out initially to be patched up later on.

The finished plastered surface shall be free from cracks, fissures, crevices, hair cracks, blistering, local swelling and flaking. The finished surface shall be true to line, level, plumb & plain and durable. The adhesion of the mortar with the background surface is of prime importance as this affects durability of plaster. Preparation of surface which has to take plastering is of great importance. Before starting the plastering work the surface should be got approved by the Engineer. In order to avoid the formation of deep and side cracks and for dispersion of cracks at the junctions between concrete surfaces and brick masonry work as also between junction of windows/door frames and brick/block masonry works, the cautionary measures should be carried out over which the plastering work as required by the Engineer.

The minute gap between window/doorframes with sills and jambs should be filled up/caulked by epoxy putty/silicon sealants/polysulphide sealant by approved methods as instructed/approved by Engineer.

The grooves shall be of required dimensions. The same shall be made to turn wherever necessary. The finish inside shall be of the same finish as that of the plaster. The lines of the grooves shall be well defined and rounded. The grooves are to be provided in plastering in internal and external surfaces as shown or directed. The rates for plaster shall include the making
of grooves.

Wall Putty Punning

Unless otherwise specified, all internal wall & ceilings of wet area surface shall be finished smooth with white cement-based wall putty.

For surface preparation, remove all loosely adhering material from the wall surface with the help of emery stone, putty blade or wire brush and clean water. The substrate should be clean, free from dust, grease and loose materials. Dry and absorbent surfaces should be moistened with sufficient quantity of clean water.

Wall putty shall be mixed with 30-35 % clean water slowly to make a paste. Continue the mixing for 10-15 minutes till a uniform paste is formed. Mixing may be done manually or by using a suitable electric mixer. Only so much quantity of putty paste which can be used within an hour after the addition of water shall be prepared at a time. Any putty mixing which is fully or partially set shall be rejected and shall be removed forthwith from the site. Application shall be done in layers. Maximum layer thickness shall be within 1.5mm – 3.0mm as instructed by Engineer.

It shall be the contractor's responsibility to ensure that cracks do not develop during the execution or subsequently during the defect liability period and the cracks if any observed shall be rectified including finishing, white washing/painting as specified, without any extra cost to the Owner, to the entire satisfaction of the Engineer.

Water Proofing Compound / Admixtures

Whenever specified, waterproofing compound or admixtures of approved make shall be added to the mortar and mixed strictly in accordance with manufacturer's specification and to the entire satisfaction of the Engineer. Refer "Outline Design Criteria" also.

Application of Plaster

Wall plastering shall be started only after the completion of ceiling plaster from top and gradually worked down towards floor. It shall not, at any place be thinner than as specified. To ensure even thickness and a true surface plaster of about 15 cm x 15 cm shall be first applied horizontally and vertically at not more than 2 m interval over the entire surface to serve as gauges. The mortar shall then be applied to the wall / surface between the gauges and finished even. All corners, junctions and roundings shall be truly vertical or horizontal and finished carefully. Generally, work in an enclosure shall be completed in one day. For larger areas if the work has to be suspended at the end of the day, plaster shall be cut clean to line. Where recommencing the plastering, edge of old work shall be scrapped, cleaned and wetted with cement putty before restarting plastering.

5.14 Painting:

The plastered surfaces shall be finished as per the finishing schedule appended to the tender document. The false ceiling, as required, shall also be finished as per the finishing schedule appended to the tender document. Painting on doors, windows, Grills, MS work, structural steel, rolling shutters, railing and other members requiring painting and polishing etc., wherever required, shall be treated with primer coat and finished with painting/polishing of approved shade and manufacture, as per CPWD Specifications, to meet the functional requirements.

PAINTING AND DECORATING

This Specification describes the general requirements of painting and decorating on internal and external surfaces, woodwork and metalwork and varnishing and polishing to be executed on projects. Materials or samples shall be approved by the ENGINEER-IN -CHARGE before fixing. All paint/polish shall be Low VOC.

Applicable Codes

IS 75 Specification for raw and refined linseed oil IS 345 Specification for transparent liquid wood filler IS 348 Specification for French polish

IS 427Specification for distemper dry colour

IS 428 Specification for distemper oil emulsion colour IS 533 Specification for gum spirit of turpentine

IS 1477 Code of Practice for painting of ferrous metals in buildings Parts I and II (Pre- treatment and Painting)

IS 2338 Code of Practice for finishing of wood and wood-based materials Parts I and II (Operation and workmanship and Schedule)

IS 2395 Code of Practice for painting concrete, masonry and plaster surfaces IS 2932 Specification for enamel synthetic exterior undercoating and finishing IS 2933 Specification for enamel exterior undercoating and finishing

IS 3140 Code of Practice for painting asbestos cement building products

IS 3537 Specification for ready-mixed paint, finishing, interior, for general purposes to IS colours

IS 3631 Specification for ready-mixed paint for finishing interior, alkyd and non-alkyd for general purposes to IS colours

IS 4597 Code of Practice for finishing of wood and wood-based products with nitro-cellulose and cold catalysed materials

IS 5410 Specification for coloured cement paints

IS 6005 Code of Practice for phosphating iron and steel

IS 6278 Code of Practice for whitewashing and colour washing

General

In manufacturers' sealed drums in colours approved by the ENGINEER-IN -CHARGE and conform to the relevant Standards.

Paints shall be such as to be capable of withstanding the effects of weather and the atmosphere and the results of wood decay and metal corrosion and shall have good spreading coverage, be easy to apply, form a thin uniform film upon application, not crack when dry and have hard and durable surfaces.

Acrylic Emulsion Paint

Acrylic emulsion paint shall be of approved make, colour and shade to the satisfaction of the ENGINEER-IN -CHARGE .

Acrylic emulsion paint shall be diluted by the addition of a quantity of water equivalent to half the volume of the paint to be applied. The paint and water shall be thoroughly mixed and then strained through cloth.

Priming coats shall be applied to surfaces by brush and allowed to dry properly, holes and depressions being filled with putty prepared with whitening and acrylic emulsion paint and rubbed

smooth and dry and touched up with acrylic emulsion paint.

Subsequent coats, diluted by the addition of a quantity of water equivalent to about 15% to 20% of the volume of paint to be applied shall be applied to surfaces by brush and allowed to dry thoroughly so that no brush marks shall be seen.

Surfaces shall be cleaned and all cracks, holes and surface defects repaired with gypsum and allowed to set hard. All irregularities shall be removed by sand papering smooth and wiped clean and surfaces so prepared shall be completely dry and free from dust before painting is commenced. In the case of newly plastered surfaces special care shall be taken to ensure that they are completely dry before any application is attempted.

Existing, previously distempered or painted surfaces shall be cleaned of grease, dirt, dust and other deleterious matter and cracks, holes and surface defects repaired with plaster of Paris, allowed to set hard, sand papered smooth and wiped clean. Flaking from previous coatings, if any, shall be thoroughly removed.

Enamel Painting

General

Enamel paint shall conform to the site in manufacturer's sealed drums and tins for relevant Standards and be of the specified make, colours andshades as approved by the ENGINEER-IN -CHARGE . Materials shall be obtained directly from approved manufacturers and brought to inspection by the ENGINEER-IN -CHARGE .

Paint for undercoats and finishing coats shall be ready mixed. Mixing by the Contractor shall not be allowed except with the prior written permission of the manufacturer's recommendation's and the relevant Standards and Codes of practice ENGINEER-IN -CHARGE , in which casepreparation of the ingredients and the control of quality shall be in strict conformity with the Materials shall be properly stored and protected when not in use with the lids of containers kepttightly closed. Paint in open containers during painting operations shall be covered with a thin layer of turpentine to prevent the formation of skin on the surface.

If required by the ENGINEER-IN -CHARGE paint supplied by the Contractor shall be quality tested in an approved laboratory as described in IS 101. Rejected paint shall be removed immediately from Site.

Application Unless otherwise specified, paint shall be applied by brush. Brushes of appropriate size shall beeither round or oval shaped and shall be maintained carefully throughout the work so as to be pliable and free from loose bristles. All brushes, rollers, implements and the like used for painting shall be cleaned of all foreign matter prior to beginning different operations.

Contents of drums and tins shall be well stirred before use and constantly during operations witha small, clean and smooth stick to prevent sedimentation at the bottom of containers.

Painting shall be carried out, as far as possible, in dry, warm weather.

Primer coats shall be applied as soon as surfaces have been cleaned and before the deteriorationof surfaces by rust and/or contamination by dust, dirt or any other deleterious material. Sufficient time shall be allowed for one coat of paint to dry before the next is applied.

Painted surfaces shall be protected from sun, rain, condensation, contamination or other surface damage until they are completely dry " We Paint" boards bring placed where necessary.

Surface preparation, the application of priming coats, undercoats and finishing coats shall be carried out as specified below or as recommended by the manufacturer.

New plaster shall be carefully rubbed smooth and thoroughly cleaned with fresh water to leave dry and smooth surfaces free from dirt. Surfaces shall not be primed or painted until they are completely dry and hard and have been approved by the ENGINEER-IN -CHARGE .

Steel surfaces shall be degreased using proprietary brand solvent cleaners approved by the ENGINEER-IN -CHARGE or mineral turpentine or petroleum and other petroleum solvents, such as trichloroethylene or other equal and approved alkali solutions or detergents.

De-rusting of steel surfaces shall be done by manual scraping using wire brushes, fine steel- wool, sand paper and the like, mechanically by sand blasting, shot blasting or by flame cleaning or chemical cleaning by methods approved by the ENGINEER-IN -CHARGE .

Enamel paint shall not be applied to woodwork that is not well seasoned. Surfaces of woodwork to be painted shall be thoroughly dry, clean and smooth and prepared by using coarse and medium grade sandpaper with finished surfaces free from scratches.

Before applying primers to surfaces of woodwork knotting shall be done with two coats of varnish made by dissolving Shellac in methylated spirits of wine or as directed by the ENGINEER-IN -CHARGE .

Plastered surfaces: Priming coats shall consist of equal parts of white and red lead mixed in boiled linseed oil to the required consistency applied uniformly over surfaces to be painted. When dry, all cracks, holes and other such defects shall be filled with a mixture of one part of white lead and 3 parts of ordinary putty. Surfaces shall then be rubbed with sandpaper and dusted clean and an undercoat thinly applied so that plastered surfaces are saturated.

Steel surfaces: Priming coats shall consist of red lead conforming to IS 102 applied uniformly over surfaces to be painted. On old or previously painted surfaces and new surfaces already primed with red lead, surfaces shall be thoroughly cleaned and primed with red lead on exposed surfaces as necessary or over whole surfaces as directed by the ENGINEER-IN -CHARGE .

Woodwork surfaces: Priming coats shall consist of red lead, white lead, raw and boiled linseed oil and patent dryers applied uniformly over surfaces to be painted. When dry, small holes, cracks, open joints and other minor defects shall be stopped with putty made from whitening mixed to proper consistency with raw linseed oil and white lead to facilitate hardening of putty. Surfaces shall then be lightly rubbed down smooth with sandpaper and dusted clean.

Finishing coats: Unless otherwise specified, finishing of all surfaces shall consist of two coats of synthetic enamel paint of approved make, colour and shade. The second coat of paint shall give a flat, semi-glossy or glossy finish as specified or as directed by the ENGINEER-IN -CHARGE and shall present on even appearance and show no brush marks. Stipple finishes, if directed by the ENGINEER-IN -CHARGE , shall be provided where required.

Antibacterial Paint

a. The Antibacterial Paint shall be able to provide anti-Microbial Protection:
b. The scope of work includes providing & applying approved makes anti-Microbial Paint on wall surface as per manufacturer’s specifications complete in all respect & directed by Engineer-

in-charge. Following are the desired characteristic of the paint:

i. The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.

ii. The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.

iii. The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

5.15 Flooring:

a. The flooring in the building shall be as per the schedule of finishes and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWDspecifications or manufactures specifications.

b. In order to keep the floor finish as per direction of Engineer-in-charge and as per tender drawings and to provide required thickness of the flooring as per specification, the level of top surface of structural floor shall be accordingly adjusted at the time of its centering, shuttering and casting. Alternatively, for maintaining the floor finish,grading with cement concrete with nominal mix 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 10mm nominal size) shall be provided.

5.15.1 Vitrified flooring tiles

Vitrified, ceramic flooring tiles in different sizes as per Schedule of Finishes (thickness to be specified by the manufacture), with water absorption less than 0.08% and conforming to IS: 15622, of approved brand and manufacture laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS : 15477 in required thickness, including grouting of joints. Tiles joints to have PVC spacers and to be filled with epoxy grouts, for minimum joint (3 mm), with a similar shade for all the pieces. 800 x 800 mm full body vitrified anti bacterial tiles or as specified in SOF (Schedule of Finishes).

c. Wherever Vitrified Tile flooring is done, it shall be with 1st Quality Full body Vitrified tiles as per finishing schedule.

d. Slope in floors shall be provided as per tender drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variationin floor level more than 3 mm.

e. Protective layer to be provided of all types of flooring.

f. The edges of steps in the staircases, counters, kitchen/pantry platform, window sills, facias and similar location shall be edge moulded as required.

Minimum Bed mortars for various types of flooring

i. Chequered tiles/stone flooring/kota stone flooring/granite flooring 20mm thick.

ii. For dado, skirting and risers of steps in Chequered tiles/stone /kota stone /granite / 12mm thick.

iii. The vertical facia and drops shall be finished with epoxy resin-based adhesive.

Granite/marble/Kota stone flooring in treads of steps and risers using single length. Prefinished nosing to treads of steps of granite/marble/kota stone.

5.15.2 Kota Stone.

25mm thick Kota stone mirror polished slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand).

5.15.3 Granite Work 18 mm thick (Jirawal White and Lakha red for floors & golden galaxy on Counters)

The granite stonework shall, in general, be carried out as per the CPWD Specifications and relevant specification for marble flooring, skirting, dado and tread/risers of steps under Flooring Sub Head of the CPWD Specifications shall prevail.

Granite stone slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified, as per the Engineer in- charge. Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Engineer-in- Charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

Before execution of the granite stone work, the contractor shall submit for the approval of the Engineer-in-Charge, the samples with following details:

a) Three representative samples for each type of granite stone specified.

b) Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.

c) Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.

d) Company profile of Suppliers.

The decision of the Engineer-in-Charge as regards the approval of the samples for the various types of the granite stones shall be final and binding on the Contractor.

The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc.to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer-in-Charge, shallnot be used in the work and shall be removed and replaced by the Contractor.

The stone work may be required to be carried out in patterns, design and / or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs / ceramic tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the approved drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

The following tolerances shall be allowed in the dimension of granite stone slab:

Slabs: Tolerance

a). Length ± 1mmb). Width ± 1mm

c). Thickness - 1mm

d). Angularity at corners ± 0.25%

The stones slabs not meeting the above tolerance limits shall be rejected and not permitted to be used in the work. Nothing extra shall be payable on this account.

Stones slabs shall have uniform thicknesses with-in the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen / wash basin platforms, vanity counters, facias and other similar locations etc. shall have edge polished calibrated thickness i.e. exposed edges shall have edge polished uniform thickness throughout the length of the work.

For the steps (risers and treads) in the linear profile, the granite stone shall be provided in single pieces up to 2.0m, unless otherwise specifically permitted by the Engineer-in-Charge. Wherever grooves are required to be provided the same is to be done, the joints shall be provided.

The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer-in-Charge.

The granite stone slab shall be fixed over low level storage cabinets using necessary adhesiveas per the manufacturer's specification. The stone shall have uniform thickness and shall be provided in sizes as per Tender drawings. The stone slab shall have uniformly levelled surface after fixing. All the joints shall be finished smoothly in a workmanlike manner.

The granite work shall be adequately protected by a layer of Plaster of Paris, which shall be maintained throughout and removed just before handing over of the works.

5.15.4 Conductive Vinyl Flooring:

Flexible PVC Conductive sheet flooring with having a total thickness of 2mm and weight of 3kg/m².Colors and pattern detail shall be dispersed throughout the thickness of the wear layer. REACH Regulation No. 1907/2006 REACH 181 contains no substances mentioned in the SVHC – list. Conductive flooring shall conform to Group P of Wear Resistance as per EN 649, Flammability of class Bfl-s1 as per EN 13501-1, Slip resistance as per DIN 51130 group of R9. Impact sound reduction of 3 dB as per ISO 140-8, Residual indentation of 0.05 mm as per EN 433, Color fastness rating ≥6 as per ISO 105-B02, Vertical resistance(R1) less than 1 x 10^6- 1x 10^8Ω as per EN 1081, and surface resistance less than 1 x 10^6- 1x 10^8 Electrical insulation to ground greater than 50 kΩ as per VDE 0100, Static electrical charge of ≤2.0kV as per EN 1815,

Thermal resistance of 0.04m²K/W as per EN 12667, resistance against chemicals EN423/ EN ISO 26987. Equivalent to Armstrong Pastell.

Installation: It is important to ensure the subfloor on which the sheet is being laid is smooth, flat & hard & free from moisture, and self-leveled. The moisture level present in the subfloor should be less than 8% before installation of the floor. Each row of tiles/strip of floor covering must be linked crosswise with a continuous copper strip. Individual rows/strips must be at least 3 m² in size and linked to the rest of the area with copper tape. In rooms of up to 40 m², connection points for equally potential bonding should be provided in at least one point in the room. In larger rooms, several connection points must be used. The installation shall be undertaken as per the manufacturer's installation instructions.

5.15.6 Heat Resistance Terrace Tiles

Heat Resistant Terrace Tiles (300 mm x 300 mm x 20 mm) with SRI (solar refractive index) > 78, solar reflection > 0.70 and initial emittance > 0.75 on waterproof and sloped surface of terrace, laid on 20 mm thick cement sand mortar in the ratio of 1:4 (1 cement : 4 coarse sand) and grouting the joints with mix of white cement & marble powder in ratio of 1:1, including rubbing and polishing of the surface up to 3 cuts complete, including providing skirting up to 150 mm height along the parapet walls in the same manner. All complete as per CPWD specification.

5.15.7 Vacuum Dewatered Concreting/Trimix Flooring

Preparation

(a) The surface to receive flooring shall be clean, free from dirt and free from foreign material.

(b) Any undulations or mortar remaining on the floor shall be trimmed.

(c) Base course shall be trimmed.

(d) The base shall be cleaned and watered before laying the floor.

(e) Work includes application at all depths and heights.

(f) The finished surface shall be kept wet for a maximum period of one week.

Concreting

(a) Concreting shall have a concrete base of M20 of specified thickness.

(b) Flooring shall have hard top on the concrete base.

(c) Flooring shall be laid in strips.

Materials

Cement ordinary portland

Sand natural / manufactured sand Aggregate - max. size 10 to 20mm Water - potable

Floor hardener - @3kg/Sq.m

Execution

(a) Mix cement, sand and aggregates as per grade M20 thoroughly with water to get an appropriate

consistency.

(b) Prepared concrete shall be laid immediately after mixing.

(c) The base shall be free from water and other foreign materials, dust and dirt.

(d) A coat of cement slurry of the consistency of thick cream shall be brushed on the surfaceof the base course.

(e) The concrete shall then be spread over this base evenly and levelled carefully.

(f) Low areas shall be filled with concrete and humps removed. Devacuumisation shall be done for removing the voids.

(g) The whole concrete surface shall be levelled, compacted by ramming and trowelling.

(h) Prepared surface shall be allowed to set.

Hardener screed

(i) Hard top to be prepared as per the specifications with Nitohardner and one partof dry cement.

(ii) The hard top shall be provided over concrete base immediately after it is set,compacted and levelled with a steel trowel.

(iii) The surface shall be trowelled to bring the hardener coat to a levelled surface.

(iv) Excessive trowelling shall be avoided.

(v) After the initial set, further compaction shall be done by steel trowelling.

(vi) Final brushing shall be made before the floor top becomes too hard.

(vii) The overall thickness of Vacuum Dewatered Flooring will not be less than 75mm.

(a)Curing shall commence as soon as the surface is hard enough to receive the water.

(b) The surface shall be covered with sacks or sand and shall be kept continuously wet for aperiod of at least one week.

5.15.7 Vinyl Flooring

Supply and installation of Natural Creation commercial heterogeneous vinyl flooring in planks. The total thickness would be 5 mm and the thickness of the wear layer would be 0.5mm. The product should be multi-layered consisting of a wear layer with PUR coating, PVC layer, fiberglass layer, and solid backing. Natural creation commercial shall conform to group T wear resistance as per EN 660-2, Flammability resistance of ≥0.45 as per ASTM E6848, Slip resistance of R8- R9 as per DIN1130, Residual indentation of ≤ 0.01mm as per ASTMF1914, Color fastness rating of ≥ 6 as per ASTM 105- B02. The product shall exhibit antistatic behavior, resistance to chemicals, and suitability to castor chair. The floor should be smooth, flat, and free from moisture. Design and shade to be as per the architect’s choice, it should be installed by an

authorized dealer in India.

5.11.1 Epoxy Terrazzo Flooring

Supply and application of 12 mm to 10mm thick Epoxy Terrazzo flooring system having Compressive strength: ≥ 65MPa as per ASTM C579, Flexural strength: ≥ 25MPa as per ASTM D790, Tensile strength: ≥ 14 MPa as per ASTM D638. The product must have elongation: ≥ 5%, when tested as per ASTM D638. Hardness of the floor has to be ≥ 75 , when tested as per Shore D hardness test. Co-efficient of linear thermal expansion of the product will be approximately $13.3x10^{-6.}$ This product should have the flammability of not more than 0.025inch/minute when tested as per ASTM D 635. Entire system should have the Green Pro Certification from IGBC.

Epoxy terrazzo layer to be applied over Epoxy high build primer and need to be properly finished, grinded and polished with suitable transparent abrasion resistant material. In case of undulated surface, a floor levelling compound can be used. Termination strip to be used of aluminium L-shape (12mm by 12mm) and to be fixed to the concrete surface as per design or termination using SS screws. All the system of Terrazzo needs to be executed by authorised applicator of the manufacturer and as per the approved method statement of the manufacturer.

Method Statement of Laying Epoxy Terrazzo Flooring Surface Preparatory Work -

1. The concrete shall have a compressive strength of not less than 25 MPa with undulations of +/- 5mm in 3m straight edge and minimum pull off strength of 1.5 N/mm2.
2. The surface on which Terrazzo is to be done should have a moisture content of less than 5 %. The moisture test is conducted by moisture meter or plastic sheet method (ASTM D4263: Standard test method for indicating moisture in concrete).
3. CDS (Clean, Dry and Sound) TEST will be conducted before starting Epoxy Terrazzo flooring work.
4. Ensure to remove any loose concrete, mortar if any observed-on surface.
5. The floor should be free from any debris, dust and traffic from other trades or any other conditions which may result in damage to flooring work in progress.
6. Grinding is done by an appropriate grinding machine to achieve the desired surface profile.
7. The entire area is to be grinded thoroughly to make the surface suitable for Terrazzo application. Any other cracks or potholes are to be repaired with suitable material prior to application of flooring. The area is to be cleaned with a vacuum cleaner to make it dust free.

SUBSTRATE REPAIRS

If the substrate contains loose concrete, laitance, or loose screed, it should be removed with the grinding machine so that a strong mother base is achieved.

CRACK REPAIRS & SURFACE IRREGULARITIES

Cracks greater than hairline width must be v-grooved and filled with epoxy-based repair material on actual consumption basis.

Any surface irregularities like Potholes, blowholes need to be addressed before priming with repair material.

PRIMER APPLICATION

Solvent-free epoxy primer is applied over the concrete to ensure maximum adhesion to the prepared substrate and to aid in placement of Terrazzo matrix. Epoxy primer is recommended as the primer for Terrazzo flooring system. Mix equal parts by volume of Resin and Hardener for three minutes with a low-speed electric drill machine. Pour primer onto the prepared concrete and spread with either a flat trowel or squeegee to a coverage of 5 sqm per Litre. Allow the primer to cure for 4-6 hours. If the surface is found to be more porous, an additional coat of primer may be required.

LEVELLING SCREED

The floor should be even before Terrazzo matrix is laid. To make the floor even, epoxy repair mortar is used as per manufacturer recommendation and site requirement.

Primer to be used after laying of levelling screed to seal the porosities. Pour primer onto the surface and spread with either a flat trowel or squeegee to a coverage as per site condition and manufacturer recommendation. During the wet state, quartz aggregates of 0.4-0.8mm (FQ Sand 40) are broadcasted at an approximate rate of 0.1 Kg/sqm.

TRANSITION STRIPS

Demarcation trims will be of aluminum L-shape (12mm by 12mm). The depth will be equal to the final finished specified floor thickness plus The trims will be installed at all terminations and either side of all movement joints. The expansion joints are brought up through the Terrazzo using the transition strips and other joints like control and cold joint will be repaired by appropriate material for laying of terrazzo. The trims are fixed on both sides using appropriate adhesive. If curved patterns are required, serrated angle trim will be

used, permitting the trim to be bent to shape.

TERRAZZO MATRIX

The Terrazzo Matrix is supplied in 4 component units, made up of resin, hardener, colorant EPI and decorative aggregates. The entire contents of the hardener component are added to the resin component and mixed with a slow speed electric mixer for one minute until a homogenous mix has been achieved. Colorant EPI is then added to the matrix to impart the desired color. The aggregates are then added to mix under slow agitation for 3 minutes.

The matrix is poured on the area between the strips and laid at a thickness of 12 mm to match the height of the demarcation trims. The matrix is levelled with a steel trowel to a flat and even finishes and allows to cure for a minimum 24 hours.

GRINDING

The Terrazzo matrix will be allowed to cure for a minimum of 24 hours prior to commencing the grinding process. The purpose of the grinding process is to evenly expose the aggregates and to highlight any voids within the screed. The Terrazzo matrix is ground dry, using vacuum assisted grinding machine using 20 or 40 grit grinding heads. One or two passes of the grinder will be required to remove for exposure of aggregates approximately 2mm. The grinding marks are then subsequently removed with the use of resin pads of 50/100 grit. It should be ensured that there are no grinding marks on the surface. All the grinding dust is removed using a vacuum and the surface should be extremely clean and dry.

GROUTING

The Terrazzo matrix is then grouted using Terrazzo Grout to fill the voids caused by air bubbles in the screed or aggregate caused by the grinding process. Terrazzo Grout is a two- component epoxy system containing resin and hardener. Apply grout by trowel to penetrate pores and allow to dry over-night.

POLISHING

Polishing is done with resin pads to remove the grout layers and to smoothen the surface. If porosities are found, repeat one more coat of grouting process.

WET POLISHING

The final polishing is carried out in wet state, using vacuum assisted floor polishing grinding equipment. The polishing process is a maximum 6-8 phase process where increasingly fine diamond polishing heads (100 to 3000) are used to achieve a superior finish.

SEALING

The recommended sealer coat is an aliphatic Polyurethane topcoat that is poured directly onto the floor and spread with a roller/squeegee to provide an even streak free finish. The sealer is allowed to cure for 24 hours and then it is buffed using a buffing machine.

CURING & HANDING OVER

The completed system may be opened to full traffic 24 hours after the sealer has been buffed. The surface should not be cleaned with water for 24 hours or cleaning chemicals for 48 hours. The finish should be inspected by the client and any concerns or defects need to be clearly highlighted prior to opening to traffic. Full chemical cure is achieved in 7 days. All polymers require 7 days at room temperature to reach optimum design strength. Lowertemperature extends curing times.

5.15.12 Epoxy Flooring:-

Providing, Supplying, and applying of a four component self-smoothing 1mm thick epoxy flooring system like Floortop 1000 of Dr.Cipy or equivalent, having a

GreenPro Certification and the technical parameters of Compressive strength: ≥ 40 MPa as Per ASTM D 579; Tensile strength: ≥ 7 MPa as per ASTM D 638; Flexural strength: ≥ 10 MPa as per ASTM D 790; Abrasion resistance should not be more than 75 mg loss as per ASTM D 4060; Pull of Adhesion test: ≥ 2 MPa for M20 grade concrete as per ASTM D 4541; Hardness, Shore D: ≥ 75 as per ASTM D 2240; Slip resistance (Dry) as per BS 8204 is 110 STV. With the average dry film thickness of about 1000 microns as per ASTM D 7091. This must be applied over screed of Cipoxy 17 at a thickness of 2mm and the technical parameters are Compressive strength: ≥ 35Mpa as per ASTM D 695 ; Tensile strength: ≥ 9 Mpa as per ASTM D 638 ; Elongation is greater than 1.8 % as per ASTM D 638 ; Flexural strength: ≥ 15Mpa as per ASTM D 790 and Pull off dhesion is greater than 2 Mpa as per ASTM D 4541. This has to be applied over an epoxy-based primer like Cipoxy 17 of Dr.Cipy or equivalent having pull off adhesion: ≥ 2 Mpa of thickness recommended by the manufacturer. All concrete has to be crack free surface of M20 or above grade with moisture barrier placed under the RCC surface. All construction joints need to be cut within 24 hours of Concrete placements. All expansion joints need to be sealed with Dr Fixit PU sealant or equivalent, as recommended by manufacturer. All the fixation in the surface has to be made prior to the application and treated. All the above process has to be undertaken by a manufacturer approved applicator. The surface has to be Clean, dry, and sound concrete must be surface prepared using Scarification & Grinding. The residual moisture should not be more than 4-5%.

5.15.13 Rubberised Flooring:-

Providing & Fixing of 8mm thick Rubber flooring Rolls with 15% EPDM & 85% SBR, Density (kg/m3):1000/1200, Hardness (Shore a):68, Stretch (MPA):2.2, Abrasion resistance: 0.0075g (ASTM-D4060-01), Rebound resistance: 55%, Friction coefficient: trends μs: 0.995 .trends μk: 0.930, Shape deformation: 42%, Length (m):10 ±5cm, Width (m):1m ±5mm, Thickness (mm): 8mm ±0.3mm etc.complete as per the direction of Engineer-in-charge.

5.15.14 Heavy Duty Vitrified Flooring:-

Providing and laying vitrified Heavy duty floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption's less than 0.08% and conforming to IS : 15622 of approved make in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand) including grouting the joints with white cement and matching pigments etc., complete.

5.16 Stainless Steel Railings

The work shall be carried out in areas as described in the finishes schedule. These specifications are in addition to CPWD specifications and as per conditions mentioned in NBC 2026

All rails and other tubular components shall be constructed using the following:

(a) Stainless steel grade AISI, type 316; surface to be 320 grain/grit finish; tubes 1- (38mm) outside diameter by 5/64” (2mm) wall thickness.

(b) Balustrade material: Stainless steel SHS, grade 316

(c) Finish: Brush finish

(d) Dimension: 40mm square to outer

(e) Maximum spacing: 1500mm c/c

(f) Specific notes: Interconnecting SS 25mm SHS between top rail and baluster, SS patchfittings 4 no for each glass panel, SS base plates, etc.

All posts and other components shall be constructed using the following:

Stainless steel grade AISI type 316, surface to be 320 grain/grit finish : post to be 2” (50 mm) by 1/2” flat bar , finish design to be strictly in accordance with design guidelines.

Stainless steel grade AISI type 316, surface to be bead blasted for: component fittings including handrail attachment support and post attachment components strictly in accordance with design guidelines.

Fastening bolts to be stainless steel.Fasteners for railings

Anchors shall be fabricated from stainless steel with capability to sustain, without failure and rusting, load imposed within a safety factor of 4, as determined by testing per ASTM E488.

Fabrication

Fabricate railing system for compliance with structural requirements of applicable code.

Pre-assemble railings prior to shipping to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and for coordination with shop drawings.

Installation

Installation shall be by done a qualified, authorized representative of the manufacturer.

Installation must be in accordance with standard or non-standard, yet applicable details (instructions) included on installation/shop drawings provided by the manufacturer

Install components plumb and in-line, accurately fitted, free from distortion or defects and securely anchored to structure.

Provide anchors, plates, angles, etc., necessary for connecting railings to structure.Any and all field welding shall be by a certified welder

Access for anchors that require through-bolting, either vertically or horizontally, to be made available by the Contractor.

Erection tolerances

Maximum variation from plumb shall be 1/4".

Maximum offset from true alignment for every 50-foot of railing shall be 1/4", non-accumulative.

Protection after installation

General contractor must provide protective covering on handrails and guardrails if constructionis not yet finished in the area where the railings are installed.

Correction of deficiencies

All deficiencies in work and/or items not meeting specified requirements shall be corrected in order to meet specification requirements at no additional cost to Employer.

5.17 Doors.

The doors and windows shall be provided as per the requirements indicated in the Tender Drawings and the respective schedules appended to the Tender document. However the typical specifications for the various types of Doors and Windows shall be as under:

Shutters-Wooden-Flush door: -

All internal doors shall be 35 mm thick ISI marked flush door shutters conforming to IS : 2202 (Part I) decorative type, core of block board construction with frame of 1st class hard wood and well matched teak 3 ply veneering with vertical grains or cross bands and face veneers on both faces including ISI marked stainless steel but hinges with necessary hinges and lipping with 2nd teak wood battens 25 mm minimum on all edges of flush door shutters including vision panel depth

Door shall be obtained from factoriesto be approved by the Engineer in - charge and. The contractor shall inform well in advance to the Engineer in charge the name address of the factory from where the contractor intendsto get the shutters manufactured.

a. The contractor will place order for manufacture of shutters only after written approval of ENGINEER-IN -CHARGE in this regard is obtained. The contractor is bound to abide by the decision of the Engineer in-charge. In case the factory already proposed by the contractor is not found competent to manufacture quality shutters, the contractor shall propose another name of another factory from the approved list for the approval of ENGINEER-IN -CHARGE .

b. The contractor will also arrange stage wise inspection of the shutters at factory with the ENGINEER-IN -CHARGE or his subordinate authorized representatives. Contractor will have no claim,if the shutters brought at site are rejected by the ENGINEER-IN -CHARGE in part or in full lot due to bad workmanship / quality or damages caused during their shifting from factory to site. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instruction in this regards are issued by the ENGINEER-IN -CHARGE or his authorized representatives.

i. Hardware

a. All hardware for doors and windows shall be of stainless steel or as specified. All hardware shall be installed using routers and counter sunk screws. Panic hardware will be provided in all staircase and escape doors. Drawer slides with steel roller ball-bearings and drawer locking system with master keying option is to be provided for all built in cabinetry work and drawer units.

b. The contractor shall procure all the hardware and the fixing shall be done in the best

workmanship like manner and in accordance with that employed for fixing hardware.

Toilet Cubicles-

Providing and fixing toilet cubicles system of approved make with 12 mm thick solid compact laminate panels included 600 mm doors, central panels front panels, should be resistant to heat, bacteria water, chemical, scratch, and impact. All necessary hardware's fitting should be Stainless Steel 316 Grade, all complete as per manufacturer's specification, drawings and direction of Engineer-in-charge.

Thickness of Compact Laminate : 18 mm Color of HPL Boards: Single Color Size of Cubicle : 1000mm (W) & 1550mm (D) x 2100mm (H) Door Size : 1995mm (H) x 610mm (W) Divider Size : 1995mm (H) Overall Height Of Cubicle : 2100mm (Including boom Gap of 100mm) Accessories: Standard - Merino Make Stainless Steel - 304 Grade accessories) a) SS "U" Channel b) SS "F" channel c) SS Coat Hook d) SS Privacy Thumb turn c/w Occupancy Indicator e) SS Door Knob f) SS Hinges with Cover g) SS Shoe Box Leg 18mm - 316 Grade h) Rubber Lining for Groove i) S.S.Screws 304 G & P.V.C Wall Plugs

Pre-painted Galvanized Steel Door Frame: As per CPWD Specification.

5.18 Aluminium works:

Aluminium work for doors, windows, ventilators with **Aluminum high performance extruded built up standard tubular sections**/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineerin-charge. All aluminium sections for door/window/ventilaots (fixed/openable) shall be Polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron).

System Aluminium Factory made Double Rebate Windows with Grill and Mesh For Single Glazed Unit

Providing and fixing of Double rebate openable windows & ventilators made of High-performance factory-made system Aluminium with Akzonobel powder coating of 60-70 microns (Any RAL Colour). Section for **Outer frame should be a single section of 91mm x 35mm, Glass shutter frame shall be of 54mm x 30mm, Mesh shutter frame shall be of 54mm x 30mm, 5mm thick Single Glazed beading shall be of 15mm x 18mm. No coupling of 2 windows shall be allowed. Any sort of deviation in the size of the profile shall not be permissible.** 5mm thick Clear Glass shall be used in all the windows & ventilators. Stainless Steel Wire Mesh shall be used in Wire mesh Shutters. 10mm Sq bar M.S. Grill/Guard bar with 150mm c/c shall be fixed in between glass & mesh shutter. All frame corners shall be joined/assembled using self-locating corner cleats (No screwing at corners shall be allowed). No coupling of 2 windows shall be allowed. All Hardware shall be used from a reputed brand, weather silicon shall be used for filling the gap between window opening & window Frame complete in all respect including all taxes. Windows shall be procured directly from OEM only,

with billing in OEM's name in favour of contractor, complete as per specifications

System Aluminium Factory-made Double Rebate Windows with Grill and Mesh For Double Glazed Unit

Providing and fixing of Double rebate windows & ventilators made of High-performance factory-made system Aluminium windows with Akzonobel powder coating of 60-70 microns. Section for **Outer frame should be a single profile of 139.80mm x 27.99mm, Glass shutter frame shall be of 75mm x 52mm, Mesh shutter frame shall be of 71mm x 30mm, Mullion size 139.80mm x 67mm, Double Glazed beading shall be of 20mm x 25mm.** 24mm DGU (Double Glazed Unit) of 6mm Solar Glass + 12mm Airgap + 6mm Solar Glass shall be used in all the windows & ventilators. Stainless Steel Wire Mesh shall be used in Wire mesh Shutters. 10mm Sq bar painted M.S. Grill/Guard bar with 125mm c/c shall be fixed in between glass & mesh shutter. All frame corners shall be joined/assembled using self-locating corner cleats (No screwing at corners shall be allowed). Glass Shutter Hardware - S.S. 304 Friction Stays of min. 10 inches & 80Kg weight bearing capacity – 2 Nos per glass shutter, Multipoint Locking 100mm long fork handle of Zinc aluminium alloy material with polymite rod – 1 No per glass shutter. Mesh Shutter Hardware - Single Point Cockspur handle 100mm long of Zinc aluminium alloy material – 1 No, Zinc aluminium alloy hinges – 2 Nos per shutter. All Hardware shall be used from a reputed brand; weather silicon shall be used for filling the gap between window opening & window Frame complete in all respect including all taxes. Windows shall be procured directly from OEM only, with billing in OEM's name in favour of contractor, complete as per specifications.

Casement Aluminium Doors – Single Rebate Doors

Providing and Fixing of Doors made of High performance prefabricated factory made system Aluminium with powder coating of 60-70 microns. Section for **outer frame should be of 73.2mm x 50mm, section for glass shutter for door should be of 92.5mm x 58mm.** All frame corners shall be joined/assembled using self-locating corner cleats (No screwing at corners shall be allowed). Double glazed hermetically sealed glazing in aluminium doors should be provided with 5mm toughened glass on both the sides, having 10mm airgap including EPDM gasket, perforated aluminium spacers, desiccants, sealant, etc. Weather silicon sealant of reputed make to be used to make glazing watertight. The system should be tested for Air tightness, water penetration as per standards. Multi point locking system along with hardware of reputed make including hinges for all the door shutters, complete for finished item of work.

D)Casement Aluminium Door Frames – Single Rebate Doors

Providing and Fixing of Door Frames made of High-performance prefabricated factory-made system Aluminium with powder coating of 60-70 microns. Section for **frame should be of 101.60mm x 44.45mm with rebate of 44mm for shutter with wall thickness of 4mm thick.** All frame corners shall be joined/assembled using self-locating corner cleats (No screwing at corners shall be allowed). 4 Nos Hinges will be there for shutters.

e)Casement Aluminium Door Frames – Single Rebate Doors

Providing and Fixing of Door Frames made of High-performance prefabricated factory-made system Aluminium with powder coating of 60-70 microns. Section for **frame should be of 100mm x 45mm with rebate of 40mm for shutter with wall thickness of 3mm thick.** All frame corners shall be joined/assembled using self-locating corner cleats (No screwing at corners shall be allowed). 4 Nos Hinges will be there for shutters

a. **General**

i. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium glazed doors, windows and ventilators in accordance with the drawings and specifications.

ii. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in the schedules/ specifications/drawings or not provided that the supply and installation of such parts can be inferred there from and are necessary to make the work complete.

iii. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

(b)Materials-

i. The members will be made out of aluminium alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.

ii. The Sections will be as per approved makes, extruded sections. As indicated in the drawings the tenderer should specifically mention which sections he is using.

iii. The weight of sections and the corresponding catalogue numbers are mentioned. The IS specifications are to be strictly adhered.

iv. The extruder using recycled materials may be preferred.

v. The alloy of extruded aluminium should be BS or IS old HE9, Alcon 50 SWP. To this effect test certificate has to be provided for the extruder.

c. Finishing:

i. The extruded aluminium section has to be mechanically finished to remove all scratches; extrusion marks etc. and subsequently thoroughly cleared in all alkali baths prior to anodizing.

ii. The anodizing with minimum average thickness of 30 microns or polyester powder coating, with minimum average thickness of 50 microns, as per item of work, shall be of desired shadeor other shades as required and to this effect the tenderer must have to produce test certificatefrom

authorized institutions Bureau of Indian Standard.

iii. The polyester powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

D) Fabrication:

i. Before commencing the fabrication the contractor shall submit to the Engineer-in - charge for their approval detailed shop drawings, based on the Tender drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements . Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer in - charge and in accordance with the approved drawings. Sections for fabrication of door/window/ventilators etc. shall be as per Tender drawings or as approved by the Engineer -in -charge.

ii.A sample of finished door / windows/ ventilator railing etc. shall be fabricated as per the shop drawings approved by the Engineer in - charge for final approval before under taking mass production/ fabrication,

iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating shall be as specified in the item specifications.

iv. All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the Engineer in -charge shall be final and binding on the contractor.

v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitred at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.

vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.

e. **Glazing for door and window:**

The glazing for door/window shall be DGU glass specification 6mm +12mm air gap +6mm CT as per SOF.

5.19 Glazing with Patch Fittings

a. General

i. The contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work

as per Tender concept drawings and specifications details.

ii. The specialist agency engaged to carry out the external glazing installation and supply shall have at least 5 years of relevant experience and have completed external glazing systems of similar nature and equivalent scale of works as shown in the tender documents.

iii. The specialist contractor shall submit an outline of recent comparable works (illustrated by appropriate drawings, sketches, photographs, brochures) by the firm / its technical partner to illustrate the competence, experience and suitability of the firm.

b. The scope of work shall include:

i. Design, preparation of shop drawings, calculations, engineering data and test reports.

ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.

iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.

iv. Exposed mullions and other support members.

v. Finishes, protection coatings and treatments.

vi. Sealing with approved sealants within and around the perimeter.

vii. All thermal insulation, fire-safing etc. including supports and/or backing.

viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.

ix. Electrical bonding and ear thing of all metal cladding elements.

x. Provisions to receive electrical outlets and cut-outs for conduits and other electrical work.xi. Glass and glazing.

xii. Transportation, storage, handling, protection and cleaning.

c. Submittals

i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.

ii. Shop Drawings.

d. **Fabrication and installation details, including followings:**

i. Plans, elevations and sections.

ii. Details of fittings and glazing.

iii. Hardware quantities, locations and installation requirements.

e. **Sample for verification**

For each type of exposed finish required for

i. Metal finish: 150mm long section of patch fittings, rails and other items.

ii. Glass: 150mm square, showing exposed edge finish.

Materials

.i. Glass

Glass shall be as specified in drawing or as per design requirement. It shall be Indian /imported hard coated reflective and heat strengthened glass. It shall be of approved make.

In toughening of Glass, rolling direction shall be parallel to the width of the glass panelsuch that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

ii. Components

Patch fittings: Stainless steel clad aluminium

Floating Transom Bar: Steel cladded in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.

Rails: Stainless steel clad aluminium.

Accessory Fittings: Matching with patch fittings and rails metal and finish for overheaddoor stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.

Anchors and fastenings: ConcealedWeather stripping: Sweep type.

iii. Hardware

Hardware should be heavy duty in matching finishConcealed Floor Closer and Top Pivots

Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beampivots, plates, and accessories required for complete installation.

Swing : Double acting; Positive dead stop, concealed with hold open angle Delayedaction closing

Concealed Overhead Holder: Grade 1, with dead stop setting coordinated withconcealed floor closer.

Push-pull set: Stainless steel finishLock set of approved make.

g. **Fabrication**

i. Provide holes and cut-outs in glass to receive hardware, fittings, rails and accessories before tampering glass. Fully temper glass using horizontal (roller- hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.

ii. Factory assembled components and factory installed hardware to greatest extent possible.

h. **Execution**

i. Examine areas and condition for compliance with requirements for installation tolerances andother conditions affecting performance of work.

ii. Install all and associated to manufacturer's written glass system componants according instructions.

iii. Set units in level and plumb.

iv. Maintain uniform clearances between adjacent components.

v. lubricate hardware and other moving parts according to manufacturer's written instructions.

vi. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

i. **Cleaning**

i. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.

ii. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by theEngineer in - charge.

iii. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.

iv. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.

v. Prior to snagging inspections, the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.

vi. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer in - charge.

vii. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.

viii. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.

ix. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall notbe in contact with glass.

x. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.

j. **Performance Guarantee:**

The contractor shall offer a minimum of 10-year Performance Warranty for the entire installation carried out.

5.19 MRI Door-RADIO FREQUENCY INTERFERENCE SHIELDING DOORS

a. Materials

Metallic-Coated Steel Sheet

Frame Anchors: Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

Design: Flush panel.

Core Construction: Manufacturer's standard vertical steel-stiffener core.

Standard Vertical Steel-Stiffener Core: Minimum 22 gage steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers.

Conductive Coating and Surfaces: Apply copper infused coating to entire door prior to application of primer. No primer is to be applied to door perimeter to allow continuous connection with conductive seals and conductive coating on frame.

Transmission Rating: Maximum levels of RFI or EMI transmission through the door assembly shall be 40dB at the 10kHz 10GHz frequency range.

Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gage (0.053-inch - 1.3-mm) thick steel, Model 2 (Fully welded, seamless face and edges).

Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Edge, 1/8 inch in 2 inches (3 mm in 50 mm).

Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge (0.053-inch - 1.3-mm), extending the full width of the door and welded to the face sheet. Finish top and bottom to provide a smooth flush condition.

Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

b.Radio Frequency Interference Shielding Frames.

General: Provide frames of the type and profile indicated, not less than thickness indicated; to comply with ANSI/SDI A250.8.

Fabricate frames with mitred corners.

Fabricate frames with "closed and tight" mitred, full depth continuously welded seams, finished smooth with no visible seam unless otherwise indicated. Knock down type frames are not permitted.

Minimum 16 gage (0.053-inch -1.3-mm) thick steel sheet

Conductive Coating: Apply copper infused coating to entire frame prior to application of primer. No primer is to be applied to frame rabbet and stop on the door side to allow continuous connection with conductive coating on the door.

Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

FrameAnchrs JambAnchors:

Masonry Type: Adjustable strap-and-stirrup anchors to suit frame size, not less than 16 (0.8 mm) gage thickness, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick. Stud Wall Type: Designed to engage stud and not less than 16-gauge (0.8 mm) thickness.

Floor Anchors: Floor anchors to be provided at each jamb. Formed from same material as frames, not less than 14 gauge (0.067-inch -1.7-mm) thick.

Mortar Guards: Provide minimum 26 gage mortar guards welded to the back of each hardware cut-out.

c. Conductive Seals & Accessories

Furnish factory installed conductive seals for opening perimeter, and threshold for field installation. Also furnish conductive caulk to ground the frame to the wall shielding material in the field.

d.Fabrication

Fabricate radio frequency interference shielding work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

Tolerances: Fabricate radio frequency interference shielding work to tolerances indicated in ANSI/SDI A250.8.

Hinge Reinforcement: Hinge reinforcements are to be fabricated in a manner which does not interfere with grounding of door conductive coating to the frame conductive coating.

Radio frequency interference Shielding Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

Welded Frames: Full depth continuously weld frame seams; grind, fill, dress, and make smooth and flush.

Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

Electrical Knock Out Boxes: Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; this includes but not limited to electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as noted in door hardware sets.

Provide electrical knock out boxes as required for Project.

Conduit to be coordinated and installed in the field from middle hinge box and strike box to door position box.

Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

Jamb Anchors: Provide number and spacing of anchors as follows:

Masonry and Stud Wall Types: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 84 inches (2137 mm) high.

Surface Hardware Preparation: Factory prepare radio frequency interference shielding work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished.

Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.

Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of radio frequency interference shielding work for hardware.

Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

Steel

Prime Finish: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

5.20 Fire Door

Submittals

- Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.
- Shop Drawings: Show the following:
    - Elevations of each door design.
    - Details of doors including vertical and horizontal edge details.
    - Frame details for each frame type including dimensioned profiles.

- Details and locations of reinforcement and preparations for hardware.
- Details of each different wall opening condition.
- Details of anchorages, accessories, joints, and connections.
- Coordination of Doors with works of other Vendors & their requirements.

- Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.
- The approved vendor should be approved in the MANAK website under Metal Fire Door Category.

(i) Insulated Hollow Metal Fire Doors

Medium Duty Hollow metal fire rated doors as per IS 3614: 2021, for 120 min integrity & 30 min. insulation. Pressed galvanized steel confirming to IS 277 with the following specification. Recommended fire door shall be tested as per IS/ISO 3008-1 & IS/ ISO 834-1, from Exova/TBW/CBRI approved lab. Labeled fire doors shall be with fire rated hardware and vision panel all as a complete assembly. Proper label confirming the type of door and the hourly rating is mandatory.

Unless otherwise specified, maximum size of door in this type:

Single shutter door :1200 mm x 2400mm

Double shutter door:2000 mm x 2400 mm

For doors above 2200 mm height (Single Doors) and 2400 mm height (Double Door) the options shall be: A man operation door of size above 2049 mm height shall be provided with a removable panel / fixed panel on top.

The construction of above panel shall be designed similar to that of a shutter in case of flush panel to match the exteriors.

Material - Frame to be manufactured from 1.60 mm (16 gauge) galvanised steel sheets complying with latest IS 277 Code or its Equivalent British Standard. Frames shall be mitered and field assembled with self-tabs. Frames to have inbuild grooved sealing system for taking fire rated seals. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Frames shall be filled with fire rated puff.

Profile - Door frame profile to be double/ single rebated of dimensions & bending radius as per relevant IS code, Manufacturers specifications & approved drawings.

Manufacture - Frame to be manufactured from 1.60 mm thick galvanised steel sheet to the specified profiles and dimensions. Frames manufactured at factory shall be knock down form with butt joints for bolted assembly at site.

Door leaf shall be 60 mm thick fully flushed double skin step design door, insulated with or without vision lite. Door leaf shall be manufactured from 1.25 mm (18 swg) minimum thick galvanized steel sheet conforming to latest IS : 277 Code of GPL Grade with Z 120 coating or its Equivalent British Standard. The internal construction of the door should be

rigid reinforcement pads for receiving appropriate hardware. The infill material shall be 120 kg high density mineral wool insulation material. Intumescent seals 15 x 1.5 mm to be provided. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4 mm. For pair of doors integrated astragals has to be provided on the meeting stile for both active and inactive leaf.

Door and frames shall be finished Pure Polyster Powder coated and shall have passed minimum 500 hours of salt spray test.

ii. **Insulated Glazed Fire Door & Partition (E/EW120, EI30)**

Insulated glazed fire door as per IS 16947 for stability, integrity (E/EW 120) & Insulation (EI 30). Pressed galvanized steel confirming to IS 277 with the following specification. Glazed door shall be tested to IS/ISO 834-1, IS/ISO 3008-1 for integrity & insulation (E/EW 120). Glazed door shall be tested from CBRI/ TBW / CERTIFIER for maximum rating of 120 mins with 30 mins Insulation. Test certificates should be made available for max door size tested as a complete assembly. Proper label confirming the type of door and the hourly rating is mandatory.

Door frames and partitions shall be single rebate frame profile of size 125 x 60 mm made out of 1.60 mm (16 swg) minimum thick galvanized steel sheet. Frames shall be butted/mitered and with mandatory provision for smoke seal and field assembled with self tabs. All transom profiles and side panels shall be from similar profile and should be as per the tested specimen. For partitions, Glass should be held in its place with 1.2 mm GI clip-on beading 19mm height. Screws shall be 8 x 19 mm steel screws, self tapping and concealed inside the beading at every 250 m c/c and a ceramic tape of the cross section of 4 mm x 13mm as per the test evidence. Door frames shall be with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. The top support formounting shall be included as per design requirement. Once frame installed should be filled with PUF as recomended by the manufacturer or engineer.

Door leaf shall be Fully Glazed SH100 profile of size 60 x 100 mm profile step box section for taking glass elements. Door leaf shall be manufactured from 1.2 mm (18 swg) minimum thick galvanised steel sheet. Glass should be held in its place with 1.2 mm x 19mm GI clip-on beading. Screws shall be 8 x 19 mm, self tapping and concealed inside the beading at every 250 m c/c and a ceramic tape of the cross section of 4 mm x 13 mm as per the test evidence. Doors shall be 60 mm thick and the internal construction of the door should be rigid reinforcement pads for stability of profile & infill of high density mineral wool. All provision should be mortised, drilled and tapped for receiving appropriate hardware. For pair of doors integral astragals has to be provided on the meeting stile. The glass shall be fire rated, ultra clear, interlayered 11mm thick Pyran Fusion, for (E) 120 minutes integrity & (EI 30) 30 minutes insulation with light transmission of minimum 89% as per EN1363 and EN1364. Glass shall have a impact resistance of 1B1 as per EN 12600 and sound insulation of 37db. Glazing kit to be provided along with steel beeding and ceramic tape.

All doors and frames shall be finished Pure Polyster Powder coated and shall have passed minimum 500 hours of salt spray test.

Vision Panel & Others for Fire Door

Vision lite wherever applicable should be 6mm clear borosilicate fire rated glass as per manufacturers recommendation with a clipon arrangement.

Shutters to have pre-drilled hinge plates with hinge guard covers. Shutters with locks to have concealed lock box with lock fixing brackets with pre-tapped holes.

For shutter with door closer reinforcement pads to be provided at appropriate location as per manufacturer’s design.

All iron mongery preparation to have adequate reinforcement for flushes fixing at site.

Vision panel to be provided with Borosilicate Clear Toughened Glass of the thickness 6 mm for up to two hours fire rating. Glass to be fixed with clip on frames for square and rectangular vision panels and with spin turned rings for circular vision panels and Glazing Tape with one side adhesive. Vision Panels to be fixed with clip-on frames for square and rectangular Vision Panels with no visible screws. Unless otherwise specified standard sizes are 200 mm x 300 mm and 360 mm diameter.

Finish

Shutters to be suitably cleaned with solvents and etch primered for receiving primer and top coats. Shutters to be primered in zinc phosphate stoving primer (35 microns DFT).

Shutters to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

FABRICATION

General: Fabricate steel door and frame units to comply with relevant IS standards (IS 3614 & IS 277) and to be rigid, neat in appearance, and free from defects including warp and buckle.

Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick (old 16 gauge), metallic-coated steel channels with channel webs placed even with top and bottom edges.

Interior Door and Panel Faces: Fabricate exposed faces of doors and panels from cold-rolled sheet steel. Core Construction: Manufacturer's standard core construction of the specified type that produces a door complying with CBRI tests.

Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

QUALITY ASSURANCE

Steel Door and Frame Standard: Comply with CBRI testing standards, unless more stringent requirements are indicated.

Fire-Rated Door Assemblies: Assemblies that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction (CBRI), for fire-protection ratings indicated, based on testing according to IS 3614 Part 2.

DELIVERY, STORAGE, AND HANDLING

Shutters to be wrapped in protective 70-micron polyethene sheets & duly strapped. All frames & shutters to be duly marked as per as per approved door schedule for easy identification at site. The doors and frames shall be cardboard-wrapped or crated to provide protection during transit and job storage. Additional protection to prevent damage to finish of factory-finished doors and frames should be provided.

Inspect doors and frames on delivery for damage and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Engineer in charge. Damaged items that cannot be repaired shall be removed and replaced as directed.

All knocked down frames shall be stacked flat & shutters vertically on minimum 4-inch- (100 mm-) high wood blocking under cover in ventilated areas. Provide spaces between stacked doors to permit air circulation.

Sequencing and Scheduling

Submit data and schedule at earliest possible date, particularly where acceptance of schedule must precede fabrication of units that must be built into other work.

5.20 Fire Curtain

Automatic Fire Curtain

Supply installation testing and commissioning of Fire Curtains with Galvanized MS powder coated head top box of suitable size, powder coated side guides (100mm x 50 mm) and bottom bars with Gravity fail safe DC motors one per roller for curtain up operation with standard battery back-up fixed into 76/88 mm steel rollers with FAB690PU fabric must be according to DIN EN 13501-1 and stainless steel reinforced glass fibre with fire-retardant aluminium pigmented polyurethane coating, with its control panel and all installation assemblies & accessories required to complete the installation. The operation shall be suitable for dedicated 230 volts UPS, 50 Hz AC supply. Both test reports EN 1634-1 & EN 12101-1 must be according to the requirement of particular project, if single roller curtain is there then single roller certificates and double roller curtain is there than double roller certificates must be submitted accordingly. The fire curtain must be according to Classification of Fire Resistance Performance in Accordance with EN 13501-2: 2016. Each Fire Curtain shall have independent control Panel suitable for 230V AC supply, provision to integrate with Fire signal, and battery backup. The emergency retract switch shall be provided on both sides of curtain. The Fire curtain shall reset automatically when fire control panel is reset. Fabric and all components sourced from the original manufacturer who has valid type test certificate of the fire curtain and third-party quality surveillance audit as per above standards including oversize certification according to applicable EN standards. The scope also includes fabrication, supply

and installation of closed MS sections corner supports for fixing side channels, design suitable for stability and integrity with two hours fire rating, wherever required for full height of Fire curtain, as per approved design, duly finished with powder coating of finish matching to side channels of fire curtains. The supplier must have a manufacturing facility and in house R&D team.

Certification required:

1. All the required test / certificates must be less than 5 Years validity.
2. No mirror certificates allowed.
3. Complete system tested in accordance with EN 1634-1 and EN 12101-1 (for minimum 240 minutes integrity & tested at 1000°C with 30 minutes radiance) with CE certificate from European Notified Body.
4. The manufacturer's valid EN certification for oversized fire curtains according to EN 15269-11 covering the sizes of offered fire curtains as per BOQ, should be available.
5. Classification: E240 EW30 with smoke leakage control.
6. Period of fire resistance (E) (integrity): 240 minutes
7. Period of Radiation (EW) (Radiation Control): 30 minutes <15kW/m2 at 1 mtr
8. Smoke Leakage Control (Sa): <3m3/m/h

Installation: The fire curtain has fixing options to suit all types of ceiling configurations and can be integrated into either a suspended or a solid ceiling. It remains hidden until required. Upon receiving a signal from the fire detection system or on loss of power with the gravity fail safe system, the curtain automatically unwinds to its operational position.

5.21 External Façade:

(ii) Stone work

Dry cladding: -

The dry cladding shall be laid as per design with stone as specified. The thickness of the stone shall be as specified. The stone shall be cut with gang saw (machine cut edges) and it shall be of uniform colour and sizes as approved by Engineer- In charge and in accordance with CPWD Specifications, including SS grade 316 cramps, pins, dowels, ledges and supports, as per design and requirements. The support structure shall be designed by the Contractor and approved by the Engineer-in- charge. Horizontal & vertical joints shall be filled with weather sealant mixed with pigment of matching shade. Groove width, if provided/ required, shall be uniform and in plumb of vertical surface.

The contractor shall get this work executed through a specialized agency. The Contractor shall submit the credential of the specialized agency well in advance for verification and only after written approval of Engineer-in-charge can the agency be deployed for this work. The contractor shall furnish a legal guarantee bond for ten years in prescribed proforma certifying that all the defects noticed during this period shall be rectified and made good to the satisfaction of Engineer-in-charge.

Wherever the stone slab dry cladding is provided exposed to environment, exposed surface and edge surfaces of the stone slabs shall be treated to make the surfaces hydrophobic by applying water repellant / hydrophobic clear coating of water soluble silicon based impregnating agent of approved make. The formulation shall be prepared and applied as per the manufacturer's recommendations. Before applying the formulation, the surface preparation shall be done as per the manufacturer's recommendations. The surface shall be cleaned using water and the formulation shall be applied on the damp surface.

It shall be applied before installation of stone on vertical surface has been completed and after necessary surface preparation.

Wet cladding: -

The wet cladding shall be laid as per design and in accordance with CPWD Specifications. The cladding shall be fixed with 12mm thick (minimum), Cement Mortar 1:3 (1cement: 3 coarse sand). Horizontal & vertical joints shall be filled with white cement mixed with pigment of matching shade.

(ii) Structural Glazing

Scope of Work

The contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazing system to the proposed building, all in conformity with the Design Basis Report & Drawings as given. Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings and/or without limiting the generalities of the foregoing, the structural glazing Systems shall include, without being limited to, the followings:

Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metalclosure, windows etc.

All anchors, attachments, reinforcement and steel reinforcing for the systems requiredfor the complete installations.

All thermal insulation associated with the system. All fire protection associated withthe system.

All copings, end closure and metal cladding to complete the system.

- All sealing and flushing including sealing at junctions with other trades to achievecomplete water tightness in the system.
- Isolation of dissimilar metals and moving parts.
- Anticorrosive treatment on all metals used in the system. Polyester powder coating aluminium sections.

The contractor shall also be responsible for providing the followings:

Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the structural glazing System.

Scheduling and Monitoring of the Work.Mock-ups, samples and test units.

performance testing of the structural glazing framing and glazing assembly.Co-ordination with work of other trades.

Protection.

All final exterior and interior cleaning and finishing of the structural glazing SystemAs-built record drawings and photographs.

Guarantees and Warranties.

All hoisting, staging and temporary services.

Conceptualizing and design of a suitable maintenance system for structural glazing.

The water tightness and structural stability of the whole structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shallbe sealed and made good all at the expense of the Contractor.

The structural glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.

Building Regulations

Structural glazing shall comply with all Government Codes and Regulations including IS codes,if any.

All structural glazing, individual aluminium and glass components and all completed work shallbe designed and erected to comply with the following:

Design load and deflection.

Structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mmmaximum whichever is less.

Structural performance of all parts of structural glazing system shall conform to relevant IS codes, wind load as per IS-875 and seismic loads as per IS-1893.Deflectionshall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.

Design Wind Loading

- 1250 N/m2 positive and negative to Podium.
- 1850 N/m2 positive and negative to Tower.
- 1900 N/m2 positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loadingequivalent 1.5 times the design wind pressure specified.

Tender Drawings and Specifications

The tender drawings indicate profile and configuration required together with relationship to

structural frame and interior building elements.

The Specification and tender drawings are of the performance type and includes only the minimum requirements of the structural glazing Wall System without limiting the Contractor to the method of achieving desired performance.

Pre-Execution RequirementsDesign Proposals

The contractor shall propose the final design in such a way that all basic functional and requirements in line with the Master Plan, Concept Plans, Technical Specifications and scope document are fulfilled and get the same approved by ENGINEER-IN -CHARGE . However, basic designrequirements as described in the specification and other requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

The design proposals shall be in the form of drawings, drawn to full scale as far as practical and specification shown in or describing all items of work including:

a) Request details as indicated on the tender

b) Metal quality finishes and thickness

c) Glass quality, coating and thickness and proposed manufacturer's brand names. drawings.

d) Sections of the mullion and transom together with structural

e) calculations.Arrangement and jointing of components.

f) Field connections especially mullion to mullion and transom to mullion.

g) Fixing and anchorage system of typical wall unit together with structural calculations

h) Drainage system and provision in respect of water leakage in the curtain wall/structuralglazing system

i) Provisions for thermal

j) Movements.Sealant and sealing method.

Glazing method.

Wind load and seismic load and any other specific load considered in the design.

Lightning protection link-up system of the curtain wall/structural glazing for connection and incorporation into the lightning conductor system of the building. Design concept must be stated in the proposal.

The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case this tolerance exceed those specified in the Specification.

Any parts of the curtain wall/structural glazing, when completed, shall be within the following tolerances:

Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m of length of any member, or 6mm in any total run in any line.

Deviation from theoretical position on plan or elevation, including deviation from plumb, levelor dimensioned angle, must not exceed 9mm total at any location.

Change in deviation must not exceed 3mm for any 3.5m run in any direction.

Samples

The contractor shall also submit samples of mullion and transom sections in lengths of 300mm with the same finish and workmanship along with the proposals and 300mmx300mm samples of glass (samples to include exposed screws and other exposed securing devices, if any).

Execution- Performance Testing

The performance tests are to be conducted on the structural glazing system, if the area of the structural glazing system exceeds 2500 Sq.ms from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science and Technology, India. The decision of the Engineer-in-charge about the necessity of testing of shall be final and binding.

General Requirements

Mock-up units shall be constructed by the contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the façade.

After approval of structural calculations and shop drawings for the structural glazing, one (1) Test Unit for performance testing of the structural glazing shall be constructed by the contractor at a laboratory approved by the Department.

Erect mock-up under manufacturers/installer’s direct supervision and employ Workmen as they would be employed during the actual erection at the job site.

Test procedures test schedules and test locations shall be submitted to Engineer in- charge for approval before testing.

Prior to fabrication of Test Units, the contractor shall submit shop drawings and calculations of the Test Unit for the Engineer-in-charge’s approval.

Production for final job site erection shall not start until approval has been obtained as a result of the mock-up test.

Test of Wind Pressure

The equivalent load of wind pressure or wind suction shall be given to the Test Unit as increasing or decreasing the inside pressure in the ‘Pressure Chamber’ at which the Test Unit is fixed.

The static wind pressure shall be applied up to 1.5 Kpa at maximum wind pressure. The variation of dynamic pressure shall be of any approximate sinecure- line.

Deflection on each observational points of the Test Unit shall be observed and recorded under the Static pressure as described above.

Any damage and harmful permanent deformation on any parts except sealing materials shall notbe found at maximum wind pressure.

The deflection on the main structural parts in these conditions shall not exceed:

1 /175 of the span between supports or 20mm, whichever is the lesser for verticalelements.

1 /250 of the span between supports for horizontal elements.

The extent of recovery of deformation 15 minutes after the removal of the test load is to be least 95%.

Test of Lateral Deflection per Floor Height

Lateral deflection per floor height shall be occurred on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

The deflection of every + 2.5mm shall be increased up to + 13mmm on the Test Unit (Static Deflection Test).

The dynamic deflection shall be applied up to + 13mm.

The variation of dynamic deflection shall be of an approximate sine-curveline, one period of 3 seconds.

The dimension of the deflection on each observational points of the Test Unit shall be measured under the condition as described above, the damage shall be observed.

Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall/structural glazing except sealant at maximum deflection.

Test of Water-tightness

Water shall be sprinkled to the Test Unit under the wind pressure. Pressure shall not be appliedto the Test Unit.

The volume of the sprinkling water in one minute shall be 5 litres/m2 min. (0.1 gal/ sq.ft.).

All water leakage and drainage system at the joint and openable sash of the curtain wall/structural glazing system shall be observed from the outside of the chamber.

Hold the test 2 times, in sequence as described below, conforming to the above mentioned conditions.

Install the test unit.

Hold 1st water-tightness test.

Hold test of wind pressure as described above. Hold 2nd water-tightness test.Lateral deflection test.

Water leakage at all parts of the Test Unit shall not be observed inside during the 1st water-tightness test.

Test Report

The Contractor is required to submit five (5) copies of test reports to the Engineer-in-Charge.Cost of Performance Test

The Contractor shall allow in his tender for the cost of the performance testing and of fabrication, erection, corrections to and demolition of the Test Units including any special provision required in the testing laboratory for the tests mentioned above.

The Contractor shall allow for amendments and adjustments to the mock-up as required by the Consultant.

If the Test Unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the Test Unit and shall have to get the Test Unit retested by the Testing Laboratorytill it passes the tests.

Cost of corrections to the Test Unit and cost of re-testing shall be borne by the Contractor at no additional cost to the Consultant.

Shop Drawings and Calculations for the Performance Testing

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for Engineer-in-Charge`s approval.

Record Drawings

The testing laboratory shall keep copy of approved Test Unit shop drawings and calculations at testing laboratory during testing of Test Unit.

The testing laboratory shall accurately and neatly record on the above-mentioned shop drawingsall changes, revisions, modification etc. made to Test Unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the Engineer-in-Charge.

Contractor’s Representatives

Full time attendance by Approved Representatives of the Contractor & subcontractor associated with the erection of curtain wall/structural glazing shall be provided for the erection of the Test Unit and for all testing of the Test Unit.

Performance Guarantee

The tenderer shall provide a performance guarantee as specified in the Specific Conditions of Contract for a period of five years, to provide for expenses, to cover the risk and cost of rectification of defect, noticed during the five years guarantee period.

Guarantee period to start from the date of completion of the project.

iii. High Pressure laminates (HPL) for External façade Cladding

The scope of work shall include the ventilated façade cladding system, integrated into the external facades, generally as indicated on the tender drawings.

External cladding work shall include:

Providing a complete HPL façade installed as a system with invisible fixing with brackets (fixed by inserts or screws) to the back of the panel, hung on horizontal aluminium rails, including continuous ventilation, weatherproof jointing system, subframe and permeable membrane incorporating, providing all materials, labour and equipment necessary to satisfactorily complete the installation and satisfy any specified performance criteria of all external wall cladding generally as described on the drawings.

Panels/sheet: High-pressure decorative laminates according to the EN 438,
homogenously reinforced with 70% natural-based fibres and thermosetting resins, manufactured under high pressure and temperature. The panels have an integrated, decorative melamine free surface with pigmented resins cured, rendering the panel highly weather resistantand suitable for external applications. Panel sizes to be worked out based on the elevations approved by ENGINEER-IN -CHARGE .

Thickness: 10/13 mm

Fire resistance: BS1, d0 (according to EN 438-7)Colour: As per approval of the ENGINEER-IN -CHARGE .Joint width:10 mm min. between panels,5 mm min. to abutments Air gap: The recommended depth for a continuous ventilated cavity is between 20 50 mm and has to be min. 50 cm^2/linear meter over the whole façade**.**

iv. **HPCC Technical Nomenclature** :

Providing & fixing High performance polymer concrete panels in approved pattern shade, finish and dimensions maximum up to 600mm width & 1200 mm length in outer peripheral thickness of 20mm and wall thickness between 10 – 12mm. The material shall be casted in controlled production environment with all precision groove making and cut sizes. The proprietary material composition mix design shall include Special exterior grade polymer binders, Portland cement, Selected, graded and sieved & fumed silica & quartz as aggregates, natural stone crushed mineral powders, Alkali resistant glass fibre of N.E.G Japan, Ownes corning or equivalent, Synthetic inorganic Iron oxide UV resistant exterior grade pigments, inorganic hydraulic binders, defoamers & Hydrophobic agents. The cladding panels shall be fixed on to existing cured plastered surface substrate wall treated with one or two coats of primer with appropriate Aluminium rectangular hollow section vertical member's framework of 50 mm X 50mm (4 mm thick) SDP Super Durable Polyurethane Powder coating) under controlled factory premises conditions Aluminium Substructure which shall be spaced out in accordance to the dimensions of the panel with minimum spacing of 600mm. The framework shall be attached through L shaped uncoated aluminium connectors of 25mm X 37mm (2mm thick) to the substrate walls. The manufactured panels shall have an evenly controlled factory – made groove for resting on to a continuous aluminium rail profiles throughout their length. The profiles are designed and manufactured for starter piece, intermediate and an inverted starter profile for the top piece. Aluminium rail profile shall ensure uniform and precision joints and shall be factory finished with Super Durable powered coated colour in approved RAL shade. All aluminium profiles, excluding substructure framework are duly treated with SDP (Super Durable Polyurethane Powder coating) of minimum 50 microns under controlled factory premises conditions, where it is heat cured for 10 minutes @ 200°C object temperature on 4 stage PT chromated substrate for superior adhesion as per ASTM D 3359 with a warranty of 10 years against any fading under exterior conditions due to exposure of UV Sunlight, Harsh weather, and exterior conditions as per AAMA 620 specifications All fixtures, and screws shall be corrosion free i.e., all rail profiles, cleats to be used should be made of 6063 T6 alloy grade and all screws used should be of M/s Hilti, Worth, Klimas, Fischer & Patta or equivalent. The groove of the width can be chosen i.e., 1.7mm, 3mm, 6.5mm, 12.6mm or 20mm. The corners junctions can be treated as regular corner fixing or Mitred

corner fixing. The entire system should be certified by an approved third-party structural consultant for a minimum structural proof load test with positive & negative wind pressure of 5kPA.All fixing details and drawings to be provided by vendor and to be duly approved by ENGINEER-IN -CHARGE at project and the work to be carried out as per direction of the Engineer- in charge.

(III) Solid Terracotta Façade

Tender Specifications Panel – CRP 15 Solid

Providing and Fixing CFP – Clay Façade Panelling system in approved shade, finish, size and in thickness of 15mm. The clay panels shall have Flexural Strength /Modulus of rupture ≥ 9 N /mm2 in accordance to ISO – 10545 -4 with breaking strength ≥ 550 N in accordance to ISO 10545-4. The panels should have water absorption ≤ 4 % in accordance to ISO – 10545-3. The surface scratch hardness value i.e., Moh's scale should be Minimum 6 in accordance to ISO -10545-2. The clay panels should have inherent properties of being resistant to stains and chemicals. The material should be Class I material in terms of reaction to fire in accordance to EN 13501-1 / ASTM E136. The entire system should be certified by an approved third-party structural consultant for a minimum structural proof load test with positive & negative wind pressure of 5kPA.

The cladding panels shall be fixed on to existing cured plastered surface substrate wall treated with one or two coats of primer with appropriate Aluminium rectangular hollow section vertical members framework of 25mm X 50mm (2mm thick) which shall be spaced out in accordance to the dimensions of the panel with minimum spacing of 600mm. The framework shall be attached through L shaped aluminium connectors of 25mm X 37mm (2mm thick) to the substrate walls. The manufactured panels shall have an evenly controlled factory – made groove for resting on to a continuous aluminium rail profiles throughout their length. The profiles are designed and manufactured for starter piece, intermediate and an inverted starter profile for the top piece. Aluminium rail profile shall ensure uniform and precision joints and shall be factory finished with Super Durable powered coated colour in approved RAL shade. All fixtures, and screws shall be corrosion free i.e., all rail profiles, cleats to be used should be made of 6063 T6 alloy grade and all screws used should be of Zinc Plated of M/s Hilti, Worth, Klimas, Patta or equivalent. The groove of the width can be chosen i.e., 1.7mm, 3mm, 6.5mm, 12.6mm or 20mm. The corners junctions to be neatly treated with adequate aluminium closed 'L' corner shaped pieces in required length in similar shade coated with factory finished Super Durable Powder, to the clay façade panel. Alternatively, the corners junctions can be treated as regular corner fixing or Mitred corner fixing. All fixing details and drawings to be provided by vendor and to be duly approved by Engineer in charge at project and the work to be carried out as per direction of the Engineer-in charge

5.22 Grill Work:

Grill Work:

a. Grills shall be provided in the windows in the Clinical and utility blocks based on the directions of the ENGINEER-IN -CHARGE . These grills shall be made out of mild steel sections.

b. All steel grills shall conform to Latest CPWD Specifications.

c. In case of grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer and finished with two or more coats of low VOC synthetic enamel pain of approved make and shade as per the directions of the ENGINEER-IN -CHARGE.

5.23 Glass Reinforced Concrete (G.R.C):

Glass Reinforced Concrete (G.R.C) Wall Cladding Tiles in approved design, size, texture, thickness, pattern and color. The thickness of the tiles should range between 12 to 18 mm (depending on the texture of the tile), allowing variance of ±2 mm in accordance with IS: 1237-1980. The composition of tiles should be '43' Grade White Portland cement, reinforced with Alkali Resistant Glass Fiber and the pigmentation should be done with exterior grade synthetic inorganic iron oxide pigments manufactured by 'BAYFERROX (Germany)' or equivalent. The pigmentation should be homogeneous and in accordance with British Standards BS EN 12878:1999. The other additives should be fine washed graded quartz, super plasticizers and integrated water proofing agents and others. The tiles should be produced with high vibration technology and should have compressive strength equivalent to M-40 Grade@28 days. The top surface of the tiles should be sealed with acrylic lacquer resulting in surface water absorption of tiles, less than 1% and water absorption by 24 hrs immersion method, less than 8%. The tiles should be applied on a rough plaster of cement mortar 1:3 (1 cement: 3 coarse sand) and the fixing of tile adhesive or equivalent as per manufacturer's laying instruction.

5.24 Texture Coatings

(Work to be carried out as per Manufacturer Specification)

Material

The paint shall be (Natural stone dust reinforced Textured coatings / premium acrylic base with silicon additives Clear coat over texture finish) of approved brand and manufacture.

This texture shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-ln-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-ln-Charge.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using cement mixed with tinted with same shade primer for minor repairs. The prepared surface shall have received the approval of the Engineer-ln-Charge after inspection before painting is commenced.

Finishing walls with textured exterior coating of natural shade1.80-2.0mm):

Providing and laying weather and Ultravoilet Resistant, Water Repellent, Dust, Dirt and Stain Resistant, Fungus and Algae Resistant natural non pigmented crushed granite Chips (100%

natural crushed Granite chips/powder) of approved make with final coat of texture with stone chips (attainable thickness: 0.90 to 1.00mm to offer grooved finish) applied with Spray over a coat of texture without chips (attainable thickness: 0.80 to 1.00mm to offer smooth surface as base coat) over a repair check with exterior grade cement mixed with acrylic primer tinted in approved shade of texture coat over a coat of acrylic primer mixed with inital coat of anti efflorsence wall sealer & water in the ratio of 2:1 complete as approved by Engineer-in-charge. Finally two coat of water base siloxine protection coat applied with roller and brush to make surface streak resistance With 7 years warranty.

b)MARMO PLAST STONE WITH IN NATURAL APPROVED SHADE WITH CLEAR COAT

Providing & laying texture paint (Finished thickness 2.5 mm to 3.00 mm) Ultra Marmoplast stone of approved make with natural stone crushed powder mixed with pigmentation (0.01 % - 3.00%) applied over plaster surface within grooves. Acrylic primer added with wall sealer to be over the surface for better adhesion of the texture with surface. 1st- coat without chips to be applied as base coat which gives added strength to the final product, to be applied with stainless steel trowel. Texture coat to be applied with chips of stone powder having available natural stone base shade with stainless steel trowel finished with acrylic trowel, final coat of siloxanes water base protection coat to be applied which make the product completely water repellent / dust resistant / anti fungal which ensures with a warranty of 08 years on shades and sustainability ,whereas grooves are to be crafted in plaster as design approved by engineering in charge.

5.25 GRC Screen Jali:-

Providing and fixing approved make Glass Reinforced Concrete (G.R.C) Screens casted with 'Spray Mix' concrete design in approved size, pattern, thickness of 40-50mm on the outer Border & 25-30mm for Internal member or overall thickness of 35mm and shade. The Screens should be made from ‘43 grade’ Portland Cement manufactured White Quartz fine graded sieve Silica Sand, Alkali Resistant Glass Fibre manufactured by **'NEG Japan, Owens Corning ‘Saint Gobain’ or equivalent,** Super Plasticizers manufactured by ‘Karochem’ or equivalent, Polymers manufactured by ‘Nova Polychem’ or equivalent and U.V resistant Synthetic inorganic pigments should be used for pigmentation manufactured by ‘Phenochem industries or equivalent. The Screens casting shall take place with layering methodology using- Direct Power Spray machines. The GRC Screens flexural strength average L.O.P should be above or equivalent to 6 N/mm² & M.O.R should be above or equivalent to 12 N/mm² for tests done on 28 days cured samples. The fixing of Screens should be done using ‘Dry fixing’ method onto structural support members i.e. R.C.C, Brick work or on to MS Framework with S.S. 304 ‘L’ shaped cleats and S.S. 304 dowel pins. Also, if required fasteners to be used of Steel Grip/ HP/ Wurth/ Hilti/ Fischer/ Klimas or equivalent. All cast in socket to be Epoxy Primer Coated. ELECTRODES to be used of Advani, Mangalam, Esab or Victor brand or equivalent. If there will be a requirement of Joint filling, then Elastomeric exterior grade paintable PU Sealant will be used. For final finishing of Screens one weather shield exterior grade water based diluted paint coat will be done if required. Vendors shall submit shop drawings of the same, the drawings to be duly approved by the Engineer in charge at site.

F.R.P Screen Jali.

Screens Jali Providing and fixing make or equivalent exterior grade fire retardant fibre reinforced polymer resin plastic composite smooth finished, back side closed screens as per approved pattern, design, shade and wall thickness between 2.5mm – 3mm. The Borders and pattern of the screen shall be casted hollow and with reinforcement of marine grade plywood at specific locations in the border, which shall be used for fixing. The material casting shall take place in controlled production environment with Isophthalic Polyester Fire-retardant resin RPL - 208, UV inhibitor Fire Retardant Gel Coat, EM 1011 layered Chopped strand emulsion mat, Fillers, UV Resistant exterior grade synthetic inorganic pigments and catalysts. The fibre reinforced composite FRP screens shall have fibre reinforcements with resin matrix that bonds the fibre. The material shall be casted in fibre moulds with ISO/ UV resistant PNG Polyester resin with UV Stabilized clear gel coats for making it UV resistant, non-fading product in exterior conditions. The product shall be made in accordance to IS :6746.1994 for fire performance characteristics and shall be classified as N-1 i.e. Fire shall dose off within 10 seconds. The periphery or borders of screens shall have marine ply reinforced for adequate fixing with Hilti self-tapping screws and in accordance to shop drawings approved by engineer in charge. The FRP screens to be treated with same shade matt finished enamel for final finished product. The same to be under the scope of painting works contractor. The product's density shall be 1460 Kg/m³ having approximate weight between 10.764 -16 Kg/m². The product shall have a tolerance of temperature variation between - 20 degrees Celsius to 65 degrees Celsius. The product manufactured shall be under following tolerances Thickness +- 10%, Dimensional (all directions) ± 1/8", 0 -10 ft. (3mm in 3m), Thickness ± 1/8" (3mm).

Protection in Hospital Building

The All Corridor which will have stretcher movement will be provided with following wall protections on both of corridor walls

Sheeting on Corridor walls

The Turnkey Contractor will Provide & install 2 mm to 3mm thk sheeting on both side wall of corridor along length of corridor for a height of 1200mm. the provided sheet should be with Anti-bacterial ASTM G21-15 result > 99.9% INHIBITS GROWTH ,Fire and smoke rating ASTM E84-17 GB8623-2012 CLASS A ,Horizontal burning UL94HB result passed ,Crashproof ASTM D256-10 el ,GB/T 14153-1993 result passed ,Chemical and corrosionresistance ASTM D543-14/ASTM D2240 -15/ASTM D638-14 result good ,Color Difference SAEJ1545-2005 result good, Color Staining EN423 :2001 result good ,Heavy metal test (LEADand CADMIUM) CA65 result good , Formaldehyde and hazardous gas volatilization that reachE0 level can pollute the environment and pass the detection of CA cdpho 1350-VOC and GB/T 18580-2017 ,Wear resistance, nondeformable. Material without sodium phthalate, no polyisobutyl phthalate, light in weight, wall sheet cladding as per approved design and shade

.(Should provide extra accessories such as outside corner ,top cap divider bar ,inside corner ,Tungsten steel strip or metal connection strips as optional accessories as per the design

Corner Guards

The Turnkey Contractor will Provide & install corner guard as per typical detail at all corners of

Corridors along with providing and installing the corner guard at the Jamb of Lift opening.

Wall Guard

The EPC Contractor will Provide & install wall guard as shown in Typical Detail on both side wall of corridor along length of corridor.

Stainless steel Crash Guards

Standard type 304, 16 Gauge stainless steel in a No. 4 satin finish. Incorporates hidden fasteners and flat front profile for a sleek design. Provides exceptional impact resistance in high abuse areas. Made using 75% post-consumer recycled material –may contribute to recycled content credit in the IGBC rating systems.
The system shall also confirm to class A fire rating and ASTM D-543 for chemical and stain resistance. The colour and design shall be as per Engineer in charge.

Zinc composite Panel :-

Supply & Installation of Open Groove Zinc Composite Panel rain screen cladding system (thickness: minimum 4mm) 990 mm X up to 3000 mm ZCP sheets made with 0.7 mm ,3 mm Mineral Core & 0.5 mm Aluminium Skin . To be fixed over Aluminium Box Section using suitable screws, cleats as per site conditions .Zcp shall have TBW testing certification for reaction to fire as per item is a rolled zinc alloyed with copper and titanium,. It is factory treated on the visible surface, giving it a rough, light grey appearance from the outset. The innovative transformation process modifies both the surface roughness of natural zinc and its colour. The heterogeneous surface, punctuated by asperities, is insensitive to fingerprints. All surface treatment for the top skin to be done by the zinc coil manufacturer at their facility .No third party coating / surface treatment shall be acceptable .

Zinc manufacturer & ZCP manufacturer should have presence in India & successfully supplied material for Indian Government Projects of similar magnitude ZCP manufacturer to submit proof of origin of goods & MTC of zinc coil from Zinc manufacturer for the lot of zinc coilused for this project .Providing & fixing in position 4mm thick. Zinc composite panels in facade and soffit of approved make conforming to ASTM standard /specifications comprising of 3mm thick FR grade mineral Core. 3mm Fire grade core is sandwiched between skins of 0.50mm thick pre-weathered engraved zinc sheet or approved shade finish zinc sheet & 0.5 mm Aluminum to have overall thickness of 4mm Fixing of surface cladding to masonry/ concrete faces/steel structure as called for, including appropriate and adequate framework of aluminum hollow sections as per drawings to fix the composite panel to the Al frame, straight/slope including all accessories. The system shall be designed in a way it should allow gaps for ventilation The system shall be designed and detailed drawing with quantities shall be provided by the manufacturer as per wind load and architectural drawing .No Silicone will be used for groove . Its an open groove system with minimum groove of15 mm. Standard Sheet Size will be 990 mm wide & length up to 3000 mm .

5.26 False Ceiling Works Specifications.

5.26.1 Aluminum perforated Metal Ceiling System.

The metallic ceiling shall have regular beveled/plain edge powder Coated aluminum ceilingtiles In size 600mm x 600 mm x 0.6 mm & color RAL 9003 white & having perforation of 1.8 dia circle with a backing of factory pressed black non woven tissue the epoxy powder coat should electro statically be applied in a controlled environment and then be baked to achieve theperfect fusion with the metal surface to be laid on to be exposed grid system 24mm comprisingmain runner, cross tees and wall angles. for installation to comprise intermediate channel of size 45mm x 0.55mm thk with two flanges of15mm each suspended at 1200 mm clipped to spring runner, bracket and connectors for spring runners securely fixed to structure using GI soffit cleats fixed to ceiling with 6mm dia and 50mm long dash fasteners, 4mm GI adjustable rods with galvanized level clips spaced at 1200mm center along with the runner by approved suspension and bracket and connectors for spring runners. Wall angles 19mm X 22mm with clips to be secured to the wall at 450mm maximum center to the successful completion of the job to the satisfaction of the Engineer-in-charge. The rate shall be inclusive of making openings for light fittings, grills, diffusers, cutouts, wastage and necessary hardware etc

5.26.3 Open Cell Ceiling Specification

Open Cell 100mm Hinge able ceiling with cell size of 100mm made out of 0.3mm thick coil coated GMS . The assembled cell ceiling panels shall be in size of 600x1200 made out of blades in 9mm (W) x 40mm (H). The assembled cell ceiling panels are then clipped into U-94 carriers in GMS, coated in black enamelled finished at 1200mm c.c. Wire clips shall hold the cell ceiling panels into the U-94 carriers. Once the U-94 carriers are installed then primary angles made out of GMS, type U1040 are cross connected to the U-94 carriers at 1200mm c.c. for lateral bracing The whole ceiling shall be suspended by M6 threaded rods installed 1200mm c.c.All panel modules must be hingeable through wire clips. The panels are fully downward demountable / hinged from the proprietary U 94 carrier section using C 94 spring panels. The system should be in accordance with Material class A2-s1, d0 according to EN 13501-01 “non-combustible”, as per the Direction of Arch-in-charge. The system will meet fire retardant standards of BS 476: Part 6 & Part 7. Tolerances according to TAIM, DIN EN 13964 and quality controlled to ISO 9001:2015 approved by SIS,LEED certification by IGBC. Finish: Coil coated RAL finish having coating thickness between 15-20 microns.

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5.26.4 Aluminium Metal ceiling:

Providing and Fixing Perforated 1.8mm dis Hook on metal ceiling 600mm wide, length upto 1200mm long, placed form- fitting and tension-free in a special concealed sub structure under protected indoor conditions. Tolerances and quality requirements according to TAIM, DIN EN 13964 and Standards. Material Thickness 0.90mm Aluminium to provide the ceiling panels without deflection. Interior grade Powder Coated 80 micron coating thickness. Demounting of panels is performed without tools. System S4 substructure consisting of U 1040 form punched angles as a lateral grid which is suspended pressure-rigid from the bare ceiling with M6 threaded rods using official approved dowel plugs. The angles are to be connected together at the ends by means of U 1041 longitudinal connectors. The spacing of the grid angles is according to the requirements of DIN 18168 and DIN EN 13964 as well as the loads of the system and are to be determined and checked by the contractor. On the grid angles, U 1005 A Z-shaped carrier profiles are attached as longitudinal profile with M6 bolts [secured against loosening]. The longitudinal connection of the Z-shaped carrier profiles are made by means of U 401 profile connectors. The spacing of the Z-shaped carries profiles is to be matched exactly to the spacing of the hook-in sides of the metal

panels so that panels rest tension-free in the system. Care is to be taken to ensure horizontal and flush alignment. It is only permissible to use structure components that have been approved by the manufacturer of the metal panels. All parts are made of galvanised steel. Company should have ISO 9001:2015 QMS certificate & All ceiling shall be TAIM Certified & LEED certification by Indian Green Building council (IGBC) . The system will meet Fire retardant standard of BS 476: Part 6 & Part 7.
The finishes of the panel shall be RAL Powder Coated Non Metallic Shade(Internal Application) in a fully automated & conveyorized powder coating system with pre-treatment nano technology & inline automatic WDS.

5.26.5 GI metal False ceiling.

Providing and fixing GI Clip in Metal Ceiling System of 600x600 mm module which includes providing and fixing 'C' wall angle of size 20x30x20 mm made of 0.5 mm thick pre painted steel along the perimeter of the room with help of nylon sleeves and wooden screws at 300 mm center to centre, suspending the main C carrier of size 10x38x10 mm made of G.I steel 0.7 mm thick from the soffit with the help of soffit cleat 37x27x25x1.6 mm, rawl plugs of size 38x12 mm and C carrier suspension clip and main carrier bracket at 1000 mm c/c. Inverted triangle shaped Spring Tee having height of 24 mm and width of 34 mm made of GI steel 0.45 mm thick is then fixed to the main C carrier and in direction perpendicular to it at 600 mm centers with the help of suspension brackets. Wherever the main C carrier and spring T have to join, C carrier and spring T connectors have to be used. All sections to be galvanized@ 120 gms/sqm (both side inclusive), fixing with clip in tiles into spring T with : GI Metal Ceiling Clip in plain Beveled edge global white color tiles of size 600x600 and 0.5 mm thick with 25 mm height, made of G I sheet having galvanizing of 100 gms/ sqm (both sides inclusive) and electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending.

GI Metal Ceiling Clip in plain Beveled edge global white color tiles of size 600x600 and 0.5 mm thick with 25 mm height, made of G I sheet having galvanizing of 100 gms/ sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation.

5.27 Roofing (For open ramp, Duct and Open to sky area)

Polycarbonate multi-layered, Multicell Connectible modular panel system for, a complete assembly of coextruded UV protected polycarbonate panels incorporated into a complete system. Standing seam polycarbonate panel system of minimum 25 mm thick (Min.) with min 1200mm (min.) width. Panels with bigger width will be preferred for reducing number of joints in the roof. Panels shall be with grip lock double tooth locking mechanism with interlocking connectible connectors running lengthwise at both sides of the panel. Panels shall be fixed on Purlins of MS structure (will be paid Separately) with 3 numbers of self-drilling screws and specials Trapezoidal Heavy Duty Fastener to ensure a pull-out load of min. 7000N (7KN) tested as per ISO 6892:1998 and IS 1608: 2005. Panels shall be solo opaque type in opaque and translucent clear combination with seven layers for

required lux level along with all fixing accessories to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels with more layers will be preferred for better insulation and improved shading coefficient. Prices includes All accessories including Aluminium profiles with EPDM Gaskets, at alternate edges with taper cutting to achieve the required profile, aesthetics and performance criteria. U value shall not be more than 1.6 Watt/m2K as per EN ISO 1077-2:2018 and respective third Party test certificate shall be produced before procurement. Panels must satisfy Dart drop impact test as per IS 14443-97 shall show no sign of breakage on Polycarbonate sheets which have been exposed to UV for a min. of 500 Hours as per ASTM G 155.Panels shall not have Yellowness Index as per ASTM D 1925 of 15 units when tested on a sample exposed to UV for 500 Hours as per ASTM G 155. Panel shall be with additional End cap/Aluminium U/F profile/ Glazing Bar for ends as required. Panel shall be fixed over MS structural steel/MS purlin (paid separately) conforming to the detail technical specifications as per approved architectural drawings. Trained and factory authorized labour with supervision to complete the entire panel installation as per drawing and direction of the engineering in charge.

Modular False Ceiling

Tiles

Modular false ceiling tiles shall be of the following material composition and specification of recommended make.

Size of tiles: 600 x 600 x 15mm

Materials shall be of the best-approved quality obtainable and they shall comply with the respective latest Standard Specifications.

Samples of all materials shall be got approved before placing order and the approved sample shall be deposited with the Engineer in charges, which will be displayed at site as a control sample.

In case of non-availability of materials in metric sizes, the nearest size in FPS units shall be provided with the prior approval of the Engineer in charges for which neither extra will be paid nor any rebate shall be recovered.

If directed, materials shall be tested in any approved Testing Laboratory and the test certificate in original shall be submitted to the Engineer in charges and, the entire charges connected with testing including charges for repeated tests if ordered, shall be borne by the Contractor.

The Contractor without any extra cost shall provide all equipment and facilities for carrying out field tests on materials if asked by the Engineer in charges.

It shall be obligatory for the Contractor to furnish certificates, if demanded by the Engineer in charges, from manufacturer or the material supplier that the work has been carried out by their

material and as per their recommendations and specifications.

Mineral Fibre Modular False Ceiling System.

Tiles

Modular false ceiling tiles shall be of the following material composition and specification of recommended make.

Size of the boards : 600 x 600 x 19/ 15mm

Edge Style : Tegular suitable for 24 OR 15mm T grids

NRC : In the range of 0.55 - 0.65

Fire performance : Class O/ Class 1 as per BS 476

Relative humidity: In the range of 95%

Light Reflectance : Greater than - 83 %

Colour : White or to shade as approved by Engineer in charges.

Material Composition : Homogenous mineral fibre comprising slag wood, starch, clay, Guar Gum etc

16mm Antimicrobial Ceiling Tile

General specification for providing and fixing 16 mm thick beveled tegular mineral fibre false ceiling tiles item to be same as mentioned above except the tile will be Anti-microbial false ceiling tiles.

Gypsum False ceiling Works

General

Design of grid layout shall be produced with co-ordinating suspension points in tandem with other service duct / cable tray layouts. The grid layout is to be superimposed on the ceiling service ducting / cabling layout and got approved from the Engineer in charges.

Suspension System & Material.

The false ceiling shall include providing and fixing GI perimeter channels of size 0.55 mm. thk. having one flange of 20 mm and another flange of 30 mm and web of 27 mm along the perimeter of the ceiling, screw fixed to brick wall/ partition with help of nylon sleeves and screws, at 610 mm centres. The suspended GI intermediate channels to be of size 45 mm, 0.9mm thk with two flanges of 15 mm each, suspended from the soffit at 1220 mm centers with ceiling angles of width 25mm x 10mm x 0.55mm thk fixed to soffit with GI cleat and steel expansion fasteners. Ceiling section of 0.55 mm thk having web of 51.5 mm and two flanges of 26 mm each with lips of 10.5mm are then fixed to the intermediate channels with help of connecting clips and in direction perpendicular to the

intermediate channel with centers. The 12.5 mm tapered edge gypboard (Confirming to IS-2095-1982) is then screw fixed to ceiling section with 25 mm dry wall screws at 230mm centers. Screw fixing is done mechanically either with screwdriver or drilling machine with suitable attachment.

Finishing

The boards are to be joined and finished so as to have a flush look which includes finishing the tapered and square edges of the board with joining compound. fibre tape and two coats of primer suitable for Gypboard (As per the recommendations / practice of India gypsum or equivalent) This includes providing the surface of false ceiling to be painted with approved quality of Plastic emulsion paint. The false ceiling surfaces shall be prepared to the satisfaction of the Engineer in charge, and shall be applied with two coats of primer, two coats of putty and touch up putty if required to achieve smooth finish. The surface shall be painted with two coats of silk emulsion paint of approved make to the satisfaction of Engineer in charges.

Moisture Resistant Gypsum False ceiling Works

Supply and installation of suspended gypsum board ceiling(Moisture Resistant) formed by a 600x600mm tiles with 15mm thickness. Foil-covered with pre-impregnated, non-toxic white paper plasterboard ceiling (Clean-room certified) including suspension system and finishing work. Suspension system, material and finishing will be same as for Gypsum False ceiling work.

5.28 Over Head Tanks:

Providing and installation of RCC water storage tank in design mix of minimum M-35 grade of capacity and number of compartments as per requirement in design basis report mixed with waterproofing compound in concrete in the proportion as recommended by the manufacturer, including centring, shuttering, scaffolding and curing including inlet and outlet stainless steel pipes ,waterproofing as described in detailed specifications of walls and slab and shall include of water supply system including water tank with water containing bleaching powder as per specification as directed . All works to be carried out at terrace level. Tenderer should give the guarantee of ten years for water tightness of the tank. price to include antifungal Commercial Glazed tiles of required size of minimum thickness 5 mm in floor/skirting and dado on 12 mm thick cement plaster 1:3 (1 cement : 3 coarse Sand)admixed with approved quality waterproofing compound as per manufactureres specifications and jointed with white cement slurry mixed with pigment to match with the colour of the tiles, including grooves. (Basic rate of ceramic tiles @ Rs. 150/- per Sqm) of approved manufacture complete as per design and drawing. Providing and fixing orange color safety foot rest in concrete including provisions in shuttering and alignment ,of minimum 6 mm thick plastic encapsulated as per IS :10910 on 12 mm dia steel bar conforming to IS:1786 having minimum cross section as 23x25 mm and overallminimum length 263 mm and width as 165 mm with min. space 112 mm between protruded legs having 2 mm ribs on tread on top surface and adequate anchoring projections on on tail length on 138 mm as per specifications

and having manufacturers permanent identification mark to be visible .Providing and fixing stainless steel 304 grade puddle flanges fabricated out of 6mm th stainless steel plate 150mm wide welded around the pipes to suitable size properly fixedin wall and top of slab of tank. complete as per drawing. Disinfection of water supply system including underground water tank with water containing bleaching powder as per specificationas directed. Providing and fixing CI manhole cover with frame (Bearing capacity weight minimum 116 kgs. for cover and frame) with necessary locking arrangement etc. complete. Providing and fixing 100mm dia CI pipe, 1M long with cowel as ventilator with wire mesh complete.

5.29 Aluminium Louver System for utilities covering.

Aluminium louvered systems - are to be fully prefabricated assembled units completed with factory finish and installed on to site fixed channel and brackets. Includes interface details suchas fire seal, flashing, sealants, extruded capping, insulations, brackets and any sub frame as required. All exposed Aluminium will be in white colour powder coated finish and the works shall be complete as directed by the ENGINEER-IN -CHARGE .

5.30 Dumbwaiter

The location of Dumbwaiters has been shown in drawings for sterile supply from CSSD to Sterile Core of Operation theatre complex. This dumbwaiter has to be provided as/Drawing by the EPC Contractor however capacity of dumbwaiter to be as per requirement of Load. Internalfinishing of Dumbwaiter should be according to the requirement of clean room.

5.31 MRI Quench Pipe

The Contractor has to provide Quench Pipe (Helium ventilating pipe) for MRI as per safety requirement to withstand the pressure requirement, requirement of clearance of exhaust from surrounding area. The work has to be done by Contractor complete in all respect.

5.32 Door for Service shafts and trap door

The Contractor has to provide Doors for All service shafts as required for maintaining and accessing the services in compliance with NBC 2026 fire requirements. The shaft door will be with Aluminium Frame and flush door shutters having matching laminate with other rooms doorin the vicinity. The shaft door should provide with L& Key for locking along with handle.

The contractor will also provide the trap door (Openable Shutter) with matching finish of false ceiling at various locations to access the MEP equipment, junctions and services above the false ceiling for maintenance purpose. The trap door should be provided with necessary

5.33 MRI Room

The Floor, wall and ceiling of MRI room will be provided by radio-frequency- and magnetic-shielding as per requirement of MRI Vendor. The contractor has to coordinate and provide necessary sunk in floor to provide RF shielding in floor. The MRI room will have 3 layered wall consist of one layer of block work, 1 layer of RF Shielding and one layer of Gypsum board dry wall (Internal) the internal gypsum board dry wall should be as per the requirement of MRI vendor/manufacture recommendation. All electrical fittings, fixtures, nails screw, struts will beof Stainless Steel or as recommended by MRI Vendor.

5.34 Firestop Sealants:

The fundamental premise of modern fire protection is based on the principles of compartmentation. Every building is designed into several compartments, to prevent or slow the spread of fire and smoke from one compartment walls, ceilings and floors. These have the potential to seriously risk the integrity of the fire compartments unless special and proven fire stopping systems are employed.Contractor to provide fire stopping systems of standard specifications to meet the levels of fire performance as per NBC 2026 Part 4. The system shall not only be designed to stop the fire but alsoto prevent the travel of smoke. Preferred make would be Promat, Hilti,3M or Bosch

5.35 Water Proofing works.

These specifications cover the general requirements of waterproofing systems to the various parts of the structure. The contractor should consider the prescribed requirements carefully and assess the best suited system for a particular part of the structure, keeping in mind the heavy rainfall of the region and high-water table possibility. The contractor is fully and totally responsible to provide buildings and infrastructure that are watertight and leak proof.

General Waterproofing Requirements

(a) The work shall be carried out by an approved specialized waterproofing agency that has a minimum of ten (10) years' experience in the proposed waterproofing systems.

(b) The specifications given below against each item are indicative in nature. The contractor in consultation with the proposed specialized waterproofing agency shall propose their detailed specification in line with the requirements given below and shall submit such specifications for approval by the Engineer.

(c) On award of work to the Contractor, such specifications after incorporation of modifications suggested by the Engineer (if any) shall become part of the contract specifications and Contractor shall execute all waterproofing works accordingly.

(d) On completion of the works, Contractor must submit a comprehensive guarantee valid for minimum 10 years. The extent of waterproofing required for different structural elements shall be as approved by the Engineer and Contractor's specifications shall match such requirements.

(e) In case of exposed water proofing treatments, required slopes shall be given to the finished surfaces of waterproofing treatment to ensure drain out of water in the desired direction.

(f) A shop drawing shall be submitted for review before executing the treatments with all relevant details of rainwater down take pipes, flashing, coving, ridge, valley, drip molds etc.

(g) The Contractor is liable for all preparatory works to affect a defect free treatment, staging, scaffolding, curing, cost of all chemicals, dewatering, ponding test for the duration as instructed by the Engineer, protection against damages of waterproofed layer, working at all levels and heights etc.

(h) 72 hrs. ponding test is mandatory over all water proofing works.

(i) The contractor must obtain proprietary waterproofing products directly from the manufacturer.

(j) The contractor must obtain cement, screened river sand, brick-bats, aggregates, integral waterproofing compounds, etc. required for screeds, protective toppings and plasters shall conform to the pertaining IS standards (IS 269, IS 8112, IS 13286, IS 383, IS 2645, IS 12118 and IS 3495).

(k) The Employer/Engineer may demand the conformance of these materials from the Specialized Executing Waterproofing Agencies / civil contractor from time to time and they shall have to produce test reports / documents to prove the conformance of these materials with their applicable standards, without any argument.

(l) All works including preparatory works for the waterproofing shall be done by the Contractor.

BASEMENT WATERPROOFING:

Under Raft Slab/Stich slab/Pile caps Waterproofing System

Supplying and installing 1.2 mm composite thick fully bonded weldable HDPE membrane conforming to IS 16471:2017 requirements of UG waterproofing structures, requirements to provide Type A fully bonded protection of UG waterproofing structures. The membrane shall exhibit 25 years of service life tested and complied in accordance with EN 13251:2016 durability certification. The membrane should be minimum 2.4 m wide comprising of an HDPE layer and a pressure sensitive adhesive layer which is covered by a weatherproof protective layer with lap Joint Strength at overlaps >15000 N/m ASTM D 1876. The membrane shall have minimum of 100mm side and end laps which shall be thermos fused with leister machines at all the joints for assuring watertightness and achieving monolithic membrane. End laps and side laps should be a minimum of 100 mm with the weld size of minimum 50 mm in case of a single weld system. In case of a double weld system, comprising of two parallel welds of 15 mm wide each with a 20 mm air channel gap in between the two weld lines. The size of the membrane should not be less than 2.4 Mtr. x 20 Mtr. to minimize the joints. This membrane shall be continued over the vertical surface but terminated at a minimum of 100mm below the top edge of the raft slab/footings and fixed as per recommendation.

The HDPE membrane should have the following minimum properties-

PROPERTIES	TYPICAL VALUE	TEST METHOD
Color	White/ Off White	Visual Observations
Roll Size	20 m x 2.4 m	
Thickness of Composite Membrane	1.2mm (Minimum 0.85mm HDPE Layer)	ASTM D 3767

Tensile Strength	25 MPa	ASTM D 412
Elongation	500%	ASTM D 412
Low Temperature Flexibility	– 25 Degree C Pass	ASTM D 1970
Resistance to Hydrostatic Head	70 m	ASTM D 5385
Peel Adhesion to Concrete	1500 N/m	ASTM D 903
Lap Joint (Side and End Laps) Peel Adhesion	15000 N/m	ASTM D 1876
UV Exposure	45 Days pass	Internal Test Method
Puncture Resistance	1000 N	ASTM E 154

Basement Retaining Wall

"Waterproofing of Un-Confined Retaining Wall:
Supplying & Installing 1.5mm thick self-adhesive , cold applied , flexible waterproofing membrane comprising of a self-adhesive rubberized asphalt with minimum 0.5mm HDPE film. Membrane should be supplied with original manufacturer's Material Test Certificate (MTC) & membrane should be installed in strict accordance with original manufacturer's instructions and contractor should produce method statement from original product manufacturer. The self-adhesive membrane shall have following minimum properties :

i. Lap Adhesion : > 670 N/M
ii. Thickness : 1.5mm with HDPE thickness of 0.5mm
iii. Elongation (to ultimate failure of rubberized asphalt) : 230%/180%
iv. Puncture Resistance : >220N
v. Selvedge 100mm
vi. Hydrophilic water bar in all horizontal and vertical Construction Joints

Self-adhesive membrane Termination on retaining wall which includes providing a chase of (20 x 20) mm at a distance of 300 mm from ground level or 150 mm from podium/roof slab level for membrane termination. The self-adhesive membrane should be dressed into the chase and pointed with mortar or as approved by supplier prior to backfilling.

All system to be installed as per supplier's recommendations, etc. complete with all lead and lift for all materials & labour & as directed by Engineer in-charge.

PODIUM WATERPROOFING

Providing & applying 2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using high pressure plural component spray equipment to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m2.

Solid Content (Zero VOC)	ASTM D 2369	100 %
Tensile Strength	ASTM D 412	15 MPa
Elongation	ASTM D 412	450 %
Tear Strength	ASTM D 624/ASTM D 1004	60 Kn/m
Adhesion (on concrete)	ASTM D 4541	2 Mpa
Dynamic Crack bridging	EN 1062-7, Method B	No cracks
Shore A Hardness	ASTM D2240	85
Resistance to hydrostatic Water pressure	ASTM D 5385/ DIN16726	7 Bar
Puncture Resistance	ASTM E 154	1000 N
Impact resistance	ASTM D 2794	17 N.m
Fire Resistance	EN 13501-1, Class B	Pass
Resistance to root	CEN TS/14416	Pass
Service Range temperature		-20 to 90 degrees Celsius
Low temperature Crack bridging ability	ASTM C 1305	3.2 mm

WATERPROOFING FOR TERRACE & INSULATION :

Waterproofing Coating: The system includes surface preparation by thorough grinding, construction joint treatment as per the methodology, making angle fillets of 75mmx75mm with polymer modified mortar at the junction between slab and parapets and allowing it to cure followed by applying two component high solids content cold applied pure polyurethane liquid elastomeric seamless waterproofing membrane meeting the requirements of LAM as per ASTM C836 and having excellent tensile strength of > 6 MPa (As per ASTM D412), elongation > 600% (as per ASTM D 412), tear strength of 35 N/mm (As per ASTM D624), adhesion to concrete of > 1.5 MPa (as per ASTM D 4541),Shore A Hardness of > 70 (As per ASTM D2240), resistance to hydrostatic pressure head of 7 Bar (As per ASTM D 5385/ DIN 16726), puncture resistance of >300N (As per ASTM E154), static crack bridging ability > 3.5 mm (As per EN 1062-7),resistance to root (As per CEN TS/14416) and fire resistance of class E (As per EN 13501-1).The coating shall be applied with a total consumption of 2.1 Kg/Sqm to achieve a total system DFT of 1.5mm thereby satisfy the requirements of LAM as per ASTM C898 and shall be applied on the entire horizontal surface over a epoxy primer coat of @ 5-6 sqmtr/litre, extending up to 300mm above the FFL on the vertical

surface as per the methodology.

Insulation Layer: Spray applying an average minimum 65mm thick GRIHA enlisted CFC & HCFC free spray applied polyurethane foam (To comply to the U-Value requirement of 0.33 W/m2K for roof as per ECBC guidelines) satisfying the requirements of application as per IS 12423-Part3 which is applied in multiple passes with each spray pass of average 10-12mm thick with a skin formation on the top of each layer to enhance imperviousness of the layer. The spray applied polyurethane foam must have a free rise density of 33-35 kg/m³ and a spray density in the range of 45- 50 kg/m³(as per ASTM D1622), initial thermal conductivity of 0.023 W/m.k at 24°C (as per ASTM C518), tensile strength of >400kPa (as per ASTM D 1623), compressive strength greater than 300kPa (as per ASTM D-1621), closed cell content greater than 95% (as per IS 11239 Part5) , water absorption less than 1.5% (asper ASTM D2856), fire test property conforming to Class B2 as per DIN 4102 .

Waterproof coating over PU Foam: On top of polyurethane foam, supplying and applying single component, elastomeric pure polyurethane coating free from bitumen & tar, which meets the requirements of LAM as per ASTM C836-18, having elongation of 400% (As per ASTM D412), Tensile strength greater than 2MPa (As per ASTM D 412), Tear strength greater than 15 N/mm (As per ASTM D 624), Water Vapor Permeability greater than 25 gm/m2/day (As per ISO 9932:91), Resistant to water pressure of 5 Bar (As per EN 12390:8), Crack bridging capability of 3.2mm (As per ASTM C1305) and extensibility after heat ageing -No crack observed (As per ASTM C1522).The coating shall be applied with a total consumption of minimum1.5 Kg/Sqm in two coats and shall be applied on the entire horizontal surface extending up to 300mm above the FFL on the vertical surface as per the methodology.

Protection Layer: Supplying & laying 150 gsm Geotextile (non-woven polyester) over the entire membrane on horizontal areas maintaining proper overlaps.

Horizontal Slope & Protection: Supplying and applying an avg of 100 mm thick M20 grade PP fiber reinforced concrete screed with Min. 75 mm thick at the rain water outlets, laid to a slope of 1 : 120, including saw cutting (approx. 6mm W x 30mm D) at 3MX4M panels within 24 hours of concrete placement and filling the groove with Expanded Polyethylene backer rod keeping the top approx. 10 mm depth open and sealing the groove on the top after 28 days of concrete placement with PU sealant or equivalent, and making angle fillet of 100mmX100mm using M20 grade concrete at the corners, compaction , curing for 7 days etc. complete .

The PU Foam shall have following Minimum properties:

Property	Test Standard	Results
Density	ASTM D 1622	45-50 kg/m3
Compressive strength	ASTM D1621	>300 kPa
Tensile Strength	ASTM D1623	>400 Kpa
Thermal conductivity	ASTM C 158	0.023 W/mk
Water Absorption	ASTM D 2842	<1.5%
Closed Cell Content	IS 11239 Part5, 1985 & ASTM D6226	> 95%
Flammability	DIN 4102	B2

The 2 component Polyurethane coating shall have following minimum properties:

Property	Test Standard	Results
Solid Content	ASTM D 2369	> 98%
Elongation	ASTM D412	>600 %
Tensile strength	ASTM D412	>6 Mpa
Puncture Resistance	ASTM E 154	>300 N
Shore A Hardness	ASTM D 2240	>70
Crack bridging displacement	EN 1062-7	>3.5 mm
Bond Strength to concrete	ASTM D 4541	>1.5 N/mm2

TOILETS/SUNKEN PORTIONS WATER PROOFING

Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means. Removal of all surface imperfections, protrusions, loose concrete & filling of cracks using SBR latex modified Mortar in the ratio Cement: Sand (1:4) and 5% of -SBR latex by weight of cement.

Applying two coats of one component elastomeric waterproofing green label certified coating by brush or roller which is complaint to HDB specification & AS/NZS 4858:2004 Class II membrane. Allow 1st coat/application time to dry for 4-6 hrs before application of second coat right angles to the first coat. It is applied @1.8 litre/ Sq.mt in 3 coats including one coat of self-primer to achieve 800–1000 microns DFT. For tile installations bonding directly to the substrate Strongly recommended to sprinkle liberally coarse quartz sand (30-60 mesh/250-500 microns) while second coat is still wet to provide key for subsequent for plaster or tile application, extends the coating vertically to the higher of 300 mm above.

Horizontal Area- Horizontal protection: Laying slope making and protection with 50mm avg. thick of M20 grade fibrated screed, Curing as per standard procedure
Vertical areas-Sprinkle sand when it is wet @ 2-3 kg/sqm and allow it to dry to form firm key to the plaster for the vertical areas. Lay 20-25 mm thick plaster in 2-3 coats over the prepared surface of cement: sand mortar (1:4) admixed with integral waterproofing compound @ 200 ml per bag of cement.

Sealing of Pipe cut outs

Supplying & sealing the Sanitary pipe inserts, provided in the floor & walls with double sided bituminous tape and supplying & grouting the gaps around the pipe inserts with non-shrink free flow grout.

Technical properties of Single component acrylic coating-

Property	Test Standard	Results
Tensile strength	ASTM D412	1.5 N/Sq.mm
Elongation at break	ASTM D412	250 %
Crack bridging	EN 1062-7	NO cracking upto 3mm
Solid Content (w/w)	SS 5 Part B2	63 ± 2
Shore A Hardness	ASTM D 2240	≥ 55 (Shore A)
Adhesion to Concrete	ASTM D 4541	≥ 1.5 N/mm2
Water Vapour Transmission	ASTM E 96	15-50 g/M2/day

Waterproofing for Water Retaining Structures - Water Tanks

Internal side Surface Preparation- Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means. Removal of all surface imperfections, protrusions, loose concrete & filling of cracks using SBR latex modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.

Providing & grouting at construction joints with cementitious grout into each nozzles (1 mtr c/c) at regular intervals as per the requirements.

Wall and Floor Junction Treatment: Making "V" grooves cut along the wall & slab joints for 10 x 10 mm using a hand cutter. After cleaning the groove thoroughly, apply one coat of water based primer and filling the gap with PU/Hybrid sealant in the groove. After curing of sealant, apply one coat of water based primer in a width of 120mm, let it cure and fix the Corner Joint tape using waterproofing coating. All Tie rods and Honeycombs should be treated as per standard construction practice. During filling of tie rod leave a gap of 10mm from the surface and the same should be filled with PU/ Hybrid sealant.

Pipes treatment: Cleaning and preparation of surface with the help of wire brush or grinder. Clean the surface with water to remove the dust. Insert the pipe with tape wrapped over the pipe into the core and support with formwork. Alternatively, the pipe to be inserted, should be appropriately roughened with hacksaw-blade followed by applying a coat of Epoxy Bonding agent and over this, sprinkling sand which will act as a key to receive non-shrink grout. Pack the core cut junction with non-shrink free flow cementitious grout. Mix ready to use grout with water @ ratio of w/p = 0.13 – 0.15 (depending upon the flowability required) with paddle mixer and pour by providing necessary shuttering and support. Allow the grout to set for 24 hrs. And do the moist curing for 5 days. The area around the pipes (10mm) shall be filled with PU/Hybrid Sealant.

Pre-Ponding Test: The area to be waterproofed shall ponded with water for minimum 24hours. If any leakages identified injection grouting should be done as per standard procedure.

Priming- Providing and applying water-based primer, which shall be mixed well and applied using roller/brush over the prepared RCC surface in one coat with coverage of 100 gm/sqm. Self-curing time of 3-12 hours depends upon the climatic conditions. (Ensure the primed surface is tacky condition before application of main coat.

Waterproofing Coating- On the Primed surface, providing and applying 2 coats of two-component, solvent-free, thixotropic coating, based on high quality elastomeric polyurethane resin waterproofing coating after mixing the two components. It shall be applied in two coats by roller only @ 1.4 kg/sq.m. (0.5 kg/sq.m. in 1st coat and remaining in 2nd coat). Let the coating cure for 3-5 days for full cure before conducting water ponding test for 24 Hrs. Gap between the two coats application shall not exceed 12 hours. The coating shall have Specific Gravity: 1.2 and solids content of 100%, Elongation of 100% & Tensile Strength >10Mpa as per ASTM D412, Hardness >40 as per ASTM D 2240, Hydrostatic Pressure resistance of 5bar as per EN12390, Adhesion to concrete >1.5Mpa as per ASTM D7234 and Water Absorption <0.5 % as per ASTM D570, certified by CFTRI as per 21 CFR 175-300 of US- FDA for potable water contact all as per manufacturers' specifications, etc complete.

Technical properties of Polyurethane coating-

Property	**Test Standard**	**Results**
Elongation	ASTM D412	100%
Tensile Strength	ASTM D412	12 MPA
Hydrostatic Pressure Resistance (Positive)	EN 12390	Passes 5 bar
Hydrostatic Pressure Resistance (Negative)	ASTM D7088	Passes 5 bar
Shore A Hardness	ASTM D2240	80
Crack Bridging	ASTM C1305	Pass (10 cycles)

Waterproofing for Water Retaining Structures -STP Tanks

Surface Preparation- Surface to be made clean, dry and sound, free of any contamination by wire brushing, Wash the concrete substrate with water pressure jet to remove all loose particles and dust. Ensure the substrate has properly cured and the concrete is profile free, no ridges or troughs. All contaminants should be removed by mechanical vacuum assisted preparation equipment such as scrabbling/shot blasting/diamond grinding to achieve a light abrasive blast to achieve preferred surface profile. Honeycombs, pin hones, imperfections should be chiselled until the sound concrete is reached. Clean the surface with water to remove the dirt, dust. It must be filled/ repaired using scratch coat prepare by mixing water-based primer and aggregates in 1:1 ratio. Apply the scratch coat by using suitable spatula/squeeze to get level surface for the upcoming primer.

Wall and Floor Junction Treatment: Making "V" grooves cut along the wall & slab joints for 10 x 10 mm using a hand cutter. After cleaning the groove thoroughly, apply one coat of water based

primer and filling the gap with PU/Hybrid sealant in the groove. After curing of sealant, apply one coat of water-based primer in a width of 120mm, let it cure and fix the Corner Joint tape using waterproofing coating. All Tie rods and Honeycombs should be treated as per standard construction practice. During filling of tie rod leave a gap of 10mm from the surface and the same should be filled with PU/ Hybrid sealant.

Pipes treatment: Cleaning and preparation of surface with the help of wire brush or grinder. Clean the surface with water to remove the dust. Insert the pipe with tape wrapped over the pipe into the core and support with formwork. Alternatively, the pipe to be inserted, should be appropriately roughened with hacksaw-blade followed by applying a coat of Epoxy Bonding agent and over this, sprinkling sand which will act as a key to receive non-shrink grout. Pack the core cut junction with non-shrink free flow cementitious grout. Mix ready to use grout with water @ ratio of w/p = 0.13 – 0.15 (depending upon the flowability required) with paddle mixer and pour by providing necessary shuttering and support. Allow the grout to set for 24 hrs. And do the moist curing for 5 days. The area around the pipes (10mm) shall be filled with PU/Hybrid Sealant.

Pre-Ponding Test: The area to be waterproofed shall ponded with water for minimum 24hours. If any leakages identified injection grouting should be done as per standard procedure.

Priming: Providing and applying water based primer, which shall be mixed well and applied using roller/brush over the prepared RCC surface in one coat with coverage of 200 gm/sqm. Self-curing time of 3-12 hours depends upon the climatic conditions. (Ensure the primed surface is tacky condition before application of main coat).

Waterproofing Coating: On the Primed surface, providing and applying 2 coats of two-component, solvent-free advance polymer coating after mixing the two components. It shall be applied in 2-3 coats by roller only @ 0.9 kg/sq.m. Let the coating cure for 3 days for full cure before conducting water ponding test for 24 Hrs. Gap between the subsequent coats between application shall not exceed 12 hours. The coating shall have Specific Gravity: 1.2 and solids content of 100%, Elongation of 100% & Tensile Strength >9Mpa as per ASTM D412, Hardness >70 as per ASTM D 2240, Hydrostatic Pressure resistance of 5bar as per EN12390, Adhesion to concrete >1.5Mpa as per ASTM D7234 and Water Absorption <0.5% as per ASTM D570, high chemical & abrasive resistance as per ASTM D543 & ASTM D4060 all as per manufacturers' specification etc complete.

Technical properties of two-component, solvent-free advance polymer coating -

Property	**Test Standard**	**Results**
Tensile strength	ASTM D412	9 N/mm2
Elongation at break	ASTM D412	100 % minimum
Crack bridging @3.2 mm	ASTM C 1305	Pass (10 Cycles)
Adhesion to concrete	ASTM D 7234:2019	2 N/mm2 (concrete failure)
Hydrostatic Pressure Resistance (Positive)	EN 12390	Passes 5 Bar

Shore A Hardness	ASTM D2240	80
Abrasive resistance	ASTM D4060	32 mg
Water absorption	ASTM D570	0.3%

Landscape Garden Waterproofing

The First part consist of all surface area should cleaned up to visible of hair cracks I aggregate texture . Cleaning of RCC member should be done by hacking tool, wire brush, wire grinder & air blower etc. Open cracks & construction joints should be sealed with cement mortar with additive.

All clean & treated area should tested for water tightness by flooding water. All wet spots & water leakage area should mark for treatment.

The Second part consisting of providing and applying high performance, low odour, one- part, fast curing, high solids, cold applied polyurethane elastomer waterproof membrane over uniform surface of slab. Apply minimum 1.6 kg/sqm to achieve the required minimum DFT of 1.Smm. PU waterproof coating shall be such which can be applied to damp/green concrete allowing faster construction and efficient waterproofing in all weather . PU waterproof coating which cannot be applied on damp concrete/green concrete inhibiting fast construction are not acceptable. PU should have following minimum properties:

i) Solid % Vol: 84
ii) Tensile Strength > 200 PSI
iii) Elongation > 500%
iv) Chemical Resistance - Excellent

shall be applied as per manufacturer specification."

Third Part consisting of laying screed to slope with minimum 50mm at rain outlet (for easy flow of water/rain water). Treated surface shall be kept ponded for continuous period of 7 days to detect any seepage/ leakage/ dampness if any, the surface then shall be cleaned to withstand weather and domestic use.

The Fourth part consist of Providing & laying rolled matrix soil filter cum drainage system of minimum 8mm thickness Cavity Drain having a compressive strength of 180 KN/sqm of 8mm height with geo textile on top, as per manufacturers specification, complete as directed.

The minimum properties should be:

1) Compressive strength 180 KN/m2

Providing and laying non-shrink grout of size 30x30mm complete around junctions.

5.40 ROAD WORK

- Roadwork shall be done as per MoRTH guidelines and applicable codal provisions.
- Black cotton soil shall be removed from the surface and replace with well compacted soil for subgrade as per MoRTH guidelines.
- M30 grade vacuum dewatered concrete as per DSR 2021, Item No. 16.75 with nominal reinforcement (as per design) in both direction and proper shuttering with the provision of grooves (6mm wide and 50mm deep) to accommodate expansion/contraction shall be provided over M10. Grooves shall be filled with poly-sulphide sealant compound etc as per direction of Engineer-in-Charge.
- Necessary provision to cross the sewer lines, drainage line, service line shall be provided in road as per direction of Engineer-in-Charge.
- Kerb channel shall be provided along the lower edge of road and before kerb stone. Kerb channel shall be as per codal provisions.
- Kerb Stones : Providing and laying at or near ground level factory made precast kerb stones M25 grade of size 100mm x 450mm of approved design in position to the required line, level and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand), including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm), including making drainage opening wherever required complete etc. as per direction of Engineer in-charge. Kerb stones shall be provided along both the edges of road. Kerb stones shall be painted with synthetic enamel paint of approved brand and manufacture with two or more coats to give even shade. Kerb stone shall be painted with the combination of two colors alternately applied as approved by Engineer-in-Charge.
- Road Markings & Signages shall be done as per MoRTH and applicable codal provisions.
- Glow studs of size 100x20 mm made of heavy-duty body shall be molded ASA (Acrylic styrene Acryloretrite) or HIP (High impact polystyrene) or ABS having electronically welded micro- prismatic lens with abrasion resistant coating.
- Marking parking places, road surface marking, road edge marking and lane marking with adequate no. of coats to give uniform finish with ready mixed road marking paint conforming to IS: 164, including cleaning the surface of all dirt, scales, oil, grease and foreign material etc. complete.

5.41 FOOTPATH / PAVER BLOCK AREA

Footpath shall be provided as per approved architectural drawing. Footpath shall have cross slope of towards kerb channel to drain the water.

Footpath shall have kerb stones along the edges. Kerb stone which is away from road shall have proper back filling to counter lateral pressure. Footpath shall be provided using 60mm thick factory made cement concrete paver block of approved shape and colour of min. M -30 grade made using block making machine with vibratory compaction laid in required pattern.

Paver block shall be laid over minimum 50mm thick compacted bed of coarse sand (locally

available), filling the joints with fine sand etc. all complete as per the direction of Engineer-in charge.

100mm thick PCC shall be laid before filling sand and placing paver blocks. Any black cotton soil shall be removed and replace with moorum before M10-PCC.

5.42 STORM WATER DRAIN (ROADSIDE DRAIN) :

The agency has to plan, design, prepare the drawings/invert levels for Storm water drain shall be combination of Pipes (in place of road crossings) and open drains and get the same approved from Engineer-in -Charge before execution.

RCC drain (minimum M25) of minimum opening 450mm wide and min.450mm deep shall be provided with necessary excavation required. Depth of drain shall be variable as per terrain of the road and Invert Level decided during execution of work. Drain shall be covered with factory made precast RCC perforated drain covers, having concrete of strength not less than M-25, of size sufficient to cover the drain opening and proper bearing on edges reinforced with 8 mm dia. Four nos longitudinal & 9 nos cross sectional T.M.T. hoop bars, including providing 50 mm dia perforations @ 100 to 125 mm c/c, including providing edge binding with M.S. flats of size 50 mm x 1.6 mm.

Base & Walls: The base & walls of drain shall be of RCC in M-25 grade as per approved design.

Plastering / Finishing: 12mm ready mixed cement plaster with neat finish in side and top of the drain. Sides of the storm water drain shall be neatly packed, dressed and the surplus excavated earth shall be utilized for filling low level or green belt development.
Culverts : Pipe culverts shall be provided at road crossings of required dia as per approved drawing with parapet up to 1200 mm height on either side of culvert.

RCC Pipes : NP2 RCC pipe of 150mm dia shall be laid to carry water from kerb channel to road side drain. NP2 pipe shall be fitted with kerb stone with proper bell mouth entry.

Road Gully Chambers: The masonry road gully chamber of required size and depth with masonry wall in cement mortar including precast R.C.C. horizontal/ vertical grating with frame completes as per standard design, as per CPWD Specifications and approved drawings.

Connection: The Storm water drain, pipes shall be connected to municipal drains as well as to the harvesting recharge pits/wells as per local body/ Environment/ MPCB etc. norms.

Contractor shall submit a shop drawing for approval to engineer in charge and other specification shall be as per CPWD.

Technical specification Civil work (Part-II)

1. Lead-Lined Wood Doors

Supply of Door Frame made out Hardwood of size 120x70 mm suitable for mounting shutter with Heat activated intumescent fire seal stripes of size 10x4mm provided in grooves on all three sides of the frame. (Payable Extra). The Door Shutter is 50 mm thick Lead Line Shutter comprising of two 10 mm thick Non Combustible Fire Rated Board, sandwiching 24 mm thick fire resistance insulation filler & 2 mm Thick Lead Sheet with 3 mm thick commercial ply on both side with Hardwood Lipping & heat activated intumescent fire seal strip of size 20 mm x 4mm mounted in the grooves of hardwood lipping on all sides except bottom (Payable Extra). The intumescent sealant is used to fill the gaps between board and internal wooden lipping.

1.1 Finish of Lead-line Doors

Apply 1 mm thick Laminate of Regular shade on both side of the each leaf of the shutter

2. Antibacterial Paint

a. The Antibacterial Paint shall be able to provide anti-Microbial Protection on all medical related area:

b. The scope of work includes providing & applying approved makes anti-Microbial Paint on wall surface as per manufacturer's specifications complete in all respect & directed by Engineer-in-charge. Following are the desired characteristic of the paint:

i. The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.

ii. The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.

iii. The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

3. Façade

Solid Aluminium Façade Systems (Safs) Battens In Solid Ral Shade Tender Specification Section 50mm X 50mm

Providing and fixing or equivalent non-combustible, Extruded Aluminium Wall and Ceiling Batten System i.e. 'BZ 1 in 6063 / T6 allow grade – in 1.4 mm (±0.2) thickness, with Snap on – CC 4' in 6063 / T6 allow grade – in 3 mm (±0.2) thickness & in maximum length of 3660mm in approved profile i.e. 50 mm with corresponding aluminium end caps in exact same sectional profile with provision of screw counters in approved solid shade finish. Battens in 50mm profiles must have depth of 50mm in approved Solid RAL Shade in Matt Finish. Battens to have stiffening radii in both face and tail to resist wind loads and clamping

pressure. The back side of the batten should be concealed with appropriate sized seamless snap on system for façade cladding or ceiling. The approved profiles and accessories must be extruded from Hindalco/NALCO/Jindal Billet in AA6063T6 supported with MTC. The Solid RAL Shade inn Matt finish on aluminium profile shall be achieved using Super Durable Polyurethane coating of specific gravity 1.6 (+/- 0.4) manufactured by M/s Color coat or equivalent under controlled conditions of heat cured for 10mins at 200 degrees' Celsius object temperature on 4 stage PT chromated substrate to result in adhesion as per ASTM D 3359 up to average 65 micron of base coat for exterior conditions to meet or exceed qualicoat/AAMA 620 specification.

The fixing of Batten System should be done using 'Dry fixing' method onto substructure using extruded aluminium profile or seamless 'snap on' method as per approved shop drawings suitably fixed using zinc plated/Stainless Steel screws and zinc plated. The fixtures, fasteners and SDST screws to be used for dry fixing should be Hilti/ Klimas/ Fischer or equivalent. The quantity of fasteners or SDST screws shall be calculated in accordance to design and actual site fixing conditions. Vendor shall submit shop drawings of same, the drawings to be duly approved from Engineer in charge at site.

4. Fabrication: - Door frames Factory Fabricated and Windows DGU based OEM fabricated

i. Before commencing the fabrication the contractor shall submit to the Engineer in - charge for their approval detailed shop drawings, based on the Tender drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements . Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators etc. shall be as per Tender drawings or as approved by the Engineer -in - charge.

ii. A sample of finished door / windows/ ventilator railing etc. shall be fabricated as per the shop drawings approved by the Engineer in - charge for final approval before under taking mass production/ fabrication,

iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating shall be as specified in the item specifications.

iv. All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the Engineer in - charge shall be final and binding on the contractor.

v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitred at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to

avoid distortion/damage.

vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.

5. Toilet Cubicles-

Providing and fixing toilet cubicles system make with 12 mm thick solid compact laminate panels included 600 mm doors, central panels front panels, should be resistant to heat, bacteria water, chemical, scratch, and impact. All necessary hardware's fitting should be Stainless Steel 316 Grade, all complete as per manufacturer's specification , drawings and direction of Engineer-in-charge.

6. Calcium silicate Board Ceiling:-

Providing & fixing false ceiling at all height including providing & fixing of framework made of special section, power pressed from M.S. sheets and galvanised with zinc coating of 120 gms/ sqm (both side inclusive) as per IS : 277 and consisting of angle cleat of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm c/c, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50 mm long with 6 mm dia bolts, other flange of cleat fixed to the angle hangers of 25 x10 x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I chanels 45 x15 x 0.90 mm running at the spacing of 1200 mm c/c, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5mm, at 450 mm c/c, shall be fixed in a direction perpendicular to G.I intermediate channel with connecting clip made out of 2.64 mm dia x 230 mm long G.I wire at every junction, including fixing perimeter channels 0.50 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/ partitions with the help of Rawl plugs at 450 mm centre, with 25 mm long dry wall screws @ 230 mm interval, including fixing of Calcium Silicate Board to ceiling section and perimeter channels with the help of dry wall screws of size 3.5 x25 mm at 230 mm c/c, including jointing & finishing to a flush finish of tapered and square edges of the board with recommended jointing compounds, jointing tapes.finishing with jointing compounds in three layers covering up to 150 mm on both sides of joints and two coats of primer suitable for boards, all as per manufacture's specification and also including the cost of making opening for light fittings, grills, diffusers, cut outs made with frame of perimeter channels suitably fixed, all complete as per drawings, specificaton and direction of the Engineer in charge but excluding the cost of painting with:8 mm thick Calcium Silicate Board made with Calcareous & Siliceous materials reinforced with cellulose fiber manufactured through autoclaving process.

7. Heavy duty vitrified tile:-

Providing and laying matt finished Heavy duty vitrified tile of size 100x100x16mm having water absorption less than 0.5% and conforming to IS: 15622 of approved make in all colours and shades in out door floors such as footpath, court yard multi models etc., laid on 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. complete as direction of Engineer-in Charge .

8. Grass Paver:-

Providing and laying 60mm thick PVC Moulded CC Grass Paver Blocks, manufactured in M-35 Grade of Cement Concrete mix to be cast on table vibrator, from approved manufacturer such as tiles, to be laid on a river sand bed of 40mm thickness in required pattern & color including cutting, leveling, sand brushing in joints and finally compaction with plate vibrator with all cost including, as per direction of Engineer-in-charge.

9. Stainless Steel Cladding on Exposed Column

Providing & fixing of SS panels for claddding of 316 grade sheet brushed finish of 1.6mm thick of approved make with composition of Chrome 17-18% and Nickel 7-8% mounted on 6mm thick ply of approved make, panels will be fixed on RCC surface with MS tube frame, silicon all complete as per manufacturer's specification , drawings and direction of Engineer-in-charge.

10. Rubberized Flooring:-

Providing & Fixing of 8mm thick Rubber flooring Rolls with 15% EPDM & 85% SBR, Density (kg/m3):1000/1200, Hardness (Shore a):68, Stretch (MPA):2.2, Abrasion resistance: 0.0075g (ASTM-D4060-01), Rebound resistance: 55%, Friction coefficient: trends μs: 0.995 .trends μk: 0.930, Shape deformation: 42%, Length (m):10 ±5cm, Width (m):1m ±5mm, Thickness (mm): 8mm ±0.3mm etc. Complete as per the direction of Engineer-in-charge.

11. Acoustic Work

11.1 Acoustic Perforated laminated Gypsum Board Ceiling

"Laminated gypsum board.

Perforated in regular dot matrix for acoustic absorption (aw>= 0.65). Mounted flat on substructure of folded galvanized steel members, with mineral wool layer (50mm) on inner side. Taped for invisible joinery. Plastic mate black paint finish.

Work included Supply and installation of Perforated Gypsum Board Ceiling as shown on the Tender drawings. All necessary hardware, seals, lifting machinery, electrical controls are included.

Acoustic Performance Absorption coef.: aw>=0.65

Description: Supporting surface to the honeycomb acoustic absorbents, with a veil and with mineral wool layer (50mm) on inner side.

11.2 Wall paneling,

Fabric wrapped Compressed glass substrate panels paneling on rear & side walls:

Providing and fixing Acoustical Wall paneling with square edge panels made of fibre glass substrate 25mm thick with a density of 120kg/m3 and meet the fire class A wrapped on the front side with an acoustical fire retardant fabric which will meet fire test of BS EN 1021 and IS: 1561-2002 and minimum weight of 340GSM with an option of colours as per the choice of the person-in-charge, of size1200mmX600mm with an NRC of upto 1.0. The panels to be pasted with approved construction adhesives over 9mm thick ply. The 9mm thick ply shall be fixed over GI framing consisting of 48x36x34x0.5mm thick GI Studs wall channels & floor channels @ 600mm c/c. Wood grained wooden perforated sound absorb slit paneling for rear wall,

11.3 Ceiling With Micro-perforated 3x3mm Square Gyp Acoustic Board:-

Providing & fixing Micro perforated Gyp acoustical ceiling, as marked in the drawings, consisting of GI perimeter channels of size 0.55mm thick (having one flange of 20mm and another flange of 30mm and a web of 27mm) along with perimeter of ceiling, screw fixed to brick wall/ partition with the help of nylon sleeves and screws, at 610mm c/c. Then suspending GI intermediate channels of size 45mm (0.9mm thick with 2 flanges of 15mm each) from the soffit at 1220mm c/c with ceiling angles of width 25mm x 10mm x 0.55mm thick fixed to soffit with GI cleats and steel expansion fasteners. Ceiling section of 0.55mm thickness having knurled web of 51.5mm and two flanges of 26mm each with lips of 10.5mm are then fixed to the intermediate channel with the help of connecting clips and in a direction perpendicular to the intermediate channel at 300mm c/c. The polyester fibre of 1000 gsm density and 50mm thick layed over the made framework and Finished in 12.5mm thick micro-perforated gypsum board of size 1200mm x 2400mm, with 3x3mm square perforations having fire class A2-s1, d0 (C1) (A2-Noncombustible, s1- Minimum Smoke, d0- No droplets, Fire rating- Class1) and tested to meet the safety requirements of EN 14190 in combination with 12.5mm thick plain gypsum board where ever required. The board to be finished with 2 or more coats of mat type plastic emulsion paint after proper jointing & making surface smooth. All complete as per drawing & design.

11.4 UPVC Fabric Stretch Paneling on rear & side walls:

Providing & fixing Acoustical wall paneling in Stretched fabric system consisting of FR grade fabric which will meet fire test of BS EN 1021 and IS: 1561-2002 and minimum weight of 340GSM of reqd. colour. 19mm UPVC grippers fixed over 50x12mm thick ply strips on GI frame consisting of 50mm thk. GI Stud wall channels & floor channels filled with 50 mm thick 1000GSM thermally bonded polyester wadding. The insulation to be covered from back by covering the frame with 19mm GI wire netting.

11.5 Acoustical Door:-

Supply and fixing of 83mm thick, 38 dB acoustic cum fire check door shutters having fire rating of 120 minutes with infill of 47 mm thick resin bonded glass wool (24kg/cum density) coated with FR Acrylic Sealant Sandwiched between two 9mm thick calcium silicate boards of (100% calcium silicate) without asbestos, brucite and meerschaum with density 1150 gms/cum, thermal conductivity 0.14W/M*K, faced with 8mm thick commercial ply on both sides and having teakwood lipping of size 15x89mm on all four edges including acoustic seals (RP 24, 16 & 38) to achieve 38 dB noise reduction. The work is too executed as per direction of architect or engineer-in-charge.

Chowkhats for the doors in second class teak wood of size 110x 90mm duly fire treated.

12. M.S WINDOWS

Supply of factory made Steel windows made out of MS Tabular tube 135 x 60/ 130 x 65 of 2.0 MM thick, with box type MS Hinges 65 mm long to be welded in window shutters, with MS Tubular 'Z' type(1.6 mm thicfire k) shutters section with glass & M.S Grill made out of MS 12 mm sq. bar with flat 20 x 5 all around with MS tower bolts 150 mm long (2 no's each shutter) , MS Handle (150 mm long) in flat 25 x 6 with MS Eye hooks (1 no. for each glass shutters only) to be welded in tabular frames provision for fixing ALdrop with base ties MS sq. bar 10 mm , necessary holdfasts 25 x 5 x 150 mm long with duly powder coated 50 microns as per approved shade. Necessary holdfasts 25 x 5 x 150 mm with duly powder coated 50 microns as per approved by EIC.

13. **Antistatic 4mm Thick Polyurethane Resin Flooring at Operation theatre and areas**

Supplying and laying of chemical resistant, antimicrobial, Polygiene® HACCP International Certified 4mm thick Polyurethane resin heavy duty flooring in approved color having temperature resistance of 90˚C at 4mm thickness and chemical resistance properties , trowel applied smooth matt colored finish , Microbial/fungal resistant incorporates Polygiene a performance based antimicrobial additive which inhibits the growth of bacteria, fungi, moulds and mildew. Non-tainting and non-dusting, over the scratch coat of Pu concrete the scratch coat cured system shall exhibit the following properties :

Fire Resistance BS476:Part 7 ,Surface Spread of Flame: Class 2 (indicative),Slip Resistance TRRL Pendulum Slip Test Dry 70 Wet 25Impact Resistance BS8204 Part1 Cat: A (<0.5mm),Coefficient of Thermal Expansion ASTM C531: 5.70 x 10-5 oC-1Water Permeability Nil–Karsten test (impermeable)Vapour Permeability ASTM E96:905g/m/24hrs (at 4mm thick),Abrasion Resistance Taber Abrader: 0.1g loss per 1000 cycles (1kg load using CS17 wheels)Compressive Strength >55 N/mm2 (BS6319)Flexural Strength >20 N/mm2 (BS6319)Tensile Strength >12 N/mm2 (BS6319) Bond Strength Greater than cohesive strength of 25N/mm2 concrete. >1.5 MPa.Substrate requirement of Concrete or screed substrate should be a minimum of 25N/ mm2, free from laitance, dust and other contamination grinding/scarifying . The substrate should be surface dry and free from rising damp and ground water pressure. Providing line marker (upto 100mm wide) in approved colour and coving of 50mm X 50mm using Epoxy resin based coving mortar at all the wall to floor junction as per approved shop drawing and direction of engineer in charge.

Note : Item should be with 10Y warranty fro OEM and to be executed by approved applicator.

14. Roller Blinds - Screen fabric

Providing and fixing of approved make roller blind having sturdy aluminium top tube of 38mm diameter, powder coated bottom bar, with suitable roller clutch mechanism and plastic ball chain. The roller blind fabric should possess the mentioned specifications: a) Composition – 36% Fiberglass & 64% Vinyl b) Openness factor - Available in 3% - 5% c) Fabric thickness – 0.43 mm +-5% & Weight - 393 gsm (± 5%) d) Width - 300 cm e) Color fastness - Grade 6 f) UV blockage – Approximately 95% - 97% g) Flame retardancy – NFPA 701 h) Anti-fungal / Anti-bacterial – ASTM E 2180 product protection i) Environmental certification – GREENGUARD Gold certified j) Acoustical value - NRC 0.50, SAA 0.50. Aluminum profile should have temper WP consisting of alloy 63400 along with

anodizing of 10 micron and powder coating of 60 micron. The tensile strength of profile should be 9.10 Kg/mm square and elongation 18. The control clutch drive unit engineered heavy duty chain drive pulley operating system consisting of gear clutch housing and locking plug containing minimum 6 ribs and inserted at minimum of 38mm into roller tube. It is self-lubricating exclusive clutch with safety pins for secure bracket installation and unlocking pin for quick manual removal. Universal clutch is most convenient for large windows down to the smallest windows. It shall be driven by a ball chain pulley with ball chain and can be positioned at right hand or left-hand side of the shade. Clutch gear ratio of 1.75:1 for reduced operating force on larger blinds. Mounting hardware brackets universal brackets including end plug bracket with lock down retainer device. Brackets finish of powder coated metal installation brackets made of stamped and hardened steel. Roller tube circular-shaped aluminum tube extruded from alloy 63400 and temper WP. Bottom rail flat-shaped extruded aluminum from alloy 63400 and temper WP. Ball chain shall be 2mm diameter cord with plastic balls molded to form an endless ball chain. It is used for raising or lowering action of the shades. Plastic parts all plastic components are UV-stable compounds available white.

15. Zebra Blinds

Providing and fixing of Zebra Blinds in band width 7.5 cm - 12 cm and is made up of 100% polyster, It comes in width of 250 - 280 cm, weight -160g/sqm - 190g/sqm, thickness - 0.50 mm - 0.70mm (opaue part), Colorfastness to light - above 4 grade. Zebra Blind tube is made of aluminum with a diameter of 36mm, botom rail is made of aluminum with powder coated having weight 390 gm/meter fitted with end caps in colour matching to the fabric and mechanism is of plastic with chain and metal bracket. The blind comes with aluminum cover with the matching fabric designed on it. Aluminum profile should have temper WP consisting of alloy 63400 along with anodizing of 10 micron and powder coating of 60 micron. The tensile strength of profile should be 9.10 Kg/mm square and elongation 18.The control clutch drive unit engineered heavy duty chain drive pulley operating system consisting of gear clutch housing and locking plug containing minimum 6 ribs and inserted at minimum of 38mm into roller tube. It is self-lubricating exclusive clutch with safety pins for secure bracket installation and unlocking pin for quick manual removal. Universal clutch is most convenient for large windows down to the smallest windows. It shall be driven by a ball chain pulley with ball chain and can be positioned at Right hand or Left hand side of the shade. Clutch gear ratio of 1.75:1 for reduced operating force on larger blinds. Mounting hardware brackets universal brackets including end plug bracket with lock down retainer device. Brackets finish of powder coated metal installation brackets made of stamped and hardened steel. Roller tube circular-shaped aluminium tube extruded from alloy 63400 and temper WP. Bottom rail flat-shaped extruded aluminium from alloy 63400 and temper WP. Ball chain shall be 2mm diameter cord with plastic balls moulded to form an endless ball chain. It is used for raising or lowering action of the shades. Plastic parts all plastic components are UV-stable compounds available white.

16. Flocked Carpet Flooring:

Providing & Fixing of Flocked textile floor of Nylon 6.6 face fiber or equivalent of approved make with 100% Nylon and completely water proof resilient backing. The flooring should be Antistatic with thickness of 4.3 mm and approximate weight of 1.8 k.g./sqm of roll form. The carpet should be completely stain resistant and of a density approx. 80 million fibers/sq.mtr (70 million fiber/sq.yd) in the width of 2 mtr .The floor covering should have Fire Test EN-13501, Appearance Retention Hexapod ISO 140-8, Friction Slip Resistance Test EN 14041 Class DS, anti-microbial treatment, with resilient waterproof backing, anti allergic which is certified by British allergy foundation. The carpet should have permanent static control. The work should be carried out by the authorized installer of the Company in India. Carpet should be laid on zero leveled surface. Carpet should be stick with SR 998 on the floor.

17. ACID OR ALKALI RESISTANT TILES

Manufacture and Finish

The tiles shall be of vitreous ware and free from deleterious substances. The iron oxide content
allowable in the raw material shall not exceed two percent. The tiles shall be vitrified at the temperature of 1100 0 C and above and shall be kept unglazed. The finished, tile, when fractured shall appear fine grained in texture, dense and homogenous. The tiles shall be sound, true to shope, flat and free from flows and manufacturing defects affecting their utility. The tiles shall be conforming to IS 4457. The tiles to be tested for water absorption, compressive strength, acid resistance as per IS 4457. Sampling procedure for acceptance tests and criteria for conformity to be as per IS 4457. The tiles shall be of required colour.

Dimensions and Tolerances

Ceramic unglazed vitreous acid-resistant tiles shall be made in three sizes namely 98.5 X 98.5 mm,
148.5 X 148.5 mm and 198.5 X 198.5 mm. They shall be available in the following thickness: 35, 30,
25, 20 and 15 mm. The depth of the grooves on the under side of the tile shall not exceed 3 mm.
Tolerance on length, breadth and thickness of tiles shall be + 2 percent.

Shape

The tiles shall be square shaped. Half tiles rectangular in shape shall also be available. Half tiles
for use with full tiles shall have dimensions which shall be such as to make two half tiles, when joined together, match with the dimension of full tile. The shape of tiles other than square shall be as agreed to between the purchaser and the manufacturer. Tiles shall be checked for squareness and warp as per IS 4457.

Performance Requirements

The tiles when tested in accordance with method given in IS 4457, shall conform to be requirement
specified in the code (IS 4457).

Loss in Abrasion

The maximum percentage of loss in abrasion of the ceramic unglazed vitreous acid resistant tiles
determined in accordance with the procedure laid down in IS 1237, shall be as mentioned in IS 4457.

Marking

Tiles shall be legibly marked on the back with the name of the manufacturer or his trade mark. Manufacturer’s batch number and year of manufacture. Each tile may also be marked with the ISI certification mark.

18. Maintenance of land scaping work

Maintenance of Trees

a. Apart from the essential watering of the plants as per the maintenance manual, Nurture the trees with organic solid manures and liquid manures, spray bioinsecticides, parasites, predators to protect the trees from pest and disease. Amend the soil on regular basis with proper soil amendments to keep the pH level between 7 - 7.5.

b. During maintenance period the plants should be maintained by regular watering, weeding, replacing dead plants, applying pesticides, Use of plant physical protection measures etc. so as to grow them vigorously.

c. Newly planted trees should be maintained by:

- Watering every alternate days @ 20 litres /watering cycle
- Applying FYM @ 10kg/ tree/ annum
- Trimming, pruning as & when required under guidance of the site-in-charge etc.
- The Trees should have proper staking so as the tree should stand erect till the Tree settles with no possibility of bending due to Wind or Rain

Maintenance of Shrubs

(a) The plants/shrubs should be maintained by regular watering, weeding, replacing dead plants, applying pesticides etc. so as to grow them vigorously.

(b) Maintenance work includes timely pruning, weeding and cutting of ground cover plants, hedges, edges, plants planted in the areas mentioned above. Application of fertilizers, manure, etc to the lawn, plant and spraying pesticide etc. as and when required.

(c) Seasonal flower beds must be replaced as and when required (approximately thrice in a year). Plant species can be changed w.r.t. season only.

(d) Removal of wild grass normally found growing in rainy season by cutting and/or uprooting so as to keep the areas free of grass.

Maintenance of Lawn

(a) For 12 (Twelve) month maintenance period the Lawns should be maintained by regular watering, weeding, replacing dead Spots, applying pesticides etc. so as to grow them vigorously.

The Lawn should be regularly mowed and maintained as good green carpet.

Sub Surface Drainage

Waterproofing of the superstructure, sub structure and proper drainage is an essential criterion

for the project. The Contractor to prepare a detailed scheme for the surface and sub surface drainage for the entire external development area with all the relevant drawings, sections, specifications and calculations. Same to be submitted to Engineer in charge for review and approval. No external development work to start prior to approval of the scheme.

Irrigation

All other streets shall have manual irrigation.

(a) Irrigation system designer must be qualified and experienced in projects of this type; equipment must be supplied by approved manufacturers; and installation must be by carried out by qualified and experienced specialist irrigation contractors.

(b) Coordinate water supply with engineers including confirmation of location of point of connections, control valves, sensors and other necessary infrastructure. Locate all equipment, controllers and valves in discreet locations, to the approval of the engineer. All equipment to be vandal-resistant and all control boxes or covers lockable.

(c) Design the system to achieve even water distribution to gardens and/or lawn areas with minimal overspray and water wastage, and to be operational at times confirmed by the Employer. The system must supply water at the 2.5-3.5Kg/cm2 and required frequency to ensure optimum growing conditions for the gardens and/or lawns, including allowance for zones of different species water requirements. Provide design and shop drawings for written approval by Engineer in Charge prior to installation.

(d) Design the system layout and sizing of all lateral pipe lines, associated sleeves, and remote-control valves as necessary to operate all heads and / or tubes with vertical sides.

(e) Drip irrigation is recommended for at least 75% of landscape planting areas to reduce evaporation. Install tubing on-grade, in equally spaced lines according to manufacturer's recommendations.

(f) Soil moisture sensors integrated with irrigation system.

(g) 75% of turf area must have sprinkler irrigation system to reduce water loses. Turf and each type of bedding area must be segregated into independent zones based on watering needs.

(h) Design the placement of sprinkler heads at spacing not more than the radius of coverage in accordance with the manufacturer's recommendations and approval of engineer.

(i) Install all pipework a minimum of 300mm below ground level, or in accordance with

local authorities' regulations and codes.

(j) Following installation, thoroughly test all equipment and operation of the system, in conjunction with Employer's representative. Provide As-built drawings and operations maintenance manuals for the system.

(k) Contractor is responsible for replacement of dead or dying plants for the full Defect Liability Period (DLP).

MKCG HOSPITAL AT ODISHA

TECHNICAL SPECIFICATIONS BUILDING MEP SERVICES

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEM

5A401.1 General

5A401.1.1 The work included in this section is for design, manufacture, fabrication, supply, erection, testing, commissioning and handing over of mechanical ventilation and air-conditioning facilities to be constructed for MKCG building. The mechanical ventilation and air-conditioning systems shall be designed for these facilities as per following codes NBC/ ECBC/ ASHRAE/ BIS/ SMACNA/ NFC

5A401.1.2 The specification describes certain broad requirements for guidance of the Contractor. Everything may not be fully specified and there may be modifications required. This however, shall not relieve the Contractor for not completing the work in every respect and or in accordance with the modern practice so that the Mechanical Ventilation and Air-Conditioning system will be completed and will satisfactorily carry out all the duties specified. The Contractor is expected to fully understand the Employers intent and requirements using the concept designs and specifications provided, develop full and comprehensive final designs and specifications ready for construction to meet all Employers requirement as stated in the General Specification Section.

5A401.1.3 The materials to be used in the work shall be of the best quality to comply with the requirements explained in the specification and as per the appropriate Indian Standard Specifications.

5A401.1.4 Planning, designing and execution of mechanical ventilation, air-conditioning, pressurization system etc. shall be as per NBC2026 norms, National Fire codes and CFO approval. The Contractor shall obtain NOC from CFO certifying that all provisions have been made as per their approval. All the fees shall be paid by the Contractor.

5A401.1.5 The Contractor shall furnish the electrical cable schedule and calculations in support of suitability of the selected electrical cable sizes.

5A401.1.6 The Contractor shall require to maintain the adequate spares for 2 years of DLP.

5A401.1.7 In Keeping with the intent of a Design/Build (D/B) contract any Individual item/equipment and material including contractual obligations which are not specifically mentioned in the specification but are required to make the equipment and installation complete and also for trouble free maintenance, for safety provision, smooth and safe operation for equipment as well as smooth execution of contract to the complete satisfaction of the Engineer shall be the Contractor's responsibility.

5A401.1.8 The following documents shall be submitted by the Contractor to the Engineer for approval.

a. General Arrangement drawing of Chiller, Pump, AHU, FCU, Air Scrubber, Air washer fans, and split units etc.

b. Design Calculation, Equipment’s Data sheet and Performance curves of the Fans.

c. Chilled Water schematic diagram.

d. Mechanical Ventilation and air conditioning system layouts.

e. Air Flow diagram of Ventilation and Air-conditioning system.

f. Foundation Details of Chiller, Heat Pump, Pump, AHU, FCU, Air Scrubber, Fans, Split units, Pipe Trestle Line, Electrical Panel etc.

g. Refrigerant Pipe line layout diagram.

h. I/O Summary for Building Management system.

i. I/O Summary for Chiller Plant Optimization System.

j. Pressure zoning diagram.

k. Design, detail engineering, development including preparation of power control, interlocking and sequence, annunciation schemes, layout drawings etc. for MCCs, Control desks of entire system.

l. Detail engineering for Air-conditioning load and ventilation system.

m. Submission of all the drawings required for detail engineering, erection including foundation drawing for all equipment, drives, testing and commissioning.

n. Dimensional layout and sectional drawings for complete scope of work including pipe and cable layout. Complete Electrical System drawing to be furnished by the Contractor.

o. Write-up manual on Operation / Control monitoring of the Ventilation and Air-conditioning system etc.

p. Manual for Maintenance, overhaul, replacement parts of the equipment.

q. Replaceable parts with ordering information.

r. Leaflets, catalogues of equipment, accessories etc.

s. Material test certificates, Equipment test certificates etc.

t. Shop drawings of the Ventilation and Air-conditioning system.

u. Any other certificate/ drawing/ manuals deemed necessary.

v. Wherever applicable soft copies, CDs, CAD drawings are to be given.

5A401.1.9 The Contractor shall be responsible for

a. Manufacture, assembly, factory painting, factory testing, packing, forwarding, transit insurance, inspection, supply and unloading at storage room.

b. Transportation to erection site, installation, mounting, laying, erection, testing, successful commissioning and handing over.

c. Safe custody including insurance during storage, Transit, erection, testing, and commissioning of all Mechanical and Electrical equipment, cables, erection materials.

d. The scope of works shall include complete erection accessories and materials, all steel members (angles, channel, plate, sheet etc.) for installation of electrical equipment, cable trays, trays installation materials and trays accessories, cable supporting structures, cable glands, cable lugs, ferrules, cable markers, jointing and termination kits and materials, pull boxes and all consumable materials for complete laying and termination of cables, erection of electrical equipment and earthing system etc.

5A401.2 System Description

5A401.2.1 Air conditioning for MKCG building

A central air conditioning system shall be designed to provide year round thermal environmental control for Hospital complex. Air conditioning shall be provided by a central variable flow chilled water recirculation system for maximum energy conservation.

The central air conditioning system shall consist of water cooled Centrifugal and screw chilling units, Heat pump, multiple primary chilled water pumps, secondary chilled water pumps with variable frequency drives, condensing water pumps, FRP induced draft cooling towers, Heat exchangers, hot water pumps for monsoon reheating, Air handling units and fan coil units, chilled, hot and condensing water piping with accessories, air distribution system, insulation, electrical panels, wiring, control wiring and earthing.

System shall provide sufficient capacity to meet peak cooling loads but must be capable of operating efficiently at part-load.

5A402 Materials and Construction Specifications

5A402.1 CENTRIFUGAL WATER CHILLING MACHINE

Water Cooled Centrifugal Water Chilling Machine with 415 V Motors Along With Variable Speed Drive

1.1.1 Scope of Work

The scope of work not limited to the following shall be:-

a) Chilling machines specified in this section are of the water cooled, centrifugal chillers with single compressor on 415 V motor, VSD Capacity control mechanism.
b) Manufacture, assemble, test at works and deliver to site, install, test and commission to the entire satisfaction of the Consultant / Employer at site.
c) Manufacturer's factory representative to be provided for coordination, start-up and testing supervision of the chillers at site.
d) Performance will be certified & witnessed in accordance with ARI Standard 550/590. Necessary documentation for factory & site testing of chillers along with tools for maintenance & operation shall be provided.
e) Irrespective to cooling method; VSD starter should be IP 54 (NEMA 12) enclosure type with factory supplied and Unit mounted/ free standing and wired.

1.1.2 Codes & Standards

The design, materials, manufacture, inspection, testing & performance of Water Cooled Centrifugal chilling machine shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed. Following codes & standards (Not Limited To) shall be followed:-

ARI 550/590 - Air Conditioning and Refrigeration Institute. Standard for Centrifugal Water Chilling Packages

ARI 575 - Air Conditioning and Refrigeration Institute. Standard Method of Measuring Machinery Sound Within Equipment Rooms (Basis of all data presented or field testing of equipment, with relation to sound requirements).

IS16590 - American National Standards Institute. Safety Code for Mechanical Refrigeration (overall general safety Requirements, relief device sizing, etc.)

1.1.3 Chiller Design Duty

a) Water Chilling Unit shall be of Centrifugal type & shall produce actual refrigeration capacity of 825 TR, cooling 1975 GPM of chilled water from 54 to 44 °F when supplied with 2475 GPM of condenser water at 32.22°C. The bidder shall submit performance characteristics of chillers for both specified conditions as above and at ARI conditions.
b) The bidder shall submit printout of computerized selection of chillers duly stamped and signed by authorized representative of the chiller manufacturer along with the tender.
c) The cooler shall be selected for 0.00050 (fps units) fouling factor and a maximum liquid pressure drop of 6.0 meters. Water side shall be designed for minimum 150 psig working pressure. The condenser shall be selected for 0.0010 (fps units) fouling factor and maximum liquid pressure drop of 10.0 meters. Water side shall be designed for minimum 150 psig working pressure.
d) Power shall be supplied to the chiller at 415 volts – 3 phase - 50 Hertz. The chiller shall use R-134a refrigerant.
e) Unit shall be minimum 4 star rated as per latest BEE guidelines, and at the time of witness test Star labelling name plate should be there on the unit.

1.1.4 Centrifugal Compressor

The chiller shall have single centrifugal compressor designed for Refrigerant HFC 134a and driven by an TEWAC / semi hermetic / hermetic motor. The compressor housing will be fully accessible with vertically split design, with the complete operating assembly removable from the compressor and scroll housing. Compressor castings will be designed for 235 psig working pressure and hydrostatically pressure tested at 355 psig. The rotor assembly will consist of a heat-treated alloy steel drive shaft and impeller shaft with a cast aluminum alloy impeller. The impeller will be designed for balanced thrust, dynamically balanced and over speed tested for smooth, vibration-free operation. Insert-type journal and thrust bearings will be fabricated of aluminum alloy, precision bored and axially grooved. The impeller shaft shall be either direct driven or connected to the speed increasing gear. The driven end of the gear shaft shall be connected with the motor through a flexible coupling for open drive chillers. The impeller shall be cast from alloy steel / aluminum alloy. This shall be statically and dynamically balanced to ensure vibration free operation. To ensure better serviceability the chiller and compressor make shall be same.

The compressor shall incorporate the necessary design features, which eliminate both the axial and radial thrust. Bearings shall be fabricated of aluminum alloy/white metal and precision bored and axially grooved. To ensure parts availability later date.

Lubrication System

The lubrication system shall form one integral part of the compressor assembly and shall ensure complete forced feed lubrication (at a controlled pressure and controlled temperature) to all bearing surfaces under any speed conditions, at start-up, at shut down and during operation at various loads. Provision shall also be made to take care that lubrication is ensured during coast down cycle incase of frequent failure of power. Thus full lubrication must be available to the machine during acceleration and deceleration periods. An oil reservoir, separate from the compressor, shall contain a submersible oil pump and an oil heater, thermostatically controlled to remove refrigerant from the oil. The oil reservoir shall be designed and stamped in accordance

with applicable pressure vessel code. An externally mounted . micron replaceable cartridge oil filter equipped with service valves shall filter oil. Oil cooling shall be done via a refrigerant cooled/water cooled oil cooler, with all piping factory or field installed. Oil side of the oil cooler shall be provided with service valves. An automatic oil return system to recover any oil that may have migrated to the evaporator shall be provided. Lubrication system shall include the following:

I. High efficiency oil filters.Low oil pressure cutout.
II. Oil coolers and oil heaters (with built-in-thermostat) to aid maintaining constant temperature.
III. Oil level indicator.
IV. Oil pressure control with pressure transducers and thermistors to digitally display through control center.

The compressor shaft seal must effectively prevent the leakage of refrigerant along the shaft during operation or shut down periods.

Capacity Control

The compressor shall be equipped with combination of speed control along with inlet guide vanes control for regulating its capacity. The positioning of the damper shall be done by means of thermostatically actuated electronic/hydraulic actuators with its sensing element in the incoming /outgoing chilled water nozzles of the heat exchanger. The automatic damper or reducing motor speed will maintain constant temperature of either Leaving or entering chilled water as selected by the user. The unit shall be so selected that it can operate from 100% Load to 25% Load at as per AHRI relief conditions defied by AHRI or IS/BEE Standards.

1.1.5 Microprocessor Control Panel

The chiller shall be controlled by a stand-alone microprocessor based control center. The chiller controller shall be factory wired and unit mounted on the chiller machine. Separate mounting of chiller controller is not acceptable, so that any shifting of the chiller will not necessitate sensor field wiring. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches. The control center shall provide reliable and safe operation, alarms and protection. The control panel shall include a high-end touch screen VGA display for user interface. The screen shall detail all operations and parameters, using a graphical/alphanumeric representation of the chiller and its major components. Data shall be displayed in either English or Metric units. The sophisticated program and sensor shall monitor the chilled water temperature to prevent freeze up. The panel shall display countdown timer messages so the operator knows when functions are starting and stopping. Every programmable point shall be displayed with the allowable ranges, so that the chiller cannot be programmed to operate outside of its design limits. The chiller control panel shall also provide:

1. System operating information including:
   a) return and leaving chilled water temperature
   b) return and leaving condenser water temperature
   c) evaporator and condenser saturation temperature
   d) differential oil pressure
   e) percent motor current
   f) evaporator and condenser saturation temperature
   g) compressor discharge temperature
   h) oil reservoir temperature
   i) operating hours
   j) number of compressor starts

2. Digital programming of set points through the universal keypad including:
   a) leaving chilled water temperature
   b) percent current limit
   c) pull-down demand limiting
   d) remote reset temperature range

3. Status messages indicating:

a) system ready to star
b) system running
c) system coastdown
d) system safety shutdown-manual restart
e) system cycling shutdown-auto restart
f) system prelube
g) start inhibit

4. The text displayed within the system status and system details field shall be displayed as a color coded message to indicate severity: red for safety fault, yellow for warnings, and blue for normal messages.

5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive shall include:

a) evaporator – low pressure
b) evaporator – transducer or leaving liquid probe
c) evaporator – transducer or temperature sensor
d) condenser – high pressure contacts open
e) condenser – high pressure
f) auxiliary safety – contacts closed
g) discharge – high temperature
h) oil – high temperature
i) oil – low differential pressure
j) oil – differential pressure calibration
k) oil – pressure setpoint not achieved
l) control panel – power failure
m) motor or starter – current imbalance

5.1 Safety shutdowns with a VSD Shall include:

a) VSD shutdown – requesting fault data
b) VSD – stop contacts open
c) VSD – 105% motor current overload
d) VSD – high phase A, B,C inverter heatsink temp.
e) VSD – high converter heatsink temperature
f) harmonic filter – high heatsink temperature

6. Cycling shutdowns enunciated through the display and the status bar, and consists of system status, system details, day, time, cause of shutdown, and type of restart required. Alarms / shutdowns with a fixed speed drive shall include:

a) multiunit cycling – contacts open
b) system cycling - contacts open
c) oil – low temperature differential
d) oil – low temperature
e) control panel - power failure
f) leaving chilled liquid - low temperature
g) leaving chilled liquid - flow switch open
h) motor controller – contacts open
i) power fault
j) control panel – schedule
k) starter – low supply line voltage
l) starter – high supply line voltage

m) proximity probe – low supply voltage
n) oil pump - drive contacts open

6.1 Alarms / shutdowns with a VSD shall include:
a) VSD shutdown – requesting fault data
b) VSD – stop contacts open
c) VSD initialization failed
d) VSD - high phase A,B,C instantaneous current
e) VSD – single phase input power
f) VSD – high DC bus voltage
g) VSD – high internal ambient temperature
h) VSD – invalid current scale selection
i) VSD – low phase A, B, C inverter heatsink temp.
j) VSD – low DC bus voltage
k) VSD – logic board processor
l) VSD – run signal
m) VSD – serial communications
n) harmonic filter – logic board or communications
o) harmonic filter – high DC bus voltage
p) harmonic filter – high phase A, B, C current
q) harmonic filter – phase locked loop
r) harmonic filter – low DC bus voltage
s) harmonic filter – DC bus voltage imbalance
t) harmonic filter – Input current overload
u) harmonic filter – logic board power supply
v) harmonic filter – run signal
w) harmonic filter – DC current transformer

Security access to prevent unauthorized change of set points, to allow local or remote control of the chiller; Access shall be through ID and password recognition. The Control center shall be capable to interface with a building automation system to provide for operation through BMS system. The necessary gateway card /Chiller system manager for transmitting the Chiller Control center data to the BMS including any software development/ configurations shall be provided along with the chillers to get all operation data, alarms, alarm history, temperatures, pressures, amps, run hrs, remote chiller start/stop, reset of chilled water temperature, reset of current limit and status messages indicating chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset, and chiller is shut down on a recycling safety etc.

The protocol for the gateways shall be Modbus-RTU / Modbus-TCP or BacNet IP / (MS/TP) as per the requirement. Cost of necessary hardware / software to integrate the chiller panel to BMS system shall be included by the chiller manufacturer / supplier. And the Subcontractor shall provide all data & access on to BMS for control and monitoring of entire HVAC system.

3.1.6 Motor

The compressor motor shall have IP54 protection and shall be either open or Semi hermetic (refrigerant cooled), squirrel cage, induction type operating at 2975 RPM. Hermetic motors shall be liquid refrigerant cooled and Open motors shall be TEWAC(Totally Enclosed Water to Air-cooled) type. Motor drive shaft will be directly connected to the compressor shaft with a flexible disc coupling to provide for factory alignment of motor and compressor shafts. For units utilizing remote electro-mechanical starters, a large steel terminal box with gasketed front access cover will be provided for field-connected conduit. Overload/ over current transformers will be furnished with all units. The motor shall be supplied with winding temperature sensors or thermistors for over temperature protection. The motor shall be suitable for load characteristics and the operational duty of the driven equipment with a mandatory margin of at least 10% over the absorbed input Kw power of the chiller and comply with these specifications and latest IEC codes. The total efficiency shall

include losses of the auxiliaries such as independent excitation, motor driven fans, lube-oil pumps etc. Lube oil pump supply voltage shall be derived from the 415V supply being given to the drive motor , so that any failure of lube oil supply is linked to the drive motor. Over voltage surge protection shall be provided to protect motor. The motor shall be designed and rated for 4 hot starts per hour with a maximum cool down period of 15 minutes. The motor shall be capable of successful operation when running at rated load with variations in voltage and frequency as follows:

I. Within □} 10% of rated voltage with rated frequency.
II. Within □} 5% of rated frequency with rated voltage.
III. Combination variation in voltage and frequency of 10%

(sum of absolute values) of the rated values, the frequency variation not exceeding □} 5% of rated frequency. Terminal box of sturdy construction shall provide enough space for terminating, connecting and earthing of XLPE - insulated copper / aluminum conductor cable. All terminal boxes shall be located at the same side of the motor and have terminal and cable glands suitable for cables specified. The terminal box shall be tested to high voltage fault withstanding test and lightening resistance test. A rupture disc to ensure pressure release mechanism to be provided in terminal box with pressure release set point at 0.5 kg/cm2 in order to facilitate safety pressure release in case of accidental flashing inside terminal box at any point of time.

Motor shall include following accessories and features:

i. Thermistors or Temperature detectors in stator windings.

1.1.7 Drive

The compressor shall be driven directly or through speed increasing gears as required. The gears and pinions shall be pressure lubricated. The gears shall be provided with oil filter and submerged oil pump. The gears should be of helical type with crown teeth designed such that more than one tooth is in contact at all times to provide even distribution of compressor load and quiet operation. Gears should be integrally assembled in the compressor rotor support and be film lubricated. Each gear should be individually mounted in its own journal and thrust bearings to isolate it from impeller and motor shafts.

1.1.8 Evaporator

Evaporator will be of the shell-and-tube, flooded type designed for 150 psig working pressure on the refrigerant side and 150 psig on waterside. The heat exchanger shall be hydrostatically tested at 1.3 times the design pressure. Shell will be fabricated from minimum 8 mm thick rolled carbon steel plates with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four feet apart. The evaporator heat exchanger will be designed IS/ ASME Pressure Vessel Code. Tubes shall be copper of 19 mm dia O.D. and minimum 0.635 mm wall thickness high efficiency, internally and externally enhanced type having plain copper lands at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube will be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes will not exceed 12 fps. Two liquid level sight glasses will be located on the side of the shell to aid in determining proper refrigerant charge. Mist eliminators or baffles will be located above the tube bundle to prevent liquid refrigerant carryover to the compressor. The
evaporator will have a refrigerant relief device sized to meet the requirements of ASHRAE 15 Safety Code for Mechanical Refrigeration. The Evaporator shall be horizontal, shell and tube type, provided with the following connections and accessories.

i. Refrigerant inlet and outlet pressure gauges.
ii. Water inlet and outlet connections.
iii. Drain and vent connections with stop valves.
iv. Pressure gauges & transducers / Temperature gauges & thermisters on water inlet and outlet connections
v. Descaling valves.
vi. Evaporator shall be factory insulated as per manufacturer’s standard

1.1.9 Condenser

The condenser shells shall be of rolled carbon steel plate with fusion welded seams. Removable compact water boxes of cast iron or welded steel with stub-out water connections shall be provided to permit access for tube cleaning and replacement. The tubes shall be finned from outside having spiral ridges from inside, roller expanded into the tube sheets providing a leak proof seal. The tube material will be copper. Intermediate steel tube supports should be provided at intervals not exceeding 1200 mm. The condenser heat exchanger will be designed IS/ ASME Pressure Vessel Code The condenser shall be horizontal, shell and tube type. The condenser shall be complete with the following accessories:

i. Refrigerant inlet and outlet pressure gauges.
ii. Water inlet and outlet connections.
iii. Drain and vent connections with stop valves.
iv. Pressure gauges & pressure transducers, and temperature gauges &
v. Thermisters on water inlet and outlet connections.
vi. Descaling valves.

1.1.10 Compressor Motor Starter

A variable speed drive will be factory installed on the chiller. It will vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analyzing information fed to it by sensors located throughout the chiller. Drive will be PWM type utilizing IGBT's with a power factor of 0.95 or better. The variable speed drive will be free standing or unit mounted in an IP54 / NEMA 12 enclosure. Field power wiring shall be a single point connection and electrical lugs for incoming power wiring will be provided. The VSD drive will be UL listed. The following features will be provided:

1. Door interlocked circuit breaker with 50KA rating capable of being padlocked.
2. Drive to be rated for 45 deg C ambient without any deration at full continuous frequency converter output current; Manufacturer catalogue should be submitted tp prove same
3. UL listed protection.
4. Over voltage and under voltage protection.
5. 3-phase sensing motor over current protection.
6. Single phase protection.
7. Over temperature protection.

1.1.11 Installation

The chilling machine shall be installed over a cement concrete platform and shall be adequately isolated as per manufacturer's recommendations against transmission of vibrations to the building structure by use of spring packages. For open type, special attention shall be paid to the alignment of the drive and driven shafts; final alignment shall be checked at site in presence of the Contractor or his authorized representatives, using a dial indicator. Compressor and motor sole plates, anchor bolts and sleeves and necessary vibration isolation pads shall be included.

1.1.12 Painting

Centrifugal water chilling machine shall be finished with durable epoxy/enamel paint. Shop coats of paint that have become marred during shipment or erection, shall be cleaned off with mineral spirits, wire brushed and spotprimed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surface.

1.1.13 Performance Rating

The unit shall be selected for the lowest operating noise level. Capacity ratings, and power consumption with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation. Capacity shall be ascertained by measurements of chilled water flow rate and temperature of chilled water in and out of the chilling unit. Power consumption shall be computed from measurements of incoming voltage & input current to the chilling machine. Power consumption of chillers shall be maximum

0.68 IKW / TR at full load at specified fouling factors and design parameters as per basis of design section of tender and minimum 4 Star rated as per latest BEE Star labelling guidelines .

1.1.14 Performance Testing

Prior to shipment, chilling machines shall be subjected to inspection and witness of performance tests by Department or his authorized representative / Consultant / Architect to verify various performance parameters as confirmed by contractor earlier at the time of award of contract. The contractor shall quote separately including the charges for all performance testing(s). The charges shall also include airfare, boarding & lodging of a maximum of three persons of Department or his representative / Consultant / Architect for each of the inspection(s) and performance testing(s). One chiller of each type /capacity shall be factory Performance tested in the presence of Department or his representative / Consultant / Architect:

Under simulated conditions of design parameters at full load (100%) at duty conditions and 4 points as per BEE standard to validated ISEER and Star labeling

The manufacturer shall supply certified test reports to confirm performance as specified. The manufacturer shall provide proper AHRI/ NABL certification documents for the test bed with submittals for inspection. The performance test shall be conducted in accordance with AHRI Standard 550/590 latest procedures and tolerances.

The equipment will be accepted if the test procedures and result are in conformance with AHRI550/590. If the equipment fails to perform within the allowable tolerances, the manufacturer will be allowed to make one revision to his equipment's and retest as required. The contractor shall pay all associated expenses resulting from retesting. In the event that this revision does not achieve submitted performance, Employer reserves the right to reject the equipment or accept with a penalty.

2.1.12 WITNESS TEST

Prior to shipment, chilling machines shall be subjected to inspection and witness of performance tests by Consultant and Owner's representative to verify various performance parameters as confirmed by vendor earlier at the time of award of contract. Performance test shall be carried out as per procedure laid down by ARI at 100%, & 50% loading. In case if the owner/consultant is unable to go by any reason, then contractor shall witness the testing at manufacturer's work & shall submit those reports along with relevant to & fro air tickets & boarding passes of travel to the country of origin of these chillers. All expenses inclusive of business class airfare, boarding lodging etc. relating to the witness test will be borne by the vendor / contractor. Fouling factor simulation for condenser and evaporator shall be done as per ARI-550/590-2003.Incremental temperature difference (to be calculated based on Normative appendix-C of ARI-550/590-2003) on account of designed fouling factors shall be added in condenser water entering temperature and shall be subtracted for leaving chilled water temperature. Chiller shall produce design refrigeration capacity and guaranteed power consumption at these corrected set of entering condenser water and leaving chilled water temperature.

SECTION – 2

WATER COOLED SCREW CHILLER WITH VFD (AHRI CERTIFIED)

2.0 WATER COOLED SCREW CHILLING MACHINES

2.1 General

The water chilling units shall be complete in all respects and shall generally comply with the specifications as given in the following paragraphs.

2.11 SYSTEM DESCRIPTION

A. Microprocessor-controlled liquid chiller shall use a semi-hermetic direct drive screw compressor using refrigerant HFC-134a only.

QUALITY ASSURANCE Chiller performance shall be rated in accordance with AHRI Standard 550/590, latest edition. Equipment and installation shall be in compliance with ANSI/ASHRAE 15 (latest edition). Cooler and condenser refrigerant side shall include in accordance with ASME or shall be GB Complied or BIS confirming. Unit shall be manufactured in facility certified ASME. Unit shall be manufactured in a facility registered to ISO 9001:2000 Manufacturing Quality Standard. Entire chiller assembly shall be proof tested and leak tested on the refrigerant side. The leak test shall not allow any leaks greater than 0.5 oz per year of refrigerant. The water side of each heat exchanger shall be hydro- statically tested as per manufacturer's standard. Prior to shipment, the chiller shall be tested & checked for proper wiring and ensure correct controls operation. Chillers shall have factory-mounted, factory-wired and factory-tested unit-mounted air cooled variable frequency drive (VFD). Proper VFD operation shall be confirmed prior to shipment.

2.2 Water Chilling Units

Each water chilling unit shall comprise:

a) Twin/Mono screw compressor .

b) Condenser with marine water boxes, accessories and supports.

c) Chiller with marine water boxes, accessories and supports.

d) Steel frame for mounting above components.

e) Microprocessor based control panel with Graphical Display of Functional data with automatic controls and display module having compatibility for interface with BMS.

f) Accessories as specified.

g) Interconnecting refrigerant piping.

h) Full charge of R-134a refrigerant and oil duly charged at factory.

i) VFD Starter for motor.

j) Painting of unit.

k) The design, manufacture and performance of Refrigerant Compressor shall comply with currently applicable statutes, regulations and safety codes. The equipment shall also conform to the latest applicable IS/ARI/ASHRAE/ISHRAE Standards. Nothing in this specification shall be construed to relieve Contractor of his responsibility. In particular, the equipment shall conform to the latest editions of the following standards:

1.1.1.1.1	IS – 660 Safety code for Mechanical Refrigeration.
1.1.1.1.2	ARI Standard 550-92 Rotary Screw Liquid Chilling Packages.
1.1.1.1.3	ASME Sec VIII /GB/BIS
1.1.1.1.4	ASHRAE Standard 15 Safety code for Mechanical Refrigeration.
1.1.1.1.5	ANSI-B-9.1 Safety code for Mechanical Refrigeration.
1.1.1.1.6	ARI-520 Standard for +ve Displacement Refrigeration.
1.1.1.2	Compressor and Condensing Units.
1.1.1.2.1	IS-5111 Code of Practice and Measurement for Rating
1.1.1.3	Refrigerant Compressors.
1.1.1.3.1	ASHRAE-23-67 Standard-Methods of testing for Rating Positive Displacement Refrigerant Compressors.
1.1.1.3.2	UL508 Industrial Control Panels.

2.3 **Compressors**

Each unit shall have a Single / Twin rotary screw direct drive capable of running at 3 phase 415±10 V, 50Hz operation at 3000 rpm semi hermetic compressor. The rotary screw shall be manufactured from forged steel, with profile which are symmetrical / asymmetrical. The profiles of screw shall permit safe operation up to the required speed as per the manufacturer's standard. The compressor shall be horizontal in design. The compressor shall be of the same make as that of the chiller or should be from the group company.

The compressor housing shall be of high grade cast iron or as per OEM standard, machined with precision, to provide a very close tolerance between the rotors and the housing. The rotors shall be mounted on anti-friction bearing designed to reduce friction and power input. There shall be multiple cylindrical/ tapered roller bearings or as other arrangements as required to handle the radial and axial loads as per OEM standard. To ensure better serviceability the chiller and compressor make shall be same.

There shall be built in / separate oil reservoir to ensure supply of lubricants to all bearings and a check valve to prevent back spin during shut down. There shall be oil pump or other means of forced lubrication of all parts during startup, running and coasting for shut down. An oil heater shall be provided in the casing.

The units shall be complete with capacity control sliding valve which permits modulation between 25% to 100% of capacity range. An oil separator shall be included

to remove oil from the refrigerant and there shall be suitable heat exchanger for oil separation.

The driving motor shall be refrigerant cooled squirrel cage hermetic type only (Hermetic compressors are not acceptable) as required, protected against damage by means of built in protection devices.

2.4 **Condenser**

Each unit shall have one shell and tube, water cooled, even pass condensers fitted with purge valve, and liquid line valve. The shell shall be of welded steel construction, fitted with steel tube sheets on either side. Tubes sheets shall be provided with 3 grooves for proper sealing of tube to tube sheet joint. Pressure relief valve shall be fitted on condenser or on oil separator in case of staggered arrangement.

The tubes shall be supported in the shell by adequate number of supports (at a distance not more than one meter) to avoid noise and vibrations and the ends properly expanded in the tube sheets to prevent leakage of refrigerant. These shall be designed for the duty specified in the schedule of equipment. The tubes shall be internally grooved & externally finned.

The water head shall be of MS, easy to remove with suitable baffles for multi pass water flow, in and out connection, gasket to prevent water leakage. Condenser shell shall be able to hold entire refrigerant charge available in the system to which the condenser is to be connected.

The condenser shall be tested with nitrogen or CO_2 gas against leaks at a pressure of 14 Kg/sq.cm on the shell side and similarly hydraulic pressure of 10 Kg/sq.cm. on the water side shall be applied when there shall be no drop in pressure indicating any leak.

The condenser shall be complete in all respects and include supports for mounting, refrigerant valves temp. sensors and differential pressure switches at water inlet and outlet etc., as required. The condenser shall be designed and tested in accordance with ASME code or BIS confirming.

2.5 **Chiller**

Chiller shall be flooded type

The shell shall be welded steel fitted with steel sheets on either side. Tubes should be supported in the shell by adequate, stiff supporting sheets and tube sheets to eliminate vibration and noise. Tubes sheets shall be provided with 3 grooves for proper sealing of tube to tube sheet joint. The tube ends shall be properly expanded in the tube sheets to prevent leakage of refrigerant. Tubes shall be removable without affecting the strength and durability of the support and tube sheet or causing any leakage in the adjacent tubes. Tubes shall be adequately supported at a distance not exceeding one meter. The tubes shall be internally grooved & externally finned.

The refrigerant heads shall be made of cast iron and the faces ground to a close tolerance to prevent leakage of refrigerant between passes and between the circuits in case of a multi circuit cooler.

The cooler shall be complete in all respect and should be fitted with:

i) Refrigerant Control valve, filter drier.
ii) Relief valve, charging connection with valve and drain valve.
iii) Water inlet and out connection with temp. sensors differential pressure switches

iv) Supports for mounting.

2.6 **Refrigerant Circuit**

The above mentioned components shall all be interconnected by suitably sized and properly designed heavy class steel / copper pipes and fittings complete with accessories and controls such as valves, liquid line sight glass, strainer, expansion valve etc. An electronically controlled expansion shall be provided to ensure smooth flow of refrigerant.

2.7 **Motors and Starters**

The compressor motor shall be suction gas cooled, hermetically sealed, two pole squirrel cage motor and of suitable rating as given under 'Schedule of Equipment' and confirm to specifications given under 'Motors, Starters and Switchgears'. The starter shall be factory fitted, unit mounted VFD starter. The starting current shall not be more than full load running amps.

2.8 **Control Console**

The unit shall be complete with a Microprocessor Based Control Console mounted directly on the unit and pre-wired with all operating and safety controls and BACNET / Mod-bus Communication card. It shall have coloured graphical display. Control console shall at least have following display:

a) Leaving chilled water temperature.
b) Chilled water inlet / outlet temp.
c) Chilled water inlet / outlet temp.

Microprocessor controls should provide the safety, interlock, capacity control, indications and accessibility necessary to operate the chiller in a safe and efficient manner.

Control system: The microprocessor control on each chiller should be factory-tested to ensure machine protection and efficient capacity control. In addition, the program logic should ensures proper starting, stopping, and recycling of the chiller. Features Control system • Menu-driven keypad/ touch screen interface for status display, set point control, and system configuration • Primary and secondary status messages • Recall of up to 10 alarm messages and 10 alert messages

Variable Frequency Drive

Unit-Mounted Air Cooled Variable Frequency Drive (VFD) with Built-In Line reactor and DC Chokes: The VFD shall be factory-mounted, factory- wired and factory-tested prior to shipment by the chiller manufacturer. All interconnecting wiring and piping between the VFD and the chiller shall be factory-installed. The VFD shall incorporate the following features:
a. The VFD shall be air cooled, microprocessor based, pulse width modulated design.
b. Integrated controls shall coordinate motor speed to optimize chiller performance over a wide variety of operating conditions.

Enclosure:
a. Pre-painted unit mounted, IP42 cabinet shall include hinged, lockable doors, in case VFD is separately mounted the same shall be IP 54 rated.
b. The VFD shall have a short circuit interrupt and withstand rating of at least 65,000 amps.

3. VFD Rating:

a. Drive shall be suitable for operation at name- plate voltage ±10%.
b. Drive shall be suitable for continuous operation at 100% of nameplate amps and 110% of nameplate amps for 2 seconds.
c. Drive shall be UL Listed, CE marked
d. Drive shall be suitable for operation in ambient temperatures up to 45 Deg C, 95% humidity (non-condensing)
User Interface: Multi line Alphanumeric display shall provide interface for programming and display of VFD and chiller parameters.
VFD Performance: a. The VFD Voltage Total Harmonic Distortion (THD) and Harmonic Current Total Demand Distortion (TDD) shall not exceed 40 % at input terminals as the point of common coupling (PCC). b. The VFD full load efficiency shall meet or exceed 95% at VFD rated amp capacity. c. Active rectifier shall regulate unity displacement power factor to 0.99 or higher.

2.9 **Accessories**

Each water chilling unit shall be complete with the following items:

a) Antifreeze thermostat.
c) Liquid line sight glass.
d) Liquid line strainer.
e) Differential pressure switches on condenser and cooler.
f) H.P., L.P. oil pressure cutouts.
g) Liquid level control on condenser

Provision of condenser water and chilled water pump electric circuits to be interlocked with chilling control panel, so that the unit cannot start, unless at least one of the pumps of each circuit is operating.

2.10 **Miscellaneous**

Each water chilling unit shall include:

Suitable steel frame to mount the components.

Suitable vibration isolation pads of high efficiency in preventing transmission of vibrations, to the satisfaction of Engineer-in-Charge.

Control panel for housing the safety controls, gauges, thermostats, switches and other related items as applicable. The panel shall be provided with microprocessor controller, factory installed. It should have display screen for indicating the parameters and fault conditions.

Full factory charge of refrigerant, as required to obtain and maintain the design conditions and the required quantity of suitable grade lubrication oil.

Each unit shall include, but not limited to, all the items listed in the foregoing paragraphs or in the "Schedule of Equipment" and drawings for this project. In addition all such items, as may be required shall be provided whether specifically mentioned or not, if considered or found necessary fulfill the intent and meaning, for the purpose of maintaining design conditions, under all extreme weather conditions.

The whole unit shall be duly painted satisfactorily in an approved color, with two coats of synthetic enamel paint.

CHILLER PERFORMANCE TESTS (at factory)

To ensure quality, guaranteed efficiency and performance in compliance with the specified conditions, one of the three package liquid chiller shall be fully witness tested at the factory before dispatch. The tests shall be conducted at the manufacturer's factory or workshop on AHRI certified test bed, where proper testing facilities are available for testing the chiller at 50%, 75% and 100% at reduced condenser temperature in accordance with AHRI. The testing will be done as per AHRI conditions & latest AHRI standard for testing.

2.11 **Installation and Testing**

- The complete water-chilling unit shall be mounted on a RCC foundation.
- All safety controls, low and high refrigerant pressure controls, starter overload trips shall be suitably set and a record of all the setting shall be furnished to the Engineer-in-Charge.

2.12 **Limitations**

- The water velocity in the condenser tube shall not exceed (10 FPS).
- The chilling machine shall be as per AHRI & tested on ARI certified test bed facility.
- Computerized selection sheet with AHRI stamp from the chiller manufacturer shall be furnished along with the technical-bid for verification of machine capacity and power consumption at full load.
- ASHRAE BACnet / Modbus output from chiller control panel

1. SMART COMPREHENSIVE AIR PURIFICATION SOLUTION COMPRISING OF EAC (ELECTRONIC AIR CLEANER) & (PLASMA IONIZATION)

1.1 EAC (Electronic Air Cleaner)

Air purification for ceiling suspended Duct able indoor units and AHU The air purification system should be suitable to reduce harmful pollutants like particulate matter (PMx), PM 2.5, allergens, pollen, smoke, bacteria, pathogens etc. based on below principal technology viz; Impingement, Polarisation and Agglomeration as a passive air It should be a slim structured unit specifically designed for integration in Return Air path of ceiling suspended indoor units, to centrally capture. It should be equivalent to Merv-14 or Higher efficiency for AHU and Duct able.

* Units with low pressure drop. It should have 3x working principles. The units shall meet ANSI/ASHRAE 52.2/ISO 16890 standards and have valid test report to verify filtration efficiency. The product has to be certified as a green product by any of the Green Building councils across the word (GreenPro). The test report for pressure drop need to be submitted for passive air purification and the same shall be demonstrated at site. Electronic Air Cleaner should consist of an Internet of Things (IoT) enabled WiFi based Smart Filtration option employing a 3-Tier Architecture.

Electronic Air Cleaner should consist of an Internet of Things (IoT) enabled WIFI/GSM based Smart Filtration option employing a 3-Tier Architecture. This architecture would serve to identify pressure drops across the filter, indicating when a cleaning is necessary due to clogging. Furthermore helps in scheduled preventive maintenance to ensure sustainability. To facilitate user interaction, a well-designed UI/UX experience in the form
of a dashboard is essential, complete with appropriate colour- coding.

1.2 AIR PURIFICATION SYSTEM (PLASMA IONIZATION)

The Active Air Purification system should consist of Supply, Installation, Testing and commissioning of Bipolar Ionisation System. The Bipolar Ionisation System must be a combination of Needle Point Model (Needle Point should have Nitinol (nickel titanium) Needles) for AHU and Duct able units and Carbon Fibre Brush Model for VRF's, System should produce positive and negative ions for creating a Bio Climate rich in ions and hence neutralising harmful pollutants including pathogens, Volatile Organic Compounds and Particulate Matter.

The Carbon Brush self-balancing ionizer should be installed at the fan inlet of fan coil units, VRF cassettes, ductless splits, Needlepoint Ionizer shall be installed at AHU and Ductable HVAC System. These ionizers should be self-contained in a potted ABS box with a moulded flange and mounting holes and is protected with an inline 500mAglass cartridge fuse. The Unit can be easily mounted at the fan inlet of any air handling system, including RTU's, ptacs, mini-splits, fan coil units and VRF systems. The Unit should accept 12-24 V AC/DC. The installer makes a duct cut out and secures the unit with self-tapping sheet metal screws. The unit can also be installed inside an AHU, Treated Fresh Air unit, Heat Recovery Ventilation Unit.

Product should have UL 867 and UL 2998 certification (for zero ozone emission). The OEM shall have Efficacy test report on COVID from any Internationally/Nationally recognised Laboratory
The System should be capable of providing periodic Preventive maintenance for automated after sales support service in form of notification/alerts and user interaction through dashboard application.
Supplier must have experience of more than 5 years of executing projects with the same technology products. and have done at least 3 multi-location projects (Private Or Government) Pan India and Minimum Value of each project must be at Least 50 Lac.
Following Certifications are mandatory to produce
The Carbon Brush and Self Cleaning nickel titanium based Needle Point Bipolar Ionizer must be UL 2043 certified for safety against fire and smoke.
The Carbon Brush and Self Cleaning nickel titanium based Needle Point Bipolar Ionizer must have UL-2998
Certification for Safety against Zero Ozone Emission as per recommendation by ASHRAE.
· The Carbon Brush and nickel titanium based Needle Point Bipolar Ionizer Should be tested on UL or Intertek/ETL to prove conformance to UL 867 for electronic devices.
Other Product Certifications required are ISO16000 , CSA C22.2# 187, and CARB.
Manufacturers shall provide Test report from Internationally/Nationally recognized Lab for proven efficacy on below pathogens with minimum kill rates for the following pathogens given the allotted time and in a space condition:
a) SARS-CoV-2 (COVID-19) Human Strain
b) MS2 Bacteriophage (Surrogates COVID-19)
c) Omicron Variant of SARS-CoV-2 d) H1N1
e) Total Bacterial Count Reduction rate of more than 90% from NABL Accredited Lab
f) Yeast & Mould/Total fungal count Reduction rate of more than 90% from NABL Accredited Lab

1.3 **INDOOR AIR QUALITY MONITORING SYSTEM-**

Supply, Installation, Testing & commissioning of IAQ Monitor (Sensor) to remotely measure the levels of PM 2.5, VOCs, CO2, Temperature, Humidity, HCHO on a real time basis. The IAQ Monitor shall be capable of getting connected with Wi-Fi. The Monitor should be capable of sending the indoor air quality information on display Screen/Mobile/Workstation as per
Client's requirement. The Monitor should indicate the quality of air through changing the colours on the display screen as per the NAAQS standards and should meet the WELL building standards. The monitor should be a 3 tier architecture including sensor Hardware, secure cloud infrastructure, monitoring apps including dashboard, android/IOS. Quoted

price shall be inclusive of all necessary arrangement as required to make the unit proper functional. The System should provide Soft Assistance in form of Notifications and Alerts for Periodic Preventive Maintenance.

1.4 STP ODOUR CONTROL BY IOFS- ION OXYGEN FUSION SYSTEM

Plasma Air Ionizer to improve Indoor air quality by using Bi-polar Ionization technology, producing equal amounts of positive and negative oxygen ions. The system kills microorganism and pathogens, remove Odour, and VOC and reduce dust particle /particulate matter / PM2.5 /PM 10.

The product should be UL / Intertek listed. The product has minimal or negligible pressure drop & low power consumption. The life of the Tube should be 17,600* hours. The power consumption of 3000 CFM units should not exceed 8 watts. The power consumption of 5000 CFM units should not exceed 16 watts. The power consumption of 10000 CFM units should not exceed 50 watts. The unit shall be installed inside Supply duct. Power to the ionization unit should be interlocked with the system fan operation. A five-position ion level control knob shall be their to vary the ion output between 50% and 100%. Tube-Based Model Should be Underwriters Laboratories Inc. Standards UL867 and UL1995 Classified as plenum rated per UL 2043.

5A402.3 VAPOUR COMPRESSION HEAT PUMP

5A402.3.1 The scope of this consists of but is not necessarily limited to the following:

a. Manufacture and supply of screw liquid heat pumps with associated motors, soft starter and accessories.
b. All associated items herein to be supplied delivered and installed.
c. In case of multiple compressors, distribution panel having one incoming and multiple outgoings (equal to number of compressors) along with cabling from panel to compressor motors. Incoming power cable will be of Aluminium. Necessary hardware to connect incoming Aluminium cable to chiller copper cabling shall be included.
d. Assembly of chiller components including connection of coolers, condensers, motors, compressors, etc. into complete refrigeration machines.
e. Provide manufacturer's factory representative's services, including coordination, and start-up and testing supervision.
f. Testing (factory and field), start-up supervision, training and providing necessary documentation and tools for operation.
g. Carry out performance test run at factory at design conditions.
h. Carry out performance test at site with available peak load and ambient conditions.
i. As per AHRI Standard 575-08, Method of Measuring Machinery Sound Within Equipment Rooms, Chiller Sound Pressure Levels at 1 metre shall not exceed 85 dBa. If proposed chiller is unable to meet this sound level at all loads and operating points then the manufacturer shall provide centrifugal chillers with active sound control and acoustics.

5A402.3.2 Quality Assurance Program

a. Heat Pump shall be rated in accordance with Parameters indicated in tender. Pressure vessels shall be designed in accordance with ASME / Equivalent Code.
b. Heat Pumps shall be the product of a manufacturer normally supplying this type of equipment.

5A402.3.3 The compressor shall have a semi-hermetic direct drive twin screw design with

capacity control slide valve (step-less), oil sump heater and differential pressure refrigerant oil flow system. Multiple pressure lubricated rolling element bearing groups shall support the rotating assembly.

5A402.3.5 Micro Computer Control Centre : Each unit shall be furnished with microcomputer control centre in a locked enclosure, factory mounted, wired and tested. The control center shall include a 40-character alphanumeric display showing all system parameters in English language with numeric data in English (FPS) units.

5A402.3.6 Digital programming of essential setpoints through a colour coded, tactile-feel keypad shall include: entering and leaving chilled water temperature and condensing water temperature; percent loading: pull down demand limiting; seven-day time clock for starting and stopping chiller (complete with local holiday schedule); and remote reset temperature range.

5A402.3.7 All safety and cycling shutdowns shall be annunciated through the alphanumeric display and consist of day, time, cause of shutdown, and type of restart required. Safety shutdowns shall include: high oil pressure; high compressor discharge temperature: low evaporator pressure: motor controller fault: and sensor malfunctions. Cycling shutdowns shall include: low water temperature; low oil temperature: chiller/condenser water flow interruption; pheat rower fault; internal time clock; and entire cycle.

5A402.3.8 System operating information shall include: return/leaving chilled water temperatures; return/leaving condenser water temperatures; evaporator/condenser refrigerant pressure; differential oil pressure; percent motor current; evaporator/condenser saturation temperatures; operating hours (Hours Run) and number of compressors starts.

5A402.3.9 Security access shall be provided to prevent unauthorized change of setpoints to allow local or remote control of the chiller, and to allow manual operation of the prorogation vanes and oil pump.

5A402.3.10 Control center shall be able to interface with the Building Automation System (BAS) to provide remote chiller start/stop reset of chilled water temperature reset of current limit; and status messages indicating chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset, and chiller is shut down on a recycling safety.

5A402.3.11 Interface With Building Automation System

All necessary hardwares / softwares to integrate the chiller panel to BAS system shall be provided by chiller manufacturer / supplier.

For the integration of Microprocessor Panel of the chilling machine with the Building Automation System, an Interface Control Document shall be developed by BAS Contractor. It shall be responsibility of HVAC Contractor to provide following to BAS Contractor for preparing the interface.

a. Hardware Protocol of Chiller Microprocessor panel.
b. Software Protocol of Chiller Microprocessor panel.
c. Communication structure relating to collection of message / event information.
d. Description of the formatted packets / blocks of data which construct controller commands / responses.

5A402.3.12 Electric Motor : Motor shall be energy efficient and suitable for 415 or 400 V±10% volts, 3 phase, 50 cycles AC supply.

5A402.3.13 Starter : Shall be close transition star delta starter or soft starter. All components of starter shall be housed in dust proof enclosure and suitable for 415 or 400 ± 10% volts 50 cycles 3 phase AC power supply.

5A402.3.14 Evaporator and Condenser

a. Shells and Water Boxes : The evaporator and condenser shells will be of rolled carbon steel plate with fusion welded seams. Hinged water boxes of cast iron or welded steel with stub-out water connections shall be provided to permit access for tube cleaning and replacement. Water boxes shall be designed for 150 psig working pressure and hydraulically tested at 225 psig. The tubes shall be finned from outside having spiral ridges from inside, roller expanded into the tube sheets providing a leakproof seal. The tube material will be copper, intermediate steel tube supports should be provided at intervals not exceeding 1200 mm.

b. Evaporator : Evaporator shall be provided with eliminator to prevent liquid carry over to the compressor. The chiller shall be provided with liquid level sight glass and a relief device (of the bursting type) to prevent excess pressure in the heat exchanger. The chiller shall be horizontal, shell and tube type, provided with the following connections and accessories:

    i. Water inlet and outlet connections.

    ii. Drain and vent connections with stop valves.

    Evaporator shall be insulated with 19 mm thick rubber based closed cell polyurethane electronic foam.

c. Condenser : The condenser shall be water cooled & shall be source of hot water. It shall be complete with the accessories.

5A402.3.15 Installation

The chilling machine shall be installed over a cement concrete platform and shall be adequately isolated as per manufacturers recommendations against transmission of vibrations to the building structure.

5A402.3.16 Painting

Screw water heating machine shall be finished with durable enamel paint. Shop coats of paint that have become marred during shipment or erection, shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.

5A402.3.17 Performance Rating

The unit shall be selected for the lowest operating noise level. Capacity ratings, and power consumption with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation. Capacity shall be ascertained by measurements of hot water flow rate and temperature of hot water in and out of the heat pump. Power consumption shall be computed from measurements of incoming voltage & input current to the chilling machine.

5A402.3.18 Witness Test

Prior to shipment, heat pumps shall be subjected to inspection and witness of performance tests by Consultant and Client’s representative at AHRI certified test bed at factory to verify various performance parameters as confirmed by vendor earlier at the time of award of contract. Performance test shall be carried out as per procedure laid down by AHRI / EUROVENT and as per specified parameter, at 100% loading.

Fouling factor simulation for condenser and evaporator shall be done as per AHRI-550/590- 2011.Incremental temperature difference (to be calculated based on Normative appendix-C of

ARI-550/590-2011) on account of designed fouling factors shall be added in condenser water entering temperature and shall be subtracted for leaving chilled water temperature. Chiller shall produce design refrigeration capacity and guaranteed power consumption at these corrected set of entering condenser water and leaving chilled water temperature. Outside tube surface area (for condenser and flooded evaporators) and inside tube surface area (for DX-Evaporator) , being inputs for AHRI mathematical model for fouling, shall be submitted along with the offer.

While demonstration of performance at factory at any loading condition, no negative tolerance is acceptable on refrigeration capacity, power factor and no positive tolerance is acceptable on power consumption, water pressure drops through evaporator and condenser.

5A402.4 Chiller Plant Manager

5A402.4.1 General

a. The Chiller Plant Manager shall be as indicated in IO Summary and as described in the specifications.
b. Network Automation/Control Engine and Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.
c. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any work-station on the control system and have access to all appropriate data. The system shall be fully web enabled as shown on the drawings and as specified in this specification.
d. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.
e. Communication between the control panels and all work-stations shall be over a high speed TCP/IP network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
f. The equipment to be monitored and controlled include the following:
    - Control of Chillers with Primary flow pumps, Condenser Water Pumps, Cooling Towers and Motorized Butterfly Valves.
    - Measurement and monitoring of the chilled water temperatures and flows.
    - IkW/TR measurement of each chiller.
    - Control of Heat Pumps with Chilled water pumps, Hot Water Pumps and Motorized Butterfly Valves.
    - Heating Capacity, Free cooling & Energy consumption.
    - Energy metering using special Energy Software with dashboard and customized reporting tools.

5A402.4.2 Data Point Summary for Chiller Plant Manager

S. No	Description	Qty	Total Points					Required signal
			DI	DO	AI	AO	SW	
A	Chiller and Heat Pump Plant							
1	Chiller/HP On/Off command							Software Integration signal
2	Chiller/HP Run status							Software Integration signal
3	Chiller/HP Fault/Alarm status							Software Integration signal
4	Chiller/HP CHW Temperature Reset Setpoint							Software Integration signal
5	Chiller/HP Current Limit Setpoint							Software Integration signal
6	Chiller/HP inlet isolation valve Open/Close command							NO/NC Relay Command to Valve
7	Chiller/HP inlet isolation valve Open/Close status							NO/NC Potential free contact from Valve
8	CW inlet isolation valve Open/Close command							NO/NC Relay Command to Valve
9	CW inlet isolation valve Open/Close status							NO/NC Potential free contact from Valve
10	Common CHW supply header temperature (Before and after Bypass							Immersion Temperature sensor
11	Common CHW/HW return header temperature							Immersion Temperature sensor
12	Common HW supply header temperature							Immersion Temperature sensor
13	Common HW return header temperature							Immersion Temperature sensor
14	Flow transmitter							0-10 VDC or 4-20mA from Flow Meter
15	Outside Air Temp/Humidity							0-10VDC from RH cum temp sensor(HE-67N3-0N0BT)
16	Chiller capacity control							

S. No	Description	Qty	Total Points					Required signal
			DI	DO	AI	AO	SW	
#	Total points for Chiller and Heat Pump Plant							
			DI	DO	AI	AO	SW	
B.	Primary Chilled & Hot Water Pumps (PCHP)-							
1	Pump On/Off command							NO/NC Potential free contact from MCC Panel/Pump VFD
2	Pump run status							NO/NC Potential free contact from MCC Panel/Pump VFD
#	Total points for Chilled Water Pumps							
C.	Condenser Water Pumps							
1	Pump Auto/Manual status							NO/NC Potential free contact from MCC Panel/Pump VFD
2	Pump On/Off command							NO/NC Potential free contact from MCC Panel/Pump VFD
3	Pump run status							NO/NC Potential free contact from MCC Panel/Pump VFD
4	Pump trip status							NO/NC Potential free contact from MCC Panel/Pump VFD
#	Total points for Condenser Water Pumps							
D.	Cooling Tower (CT)-							
1	Fan Auto/Manual status							NO/NC Potential free contact from MCC Panel/CT VFD
2	Fan On/Off Command							NO/NC Potential free contact from MCC Panel/CT VFD
3	Fan Run status							NO/NC Potential free contact from MCC Panel/CT VFD
4	Fan Trip status							NO/NC Potential free contact from MCC Panel/CT VFD
5	CT inlet/outlet Isolation valve Open command							NO/NC Relay Command to Valve

S. No	Description	Qty	Total Points					Required signal
			DI	DO	AI	AO	SW	
6	CT inlet/outlet Isolation valve Open/close status							NO/NC Potential free contact from Valve
7	Common CW supply header temperature							Immersion Temperature sensor
8	Common CW return header Temperature							Immersion Temperature sensor
9	CT level HI/LOW							Single level switch
10	CT fan modulate							At VFD
#	Total points for Cooling Tower							
E.	Chiller Diagnostic Points							
1	Leaving chilled liquid – setpoint							
2	Motor current limit –setpoint							
3	Leaving temperature chilled liquid –							
4	Entering temperature chilled liquid –							
5	Leaving condenser liquid – temperature							
6	Entering condensor liquid – temperature							
7	Evaporator pressure							
8	Condensor pressure							
9	Oil – low differential pressure							
10	Motor FLA current							
11	Discharge pressure							
12	Operating hours							
13	Unit safety fault code							
14	Unit cycling fault code							

S. No	Description	Qty	Total Points					Required signal
			DI	DO	AI	AO	S W	
15	Operation code							
16	Evaporator – low pressure							
17	Evaporator – low-pressure – smart freeze							
18	Evaporator – transducer or leaving liquid probe							
19	Condenser – high pressure							
S. No	Description	Qty	Total Points					Required signal
			DI	DO	AI	AO	SW	
20	Condenser – pressure transducer out of range							
21	Discharge – low temperature							
22	Oil – high temperature							
23	Oil – low differential pressure							
24	Oil – clogged filter							
25	Motor controller – loss of current							
26	Oil – high pressure							
27	Oil – separator – low level							
28	Leaving chilled liquid - low temperature							
29	Motor controller – loss of current							
30	Sys Oil Temperature							
31	Sys Oil Pressure							
32	Sys Oil Filter Pressure							
33	Slide Valve Position							
34	Sys Discharge Temp							

S. No	Description	Qty	Total Points					Required signal
			DI	DO	AI	AO	SW	
35	Sys.evaporator saturation temperature							
36	Sys.evaporator sub temperature							
37	Sys.condenser saturation temperature							
38	Evaporator refrigerant temperature							
39	Evaporator small temperature difference							
40	Condenser small temperature difference							
43	Sys. Start times							
	Total diagnostic points							

5A402.4.3 System Hardware

The system architecture shall be as follows:

The Chiller Plant Manager (CPM) shall use an open architecture and fully support a multi- vendor environment. To accomplish this effectively, the CPM shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

The system shall be designed into three tiers and contain a field tier (the tier that contains all of the field level controllers, and application specific controllers), an automation tier (this is the tier that connects all of the field tiers), and an enterprise tier (this is the tier that connects all of the automation tiers). No two-tier design is acceptable.

The CPM shall consist of the following hardware and software:

- Standalone Network Automation/Control Engine(s)
- DDC Field Equipment Controller(s) and BTL Certified Input / Output Module(s)
- Workstation and Energy Management

5A402.4.4 Software Standalone Network

Automation/Control Engine

a. Controller shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:
   - BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
   - It shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

- It shall be tested and certified as a BACnet Building Controller (B-BC).

b. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications.

c. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

d. This must have Unlimited number of user license without any additional cost of license on the OWS.

e. Network engine shall be able to access by 4 simultaneous user.

f. Network engine shall l be browsed by Microsoft Internet Explorer and Netscape Navigator

g. Network engine processor should be of 32 bit configuration
h. Network engine should have inbuilt display and keys to operate in absence of PC

i. Network engine should have inbuilt IO points , functionally able to act as a DDC controller as well as a Supervisory controller.

j. Network engine should support AHARAE standard BACnet MS/TP protocol , Proprietary Protocol shall not be accepted

k. Network engine should support integration of third party protocol (eg MODbus-RTU) seamlessly without adding additional hardware

l. For BACnet MS/TP or IP integration, the Network engine should be support auto discovery to discover the field devices and field points

m. Network engine should support DHCP function for IP

5A402.4.5 addressing Workstation and Energy Management Software

a. The system shall provide a real-time database incorporating data from analog, logical or pulse inputs.

b. It should be support up to 1000 TCP/IP addresses for the supervisory controllers in the Enterprise network

c. Historian of point data shall be configurable as part of the point definition. Historian shall be provided for both snapshots and averages with intervals ranging from 5 seconds to 24 hours

d. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility

e. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format

f. The system shall be able to store all the events

g. The operator interface shall be flexible in its connection to the CPM server. Both serial wireless, 3G and LAN connection shall be possible. The operator interface shall provide standard dial- up modem support. Using other packages such as Microsoft

Terminal to make the modem connection shall not be acceptable.

h. CPM management level software shall have Unlimited number of user license without any additional cost of license on the OWS.

i. CPM software shall be web based software shall allow 5 simultaneous user access.

j. Server software shall be able to browsed by Microsoft Internet Explorer and Netscape Navigator

k. Energy Management software capable of fetching the energy data from the BMS and store the data into separate application database (SQL) for analysis. This Software should have the following Key features:
   - Segmentation of energy information at a glance.
   - Customisable energy dash-board.
   - Energy report generation against selection of time and frequency.
   - Co2 Emission Calculation and Reporting.
   - Web Based Tool. No Additional Software should be Required.
   - Automatic Alarm Email / SMS Option must be avaialable

l. The software shall have Ready Access Portal Architecture , graphics and management software shall be accessible thru smart phones.

m. A minimum of 100 unique passwords shall be supported. Provide a minimum of 100 categories of systems to which individual operators may be assigned.

n. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of 5 years in advance.

o. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers.

p. The system shall provide flexible trending allowing real-time, historical or archived data to be trended in a variety of formats. In addition, trend data types shall be able to be combined to allow for comparisons between data e.g. current real-time data versus archived data

q. The system shall support a flexible reporting package to allow easy generation of report data. The reports provided should include pre-configured standard reports for common requirements such as Alarm Event reports and custom report generation.

r. The system shall provide up to six levels of security providing varying degrees of access to system operation and configuration functions.

5A402.4.6 DDC Field Equipment Controller(s) and Input/Output Module(s)

a. General purpose DDC controllers shall be minimum 32 bit microprocessor based with FLASH base of operating system.
b. The devices shall be programmable and capable of extensive measuring, control and monitoring functions.
c. All DDCs shall support modular architecture with the following:
d. A CPU with Power Supply Module
e. Distributed I/O modules to accommodate Input/Output points.
f. Energy management programs such as optimum start/stop, load reset, duty cycling, night purge, distributed demand control and others must be resident on each DDC.

g. As a backup, DDC's shall store DDC programs and data files on non-volatile EEPROM or flash memory to allow simple and reliable additions and changes. Each DDC shall have a 72 hours battery backed real-time clock.

h. Each panel shall be provided with a socket for a Portable Operators Terminal (POT) which can be connected via Bluetooth communication for easy access for testing & trouble shooting and no need to open the panel, and a port for network communications In max. speed of 76Kbps

i. All the DDC should be BTL listed.

j. DDC shall support PRAC and PID logic

k. The DDC software configuration tool shall use be GUI based logics.

5A402.5 Chiller Plant Optimizer

a. The Chiller Plant Optimizer shall be as indicated in IO Summary and as described in the specifications.

b. Network Automation/Control Engine and Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.

c. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any work-station on the control system and have access to all appropriate data. The system shall be fully web enabled as shown on the drawings and as specified in this specification.

d. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

e. Communication between the control panels and all work-stations shall be over a high speed TCP/IP network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.

f. The equipment to be monitored and controlled include the following:
   - Control of Chillers with Primary flow pumps, Condenser Water Pumps Cooling Towers and Motorized Butterfly Valves.
   - Measurement and monitoring of the chilled water temperatures and flows.
   - IkW/TR measurement of each chiller.
   - Energy metering using special Energy Software with dashboard and customized reporting tools.
   - Optimizing the energy utilization of Chiller and pumps based on ambient temperature, instantaneous load with best efficiency point of each equipment controlled by equipment.

5A402.5.1 SYSTEM HARDWARE

The system architecture shall be as follows:

The Chiller Plant Optimizer (CPO) shall use an open architecture and fully support a multi- vendor environment. To accomplish this effectively, the CPM shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

The system shall be designed into three tiers and contain a field tier (the tier that contains all of the field level controllers, and application specific controllers), an automation tier (this is the tier that connects all of the field tiers), and an enterprise tier (this is the tier that connects all of the automation tiers). No two-tier design is acceptable.

The CPM shall consist of the following hardware and software:

1. Standalone Network Automation/Control Engine(s)

2. DDC Field Equipment Controller(s) and BTL Certified Input / Output Module(s)

3. Workstation and Energy

5A402.5.2 Management Software Standalone

Network Automation/Control Engine

a. Controller shall provide supervisory control over the control network and shall support all three
(3) of the following communication protocols:
- BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
- It shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
- It shall be tested and certified as a BACnet Building Controller (B-BC).

b. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications.

c. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

d. This must have Unlimited number of user license without any additional cost of license on the OWS.

e. Network engine shall be able to access by 4 simultaneous user.

f. Network engine shall l be browsed by Microsoft Internet Explorer and Netscape Navigator

g. Network engine processor should be of 32 bit configuration

h. Network engine should have inbuilt display and keys to operate in absence of PC

i. Network engine should have inbuilt IO points , functionally able to act as a DDC controller as well as a Supervisory controller.

j. Network engine should support AHARAE standard BACnet MS/TP protocol , Proprietary Protocol shall not be accepted

k. Network engine should support integration of third party protocol (eg MODbus-RTU) seamlessly without adding additional hardware

l. For BACnet MS/TP or IP integration, the Network engine should be support auto discovery to discover the field devices and field points

m. Network engine should support DHCP function

5A402.5.3 for IP addressing Workstation and Energy

Management Software

a. The system shall provide a real-time database incorporating data from analog, logical or pulse inputs.

b. It should be support up to 1000 TCP/IP addresses for the supervisory controllers in the Enterprise network

c. Historian of point data shall be configurable as part of the point definition. Historian shall be provided for both snapshots and averages with intervals ranging from 5 seconds to 24hours

d. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility

e. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format

f. The system shall be able to store all the events

g. The operator interface shall be flexible in its connection to the CPM server. Both serial wireless, 3G and LAN connection shall be possible. The operator interface shall provide standard dial- up modem support. Using other packages such as Microsoft Terminal to make the modem connection shall not be acceptable.

h. CPM management level software shall have minimum 5 number of user license without any additional cost of license on the OWS.

i. CPM software shall be web based software shall allow 5 simultaneous user access.

j. Server software shall be able to browsed by Microsoft Internet Explorer

k. Energy Management software capable of fetching the energy data from the CPM and store the data into separate application database (SQL) for analysis. This Software should have the following Key features:
- Segmentation of energy information at a glance.
- Customizable energy dash-board.
- Energy report generation against selection of time and frequency.
- Co2 Emission Calculation and Reporting.
- Web Based Tool. No Additional Software should be required.

- Automatic Alarm Email / SMS Option must be available
- Optimizing the energy utilization of Chiller and pumps based on ambient temperature, instantaneous load with best efficiency point of each equipment controlled by equipment.

l. The software shall have Ready Access Portal Architecture, graphics and management software shall be accessible thru smart phones.

m. A minimum of 100 unique passwords shall be supported. Provide a minimum of 100 categories of systems to which individual operators may be assigned.

n. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of 5 years in advance.

o. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers.

p. The system shall provide flexible trending allowing real-time, historical or archived data to be trended in a variety of formats. In addition, trend data types shall be able to be combined to allow for comparisons between data e.g. current real-time data versus archived data

q. The system shall support a flexible reporting package to allow easy generation of report data. The reports provided should include pre-configured standard reports for common requirements such as Alarm Event reports and custom report generation

r. The system shall provide up to six levels of security providing varying degrees of access to system operation and configuration functions.

s. CPM should be integrated with BMS on open protocol over IP.

5A402.5.4 DDC Field Equipment Controller(s) and Input/Output Module(s)

a. General purpose DDC controllers shall be minimum 32 bit microprocessor based with FLASH base of operating system.
b. The devices shall be programmable and capable of extensive measuring, control and monitoring functions.
c. The DDC Controller should be UL Listed with BACnet testing lab certified (BTL)
d. All the Network & Supervisory controllers should communicate on BACnet over IP with all field DDC controllers.
e. All DDCs shall support modular architecture with the following:
    1. A CPU with Power Supply Module
    2. Distributed I/O modules to accommodate Input / Output points.
f. Energy management programs such as optimum start/stop, load reset, duty cycling, night purge, distributed demand control and others must be resident on each DDC.
g. As a backup, DDC's shall store DDC programs and data files on non-volatile EEPROM or flash memory to allow simple and reliable additions and changes. Each DDC shall have a 72 hours battery backed real-time clock.
h. Each panel shall be provided with a socket for a Portable Operators Terminal (POT) which can be connected via Bluetooth communication for easy access for testing & trouble shooting and no need to open the panel, and a

port for network communications In max. speed of 76Kbps

i. All the DDC should be BTL listed.
j. DDC shall support PRAC and PID logic
k. The DDC software configuration tool shall use be GUI based logics.

Note : 1. Chiller Plant Optimizer to be provided with plant optimizer.

2. Vendor to include all field devices

5A402.5.5 as per the I/O list. Temperature Sensor

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications:

1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be at least ± 0.25 degrees F and sensitivity of at least 2 ohm/F.

2) Immersion sensors shall be provided with separate stainless steel thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of atleast 10 kgf/cm2.

3) The connection to the pipe shall be screwed ¾ inch NPT (M). An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.

4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.

5) Outdoor air temperature sensor shall be provided with a sun shield.

6) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be of any of the

following types : 1) PT 100, PT 1000, PT 3000

2) NI 100, NI 1000

3) Balco 500.

5A402.5.6 Differential Pressure Switch for Pipe Work

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%- 30% of the scale range. The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

5A402.5.7 Pressure Transmitter for Water

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer’s standards. The pressure detector

shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10 o C to 60o C with ambient ranging between 0 o C to 55 o C.

5A402.5.8 Level Transmitter

The level transmitter shall have to meet the following

requirement: Type : Capacitance

type/Conductivity type Mounting :

Vertical in cooling tower sump.

Connection : Flanged ANSI 150 lbs

RF Carbon steel Float material : 316 SS

Stem Material : 316 SS

Output : 4-

20mA / 0-10 V Switch

Enclosure: IP 55

5A402.5.9 Flow Meter

Water flow meters shall be Ultrasonic type. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Consultant, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to 'zero' the flow meter without any external instruments, with the overall accuracy of atleast ± 1% full scale.

5A402.6 CENTRIFUGAL PUMPS

5A402.6.1 Secondary and Condenser water Pump casing shall be close-grained cast iron of heavy section, horizontally / vertically split for, making possible complete servicing of rotating parts without breaking piping or motor connections. Motor to pump connection shall be of the flexible coupling type. Primary and Hot water pumps will be back pull out end suction type.

5A402.6.2 Suction passages shall be volute in form, promoting smooth entry to impeller and increased efficiency. Impeller shall be bronze or gun metal, or Stainless Steel (cast grade CF8) double suction, enclosed type, hydraulically balanced and passages smooth-finished for minimum friction and maximum efficiency.

5A402.6.3 Impeller rings shall be secured from relative movement by tongue and groove fittings. Shaft shall be high tensile strength steel, protected by gunmetal sleeves extending through stuffing boxes. Stuffing boxes shall be extra deep, water sealed with renewable bushes. Shaft shall be supported in ball / journal bearings, grease lubricated, contained in easily removable housing. Pumps shall be fitted with mechanical seals, an air valve, two grease lubricators, drain plug and water seal drain connections.

5A402.6.4 Motor shall be energy efficient (IE-3), totally enclosed, fan-cooled, class-F insulation. Motor shall be specially designed for quiet operation and its speed shall not exceed 1440 rpm. Motor rating shall have minimum of 10% margin on rated power or sufficient to meet the input power requirement at duty point. Motor shall be suitable for 415±10% volts, 3 phase, 50 cycles AC, power supply.

5A402.6.5 Base shall be of a size suitable for the pump, motor and shaft shall be constructed of cast iron or welded steel. Flexible / spacer type coupling shall be protected by a guard mounted on the common base.

5A402.6.6 Installation: The pump shall be installed on a concrete foundation with vibration isolators as per Approved-for-Construction shop drawings.

5A402.6.7 All pumps, motors and bases shall be supplied with approved finish. Shop coat of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the adjoining areas.

5A402.6.8 Pump performance curves and power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation.

5A402.7 VARIABLE SPEED PUMPING SYSTEM

5A402.7.1 The scope of this section comprise the supply, erection, testing and commissioning of variable speed pumping package consisting of following :

a. Individual Components
b. Pump Control Panel
c. Pump logic Controller
d. Adjustable Frequency Drive
e. Differential pressure transmitter (Min. 2 Nos. per zone)
f. Logic Programming for sequence of Operation
g. Power wiring and control wiring shall be carried out by installation Tenderer as shown on the field connection drawings and wiring diagrams supplied with the pumping package.

5A402.7.2 The pumping package shall be assembled by the pump manufacturer. An assembler of pumping systems not actively engaged in the design and construction of centrifugal pumps

shall not be considered a pump manufacturer. The manufacturer shall assume “Unit Responsibility” for the complete pumping package. Unit responsibility shall be defined as responsibility for interface and successful operation of all system components supplied by the pumping system manufacturer.

5A402.7.3 All functions of the variable speed pump control system shall be tested at the factory prior to shipment. This test shall be conducted with motors connected to AFD output and it shall test all inputs, outputs and program execution specific to this application.

5A402.7.4 The pump logic controller assembly shall be listed by and bear the label

of Underwriter's Laboratory INC. (UL). The controller shall meet Part 15 of FCC regulations pertaining to class A computing devices. The controller shall specifically designed for variable speed pumping applications.

5A402.7.5 The controller shall function to a proven program that safeguards against hydraulic conditions including :

a. Pump flow surges
b. Hunting
c. End of curve
d. System over pressure.
e. Motor overload

5A402.7.6 The pump logic controller shall be capable of receiving up to multiple discrete analog inputs from zone sensor / transmitter as indicated on the drawings. It will then select the analogue signal that has deviated the greatest amount from its setpoint. This selected signal shall be used as the command feedback input for a hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a different set point value.
Controller shall be capable of controlling upto three pumps in parallel.

5A402.7.7 All sensors / transmitter in puts shall be individually wired to the pumps logic controller for continuous scan and comparison function. Necessary signal boosters shall be indicated in case of long length of cabling. All analog inputs shall be provided with current limit circuitry to provide short circuit protection and safeguard against incorrect wiring of sensors.

5A402.7.8 The scan and compare rate that selects the command set point and process variable signal shall be continuous and automatically set for optimum performance.

5A402.7.9 The pump logic controller shall have an additional analog input for a flow sensor. This input shall serve as the criteria for the end of curve protection algorithm.

5A402.7.10 The hydraulic stabilization program shall utilize a proportional-integral-derivative control function. The proportional, integral and derivative values shall be user adjustable over an infinite range.

5A402.7.11 The pump logic controller shall be self prompting. All messages shall be displayed in plain English. The operator interface shall have the following features :

a. Multi-fault memory and recall last 10 faults and related operational data
b. Red fault light, Yellow warning light and Green power ON light.
c. Soft-touch membrane keypad switches.

5A402.7.12 The display shall have four lines, with 20 characters on three lines and eight large characters on one line. Actual pump information shall be displayed indicating pump status.

5A402.7.13 The following communication features shall be provided to BAS :

a. Remote system start / stop non-powered digital input.

b. Failure of any system component. Output closes to indicate alarm condition.
c. One 4-20 mA output with selectable output of :
   - Frequency
   - Process Variable
   - Output Current
   - Output power.

5A402.7.14 The following communication features shall be provided to the building automation system via an RS-485 port utilizing BACnet protocol or open protocol.

a. Individual Analog Input
b. Individual Zone Set Points.
c. Individual Pump / AFD on/off status.
d. System percent speed.
e. System Start / Stop command
f. System operation mode.
g. Individual KW signals.
h. System flow

5A402.7.15 The pump logic controller shall be in a NEMA 1 Enclosure.

5A402.7.16 The adjustable frequency drives shall be Pulse Width Modulation (PWM) type, microprocessor controlled design.

5A402.7.17 The Adjustable Frequency Drive (AFD), including all factory installed option, be tested to UL standard 508. The AFD shall also meet C-UL and be CE marked and built to ISO 9001 standards.

5A402.7.18 The AFD shall be housed in a NEMA 1 enclosure. AFD with plastic enclosure shall not be acceptable. AFD shall be housed in IP 21 enclosures for indoor applications. For outdoor applications AFDs shall be housed in IP 54 enclosure.

5A402.7.19 It shall be possible to install the AFD cum pump controller in any adequately ventilated standard electrical panel for the pumps.

5A402.7.20 It shall be possible to vary the speed of the pumps manually by using the +/- speed variation keys in the display panel of the AFD.

5A402.7.21 The speed reference signal shall be customer selectable for 0- 20 mA or 4 – 20 mA or 0 – 10V DC

5A402.7.22 The AFD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no de-rating. This voltage vector control shall minimize harmonics to the motor to increase motor efficiency and lift. Power factor shall be near unity regardless of speed or load.

5A402.7.23 The AFD shall have balanced DC link reactors to minimize power line harmonics. AFDs without a DC link reactor shall provide a 3% impedance line reactor.

5A402.7.24 Input and output power circuit switching can be done without interlocks or damage to the AFD.

5A402.7.25 The following customer modifiable adjustments shall be provided :

a. Accel time.

b. Decel time.
c. Minimum Frequency.
d. Maximum Frequency.

5A402.7.26 RS-485 communication port shall be available for communicating with BMS. It shall be possible to accept start/ stop , reset, reference from BMS and report the operating parameters to the BMS thru the RS – 485 port. Utilizing BACnet protocol or open protocol.

5A402.7.27 An automatic energy optimization selection feature shall be provided. This feature shall reduce voltage when lightly loaded and provide a 3% to 10% additional energy savings.

5A402.7.28 The AFD Maximum operating ambient temperature shall not less than 104 degrees F. AFD shall be suitable for operation in environments upto to 95% non-condensing humidity.

5A402.7.29 The AFD shall be capable of displaying the following information in plain English via an alphanumeric display:

a. Reference % of control signal
b. Frequency.
c. Voltage
d. Current
e. Kilowatts per hour
f. Fault Identification.
g. Percent Torque.
h. Percent Power
i. RPM
j. Fault indication with text.
k. Display of feedback signal.

5A402.7.30 AFD shall be equipped with data log menu that will allow storage of the type of faults that have occurred. Last fault memory shall be required in the event of power failures. The log shall also contain trending data over time to indicate the status of the main inverter control signals prior and subsequent to the fault.

5A402.7.31 Field mounted differential pressure sensor shall transmit an isolated 4-20mA dc signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have a corrosion resistant steel body with 1/8” NPT process connection. It shall have a NEMA 1 electrical enclosure capable of withstanding 450 PSI static pressure. Accuracy shall be within 0.5% of full span.

5A402.8 COOLING TOWERS

5A402.8.1 **CTI CERTIFIED COOLING TOWER WITH VFD (INDUCED DRAFT CROSS FLOW):**

5A402.8.2 **1.1 General:**

The scope of this section comprises, the Supply of factory manufactured, site assembled Induced -draft, Axial fan, Multi-Cell Cross flow cooling tower(s), conforming in all aspects to the specifications.

5A402.8.3 **Type**

Cooling tower shall be Single cell, Induced draft Cross Flow Cooling tower. For multi-cell units, each cell shall be able to operate independently.

Cooling towers shall meet the following: -

- Cooling Tower shall be CTI certified for thermal performance and shall carry relevant certification label.
- Sound performance shall be in accordance with CTI ATC-128.
- Heat rejection Performance shall be in accordance with CTI -STD-201.
- Performance (Power) requirement should be minimum as per ASHRAE 90.1 or higher performance.
- Seismic design requirements shall be in accordance with relevant provisions of IS Code/ National Building Code of India latest amended till date of procurement.
- Cooling towers shall be OSHA certified for safety standards.
- Software generated selections shall be furnished for thermal and sound performance.
- CQC/Third party certified document for water drift loss conservation.

5A402.8.4 **1.2 Thermal Capacity:** Successful bidder shall do the actual calculations for arriving at capacities required, minimum capacities of the cooling towers provided in tender, whichever is higher shall be provided without any addition cost.

1.4 Quality Assurance: The cooling tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001 to ensure consistent quality of products and services.

1.5 Warranty: The manufacturer's standard equipment warranty shall be for a period of not less than 12 months from date of startup.

5A402.8.5 **2.0 CONSTRUCTION DETAILS:**

5A402.8.6 **CASING**

5A402.8.7 **2.1 FRP casing:**

The casing shall be made out of FRP construction of suitable thickness and UV resistant Fiber Glass Reinforced polyester stabilized with finished surface outside and smooth surface in side. It shall have sufficient structural strength to adequately withstand high wind pressure of as recommended by IS Code/ National Building Code of India.

It shall be designed for the minimum structural strength to adequately withstand high wind pressure of not less than 21 psf and seismic load upto 0.88g on any external surface and vibration.

5A402.8.8 **2.2 Structure**

The Structure shall be made out of zinc coated steel as specified in the BOQ.

Galvanized sheet steel shall comply with ASTM A 653/ A 653 M and the zinc coating on galvanized steel shall conform to G-235/ Z-700. All the joints should be sealed watertight. Fasteners should be of corrosion resistance zinc or HDG or taping screws for assembly with galvanized steel washers, neoprene backing where required for preventing leaks. Welded connections should be continuous and watertight. It shall have sufficient structural strength to adequately withstand high wind velocities and vibration as specified above.

5A402.8.9 **2.3 Heat Transfer Section:** The heat transfer sections(s) shall consist of a wet deck surface, spray water distribution system/ Hot Water Basin, Sump and drift eliminators arranged for optimal thermal performance with minimal drift.

5A402.8.10 **2.4 Wet Deck Surface:** The wet deck surface shall be formed from self-extinguishing PVC material and shall be impervious to rot, decay, and fungus or biological attack. The wet deck surface shall be manufactured and performance tested by the cooling tower manufacturer to assure single source responsibility and control of the final product.

Fills shall be of PVC hanging type for cross flow technology resistant to rot, decay and biological attack to facilitate for an even spread of water over fill heat transfer surface. Fill sheets shall either be suspended from tower deck structure under side & shall be elevated above the floor of the cold-water basin to facilitate cleaning and easy replacement for cross flow towers for easy removal and replacement for counter flow towers. Fill shall be arranged in such a manner to ensure negligible resistance to air flow and eliminate water spots and prevent fouling through scales that may form. Fills shall be having thickness of minimum 13 mil thickness and suitable for entering water temperatures up-to and including 130 deg F.

The Fill with integral louvers and integral drift eliminators are formed from self-extinguishing (per ASTM D-568) polyvinyl chloride (PVC), having a flame spread rating of 5 per ASTM Standard E84-77a, and are impervious to rot, decay, and fungus or biological attack. The eliminators are designed to effectively strip entrained moisture from the leaving airstream with a minimum of air resistance.

5A402.8.11 **2.5 Water Distribution System:**

Hot Water distribution system shall be open basin for easy cleaning, and constructed of FRP. The hole pattern(s) must be specially designed according to different water flow, which brings more even water distribution. The system shall be self-draining and non-clogging. Spray nozzles shall be cleanable stainless steel, bronze or high impact plastic, non-clog, removable type properly spaced for even distribution. Cover shall be provided for entire nozzle area or flume / trough area so that it is not exposed to the ambient environment thus making the system more hygienic and freer from dust and bacteria. The hot water basin covers shall be provided to prevent debris from entering the hot water basin, ensuring reliability of the system. They also assist in lowering sound levels.

5A402.8.12 **2.6 Cold Water Basin:** Cold water basin (CWB), Hot water basin (HWB), Casing panels and fan cowl are non-corroding fiberglass-reinforced polyester (FRP). The cold water basin should be one piece design. The cold water basin shall be fitted with large area lift out stainless steel strainers with perforated openings sized smaller than the water distribution system nozzles and an anti-vortexing device to prevent air entrainment. The Basin area under the fill is sloped toward the depressed centre section to facilitate cleaning. The strainer and anti-vortexing device shall be constructed of the same material as the basin to prevent dissimilar metal corrosion. Standard basin

accessories shall include a copper make-up valve with large diameter polystyrene filled plastic float for easy adjustment of the operating water level.

5A402.8.13 **2.6 Drift Eliminators:** Eliminators shall be constructed of specially formulated plastic material and be removable in easily handled sections. It must have a minimum of three changes in air direction. Drift losses of CT to be restricted below 0.0009% of the circulation water.

5A402.8.14 **3.0 MECHANICAL EQUIPMENT:**

5A402.8.15 **3.1 Fan(s):** Fan(s) are driven by multiple neoprene/polyester V belt designed specifically for evaporative cooling equipment service. Motor is mounted on an adjustable motor base. It shall be statically, and dynamically balanced, forwardly curved, axial flow fans selected to provide optimum thermal performance with minimal sound levels. Fan housing shall have curved inlet rings for efficient air entry and four-sided rectangular discharge cowls shall extend into the basin to increase fan efficiency and prevent water from splashing into the fans.

5A402.8.16 **3.2 Bearings:** Fan(s) and shaft(s) shall be supported by heavy-duty, self-aligning, re-lubricatable bearings with aluminum alloy housings, designed for a minimum L10 life of 40,000 hours. Split bearings shall be provided for ease of maintenance. The Fan sheaves must be non-corrosive cast aluminum, motor sheaves of cast Iron.

5A402.8.17 **3.3 Fan Drive:** The fan(s) shall be driven by matched V-belts with taper lock sheaves. Motor shall be located on a heavy-duty motor base, adjustable by a single threaded bolt-and-nut arrangement.

A heavy gauge, hot-dip galvanized steel wire fan guard is provided over each fan cylinder. The fan guard is shipped loose for field installation.

5A402.8.18 **3.4 Fan Motor:** Furnish maximum 1500 RPM Totally Enclosed, Fan Cooled (TEFC)/ Totally Enclosed Air Over (TEAO), squirrel cage, ball bearing type fan motors suitable for outdoor service. Motor(s) shall be suitable for 415 + / - 10% volts, 50 hertz, and 3 phase electrical service. Motor shall be IE-3. Motor shall be suitably rated to operate with VFD. VFD shall be compatible to the fan motor and in compliance with the specifications (refer VFD specification).

5A402.8.21

5A402.8.19 **3.5 Motor Space Heater:** All induction motors for fans are equipped with space heater as standard. Space heater will prevent condensation from generating and accumulating inside the motor to further protect the motor. Unless otherwise stated, voltage of space heaters is 220-230 VAC/ 50 or 60 Hz based on motor configuration. The power of the motor and the space heater should be interlocked. Make sure that the space heater is switched off before the motor is switched on and turned on two hours after the motor is turned off.

5A402.8.20 **4.0 WATER CONNECTIONS:**

Top Inlet Connections: Two (2) hot water inlet flange pattern connections, suitable for ISO 7005 PN1.0Mpa flat face flanges, are located at the top of the designated cell(s).

Bottom Outlet Pump Suction Connection: The unit will provide with a bottom hole pattern(s) for mating with an ISO7005 PN1.0Mpa flat face flange. The hole pattern is located in the depressed area of the cold-water basin and appropriately sized for design flow. The flat face flange, full face gasket, and hardware are supplied and installed by

others. Also included is a large area, lift out strainer made of SST304 has perforated openings sized smaller than the water distribution orifices. Strainer includes anti-vortexing baffle to prevent air entrainment. Please see the submittal package for the connection size.

Equalizer Connection: The unit will be provided with a bottom equalizer connection.

5A402.8.21 ACCESS:

5.1 Internal Walkway and Basin Access: Access doors shall be provided for easy access to the make-up water assembly and suction strainer for routine maintenance. The maintenance plenum should be adequately sized to allow movement of people comfortably w/o restricting their capacity to work.

An HDG internal walkway duly supported from the bottom shall be provided to service the motor and drives.

5.2 **External Ladder to Top of Unit & Handrail unit:** A galvanized ladder along with safety cage is provided to access the top of the unit. The elevated platform shall be provided over the top of the cooling tower so that person can go to the top of the tower for easy maintenance. The ladder & Handrail should meet pertinent OSHA standards and regulations.

5A402.8.21 SOUND:

6.1 Sound Level: To maintain the quality of the local environment, the maximum sound pressure Average levels (dB) measured 1.5 m (5 ft) from the cooling tower operating at full fan speed must be below 72 dB at air inlet.

Location	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB (A-wgtd)**
Air Inlet									
End									
Back (not on D-models)									

5A402.8.22 PERFORMANCE DATA:

Complete performance ratings & power consumption at varying loads and outdoor wet bulb temperature, shall be submitted with the tender and verified at the time of testing & commissioning of the installation.

Manufacturers shall submit certificate from CTI validating capacity and sound performance of cooling tower at tender design conditions form the selection software (entering and leaving condenser water temperature, entering air wet bulb temperature, water flow rate, fan kW).

The performance required for cooling tower should be 80 USGPM/ HP or more, when tested according to CTI ATC-105 procedure.

Software selection to be submitted by OEM showing the sound ratings as tested in accordance with CTI ATC-128. The Cooling tower approach at WBT-73 °F should not be more than 7 °F i.e. Condenser in: 80 °F.

Cooling Tower Outlet Temp in reference to WBT.

WBT (Deg F)	**64**	**68**	**73**	**76**	**80**	**83**	**85**	**87**
Cooling tower Approach								
Cooling Water Out temperature								

5A402.9 **AIR HANDLING UNITS**

AHU - FM,CS Double Skin Floor Mounted AHU: Supply, installation, testing and commissioning of factory fabricated Double Skinned Chilled Water Eurovent certified (Leakage class L1, Casing strength class D1, Thermal transmittance class T2, Thermal Bridging factor TB2) Air- handling unit Floor mounted Horizontal & Vertical type/ Ceiling Suspended , fabricated out of extruded aluminium section with 0.6mm pre-plasticized / pre-coated Galvanised steel sheet outside & 0.6mm plain Galvanised steel sheet inside complete with blower section with single / multiple Backward Curve Aerofoil design blades Non-metallic EC fans made from composite material with minimum IE4 rated Motors. Smart VSD controller with ready BMS configuration an Digital I/O points, Auto RPM Modulation based on set parameters either constant Airflow/Constant Temperature, MODBUS enabled controller, Fire integration setting, Fan ON/Off Status, Scheduling facility to Auto On/off based on set timing, IOT functionality for future integration to access from any point with internet power control panel with necessary switchgears incoming & outgoing, blower suitable for static pressure as required (Fan Static given below is for guideline), blower motor TEFC (IE5) type and IP55 suitable for operation on 415 volts ± 10%, 50 Hz ± 5% AC supply,, 4 / 6 Row cooling coil made of Aluminium finned Copper tube, Copper Header, pre-filter section with non-woven synthetic media MERV 8 or EAC filters in extruded aluminium frame, polished stainless steel drain pan made out of 22 G sheet duly insulated etc. without face and bypass dampers. System should be designed keeping in mind operational energy efficient methodology so that it should not consume more than 0.188 watts per cfm.
The AHU panels shall be insulated with 50mm thick of 40 Kg/m³ density PUF & shall have thermal break profile. The motor & blower assembly shall be mounted on Aluminium extruded section only. The complete AHU shall conform to standard speciation. The face velocity across coil shall be limited to 137 MPM maximum.

Air washer unit

factory fabricated Double Skinned Air- washer unit floor mounted type fabricated out of extruded aluminium section with Aluminium Bird Louvers followed by 10micron filters 0.6mm pre-plasticized / pre-coated Galvanised steel sheet outside & 0.6 mm plain Galvanised steel sheet inside for Dry section & 0.6mm SS304 for Wet section to avoid rusting, Blow through type unit to be designed with Backward Curve Aerofoil design blades Non metallic EC Bluefin fans made from composite material with minimum IE4 rated Motors. Smart VSD controller with ready BMS configuration an Digital I/O points, Auto RPM Modulation based on set parameters either constant Airflow/Constant Temperature irrespective of filter choking flow should remain constant on delivery side, MODBUS enabled controller, Fan ON/Off Status,, blower suitable for static pressure as required (Fan Static given below is for guideline), blower motor TEFC (IE5) type and IP55 suitable for operation on 415 volts ± 10%, 50 Hz ± 5% AC supply, tank shall be made of 18 G stainless steel. Tank should be 1.6mm thick and made of SS-304, Minimum depth of tank should be 300mm and is designed such a wat to carry extra droplets from final Airwasher section.

The Air-washer shall be complete with fill of depth 300 mm deep pads followed by 4 bend PVC eliminators & face velocity across the fill shall be limited to 152 MPM. The Air-washer shall have an efficiency of 90% & shall be complete with water circulation pump GI B Class interconnecting piping & valves Aluminium viscous filters. The Air-washer shall have an saturation efficiency of 90% & shall be complete with water circulation pump GI B Class interconnecting piping & valves Aluminium viscous filters. The air washer panels shall be insulated with 25mm thick & 40 Kg/m³ density PUF. The Airwasher shall conform to speciation given in the tender & shall be of following capacity.

AHU for OT

Double Skin Floor Mounted AHU: Supply, factory fabricated Double Skinned Chilled Water Eurovent certified (Leakage class L1, Casing strength class D1, Thermal transmittance class T2, Thermal Bridging factor TB2)Air- handling unit floor mounted fabricated out of extruded aluminium section with 0.8mm pre-plasticized / pre-coated Galvanised steel sheet outside & 0.8 mm polished SS sheet inside complete with supply & exhaust blower section with single / multiple Backward Curve Aerofoil design blades Non metallic EC Bluefin fans made from composite material. Smart VSD controller with ready BMS configuration an Digital I/O points, Auto RPM Modulation based on set parameters either constant Airflow/Constant Temperature, MODBUs enabled controller, Fire integration setting, Fan ON/Off Status, Scheduling facility to Auto On/off based on set timing, IOT functionality for future integration to access from any point with internet power control panel with necessary switchgears incoming & outgoing, blower suitable for static pressure as required (Fan Static given below is for guideline), blower motor TEFC (min. IE4) type and IP55 suitable for operation on 415 volts ± 10%, 50 Hz ± 5% AC supply, 6/8 row cooling & 2 row heating coil made of Aluminium finned Copper tube, Copper header with coil section, pre-filter section with non woven synthetic media MERV 8 filters in extruded aluminium frame in both the supply & exhaust side of AHU, fine filter section with MERV 13 filters in extruded aluminium frame in supply after fan, (Hepa filters shall be at terminals along with laminar flow plenum & not to be included in the cost),

mixing chamber. System should be designed keeping in mind operational energy efficient methodology so that it should not consume more than 0.259 watts per cfm.

Double Skin Floor Mounted TFA: factory fabricated Double Skinned Chilled Water Eurovent certified (Leakage class L1, Casing strength class D1, Thermal transmittance class T2, Thermal Bridging factor TB2)Air- handling unit floor mounted fabricated out of extruded aluminium section with 0.8mm pre-plasticized / pre-coated Galvanised steel sheet outside & 0.8 mm polished SS sheet inside complete with supply & exhaust blower section with single / multiple Backward Curve Aerofoil design blades Non metallic EC Bluefin fans made from composite material. Smart VSD controller with ready BMS configuration an Digital I/O points, Auto RPM Modulation based on set parameters either constant Airflow/Constant Temperature, MODBUs enabled controller, Fire integration setting, Fan ON/Off Status, Scheduling facility to Auto On/off based on set timing functionality for future integration to access from any point with internet power control panel with necessary switchgears incoming & outgoing, blower suitable for static pressure as required (Fan Static given below is for guideline), blower motor TEFC (min. IE4) type and IP55 suitable for operation on 415 volts ± 10%, 50 Hz ± 5% AC supply, 8 row cooling made of Aluminium finned Copper tube, Copper header with coil section, pre-filter section with non-woven synthetic media MERV 8 filters in extruded aluminium frame in both the supply. System should be designed keeping in mind operational energy efficient methodology so that it should not consume more than 0.259 watts per cfm.

5A402.12 FAN COIL UNITS

5A402.12.1 The fan coil units shall be horizontal type ceiling-suspension duct-able. All units shall be complete with chilled water coil, one or more centrifugal fans and motor, cleanable fabric filters, insulated condensate drain pan.

5A402.12.2 Horizontal type units mounted within ceiling space shall be provided with a GI casing of 18 gauge, the coil and fan section with provision to mount filters within the fan section.

5A402.12.3 The interior chassis shall be constructed of not less than 16 gauge cold rolled galvanized sheet steel bonderized and painted with approved shade of powder coating finish.

5A402.12.4 Primary drain pan shall be pre-pressed 22 gauge SS-304 and an additional inner bottom panel of 22 gauge SS-304 shall be provided to prevent damage to, and floatation of the bottom panel insulation. The pan shall be insulated with not less than 6 mm thick nitrile rubber (class O as per BS

476) insulation shall be effective to prevent condensation.

5A402.12.5 All cooling coils shall be standard three-row staggered seamless copper tube with aluminum sine wave fins. The coil shall be fitted with dielectric coupling or adaptor for connection with MS pipes. Tubes shall be minimum 10 mm OD and wall thickness shall be minimum 0.40 mm. Fin spacing shall be 4 - 5 fins per cm.

5A402.12.6 All bends and joints shall be enclosed within insulated end sections of the base unit for protection against sweating. Tubes shall be mechanically expanded for minimum thermal contact resistance with fins. Air vent shall be provided in headers at a level higher than coils

5A402.12.7 All coils shall be factory tested at 21 KG per sq. cm (300 psig) air pressure while submerged in water.

5A402.12.8 Fans shall be centrifugal forward curve DIDW, direct driven by a fractional horse power shaded-pole motor.

5A402.12.9 Motor shall be 220 ± 6% volts, 50 cycles single phase, energy efficient, six pole, shaded pole type, speed not exceeding 1000 rpm at maximum airflow. Motors shall have three speed windings and shall be factory wired to a terminal block mounted within the fan section.
Motors shall have extended shaft on both sides.

5A402.12.10 Thermostat shall be automatic resettable during power failure.
Manual reset shall not be required when power resumes. All setting shall remain intact during power outage.

5A402.12.11 Fan coil units shall be selected for the lowest operating noise level having standard sound level rating of NC 30 at low speed and NC 35 at medium/high speed.

5A402.13 DRY SCRUBBERS

5A402.13.1 Dry scrubbers comprising of electrostatic sections for use in kitchen exhaust / grease exhaust air treatment.

5A402.13.2 Air Cleaning System utilizing Industrial Electrostatic Air Cleaners (and Odour Removal System) shall be incorporated with the Kitchen Exhaust System to remove cooking exhaust contaminants (such as grease, cooking fumes, oil mist and smoke) and odour to comply with NEA requirements.

5A402.13.3 The Industrial Electrostatic Air Cleaners (IEAC) shall be installed ideally along with duct after the cooker hood.

5A402.13.4 The unit shall provide efficiency of 90% or better for single pass base on ASHRAE test method at flow rates of 800 – 1500 CFM per module (supported by sample test report by a US laboratory). Multiple units can be joined together for increased volume. The system shall be suitable to connect to fan section with average velocity of 500 FPM across air cleaner.

5A402.13.5 The Industrial Electronic Air Cleaning System shall be supplied as a one piece factory joined assembly of individual section(s) selected to treat oil

mist, smoke, fume, grease & dust / powder problems.

5A402.13.6 Housing shall be constructed with minimum 1.4 mm thick galvanized steel sheet (16 gauge) with reinforced structure and powder coated to protect against rust and corrosion. It shall have a hinged door for cell access, located one side to the unit. The door shall be gasketed to prevent air leakage. There shall be a safety interlock switch to cut off primary supply when the access door is opened.

5A402.13.7 Ionizing-Collecting Cell(s) shall be of one-piece construction consisting of a series of repelling and collection plates. Both repelling and collector plates shall be aluminium alloy material, rigidly retained in place with tubular spacers and tie rods. Each plate shall be corrugated, perpendicular to airflow direction. Each cell shall weigh not more than 16 kg with at least 9 ionizing wires.

5A402.13.8 Ionizing electrodes / wires shall be of tungsten material, rigidly supported both vertically and laterally. Ionizing electrode to ground electrode spacing shall be 1.0" (25 mm). High voltage support insulators shall be of Teflon material for dielectric strength.

5A402.13.9 Each Ionizing / Collecting Cell shall be capable of handling up to 3000 cmh of air. There shall be one to four such ionizing / collecting cells per module. Each module shall handle up to 3000 CMH, 6000 CMH, 9000 CMH and 12000 CMH per module respectively. Multiple units of the same or different modules may be needed to handle higher air flow capacities.

5A402.13.10 Electrical interlocks shall be provided to prevent access to the high voltage components without first interrupting the primary input power. The power supply shall operate over a temperature range of -32 degrees F to 140 degrees F and shall have self protect overload cut off switch. They shall have 02 LED lights to indicate the performance status of the ionizing/collecting cell.

High voltage output components in the power supply shall be sealed with epoxy for moisture resistance.

Factory wiring will be in accordance with the National Electrical Code. Required field wiring shall conform to the National Electrical Code and any local code requirements.

5A402.14 HEAT RECOVERY WHEEL SPECIFICATION:

5A402.14.1 HEAT RECOVERY SECTION

The Heat Recovery section shall include enthalpy wheels and shall have minimum recovery of 75 % of total heat, i.e. both sensible and latent (each being 75 %). Necessary computerized selection of the wheel should be provided along with the bid to justify the same. The wheel shall be made of pure aluminium foil coated with molecular sieve desiccant with pore diameter of 3^{o}A.The cross contamination between the two air streams shall be nil and leakage less than 0.04%. The vertical and radial

run of the wheel shall be less than 1 mm per meter of diameter. The wheels shall have non contact labyrinth seals for effective sealing between the two air streams.
Detailed specification for the wheel shall be as per 8.0 i.e.

5A402.14.1.1 "HEAT RECOVERY WHEEL"

Heat Recovery Wheel specifications:

Rotor/wheel matrix shall have the following Matrix —

5A402.14.1.1.1 The substrate: The substrate or wheel matrix should be made of pure aluminum foil so as to allow.

a) quick and efficient uptake of thermal energy.

b) sufficient mass for optimum heat transfer

c) maximum sensible heat recovery at a relatively low rotational speed of 20 to 25 rpm.

The substrate shall not be made from any material which is combustible or supports combustion like synthetic fibrous media.

The wheel shall have minimum 75% both Sensible and Latent Balanced Effectiveness as per AHRI 1060.

The wheel has to be certified as per DIN EN ISO 846 with 0% fungal and bacterial growth at 95% Relative humidity and above.

Fire rating: ASTM E84 certification with 0% for Flame spread classification should be confirmed by manufacturer.

The Heat Recovery Wheel shall be certified for Safety Standards CSA C 22.2 No. 236 – 11, Heating & Cooling Equipment

No Lead, Cadmium or Mercury (Restricted Substances) as per ROHS shall be allowed. The Rotor shall meet requirements of ROHS Annex II of 2011 / 65 / EU and Amendment (EU) 2015/863.

The Wheel shall be AHRI certified in accordance with standard 1060 and carry the AHRI certification stamp.

The product shall be produced in an ISO certified facility

Necessary software selection of the wheel has to be enclosed to justify the pressure drop and efficiency calculations. the selection software shall show HRW performance in summer, monsoon & winter.

5A402.14.1.1.2 The Desiccant: The desiccant should be water molecule selective and non-migratory. The desiccant should be molecular sieve 3Å, (certified by a third party lab to have an internal pore diameter of 3Å), so as to keep the cross contamination to absolute minimum and also ensure the exclusion of contaminants from the air streams, while transferring the water vapour molecules.

The desiccant, of sufficient mass which should not be less than 5 kg per 1000 cfm of air, should be coated with non-masking porous binder adhesive on the aluminum substrate so as to allow quick and easy uptake and release of water vapour. A confirmation has to be provided by manufacturer of wheel to this effect. A matrix with desiccants impregnated in non-metallic substrates, such as synthetic fiber, glass fiber, etc. will not be accepted.

The rotor/wheel matrix shall have equal sensible and latent recovery.

The weight of desiccant coating and the mass of aluminum foil shall be in a ratio so as to ensure equal recovery of both sensible and latent heat over the operating range. Accordingly, a rotor matrix which has an etched or oxidized surface to make a desiccant on a metal foil and results in insufficient latent recovery and hence unequal recovery, or a rotor matrix made from desiccant integrated in a synthetic fiber matrix which result in insufficient sensible recovery, high rotation speed, and unequal recovery, will not be accepted.

5A402.14.1.1.3 **Rotor**: With optimum heat and mass through matrix formed by desiccant, of sufficient mass, coated on an aluminum foil, the rotor should rotate at lower than 20 to 25 RPM, thereby also ensuring long life of belts and reduced wear and tear of seals.

The rotor shall be made of alternate flat and corrugated aluminum foil of uniform width.

The rotor honeycomb matrix foil should be so wound and adhered (full node line adhesive to be provided) so as to make a structurally very strong and rigid media which shall not get cracked, deformed etc. due to change of temperature or humidity.

The rotor having a diameter up to 2400 mm shall have spokes to reinforce the matrix. The internal threaded rod type spokes shall not be acceptable as it weakens the wheel structural strength thereby reducing the service life. From 2000 mm diameter upwards, the option of a special wing structure, to prevent the rotors from wobbling or deforming due to the successive pressure differentials, will be available.

Sectioned wheels, with pie segments, capable of being assembled in the field, shall be available as an option, above 2600 mm in diameter.

Wheels above 3400 mm in diameter shall be segmented and provided with wing structures spokes and flanged rim. The segmented wheels shall be provided with field rotation adjustment mechanism.

The HRW hub shall be fabricated out of heavy-duty steel in order to have high mechanical strength. Light duty Aluminum hub shall not be accepted.

The surface of the wheel/rotor should be highly polished (FACED) to ensure that the vertical run out does not exceed $\pm$ 1 mm for every 1-meter diameter, thereby ensuring, negligible leakage, if labyrinth non-contact seals are provided, and minimal drag, if contact wiper seals are provided.

The radial run out also shall not exceed $\pm$ 1 mm for every 1-meter diameter, thereby minimizing the leakage/drag on the radial seals, and minimise the fluctuation in the tension of the drive belt.

The number of wraps (of alternative corrugated and flat foil) for every inch of rotor radii shall be very consistent so as to ensure uniform air flow and performance over the entire face in the air stream. Flute height and pitch will be consistent to a very tight tolerance to ensure uniform pressure drop and uniform airflows across the rotor face.

The rotor shall be a non-clogging aluminum media, having a multitude of narrow aluminum foil channels, thus ensuring a laminar flow, and will allow particles upto 800 microns to pass through it.

The media shall be cleanable with compressed air, or low-pressure steam or light detergent, without degrading the latent recovery.

5A402.14.1.1.4 The Cassette / casing

The recovery wheel cassette/casing shall be manufactured from tubular / sheet metal structure to provide a self-supporting rigid structure, complete with access panels, purge sector, rotor, bearings, seals, drive mechanism complete with belt. The sheet metal should be coated with a special corrosion inhibitor coating and a certificate for the same should be provided.

The rotor/wheel should have a field adjustable purge mechanism to provide definite separation of airflow minimizing the carryover of bacteria, dust and other pollutants, from the exhaust air to the supply air. It shall be possible, with proper adjustment, to limit cross contamination to less than 0.04% of that of the exhaust air concentration.

The face and radial seals shall be four (4) pass non-contact labyrinth seals / brush seals for effective sealing between the two air streams, and also for a minimum wear and tear ensuring long life of the seals.

PERFORMANCE TESTING

The Heat Recovery rotor manufacturer shall have the facility to show the design performance at a controlled lab / test facility. The facility should have the ability to show rotor performance at the design conditions and also at a few design points representative of the expected conditions to be seen at site during the year / changing ambient conditions. Various aspect at the lab such as air flow of Supply and Return, temperature & RH of inlet and out let conditions should be covered at the lab level for witness test.

5A402.14.2 PASSIVE DESICCANT WHEEL

5A402.14.2.1 ROTOR

The Desiccant Honeycomb Rotor Media shall be adsorbent, non toxic, non flammable, fully water washable. The substrate of the rotor **shall not** be made from asbestos or any synthetic material, and shall not have any toxic desiccants impregnated like lithium chloride, etc.

The desiccant media shall have in-situ synthesized metal silicate desiccant on an inert inorganic fibre substrate. The synthetic media shall not be acceptable.

The Usable desiccant mass shall be at least 80% of the media weight, so as to ensure high performance and minimal heat carry over.

The net organics in the honeycomb media shall not exceed 2%.

The desiccant media shall have a Stainless Steel Rim & perimeter flange which should encircle the entire perimeter so as to allow greater durability and to roll the rotor on the ground, without damage. The perimeter flange should be smooth and consistent to serve as a perimeter seal surface, thus ensuring long life for the perimeter seal, without being cut, torn or otherwise damaged.

The desiccant media shall not fracture due to repeated temperature and moisture cycling and all the materials of construction shall be non toxic.

The surface of the media shall have a special edge hardening so as to ensure a smooth surface and long life of both the media and the seal contacting it.
The desiccant media shall not use any **organic burn off** process, as this shall weaken the media structure.
The manufacturer shall declare that no acid has been used in manufacturing process since any acid used causes the media to weaken and be acidic in nature. Acidic media also causes harm to process / occupants.

No shrinkage of media is acceptable during initial period of usage. No on field rotor adjustment shall be acceptable by arrangement on rotor rim. The Desiccant Rotor can be of make “DRI, Seibu Giken, Proflute”.

5A402.14.2.2 CASSETTE

The desiccant rotor shall have integral long-life bearings supported by a simple fixed shaft design to allow a simple slide out of the rotor/bed.

Chain Drive

SS Welded Frame

Bulb Seal (Diff Static Pressure) Wiper Seal not acceptable

5A402.14.2.3 CERTIFICATIONS & PERFORMANCE

The Desiccant Wheel shall be certified for Standard for Safety as per UL 1995

The Desiccant Wheel shall be certified for Safety Standards CSA C 22.2 No. 236 – 11, Heating & Cooling Equipment

The desiccant media shall be certified by a third party lab as per guidelines of DIN EN ISO 846 for zero fungal and bacterial growth. The Wheel shall be certified for NIL bacterial growth as per ASTM E2149:13A and AATCC-100

No Lead, Cadmium or Mercury (Restricted Substances) as per ROHS shall be allowed. The Rotor shall meet requirements of ROHS Annex II of 2011 / 65 / EU and Amendment (EU) 2015/863.

The desiccant media shall confirm to Flame Spread Index 0 and Smoke Developed Index 0 in accordance to ASTM E84 – 13A Test for Surface Burning Characteristics or Test Method published in NFPA 255, UL 723 & UBC 8-1.

The Desiccant rotor manufacturer shall have the facility to show the design performance at a controlled lab / test facility. The facility should have the ability to show rotor performance at the design conditions and also at a few design points representative of the expected conditions to be seen at site during the year / changing ambient conditions. Various aspect at the lab such as configuration, regeneration air flow and temperature, process inlet and out let conditions should be covered at the lab level for witness test.

The heat recovery wheel, Passive Desiccant wheel & Casing (DOAS UNIT) should be from the same manufacturer

5A402.15 Fans

5A402.15.1 Centrifugal Fan

a. Centrifugal fan shall be DWDI / SWSI Class I construction arrangement 3 (i.e. bearings on both the sides) for DWDI fans complete with access door, squirrel-cage induction motor, V-belt drive, belt guard and vibration isolators, direction of discharge / rotation, and motor position shall be as per the Approved-for-Construction shop drawings.

b. Housing shall be constructed of 14 gauge sheet steel welded/bolted construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans(greater than 1250mm dia), however neoprene / asbestos packing should be provided throughout split joints to make it air-tight.

c. 18-gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout door with handles and

neoprene gasket. Rotation arrow shall be clearly marked on the housing.

d. Fan Wheel shall be backward-curved/inclined non-over loading type. Fan wheel and housing shall be statically and dynamically balanced. For fans upto 450 mm dia, fan outlet velocity shall not exceed 550 meter/minute and maximum fan speed shall not exceed 1450 rpm. For fans above 450 mm dia, the outlet velocity shall be within 700 meter/minute and maximum fan speed shall not exceed 1000 RPM. High static pressure fan speed shall be as per manufacturer.

e. Shaft shall be constructed of steel, turned, ground and polished.

f. Bearings: shall be of the sleeve / ball-bearing type mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil / grease pack pillow block type.

g. Motor: Fan motor shall be energy efficient and suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, squirrel-cage, totally enclosed, fan-cooled motor, provided with class F insulation, and of approved make. Motor name plate horsepower shall exceed brake horsepower by a minimum of 10%. Motor shall be designed especially for quiet operation and motor speed shall not exceed 1440 rpm. The fan and motor combination selected for the particular required performance shall be of the most efficient (smallest horse power), so that sound level is lowest. Motor shall have a minimum efficiency of IE3 or as per relevant BIS/NEMA codes.

h. Drive to fan shall be provided through belt with adjustable motor sheave and

i. Standard belt guard. Belts shall be of the oil-resistant type.

j. Vibration Isolation : MS base shall be provided for both fan and motor, built as an integral part, and shall be mounted on a concrete foundation through vibration isolators. The concrete foundation shall be at least 15 cm above the finished floor level, or as shown in approved-for- construction shop drawings.

k. Centrifugal fans for smoke extract application shall have external belt drive and motor. Fan & casing shall be internally rated for 250 degree C for 2 hours.

l. Fan shall confirm to AMCA standard 211 and 311.Fan must be tested in accordance with ANSI/AMCA standard 210 – 99 and AMCA standard 300- 96 in a AMCA accredited lab. Fans shall be certified to bear the AMCA label for Air and sound performance.

5A402.15.2 **Axial Flow Fan (Standard)**

a. Casing : shall be constructed of heavy gauge sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be of structural steel thickness as per OEM standards capable to handle the weight of the motor and properly machined to receive the flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Fan casing are with internal punched inlet and outlet flanges to prevent air leakage, for size upto 1600 mm dia and shall be constructed of rolled steel with a continuous seam welded. Support brackets for ceiling suspension shall be welded/bolted to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be hot dip galvanized with minimum 220 GSM zinc coating..

b. Rotor : hub and blades shall be cast aluminium /aluminium alloy construction. Blades shall be die-formed aero foil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Rotor shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. Taper lock bushing shall be used to mount the propeller to the motor shaft. The impeller and fan casing shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

c. Motor: shall be energy efficient IE 3 (as per IS 12615) squirrel-cage, totally-enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class `F' insulation. Motor shall be specially designed for quiet operation. For lowest sound

level, fan shall be selected for maximum efficiency or minimum horsepower. Fan total efficiency should not be less than 70 %. Sound level for fresh air fans should not be more than 70 Dba @ 3mtr distance and for pressurization fans should not be more than 85 Dba@ 3mtr under hemispherical reverberant room conditions. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.

d. Drive : to fan shall be direct.

e. Vibration Isolation : The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

f. Accessories : The following accessories shall be provided with all fans :

i. Outlet cone for static pressure regain.

ii. Inlet cone.

g. Axial Flow Fan shall be AMCA certified for Air and Sound performance in accordance to AMCA 210 and AMCA 300. Fan shall be suitable for both indoor and outdoor application with all accessories. Base fan performance shall be at standard conditions.(density 1.2 Kg/Cu.mt.)/actual altitude conditions. AMCA seal shall appear in the technical submittal of fan.

5A402.15.3 Axial Flow Fan (For fire, Smoke and heat exhaust)

a. Fan shall be suitable for mounting in duct or wall / floor / slab as required. Fan shall be complete with motor, motor mount, (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

b. Casing : shall be constructed of heavy gage sheet steel and shall withstand minimum of 250 deg.C for minimum 2 hrs. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be of structural steel thickness as per OEM standards and suitable to handle the weight of the motor and propeller, machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Fan casing are with internal punched inlet and outlet flanges to prevent air leakage, for size upto 1600 mm dia and shall be constructed of rolled steel with a continuous seam welded confirming to UL standards. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be hot dip galvanized with minimum 220 GSM zinc coating.

c. Rotor : hub and blades shall be cast aluminum /aluminium alloy construction and shall withstand minimum temperature of 250 deg for a minimum of 2 hrs. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Rotor shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided for sizes above 180. Taper lock bushing shall be used to mount the propeller to the motor shaft. The impeller and fan casing shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

d. Motor: shall be energy efficient IE3 (as per IS 12615) squirrel-cage, totally-enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class `H' smoke spill insulation. Motor shall be specially designed for quiet operation. Fan total efficiency should not be less than 70%. Sound level for normal exhaust air fans should not be more than 75 dBA @ 3mtr and for smoke spill exhaust fans should not be more than 85 Dba @ 3 mtr under hemi spherical reverberant room conditions. All high

temperature fans should be either EN 12101 -3 or UL listed for high temperature (UL power and smoke ventilation listed) for minimum of 250 deg. For minimum 2 hrs and should be UL or CE labelled. Motor conduit box shall be mounted on exterior of the fan casing and lead wires from motor to the conduit box shall be protected from the air stream by enclosing in the flexible metal conduit/vane.

e. Drive : Fan shall be provided through direct .

f. Vibration Isolation : The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

g. Accessories : The following accessories shall be provided with all fans :

i. Outlet cone for static pressure regain.

ii. Inlet cone.

h. All high temperature fan assembly(fan, impeller, fan casing, motor base frame along with motor) to be used for fire applications shall bear the certification/listing of UL/CE (in addition of being AMCA certified for sound and air performance) confirming to UL standard for "Power Ventilation for smoke control system" or EN 12101-3-2002 smoke and heat control system specification for power and smoke ventilation.

i. Axial Flow Fan shall be AMCA certified for Air and Sound performance in accordance to AMCA 210 & AMCA 300 for both indoor and outdoor application with all accessories. Base fan performance shall be at standard conditions (density 1.2 Kg/Cu.mt.)/actual altitude conditions.

5A402.15.4 Propeller Fan

a. Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

b. Mounting Plate shall be of steel construction, square with streamlined venturi inlet (reversed for supply applications) coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

c. Fan Blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.

d. Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed thru the full range of specified fan speeds.

e. Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with prelubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6% volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply.

f. Accessories : The following accessories shall be provided with propeller fans: Wire guard on inlet side and bird-screen at the outlet.
Fixed or gravity louvers built into a steel frame at the outlet. Regulator for controlling fan speed for single phase fan motor. Single phase preventers for 3 phase fans.

5A402.15.5 Circular Inline Fans

a. Circular inline Centrifugal duct fan shall be a straight through radial fan. It should be compact.

b. The fan shall cope with high pressure and long duct runs, whilst still operating at an acceptable sound level.

c. The circular inline fans should be moisture resistant and should be approved for installing in humid or damp environments. The fans should be rated IP-44 when installed in a duct system. The casing should be manufactured from pre galvanized steel. Automatic thermo – contact shall open up if the temperature within the motor

windings becomes excessive. Fan should be equipped with CE certified external rotor single phase asynchronous motor. Fan shall be AMCA certified for Air and sound performance in accordance with AMCA 210 and AMCA 300.

5A402.15.6 Cabinet Inline Fans

The Cabinet of the cabinet inline fans should be manufactured in 20 gauge galvanized steel complete with inlet and outlet spigots. The Mounting brackets and access panel should be fitted as per manufacturer standard. The impeller of the fans should be with high efficiency forward curved DIDW type. The scroll of the fans should be fabricated with galvanized sheet steel. The motor of the fans shall be Squirrel cage induction type with bearings swealed for life. The motor shall be suitable for single phase electrical supply. The cabinet of the fan shall be of double skin construction with 20 gauge GI outer skin with 25 mm glass wool wrapped tissue paper and covered with 20 gauge perforated GI sheet from inside. Fan shall be AMCA certified for Air and sound performance in accordance with AMCA 210 and AMCA 300.

5A402.15.7 **Car Park Ventilation & Smoke Extraction Fans**

a. System description and functional responsibilities

b. The contractor shall provide a turnkey car park ventilation system that is consistent with the scheme as indicated on the drawings. The proposed scheme utilizes Jet fans with main intake and exhaust fans located along the perimeter of the car park. The system shall serve both CO evacuation and smoke extract function.

c. The contractor shall provide a full engineering proposal that includes the following information for review by the Engineer.

- CFD models for the car park allowing 3 number runs each for CO and Smoke Extract mode.
- Specification, manufacturer's data and performance data for all devices and equipment to be utilized in the system.
- Control schematic for operation of the system.
- All ancillary devices such as motorized dampers, silencers, smoke detectors, CO detectors, etc. that are required to ensure proper system operation in both the CO and smoke modes.
- All necessary devices that are required to interface with the base building systems such as fire alarm and detection BMS etc.

d. The system principles are as follows:

- Smoke control designed to provide such a much safer engineered system.
- Fully automatic smoke control.
- Lower the air temperatures during fires.
- No ductwork distribution.
- Improved firefighting access.
- High air movement preventing fire spread.
- Efficient cross ventilation.

e. System description:

The main extract fan shall be axial fans mounted in parallel. All fans shall be located close to risers. Jet fans shall be located throughout car park level to assist in the air movement. Control philosophy for jet fan system shall be as under.

Case	6 ACPH fans	6 ACPH smoke fans	Jet Fans
Normal case :{CO < 25ppm}	ON	OFF	OFF
Normal case : { 25ppm <CO< 35ppm }	ON	OFF	Low speed
Normal case :{ CO>35ppm}	ON	OFF	High speed
Fire case	ON	ON	High speed

Fire / Smoke detection shall be based upon multi-criteria smoke detector which shall indicate the area in which the fire is located. Upon detection the main extract fans shall operate at full speed, increasing the airflow on the fire floor. The control system shall determine set of extract fans to be activated to contain the smoke.

The distribution and selection operation of these Jet fans on the fire floor shall contain and channel smoke through an air corridor. The air corridor shall be created by the jet streams of the induction fans, and guided towards the extract point. The air velocity within the corridor shall be sufficient to overcome the buoyancy effect for a designed fire load as per BS / European codes.

All fans in car park and for smoke extraction shall be rated to withstand a temperature rating of 250degC for a period of 2 hours. The cable supplying the power to these fans shall also be fire rated. The entire fan including motor, terminals and incoming cables shall also be suitable for 250degC for a period of 2 hours.

The car park ventilation system shall be a standalone life safety system. The control system shall be of the intelligent PLC type assuming control of both carbon monoxide and smoke evacuation

f. CO Detection

The car park ventilation systems shall be controlled by an individual CO-Monitoring system for entire car park to optimize efficiency. The contactors within the motor control panel shall be controlled by a Carbon Monoxide monitoring panel which shall contain DDCs (Direct Digital Controllers) where the pre-determined switching strategy and logic shall be loaded. The CO monitoring panel shall receive signals from CO sensors located throughout the levels at a spacing of no. more than 1 per 350 m2. The 24Vac power supply for the CO sensors shall be mounted in the same panel. The power supply shall be looped across the CO sensors. The proposed CO sensor shall provide a 0-10 VDC signal for measuring the CO level in the car park area.

CO monitoring devices shall be mounted remotely throughout the car parks. The devices shall be mounted in accordance with the manufacturers guidelines but no greater than 1.5 m above FFL.

The contractor should refer to the specific requirements of the sensor supplier for quantities of CO-detectors.

g. CO Sensor : The sensor shall be suitable for wall mount & capable of following features:

- Digital display of the CO level : 0 to 200 ppm
- Analog output : 4 to 20 mA / 0-10VDC
- Low Voltage operation : 24 VAC / VDC
- Wall Mount Configurations
- Test Switch : Provides mode for system self test.
- Automatic Calibration (Field Calibration Kit)
- Over-range indication.
- Start-up mode : steps display and output through test ranges.
- Solid – Stat sensor : Life expectancy of 7 to 10 years.
- Multiple sensors with one power supply.

Carbon monoxide sensor shall comprise of a carbon monoxide meter and a 4-20mA/ 0-10 VDC transmitter an all-electronic system that utilizes a microprocessor to measure carbon monoxide (CO) levels, calculate various calibration factors and analog output. The sensor shall averages samples over a time period and updates the output every 2 ½ minutes. The sensor shall be intended to be used in enclosed parking garages, where it provides CO data to building automation computers or controllers. A UL knockout box shall house the sensor and provide an easy-to-mount, study housing for the system.

Sensors shall be mounted on walls or columns about 1600 mm above the floor. Sensors shall be evenly spaced and not put in corners, or directly in front of air inlets. Each sensor must have a cable directly to the control panel.

In addition to above CO-sensor shall comply with following:

- Power 24 VAC / VDC @ 150 mA
- Measurement range 0 to 200 ppm of CO (4-20 mA)
- Electrical class General Purpose, non-hazardous.
- Operating temperature range 0 deg. To 125 deg.F (-18 deg. To 52 deg.C)

h. Fire / smoke detection

The car park ventilation system shall be designed based on 12 ACPH in fire mode. The car park ventilation system shall interface with the fire alarm control panel to receive signals from the detectors.

The Contractor shall be responsible for the full integration of the fire alarm and car park ventilation control systems.

i. Control Panels : The manufacturers engineered solution shall allow for a stand alone intelligent PLC control system for both CO monitoring and smoke control. Each car park shall have individual PLC Control Panel. The PLC control system shall be seperate for each level of entire car parking and shall control all exhaust & jet fans located on each level. The broad logic shall be as follows:

PLC based Logic panel shall be provided to receive signals from the Carbon Monoxide Detector panel and the Fire Control Panel which will contain DDC (Direct Digital Controller) to give command to Jet and Exhaust fans for their operation on the basis of the logic provided to the PLC panel as shown below:-

Condition 1 Under normal ventilation conditions, when CO PPM level is below 25PPM, Jet fans will be OFF, 6 ACPH fans will be ON and 6ACPH fire fans will be OFF.

Condition 2:. When CO level increases beyond 25PPM but less than 35PPM, jet fans will start at low speed, 6 ACPH fans would continue to be ON and 6 ACPH fire fans will continue to be OFF.

Condition 3:. When CO level goes beyond 35PPM, Jet fans will run on high speed, 6 ACPH fans would continue to be ON and 6 ACPH fire fans will continue to be OFF.

Condition 4:. In event that smoke is detected in the car park, Jet fans will run at high speed and both 6 ACPH and 6 ACPH fans will be ON.

5A402.16 **Split Air Conditioning Units**

5A402.16.1 The Split Units shall consist of hermetically sealed Scroll compressor, motor, air cooled condenser, sump heaters, integral refrigerant piping and wiring, all mounted on a steel frame.

5A402.16.2 Compressor shall be hermetic sealed Scroll, serviceable type and shall have dual pressure stat, and an operating oil charge. The motor shall be suction gas cooled and shall be sealed against dirt and moisture. The motor shall be suitable for 415±10% / volts or 230±10 % volts, 50 Hz supply.

5A402.16.3 Indoor unit to be installed for Split Unit within building shall be housed in insulated cabinet consisting of cooling coil, blower with motor, filter and insulated drain pan. Cassette type units will have drain pumps with sufficient head to discharge condensate to the designated location.

5A402.16.4 The units shall be high wall mounted, Cassette type or Ductable type. The unit shall include pre-filter, fan section and DX-coil section. The housing of unit shall be light weight powder coated galvanized steel. Unit shall have an attractive external casing for supply and return air.

5A402.16.5 Indoor Units shall have inlet filters, which are easily cleanable and replaceable.

5A402.16.6 Refrigerant piping and fittings interconnecting compressor condenser shall be all copper and valves shall be brass / gunmetal construction.

5A402.16.7 Indoor units shall have wireless remotes.

5A402.16.8 Anticorrosion treatment on coils shall be done for

5A402.16.9 avoiding corrosion. All units shall have adequate

insulation or Lining to avoid condensation.

5A402.16.10 The Outdoor units shall be provided with ribbed rubber pad vibration isolators.

5A402.16.11 Split units shall be factory finished with durable alkyd spray enamel. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, then coated with enamel paint to match the finish over the adjoining shop-painted surface

5A402.16.12 UPVC pipes of 25 mm diameter and fittings shall be used for condensate, from Evaporator Unit to drain point. The joints shall be properly sealed so that there is no water leakage. U-trap of sufficient depth shall be provided at the end to prevent entry of outside air through drain pipe. Additional

insulation drain tray shall be provided below the Evaporator Unit, if required

5A402.16.13 Both indoor unit and outdoor unit shall be factory assembled, tested and filled with first charge of ecofriendly refrigerant before delivery at site

5A402.16.14 The noise level for outdoor unit shall not be more than 60 dB (A) at normal operation measured horizontally 1m away and 1.5 m above ground level.

5A402.16.15 Indoor Units shall have very low noise in the range of 35 - 45 dB (A) at maximum fan speed, measured at 1m away.

5A402.16.16 Insulation of cold lines shall be carried out with nitrile rubber insulation sheets and tubes of appropriate thickness so that condensation does not occur.

5A402.16.17 Cooling coil and refrigeration parameters shall be designed in such a way that supply air temperature shall not be less than 14 deg C or 1 deg C above room dew point temp, whichever is more. The Contractor shall guarantee inside conditions with selected supply air temperature.

5A402.16.18 All Outdoor units shall be mounted with Powder Coated Mild Steel Frame, Brackets, and Hangers etc. With proper size anchor Fasteners.

5A402.16.19 All split units shall be of BEE 5 star rating.

5A402.20 VRV/VRF SYSTEM

The outdoor unit shall be factory assembled, weatherproof casing (The Material of casing shall be OEM's standard design), constructed from heavy gauge GI sheets steel panels and coated with baked enamel finish. The outdoor unit shall be completely factory wired, tested with all necessary controls & filled with first charge of refrigerant.

VRF outdoor units must be made in India. OEM certification is required. All the compressors of the outdoor units must be 100% DC inverter hermetically sealed scroll type. Each module of outdoor unit must have combination of only Inverter Compressor, suitable to operate at heat load proportional to indoor unit requirement. All the VRF Machines must include compressors manufactured by OEM only. OEM Certification is Must.

The system shall have the feature of variable refrigerant temperature which enables variation in evaporator temperature automatically based on the load requirements and ambient conditions. This feature shall work in conjunction with VRV technology to achieve best part load efficiency.

All outdoor units must be equipped with nighttime quite operation function which results in less sound level in nighttime operations of the outdoors.

The outdoor units shall have a unique feature of auto sequencing which is automatically enabled to ensure balanced operation of each outdoor unit to improve longevity of equipment and stable operation. It should also be provided with duty cycling for switching starting sequence of multiple Outdoor units.

All the compressors installed in outdoor unit shall be inverter driven. The modules with capacities above 14 HP shall have at least two inverter compressors. In case of combined capacity (single circuit) of outdoor units 30 HP or above, the combined outdoor unit shall have at least 3 inverter

compressors so that the operation is not disrupted with failure of any compressor. The inverter technology-based D.C Twin Rotary/ Scroll type VRV / VRF equipment should be capable so that refrigerant piping between indoor units and outdoor unit shall be extendable up to 165m of equivalent length with maximum level difference between outdoor & indoor unit of 50m & level difference between two indoor units shall be maximum up to 15m.

Selected module should have COP 4.7 at 50% load as per AHRI 1230 and each module should have at least one inverter compressor/unit.

The COP for the same may be furnished as per standard proforma.

All the details pertaining to power consumption as per ARI standard should be duly filled and furnished as per the sheet enclosed.
The above COP values as indicated are required to be furnished in Original by the tendered directly from the original equipment Manufacturer (OEM) with OEM' seal and signature on all documents.

The outdoor unit shall be factory tested and filled with first charge of ecofriendly green refrigerant gas before delivering at site.

It should also be provided with duty cycling for D.C inverter Twin Rotary/ Scroll compressors capable of changing the rotating speed of compressor by inverter controller to follow variation in cooling loads & switching starting sequence for better stability and prolonging equipment life or similar features if available in D.C Twin Rotary/Scroll will also be accepted.
The unit shall be provided with its own microprocessor control panel with provision for integration with the building management system for Air-conditioning system.

The machine must have a sub cool feature to use coil surface more effectively through proper circuit bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.

The noise level shall not be more than 68 dB (A) at anechoic chamber conversion value, measured horizontally 1m away and 1.5m above ground level.

The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss and should be fixed with DC/AC fan motor for better efficiency and should have the capability of modulating the speed with reference to the load. The unit should also be capable to deliver minimum 75 Pa external static pressure to meet long exhaust duct connection requirement.

In case of trouble occurs in an indoor unit(s), the continuous operation of system should be possible.

The outdoor unit shall be designed in such a way that cleaning of condenser coil should be easy & inspection/ replacement of compressor should be easy.

The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

Mounting shall be done on duly painted GI stand made up of 50x50x6mm thick angle iron, which shall be provided without any additional cost.

The units shall be suitable for Refrigerant R-410A.

Compressors
The compressor shall be highly efficient inverter-based D.C Twin Rotary / Scroll type.

The system should response efficiently in accordance with the variation in cooling or heating load requirement. The Compressor should be provided with intermediate backpressure mechanism to

minimize operation loss due to refrigerant leakage, to ensure stable low-load operation.

ii. All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

iii. Oil heaters shall be provided in the compressor casing or alternate oil heating arrangement needs to be provided as per manufacturer standard equipment's.

Oil Recovery system

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths. If required, the system must be provided with oil balancing Circuit to avoid poor lubrication.

Refrigerant Circuit

The refrigerant circuit shall include liquid and gas shut-off valves and a solenoid valves at condenser end. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution. All necessary safety devices shall be provided to ensure the safe operation of the system.

Heat Exchanger
The heat exchanger shall be constructed with copper tubes mechanically bonded to Aluminum fins to form a cross fin coil. The aluminum fins shall be covered by ant-corrosion resin film. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

Safety Devices
All necessary safety devices shall be provided to ensure safe operation of the system.

Whatever safety devices are required shall be part of outdoor unit:- high pressure switch, fan drive overload protector, over load relay, overload & Over voltage protection having inverter based technology & digital based technology.

The outdoor roof mounted units shall be provided in such a fashion that these do not affect the overall aesthetics and ambience of the building. If required these units shall be suitably camouflaged to give good aesthetic look.

INDOOR UNITS

All indoor units as specified shall have, in general at the highest operating level, noise Levels less than 46 db. For critical applications noise levels below these limits may, however, be specified during design stage.

i. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variation of the room.

ii. The address of the indoor unit shall be set automatically or through central controller in case of individual and group control system. The fan shall be direct driven type, mounted directly on motor shaft having support from housing. The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system.

iii. The cooling coil shall be made out of seamless copper tubes and having continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the

direction of airflow. The tubes shall be hydraulically / mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21 kg/sq.m air pressure under water.

iv. Indoor unit shall have cleanable type filter fixed to an integrally moulded / moulded plastic frame. The filter shall be slide in and neatly insertable type. It shall be possible to clean the Filters either with compressed air or water.

v. Each unit shall have Electronic control expansion valve for variable refrigerant Flow effect.

vi. Each indoor high unit shall be with corded/cordless LCD type remote controller as per requirement. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

vii. ±5% variation in indoor capacity of cassette/Hi Wall is acceptable subject to the Manufacture standard.

Suitable drain pan and drain arrangement shall be part of all IDUs.

Each type of unit shall be supplied complete with Air distribution panel whether specified or Not.

The panel shall have removable return air core for cleaning air filter and maintaining motor etc.

Indoor Control Unit shall have Cordless Type controllers.

The drain pan of the units shall have an antibacterial treatment that uses silver ions and prevents the growth of slime, mould and bacteria that causes blockage and odours.

Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam.

The units shall have air filters, which has anti mould and anti-bacterial treatment that prevents the growth of mould generated from dust or moisture that may adhere to filter. Unit shall have variable air volume function which will automatically adjust the fan speed based on load condition. The controller shall be able to change angle of swing flap individually as per requirement.

All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view. It should have provision of connecting branch duct.

CEILING MOUNTED CASSETTE TYPE UNIT (Indoor Unit) :-

The cassette unit shall be ceiling mounted.

The units include pre-filter, fan section and DX coil section. The housing of units shall be lightweight powder coated galvanized steel. Units shall have external casing of ABS Plastic for supply and return air. The body shall be light in weight and shall be able to suspend from four corners. Unit shall have an external attractive panel for supply and return air which should be treated with a dirt repellent coating. Unit shall have round way supply air grilles on sides and return air grille in center.

i) 4 Way Cassette type indoor units:

(a) These units shall be installed between the bottom of finished slab & top of false ceiling.

(b) Unit shall have provision of connecting fresh air without any special chamber &without increasing the total height of the unit (320 mm maximum).

(c) The unit must have in built drain pump, suitable for vertical lift of 750 mm.

(d) Unit must be insulated with sound absorbing thermal insulation material, Polyurethane Foam. The sound pressure level of unit at the highest operating level shall not exceed 46 dB (A).

(e) The unit must have drain pump kit if. The drain pump must be suitable to lift drain up to1000 mm from the bottom of the unit.

ii) 4 Way Compact Cassette type indoor units.

(a) The compact cassette unit should perfectly fit into ceilings and match the standard architectural modules, without the need to cut ceiling tiles.

(b) The flaps fold tightly against the ceiling when operation stops so that the ceiling is affected only slightly even if air conditioning is installed.

(c) Designed for simple & easy installation and maintenance. It should be slim in design only268 mm in height even when an electrical box is located inside the unit.
d) The unit must have drain pump kit if. The drain pump must be suitable to lift drain up to1000 mm from the bottom of the unit.

HIGH WALL MOUNTED UNITS (Indoor Unit) :-

The units shall be wall-mounted type. The unit includes pre filter, fan section & DX coil section.

Wall mounted units must be compact & stylish design that does not detract from the Décor of the room. The housing of unit shall be light weight powder coated galvanized steel.

(b) Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.

(c) The unit must have provision of adding drain pump kit if required and same shall be provided. The drain pump must be suitable to lift drain up to1000 mm from the bottom of the unit. The drain pan and air filter of the unit should be kept clean by mould proof polystyrene.

(d) The sound pressure level of unit at the highest operating level shall not exceed 46 dB(A).

(e)Refrigerant control in the indoor unit shall be through Electronic Expansion Valve.

Concealed duct type units

(a) These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise.

(b) The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.

(c) Each indoor unit must have electronic expansion valve operated by microprocessor thermostat-based temperature control to deliver cooling/ heating as per the heat load of the room

(d) The Sound Pressure level of unit at the highest operating level shall not exceed 38 dB (A), at a vertical distance of 1.5 m below the units with duct connected to unit.

(e) The unit must have provision of adding drain pump kit & shall be provided as per requirement. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

Installation:

(a) The units shall be mounted on ribbed rubber pads for vibration isolation. The contractor shall supply the required charge of refrigerant, lubricant and other consumables, for commissioning and testing of the equipment.

(b) All the equipment shall be thoroughly tested and checked for leaks. All safety controls Shall be suitably set and a record of all setting shall be furnished to the project supervisor.

(c) Providing and fixing GI structural support for condensing unit with vibration isolator pad In-between support and structure and vibration isolation suspender and pads for evaporating units shall be in scope of contractor.

Refnet Joints / Header Joints

Design, Supply & installation of the V-Joint/ Refnet separation refrigeration pipe joints and headers in the appropriate orientation to enable correct distribution of refrigerant. The Distribution Joints should be Duly insulated with pre-formed sections of Expanded Polystyrene/Equivalent.

Refrigerant Piping
s
(a) All refrigerant pipes and fittings shall be type 'L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder. The copper thickness of wall shall be 20G/ 22G(0.7 to 1 mm)

(b) All joints in copper piping shall be swaged joints using low temperature brazing and/ or silver solder. Before joining any copper pipe or fittings, its interior shall be thoroughly cleaned be passing a clean cloth via wire or cable through its entire length. The piping Shall be continuously kept clean of dirt etc. while construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

(c) Refrigerant lines shall be sized to limit pressure drop between evaporator and Condensing unit to less than 0.2 kg per Sq.cm.

(d) After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen at a pressure of 20 Kg per Sq. cm. (High side) and 10 Kg per Sq. cm (Low side). Pressure shall be maintained on the system for 24 hours.

(e) The system shall then be evacuated to a minimum vacuum of 70 cm. of mercury and held for 24 hours, during which time; change in vacuum shall not exceed 12 cm of mercury.

(f) All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers and shall include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits except Y joint/separation tubes.
i. Refrigerant piping for the air-conditioning system shall be up to 19.1 mm dia of soft seamless copper tubes & for above 19.1 mm dia the pipe material shall be of hard seamless copper tubes with pipes material being hard drawn copper pipe

ii. Before joining any copper pipe or fittings, its internals shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently it shall be thoroughly blown out using nitrogen gas.

iii. The supplier of air-conditioning system shall choose sizes as designed and erect proper

interconnections of the complete refrigerant circuit. The thickness of copper piping shall not be less than 20 SWG for pipes up to 19.1 mm, 18SWG for pipes between 19.1 mm to 31.9 mm and above 31.9mm shall be 16 SWG for larger dia as specified by OEM.

iv. The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturer's specified diameter. All refrigerant pipes shall be properly supported and anchored to the building/ structure using steel hangers, G.I. trays, fasteners, brackets and supports which shall be fixed to the building/ structure by means of inserts or expansion shields or anchor fasteners of adequate size and number to support the load imposed thereon.

v. The refrigerant piping should be laid in such a way that it should not distort the interior of the room as well as exterior elevation of the building, wherever the refrigerant pipe has to be laid across the room, it should be laid in a concealed manner by making appropriate boxing arrangement matching with the interior of the room. All associated minor Civil Engineering works (like chasing on wall, ceiling &replastering& repainting etc.) related with the above
Items are included in the scope of work.

vi. To protect Nitrile rubber insulation of outdoor installed copper piping from degradation due to ultra violet rays and atmospheric condition, it shall be covered with polished coating of at least two coats of resin and hardener (poly bond make or equivalent). Fiber glass tape shall be helically wound with adequate overlap & coated with two coats of resin with hardener to give smooth & plain finish.

vii. Entire liquid and suction refrigerant pipe lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm/ 13mm thick electrometric nitrile rubber.

The joints shall be properly sealed with synthetic glue to ensure proper bonding of the ends.

Drain Piping duly insulated

The drain pipe connection of each fan coil unit to the main header should be should be minimum 25 mm dia / 32 mm dia as required or as per OEM design as required. The header pipe should be of 40 mmdia/32 mm dia as required. The drain-pipe should be heavy CPVC pipe ISI marked and conforming to relevant to IS: 4985 - Class I complete with fitting as required whereas the connection of the fan coil unit to the rigid PVC (heavy gauge ISI marked) pipe should be with flexible braided pipe. The drain piping should be insulated with 6 / 9 mm thick tubular nitrile rubber insulation having K valve 0.037 W/mk at a mean temperature of 200 C at min. density of 55 kg./m3. The joint shall be properly sealed with synthetic glue or solvent cementing as per manufacturer recommendation to ensure proper bonding of the ends.

For proper drainage of condensate U trap shall be provided in the drain piping, wherever required. All pipe supports shall be prefabricated and pre-painted slotted angle supports, properly installed with clamps. The condensate drain pipe arrangement for disposal of condensate water be made in such a way that there should not be any leakages of condensate water inside rooms as well in the route of drain water pipe line & water should be discharged at the proper location. All associated Civil Engineering works as per requirement at site in above connection like making chase in the wall & restoring it original shape by re-plastering &repainting, etc. are included in the scope of work. The arrangement of drain-pipe shall be made in such a way that it should not affect the aesthetic of the building as well as is maintenance friendly & easily accessible.

5A402.17 **PLATE HEAT EXCHANGER SPECIFICATION**

5A402.17.1 GENERAL (AHRI Certified)

5A402.17.1.1 Scope

5A402.17.1.1.1 This specification covers the requirements for design, materials, fabrication and testing of Plate Heat Exchangers.

5A402.17.1.2 Definitions

5A402.17.1.2.1 Plate Heat Exchanger - Is a pressure vessel consisting of a set of gasketed heat transfer plates supported in a frame capable of easy opening and closing.

5A402.17.1.2.2 Plate Pack - Is the assembly of plates, which form the hot and cold fluid channels.

5A402.17.1.2.3 Gaskets - Contain the process fluids between the plates and direct the fluids into their respective flow channels.

5A402.17.1.2.4 Fixed Plate - Is the stationary end of the exchanger. Customer connection ports should be located on this cover.

5A402.17.1.2.5 Pressure Plate - Is the movable end of the exchanger. This head can be moved away from the plate pack, thus permitting access to the plates for inspection or cleaning.

5A402.17.1.2.6 Ports - Customer connections, which should be studded.

5A402.17.1.2.7 Carrier Bar - Is the top bar from which plates are hung. The carrier bar is supported by the fixed plate, and the pressure plate or end support. Plate sliding surface should be lined with SS-316 strip.

5A402.17.1.2.8 Guide Bar - Is the bottom guide for the plates and movable head. It is attached to the fixed plate, and the pressure plate or end support.

5A402.17.1.2.9 Tie Bolts & Nuts - Hold the plate assembly together between the fixed and movable heads.

5A402.17.1.2.10 End Support - Supports the carrier bar and guide bar for larger units.

5A402.17.1.2.11 Frame - Is the assembly that provides the structural support and pressure containment for the plates. It consists of the fixed plate, pressure plate, carrier bar, guide bar, tie bolts, nuts and end support.

5A402.17.2 GENERAL REQUIREMENTS

5A402.17.2.1 Limits of Supply

5A402.17.2.1.1 Seller shall provide a fully assembled exchanger, requiring no additional on-site assembly.

5A402.17.2.1.2 Items to be supplied by others.
a) Anchor bolts
b) External process piping, nuts etc

5A402.17.2.2 Performance Guarantee

5A402.17.2.2.1 Vendor shall warrant goods against faulty workmanship or the use of defective materials, under normal use and service, and that such goods will conform to mutually agreed upon written specifications, drawings and are guaranteed to meet specified performance requirements, for a period of twelve (12) months from the date of shipment.

5A402.17.2.3 DESIGN REQUIREMENTS

5A402.17.2.3.1 Thermal Design

5A402.17.2.3.1.1 To maintain velocity and reduce fouling, unit shall be sized to provide 20% of the extra area then required. It should be a single pass solution.

5A402.17.2.3.1.2 The unit shall be designed for future expansion to accommodate a minimum of twenty (20) percent extra heat transfer surface area.

5A402.17.2.3.1.3 Liquid velocity through the inlet and outlet ports shall be a maximum of 6 m/s, to optimise pressure drop and erosion.

5A402.17.2.3.2 Mechanical Design – PHE shall be AHRI Certified.

5A402.17.2.3.1 Frame, tie bolts, and supports shall permit the future installation of twenty (20) percent additional plates. This will also allow ease in disassembly and cleaning of the unit as furnished.

5A402.17.2.3.2 Plates

a) Minimum thickness of each plate shall be 0.5 mm.

b) The plate nozzle connections shall be arranged to force each fluid across the plate surface in a parallel path (i.e. inlet & outlet connections shall be on same side and not diagonal).

c) Plate design must be adequate to withstand a hydro test pressure of 1.3 times the design pressure. Each side shall be pressurized independently during testing.

d) Gasket grooves must be designed such that it holds the gasket from three sides.

e) Plates must be supported by the carrier bar. Carrier bar surfaces that are in contact with the heat transfer plates shall be stainless steel. The plate should have provisions for self-aligning outside heat transfer area.

f) The guide bar shall be designed to maintain plate alignment. Guide bar shall not be used for support. Guide bar shall be stainless steel.

g) The first and last plates of the plate pack shall be designed to prevent fluid contact with the fixed or movable heads.

5A402.17.2.3.3 Gaskets

a) Gaskets shall be of the non-glued design.

b) All gaskets must be elastomeric. Inelastic gaskets, such as compressed asbestos, must not be used.

c) Gaskets shall be designed so that the gasket groove on plate is in their metallic contact from three sides.

d) Port holes in each plate must be fully gasketed and vented to the atmosphere to force any leaks to the outside. This form of positive venting will eliminate mixing of the process fluids due to gasket failure.

5A402.17.2.3.4 Fixed and Pressure Plates

a) All nozzle connections shall be located on the fixed plate for single pass arrangement.

b) For tie bolts of 1 inch or greater diameter, the fixed and pressure plates shall be provided with slotted holes, to facilitate assembly and disassembly of the unit.

c) The pressure plate shall be supported by the carrier bar and guided by the guide bar.

d) Unit design shall prevent the fixed and pressure plate from contacting the fluids circulated. Metal nozzle liners compatible with the plate material, or nozzle projections shall be provided.

5A402.17.2.3.5 Tie Bolts and Nuts

a) The tie bolt length shall allow the addition of twenty (20) percent more plates.

b) Tie bolts and nuts shall be EN18, zinc plated for improved corrosion resistance.

5A402.17.2.3.6 Ports

a) For units with studded ports, corrosion resistant stud bolts shall be provided by the manufacturer.

b) Metal port liners shall be provided per 3.2.4 above.

5A403 Air Distribution

5A403.1 Scope

5A403.1.1 The scope of this section comprises supply fabrication installation and testing of all sheet metal ducts, supply installation testing and balancing of all grilles registers and diffusers, in accordance with these specifications and the concept / general arrangement shown on the Drawings.

5A403.2 Duct Materials

5A403.2.1 All ducts shall be fabricated from galvanized steel sheets of the following thickness. For GI ducting, Zinc coating shall be Lead free.

Rectangular Ducts G.S.	External Pressure 250 Pa Duct Section Length 1.2 m (4 ft.)		
Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1–500 mm	26	C and S Connector	Nil

Rectangular Ducts G.S.	External Pressure 250 Pa Duct Section Length 1.2 m (4 ft.)

Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
501 – 750 mm	26	C and S Connector	Nil
751 – 900 mm	26	TDF Flange	Nil
901 – 1200 mm	24	TDF Flange	Nil
1201 – 1500 mm	22	TDF Flange	Nil
1501 – 1800 mm	22	TDF Flange	JTR or ZEE BAR
1801 – 2100 mm	20	TDF Flange	JTR or ZEE BAR
2101 – above	18	TDF Flange	JTR or ZEE BAR

Rectangular Ducts G. S.	External Pressure 500 Pa		
	Duct Section Length1.2 m (4 ft)		
Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1–400 mm	26	C&S Connector	Nil
401-700 mm	24	C&S Connector	Nil
701-900 mm	24	TDF Flange	Nil
901-1000 mm	22	TDF Flange	Nil
1001-1200 mm	22	TDF Flange	JTR or ZEE BAR
1201-2100 mm	20	TDF Flange	JTR or ZEE BAR
2101-above	18	TDF Flange	JTR or ZEE BAR

5A403.2.2 Sheet metal ducts shall be fabricated out of galvanized steel sheets. Fabrication of ducts shall be through well-conditioned Triplex lock former or multiple lock formers, conforming to relevant BIS Codes. Sheets used shall be produced by Hot Dip Process and galvanizing shall be Class VII - Light Coating of zinc, Nominal 180 gm / Sq.m surface area.

5A403.2.3 Samples of sheet from each lot selected at random by Engineer and

shall be subject to approval and gotten tested for thickness and zinc coating at The Contractor's expenses

5A403.2.4 All ducts shall be fabricated and installed in workmanlike manner, generally conforming to relevant BIS Codes. Round exposed ducts shall be die-formed for achieving perfect circle configuration.

5A403.2.5 Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

5A403.2.6 Changes in dimensions and shape of ducts shall be gradual. Air-turns (Vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

5A403.2.7 Ducts shall be fabricated as per approved Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

5A403.2.8 All sheet metal connection, partitions and plenums required to confine the flow of air to and through the filters and fans shall be constructed of 18 gage GSS / 16 gauge aluminum, thoroughly stiffened with 25 mm x 25 mm x 3 mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Doors shall be not less than 45 cm x 45 cm in size.

5A403.2.9 Plenums shall be panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards G S sheet and riveting shall be done from outside.

5A403.2.10 Self-adhesive rubber lining minimum 5 mm thick instead of felt shall be used between duct flanges and between duct and duct supports in all ducting installation.

5A403.2.11 The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Engineer in all its parts and details.

5A403.2.12 All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the Drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required area being maintained) all as per the site requirements.

5A403.2.13 All ductwork shall be independently supported from building construction.

5A403.2.14 All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel rod under ducts. The spacing between supports should be not greater than 2.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting.

5A403.2.15 Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats.

5A403.2.16 Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners.

5A403.2.17 Ducting over furred ceiling shall be supported from the slab above, or from beams, after obtaining approval of Engineer. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other the Contractor's work in the building

5A403.2.18 Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality expanded polystyrene around the duct and totally covered with fire sealant such as fire barrier mortar for complete sealing.

5A403.2.19 All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.
Flexible connections shall be constructed of flame retardant, water proof, silicon rubber impregnated flexible connection at least 10 cm long securely bonded and flange bolted on both sides. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

5A403.2.20 Aluminium Ducts (for OT and MRI) Material Shall Be One Commercial Gauge Higher With 22 G As Minimum.

5A403.3 Dampers

5A403.3.1 Dampers: All duct dampers shall be opposed blade louver dampers of robust 16 G GSS construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.

5A403.3.2 Dampers shall be provided with suitable links levers and quadrants as required for their proper operation. Control or setting device shall be made robust, easily operable and accessible through suitable access door in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.

5A403.3.3 Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings, for the proper volume control and balancing of the air distribution system.

5A403.3.4 Pressure relief dampers: Pressure relief dampers shall be constructed with 18G Aluminum construction with parallel blade construction. Leafs shall be 100% air tight upon closure. Leafs shall be loaded with spring

pressure of stiffness (k value) corresponding to set point pressure.

5A403.3.5 Non-return damper (Back draft damper): Non return damper shall be constructed out of 16G GSS. Blades shall ensure 100% air leak proof performance on closure. Design shall ensure that no rattling noise is produced at design duty.

5A403.4 Fire & Smoke Dampers

5A403.4.1 All supply and return air ducts at AHU room crossings and at all floor crossings and shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating. These shall be of multi-leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct.

5A403.4.2 Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span. The dampers shall meet the requirements of NFPA90A, 92A and 92B. Dampers shall have a fire rating of 1.5 Hrs. in accordance with latest edition of UL555 and shall be classified as Leakage Class 2 smoke damper in accordance with latest version of UL555S.

5A403.4.3 Each fire/smoke damper shall be AMCA licensed and bear the AMCA seal for air Performance. Pressure drop shall not exceed 7.5Pa when tested at 300 m/min face velocity on 600x600mm size damper. Actuator shall be UL listed.

5A403.4.4 Each damper shall be supplied with factory mounted sleeve of galvanized steel of thickness as per SMACNA and of minimum 500 mm long.

5A403.4.5 Damper Frame shall be a roll formed structural hat channel , reinforced at corners, formed from a single piece of 1.6mm galvanized steel . Damper blades shall be airfoil shaped (equivalent to 2.3mm thickness strength) roll formed using 0.8 mm thick single piece of galvanized sheet.

5A403.4.6 Electric Actuator of suitable Torque and as approved by UL shall be factory mounted and tested. The actuator shall be suitable for 24V AC supply.

5A403.4.7 The damper shall be equipped with a device to indicate OPEN and CLOSE position of Damper blades through a link mounted on the damper blade.

5A403.4.8 Each damper shall be provided with its own control panel, mounted on the wall and suitable for 240 VAC supply. This control panel shall be suitable for spring return actuator and shall have the following features:

- Potential free contacts for AHU fan ON/ Off and remote alarm indication.
- Accept signal from external smoke / fire detection system for tripping the electrical actuator.
- Test and reset facility.
- Indicating lights / contacts to indicate the following status:
- Power Supply On
- Alarm
- Damper open and close position.

5A403.5 Fire Dampers

5A403.5.1 Fire damper shall be rated for at least 1½ hour fire rating as per UL555/1995 tested by CBRI.

5A403.5.2 Fire damper blades shall be one piece folded high strength 16 gage galvanized steel construction. The blades shall be held in position through fusible link of temp 74 degree C (165°F).

5A403.5.3 Damper shall be equipped with UL labelled Fusible Link with Temperature setting 74 degree C (165°F). Fire dampers shall have been tested to close under dynamic air flow conditions with pressure up to 1000 pa and velocities up to 10.2 m /sec. Fire damper shall be approved for Horizontal or vertical installation as may be required by the location shown in the drawings.

5A403.5.4 Damper Frame shall be a roll formed structural hat channel, reinforced at corners, formed from a single piece of 1.6mm galvanized steel. Damper blades shall be roll formed 3-v groove (1.6mm thick) or airfoil shaped in case of 3 Hrs.

5A403.5.5 Fire damper shall be equipped with a electric limit switch to indicate open and close position of the damper blades.

5A403.5.6 Fire Damper shall be installed in wall or floor opening using galvanized steel sleeve of minimum 500 mm length of sheet thickness for fire & smoke damper as per SMACNA and as per Installation instruction of Manufacturer.

5A403.5.7 Fire damper sleeves and access doors shall be provided within the duct in accordance with the manufacturer's recommendation.

5A403.6 Supply and Return Air Registers

5A403.6.1 Supply and return air registers shall be of either steel or aluminum sections. Steel construction registers shall have primer Coat finish whereas extruded aluminum registers shall be either Anodized or Powder Coated. These registers shall have individually adjustable louvers both horizontal and vertical. Supply air registers shall be provided with key operated opposed blade extruded aluminum volume control damper anodized in matt black shade.

5A403.6.2 The registers shall be suitable for fixing arrangement having concealed screws as approved by Engineer. Linear continuous supply cum return air register shall be extruded aluminum construction with fixed horizontal bars at 15 Deg. inclination and flange on both sides only (none on top and bottom). The thickness of the fixed bar louvers shall be minimum 5.5 mm in front and 3.8 mm in rear with rounded edges. Flanges on the two sides shall be 20 mm/ 30 mm wide as approved by Engineer. The grilles shall be suitable for concealed fixing. Volume control dampers of extruded aluminum anodized in black color shall be provided in supply air duct collars.

5A403.6.3 All registers shall be selected in consultation with the Engineer. Different

spaces shall require horizontal or vertical face bars, and different width of margin frames. These shall be procured only after obtaining written approval from Engineer for each type of register.

5A403.6.4 All registers shall have a soft continuous rubber/foam gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers for air flow shall not be less than 66 percent of gross face area.

5A403.6.5 Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be pivotable to provide pattern with 0 to +45 degree horizontal arc and up to 30 degree deflection downwards. Bars shall hold deflection settings under all conditions of velocity and pressure.

5A403.6.6 Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.

5A403.7 Supply And Return Air Diffusers

Rectangular Diffusers shall be extruded aluminium construction, square & rectangular diffusers with flush fixed pattern for different spaces.

5A403.7.1 Supply air diffusers shall be equipped with fixed air distribution grids, removable key- operated volume control dampers, and anti-smudge rings as re-required in specific applications. All extruded aluminium diffusers shall be provided with removable central core and concealed key operation for volume control damper.

5A403.7.2 Linear Diffuser shall be extruded aluminium construction with removable core, one or two way blow type. Supply air diffusers shall be provided with volume control/ balancing dampers within the supply air collar.

5A404 PIPING

5A404.1 Scope

5A404.1.1 The scope of this section comprises the supply and laying of pipes, pipe fittings and valves, testing and balancing of all water and refrigerant piping required for the complete installation. All piping inclusive of fittings and valves shall follow the applicable Indian Standards.

5A404.2 Chilled, Hot and Condensing Water Piping

5A404.2.1 Following material shall be used for pipes and fittings.

Pipes Nominal size (mm)	Material Specification
<150	IS 1239 Part-1
200 and above	IS 3589 Gr. FE 410 (8mm thick)
Fittings Nominal size (mm)	Material Specification
<40	Socket welded, ASTM A105 construction as per ANSI B16.11
50-150	Butt welded, ASTM A234 Gr. WPB as per ANSI B16.11

>200	Site fabricated from IS 3589 Gr. FE 410 (8mm thick)
Flanges Nominal size (mm)	Material Specification
< 150	IS 2062 Gr.A construction as per ANSI B16.5
> 200	IS 2062 Gr.A, construction as per ANSI B16.5

5A404.2.2 All pipes and their steel supports shall be thoroughly cleaned and given one primary coat of red oxide paint before being installed. For vibration isolators premoulded polyurethane pipe sections of 160 Kg/m3 density with adhesive shall be fixed between pipe and MS support. 10 mm thick MS 'U' clamp with vibration pad shall be fixed on the pipe so that the pipe is kept in position.

5A404.2.3 All supports exposed to ambient shall be painted with two coats of epoxy. For condenser water piping running exposed to ambient, 2 coats of Epoxy paint shall be applied over piping . Then One coat of zinc chromate primer shall be applied. Finally colour painting shall be provided for identification of services.

5A404.2.4 Fittings shall be malleable casting of pressure rating suitable for the piping system. Fittings used on welded piping shall be of the weldable type.

5A404.2.5 Test points (NPT/BSP socket) shall be installed on piping wherever required to check the pressure and temperature.

5A404.2.6 Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used.

5A404.3 Valves:

5A404.3.1 Ball and butterfly valves conforming to the following specifications shall be provided :

Size	Construction	Ends	Type
15 to 40 mm	Forged Brass	Screwed	Ball
50 mm and over	Body Cast iron,	Wafer	Butterfly

5A404.3.2 Valves shall l be suitable for PN 16 rating. Butterfly valve should be of wafer type long neck construction single stem design with center lugs to ensure proper alignment of pipe flanges.

5A404.3.3 Butterfly valves: It shall have Epoxy Coated cast iron body with Integrally moulded EPDM liner of replaceable type. The liner shall be integrally moulded on hard backup ring and shall be suitable for PN 16 rating. All butterfly valves shall be provided with locking devices.
Valves 250 mm and above dia shall be gear driven.

5A404.3.4 Automatic balancing valves shall automatically control flow rates within ±

5% accuracy. Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil/ helical spring to avoid corrosion. Four operating ranges shall be available with the minimum range requiring less than 14 kPa to actuate the mechanism. Manufacturer shall provide independent laboratory tests verifying assurance of performance.

5A404.3.5 Balancing cum control valves shall be sized based on flow rates and pressure drops across cooling coil.

5A404.3.6 Manual double regulating balancing valves shall be provided at chiller, condenser, various tap-offs line. These valves shall have built-in pressure-drop measuring facility to compute flow rate across the valve. The test cocks shall be long enough to protrude out of pipe insulation. To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a computerized balancing instrument which shall enable the operator to read the flow directly without the use of diagrams or tables.

5A404.3.7 All ball valves and ball valves with Y strainer shall be brass forged body construction with chrome plated brass ball and handle of stainless steel constructions.

5A404.3.8 Non return valves: shall be dual plate check valve in accordance with the following Specifications :

Size	Construction	Ends
40 to 300 mm CI IS 210 Gr. FG 260	Body: Grey Cast iron Plates: CF-8 (SS-304), Hinge/Stop Pin: SS-410 Sprin g(s): SS- 316. Seal: EPD M	Flanged (Epoxy Coated),
350 mm to 500 mm CI IS 210 Gr. FG 260	Body: Grey Cast iron Plates: SS- 409. Hinge/Sto	Flanged (Epoxy Coated),

p Pin: SS-

410

Spring(s):

SS-316.

Seal: EPDM

5A404.3.9 The bearing shall be PTFE material. Valves shall be PN 16.

5A404.3.10 'Y' type Strainer: It shall be suitable for PN 16 shall be fabricated out of MS 'C' class pipe two sizes higher than that of Strainer pipe size. Flanges as per ANSI B16.5 shall be provided at inlet and outlet connectors. The body shall be hot dip galvanized. Permanent magnet shall be provided in the body of the Strainer to arrest MS particles. Filter element shall be of non- magnetic 20 gage SS sheet with 3 mm perforation. Cartridge having five different type of filters made out of SS 304 with different mesh sizes shall be provided. These will be replaced so as to get good quality of water in system during commissioning. Strainers shall be provided at inlet of each Air Handling Unit and Pump.

5A404.3.11 Pot Strainers: Body shall be fabricated out of MS plate IS 2062. Thickness of sheet shall be as per size of the strainer chamfered pipes with flanges shall be provided at inlet /outlet connections of the strainer. The tangential entry of water shall create a centrifugal action and due to velocity shall separate sediments and deposit on the inner surface of Filter Element and at bottom of the Strainer. Butterfly valves shall be provided at inlet / outlet connections. The strainer body shall have two separate chambers properly sealed to avoid mixing of filtered and unfiltered water. A powerful magnet shall be provided in the body to arrest MS particles.
Filter element of Pot Strainer shall be of non-magnetic 18 gage SS sheet properly reinforced to avoid damage of the element. A cone with sufficiently large drain pipe with butterfly valve shall be provided at the bottom chamber to flush-out foreign particles. This arrangement shall avoid frequent opening of Pot Strainer for cleaning of filter element. Gage connection shall be provided at inlet and outlet connection.

5A404.3.12 Pot strainers shall be provided with automatic backwash system. This shall be with heavy duty reduction gear motor provided at top of upper lid. During backwash, motorized drain valve shall be opened along with vent cock. Entire operation shall be performed through BAS.

5A404.3.13 Size of various Pot Strainer, Filter Element and Thickness of MS sheet shall be as under:

Pipe size	Pot Dia	Pot HT	Element Dia	Element HT	MS Plate Thickness
(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
50	300	400	200	240	6

80	350	450	250	250	6
100	450	500	300	280	6
125	500	600	330	340	8
150	540	700	360	390	8
200	610	815	400	470	8
250	800	955	550	510	8
300	1000	1105	750	580	8
350	1190	1300	895	678	12
400	1350	1500	1020	785	12
450	1518	1700	1060	890	12
500	1690	1800	1100	900	12
600	2000	2200	1500	1160	12

Each Port strainer shall be provided with a Manufacturer Test Certificate.

5A404.3.14 SIDE STREAM FILTRATION SYSTEMS HYDRO CYCLONE (CENTRIFUGAL TYPE)

Purpose:

The system will remove unwanted solids from cooling water system using a centrifugal-action vortex separator. The liquid-solid separation system will help prevent particle fouling of the cooling systems components, reduce maintenance and servicing routines, maintain optimum energy efficiency of the heat exchange process, limit blow down and control harmful bacteria growth in the system.

Side Stream Installations:

Control of solids in the re-circulated cooling water system shall be accomplished via a side-stream flow of not less than 15% of the full-stream system flow through a completely assembled separation/filtration package. The package's pump shall provide sufficient pressure for the re-introduction of side stream fluid back into system flow.

System Performance Requirements:

Each unit must be tested by the manufacturer prior to shipment to ensure it conforms to stated operating specifications.

Solids Removal Effectiveness:

Systems in a single pass through the separator, given solids with a specific gravity of 2.6 and water at 1.0, particle removal efficiency is expected to be

98% for particles of size 74 microns and above. Performance test results should be submitted for the same by vendor. Additionally, fine particles as well as lighter and heavier than mentioned above shall also be removed, resulting in an appreciable aggregate removal of particles (up to 75%) as fine as 5 microns. In Re-circulating Systems 98% performance should be guaranteed to be as fine as 40 microns (given solids with a specific gravity of 2.6), with correspondingly higher aggregate performance percentages (up to 90%) of solids as fine as 5 microns.

Maximum working pressure: 10 bar

Maximum operating temperature: 55º C.

Construction:

The separator package shall provide for initial pre-straining prior to pump suction (except for side stream applications), followed by direct pumping through a specific centrifugal-action solids-from liquid separator. Separated solids be purged periodically to desired disposal with an automatic purge valve. Automatic controllable purge valve through programmed HMI PLC based panel for better operationality and maintenance for removal of solid particles, dedicated controller for purge valve not allowed.

Pump:

End-suction, single stage; TEFC motor; cast iron housing; bronze/SS impeller; shaft Sleeving should tough material; silicon carbide mechanical shaft seal; flooded suction required.

Separator

Centrifugal-action accessible design, incorporating a true tangential inlet with dumbbell type design, employed to promote the proper velocity necessary for the removal of the separable solids. The dumbbell design for optimum flow transfer, laminar action and particle influence into the separation barrel. The separator's internal vortex shall allow this process to occur without wear to the accelerating slots. Separated particle matter shall spiral downward along the perimeter of the inner separation barrel, in a manner which does not promote wear of the separation barrel, and into the solids collection chamber located at bottom of separator. The separator shall be of unicell construction with Mild Steel (IS2062) or equivalent quality steel. Level of filtration & effectiveness must be as per given specification. Separator should have inspection opening.

Electrical Control:

IEC starter with overload module; PLC Based & HMI display; re-set/disconnect/trip switch. Power requirement: 415-volt, 3 phase, 50 Hz. With feature like overload protection, fault alarm, etc. IP55 protection. Compatibility with BMS (RS485)

Valves:

Ball valves on purge line for isolation of solids-handling/purging equipment. Optional inlet/outlet valve kit is available.

Base Frame

MS (IS2062 or equivalent) C-Chanel with epoxy paint finish.

5A404.3.15 **DYNAMIC PRESSURIZATION UNIT, EXPANSION TANK WITH BUILT IN DE-AERATOR & TOP UP**

- Expansion, Pressurization, deaeration and Top up of the chilled water system to be provided by an integrated unit comprising of Pressure-less expansion tank with coalescing pall rings, Dynamic Pressurization unit with integrated automatic water make-up connection complete with state of the art digital controller.

- The pressurization unit shall be sized appropriate to the total system expansion volume and maximum operating pressure. The units shall be Manufactured and designed in accordance with European Pressure Equipment Directive PED 2014/68/EU.

- The units shall be Manufactured and designed in accordance with European Pressure Equipment Directive PED 2014/68/EU.
- The controller shall regulate the pump unit to operate as Cyclic duty - standby/assist with automatic changeover.

- System pressure shall be regulated within ± 0.2 bar (2.9 psi) of the set pressure. High- and Low-pressure alarm setting shall be selectable by the user.
- The pressurization unit shall have non-return valve, flow restrictor valve and solenoid valve as well as a safety relief valve for the vessel and a "Y" strainer for safe operation. Solenoid Valves to be used to avoid Pressure Surges, i.e. unit shall not incorporate electrically actuated ball valve in the spill line since it takes time to react and increases pressure peaks which otherwise would lead to malfunctioning of the system.
- Top-up function shall be programmed according to system requirements. The unit shall have flood limiter algorithm to shut down the system in the event of a serious leak. Water level in the expansion vessel(s) shall be maintained to a minimum value.
- The system pressure to be monitored by a touchscreen microprocessor controller. The control unit shall read the system pressure via a pressure transducer and shall maintain the pressure within the close tolerance limit of +/- 0.2 bar.

- The degassing of a partial flow of the installation water shall be processed according to an optimized time schedule with selected table degassing programme in the controller. After a period of continuous degassing (adjustable and depending on the installation volume) at the start up, the controller shall switch automatically to an interval degassing mode.

- The system shall be able to offer following Communications/Connectivity:

o USB port for saving the operational log or performing a Firmware update.

- Ethernet port to connect the unit to a Building Management System (BMS) via Modbus or Bacnet,
- RS-485,
- BMS via Modbus or via Bacnet.
- Wireless Communication to connect and perform seamless commissioning even remotely through same organization's smartphone application.
- Canbus ports or the interconnection of multiple Pressurization units.
- In case of two or more dynamic pressurization units : The units shall incorporate Co-Operation mode where Slave can automatically take over in the event of the Master failing or functioning poorly ('Floating Master') without interrupting the pressure maintenance of the CHW system

- In order for customer or OEM to remotely monitor & control operation, fault diagnosis related needs, it is essential that below features be available in the system :

- The unit shall be with Remote Service to create insights into the use of the installations & maintenance. The remote service platform shall enable remote service, alerting and notifications and contain all devices info and history. Remote Service portal shall enable you to perform analyses, optimize the system, and execute preventive maintenance.
- The system can be remotely monitored and access the units for Health Check, Commissioning and provide immediate notification when an installation or product has a malfunction. The gateway shall have a serial connection to connect to the device and use highly secured cellular technology for connecting to the remote service cloud platform.

- Analog voltage output signals for remote indication of vessel level and system pressure (0-10V).
- Event logging: Alarm activations, Pump Run counter (activations per pump), Cumulative run timer (hours per pump), Electrical interruption.
- Controller shall display fault code and generate the alarm in case of any fault situation.

- The pressure-less expansion vessel(s) shall be cylindrical, Manufactured and designed in accordance with European Pressure Equipment Directive PED 2014/68/EU.

- A high capacity brass automatic air vent shall be installed on the top of the vessel. The 'Turbo-vent' function shall release the Air via an automatic air vent installed on the top of the vessel

- Vessel volume shall be calculated according to the system expansion volume. Every vessel in the unit shall have the same size. Levelling of the vessel shall be facilitated by adjustable feet. Condensate drain cock shall be installed within the base of the vessel.

- Efficiency of the vessel volume shall be minimum 80%, For De-aeration Integrated micro bubble separator with PALL rings shall be an integral component of pressurization unit and be installed within the inlet of the expansion vessel providing removal of micro-bubbles down to value 18μm.

- The expansion vessel(s) shall be fitted with a replaceable butyl rubber bladder with rupture sensor . As unit is subject to atmospheric pressure, tank pressure rating should be 3 Bar. Maximum continual working temperature of the bladder shall be 70 °C (158 °F).

- Main vessel must have a Weight sensor to provide vessel content information in percentage.

- Main vessel must be connected to the Pressurization unit using flexible hoses.

- The use of secondary pressurized expansion tank is not accepted.

- Expansion Tank shall have third party certificate (TUV / Lloyds registered).

- The controller shall display the vessel contents, system pressure and status of the main operating components in real-time on the graphical display. This acts as confirmation that pump(s) or valves are operating and responding as required, while also verifying the system setup.

- Pressurization unit shall to be factory assembled, with Factory conforming to ISO 14001:2015 and BREEAM. The product shall be installed according to the manufacturer's instructions using manufacturer's approved components.
- Manufacturer's Authorized representative shall submit their Pre-commissioning and Commissioning Report Format during Order Finalization with agreed Set Parameters

5A404.3.16 **PRESSURE INDEPENDENT BALANCING & FLOW CONTROL VALVES** (PIBCV):

A. Supply, Installation Testing and Commission of PIBFCV Valves based on below specifications.

B. Contractor shall coordinate with the manufacturer and provide the relevant pipe sizes and selections for each unit based on Flow rates. Contractor shall prepare a schedule indicating the PIBCV requirement for each equipment/location in accordance with manufacturer's recommendation.

5A404.3.16.1 **Technical Specifications**

1. The Stroke length of the modulating Valve shall be independent of flow setting.

   The modulation and flow setting shall be one combined unit; flow setting on horizontal plane & flow control on vertical plane with linear movement to ensure full stroke modulation.

2. Valve must be Full Stroke at any given flow setting, it must have minimum stroke length of 5mm for DN 20, 5.5mm for DN 25-32, 15mm for DN 40, min 15mm- max 20mm for DN50, 20mm for DN 65-80, min 20mm- max 40mm for DN100, 40mm for DN 125, 43mm for DN 150-200, 48mm for DN 250, and should not reduce when flow setting is performed, to ensure precise controlled modulation, avoid operation like on/off valve.

3. The KV values at each Flow pre-setting needs to be documented and shown in the submittal data sheets of the valve by manufacturers. Accuracy of Dynamically balancing the system +/- 10% is acceptable as per CIBSE / BSRIA Commissioning Guidelines. In absence of KV value at each flow pre-setting in PIBCV flow to be measure after installation of AID such as metering stations installed after every PICV or verify flow using ultrasonic flow meter. Accuracy mentioned in the catalogues can be played based on the Minimum and Maximum Differential pressure PICVs can handle.

4. The valve shall have Metal to Metal seating. Plastic to Metal seating / Plastic to Plastic seating is not acceptable for all sizes to reduce risk of leakage.

5. Valve shall be pressure independent, and control pressure across the temperature control valve orifice.

6. Shall Control and regulate the pressure by an integrated pressure controller made of PPS Glass composite /Stainless Steel & HNBR/ EPDM Diaphragm design, stainless steel spring, and shall require no internal maintenance or replaceable parts / cartridges.

7. Valve shall have internal capillary tube from ½” to 12” to avoid damage while transportation/ installation. No external Capillary tube shall be used for DP controller throughout the entire size range.

8. The Valve bonnet shall be top entry type to allow access to internal components without removal of valve body from the chilled water/ hot water line for easy maintenance. On site replacement of working components can be commenced.

9. The valve shall provide user adjustable maximum flow within valve control range. Adjustment method shall indicate scale for maximum & minimum of valve flow range and shall have lockable adjustment mechanism.

10. Shall regulate differential pressure across the control valve section to provide 100% control valve authority and maintain a linear flow characteristic. Equal Percentage characteristics shall be achieved through actuators through precise programming. Mechanically achieved fixed equal percentage characteristics directly from the valve is not acceptable.

11. Valve shall accurately control the flow from 0 -100% full rated flow with an operating pressure differential range of 2.5 to 115psi for valve sizes ½” to 1-¼”, 3 to 115psi for valve sizes 1-½” to 12”.

12. The valve shall have a maximum operating differential pressure of 115 PSI, manufacturer shall give confirmation against noise/vibration problem at 115 PSI.
13. Valve shall be offered in sizes ranging ½" to 12", providing a flow rate range of 0.29 to 2865gpm
14. Valve shall be available with female thread with ISO 228 for sizes ranging from ½" to 2" and EN 1092 -2 flange sizes ranging from 2-½" to 12.
15. Provide forward seated globe pattern design, to close flow against the direction of flow. The Valve from½" to 12" shall all have class IV leakage 0.01% of the valve maximum flow.
16. The valve shall have a flow measurement accuracy of +/- 5% in order to facilitate precise chilled water balancing. Flow limitation accuracy of +/- 10% for the entire operating range up to 8 bar is acceptable. Valve shall have published Flat line curves for Flow Vs Differential Pressure demonstrating true Pressure independent wrt. to constant flow.
17. Valve shall be tested to BSRIA BTS -01 standard. Including 3rd party BSRIA tests for equal percentage characteristics for at least 5 different sizes.
18. The Pressure independent control valve shall have 3 test ports, capable of measuring inlet pressure – p1, outlet pressure- p3 and Differential pressure. Across p1 and p2 the valve shall be able to measure real time flow using KV methodology with flow measurement accuracy of +/- 5%. KV values must be available in the technical Data sheet, separately given Kv values shall by verified by 3rd party. BSRIA report confirming the accuracy of flow measurement shall be provided. Manufacturers must submit detailed Testing verification Procedure in submittal and contractors must demonstrate and verify the flow based on Table below:

Valve ID	Valve type	Dim.	Pre-set	True Flow measured thru P/T plug Δp (P1-P2) [kPa]		
				KV-signal	Verified Δp	Flow
Pump Type				Regulation mode		
Installation						
Signature						
Date						

19. The valve shall be capable of closing against a maximum differential

pressure of 800 kPa (8 bar) with a leakage rate at maximum 0.01% of max rated volumetric flow and comply to EN1349 Class IV.

20. The valve shall have a linear characteristic, which shall be converted to equal percentage by the actuator and linear improved controls between Input Signal vs. Heat Output. The control valves used for Terminal Units (FCUs, AHUs and FAHUs) should have a Logarithmic control characteristic through actuator. Equal percentage characteristics by the valve is not acceptable, it has to be achieved by the actuator. The control valves used for Heat Exchangers should have a Linear control characteristic.

5A404.3.17 Automatic Balancing Valve

Supply, Installation, Testing and Commissioning of Automatic Balancing Valve in Each of the Chiller Outlet to ensure the designed flow by maintaining a constant differential pressure. The flow cartridge installed within the valve housing, shall be ensuring the design flow rate is achieved irrespective of fluctuating pressure conditions. These cartridges shall have a replaceable orifice plate for higher flexibility and a resistant diaphragm for higher accuracy, also eliminating friction, noise and impact from water hammer. The cartridge can also be removed for ease of maintenance and system flushing whilst, it should have self-cleaning function ensuring that any dirt present in the system does not compromise the accuracy and operation.

The valve shall operate by means of automatic balancing stainless steel cartridges with replaceable orifice plate and internal EPDM diaphragm. The pressure class of the valve shall be PN16/PN25. The valve housing shall be made of ductile iron type GGG40. The valve shall comply with flanges according to EN/ANSI standards. Cartridge Material shall be AISI 304, Spring of AISI 316, Diaphragm shall be of HNBR (LP cartridges) and HNBR reinforced (HP cartridges). All Valves shall be rated for Temperature -20 to +110 C and Differential Pressure range of 13 - 600 kPa. Each Valve shall have P/T plugs for Checking Differential Pressure and Flow.

5A404.3.18 AUTOMATIC TUBE CLEANING SYSTEM

BALL TRAP:

The ball trap shall be mounted between two flanges - (BS Table 10 E) Grade B, 15 days 100 lbs capacity, at the outlet line of the condenser. The casing shall be made from a MS material of IS2062 Grade B. The Ball trap shall have epoxy based finished paint. The screen inside is made from stainless steel SS304L perforated metal sheet.

The Ball Trap should have pressure drop of less than 800 mm of WC. The body of the Ball trap shall be of size as nozzle or flange size or the pipeline size in which Ball trap must be installed. For example, if the pipeline size is 10 inches the Ball trap body should be of 10 inches.

The Ball Trap shall have Race Face Flange with gasket on only inner dial of pipe and should not be on the entire flange dia to avoid leakage.

BALL COLLECTOR:

The ball Collector shall be made of suitable size capable of storing all the sponge balls required and should be made from MS material of IS2062 Grade B. The Ball collector should have epoxy based finished paint. The Ball Collector should have a sight glass for monitoring the balls. Toughened glass should be used and should be mounted by Allen key fasteners or SS nut bolt.

SKID WITH PUMPS & VALVES:

The Common Skid should have pipe and flanges of MS material IS2062 Grade B. All welding of Skid shall be performed by Argon weld. The Skid frame should be of MS material of same IS2062 grade B. The Skid valves should be of diaphragm type or equivalent with all joints to be flanged and bolted. The valves used for injection and collection from respective chillers shall be of actuator type with minimum IP54 protection and less tan 10s running time for open or close function with NEMA –II protection. The valve should be suitable to work in high humid environment up to 95% (Non-condensing) RH. All fasteners shall be of high-tension grade 9.8, 10.9, 12.9. Pumps & Motorized Valves shall be from reputed makes as per list of approved makes.

Control Panel:

The Control Panel should be PLC based with LCD depiction of injection and collection cycle. The touch display should show system wise running along with pump running and off condition. The alarms and faults shall be indicated on the screen in case of any issue in operation. Display must be Touch type, graphical presentation, and with multi-level security passwords with defined functional authorities. The PLC Panel should have IOT Ready Option & system manufacturer should have digital platform (App Based) for demonstration of key parameters of chiller efficiency for Future Scalability

Working Principle - Activity Sequence

The operation is based on the circulation of the sponge ball through the condenser tube. The sponge ball must be pushed to the condenser inlet in **not more than 5 seconds** by a **high flow of water (min. 7L/S)** which can be produced by a high-pressure source **at least 2bar** higher than the injection point at the condenser inlet. The source can be obtained by a single water injection pump in water injection system. Water injection system will be operated by a PLC controller which is pre-programmed to execute the cleaning process in two consecutive steps. There shall be ball injection cycle and ball collection cycle. The proposed system should be manufactured and complied with ISO 14001:2015, ISO 9001:2015. The system must be CE + RoHS compliant and in accordance with UL standards.

1. **STEP 1:**

   The PLC shall activate the cleaning process by detecting the on/off status of the corresponding chiller (or condensing water isolating valve). If the chiller is on, the PLC shall command the control valves to open to manage the injection. The check valves shall be installed in the location as shown on the scheme above and as close as possible to the collector to ensure correct water flow direction during the injection cycle and the collection cycle.

2. **STEP 2:**

   The injection cycle, the PLC shall command the injection control valve to open

for couple of seconds (the collection control valve kept closed in the cycle) and then close. The water pressure from the pump shall be used to push the water inside the injector to the collector and force all balls in the collector to the condenser.

3. **STEP 3:**

   The cycle shall be completed until the ball passing through the condenser where it should clean all the deposits on internal surface of the tubes. After leaving condenser the balls shall be trapped inside the ball trap unit.

4. **STEP 4:**

   After the injection cycle is finished, the PLC shall command the collection control valve to open for couple of seconds (the injection control valve kept closed in the cycle) and then close. The negative pressure shall let the ball return from the ball trap unit back to the collector where the rinsing of the balls is carried out and then water is discharged to the outlet header of Condenser which goes to cooling tower. The ball shall wait in the collector until the next injection cycle. The time of the collection cycle is normally pre-set at 27 minutes.

5. A single pump should be on skid and shall be running during injection and collection cycles.

6. The pressure drop across ball trap shall not be more than 800mm.

7. The Valves shall give feedback to Control PLC of functioning.

8. The Control PLC shall raise an alarm in case of any malfunctioning of system

9. The total time of the whole cycle (injection and collection cycle) shall be 3 - 4 minutes.

10. A maximum number of 4 Condensers should be controlled by single skid and Control Panel. If the number of Condenser increases beyond 4, additional Skid with Control Panel should be considered and should be followed consequently.

Testing: The Manufacturer shall have Hydrostatic Test Bed Facility to Witness Factory Acceptance Test for Hydrostatic Testing of machine at 10 Bar Pressure.

5A404.4 Cold Water and Drain Piping

5A404.4.1 All pipes to be used for cold water (makeup) shall be GI and drain,

condensate drain and fittings shall be U-PVC.

5A404.4.2 All jointing in the pipe system shall be by screwed joints and/or by screwed flanges using 3 mm 3 ply rubber insertion gaskets. Pipe threads and flanges shall be as per relevant BIS Codes.

5A404.4.3 All pipes support shall be mild steel, thoroughly cleaned and given one primary coat of red oxide paint before being installed.

5A404.4.4 Gate valves, globe valves, check valves and strainers shall be similar to those specified for chilled, condensing and hot water piping.

5A404.4.5 For proper drainage of AHU Condensate, 'U' trap shall be provided in

5A404.4.6 the drain piping. All condensate drain piping shall be insulated and painted as per the section "Insulation".

5A404.5 Pressure Gages and Thermometers

5A404.5.1 Pressure gages shall be stainless steel and shall be provided at suction and at discharge of each pump, at chilled water supply and return at each air handling unit, at each chiller and condenser.

5A404.5.2 Pressure gage sockets on insulated pipes and accessories shall be extended up to insulation to avoid damage of insulation for replacement of gages. Pressure gauges shall be provided with ball valve and syphon tube.

5A404.5.3 Thermometers shall be stainless steel and shall be provided at chilled water supply and return at each air handling unit, at each chiller and condenser.

5A404.5.4 Thermometers on CHW lines shall be with long stem. Thermometer socket shall be extended upto insulation thickness so that the thermometer shall be removable without damaging the insulation.

5A405 INSULATION

5A405.1 Scope

The scope of this section comprises the supply and application of insulation conforming to these specifications. The insulation material shall be Closed Cell Elastomeric Nitrile Rubber.

5A405.2 Material

DUCT Insulation

Thermal insulation material for Duct Physically / Chemically crosslinked polyethylene foam, with factory reinforced aluminum foil facing, with Class O fire properties, with very low fire propagation of < 5.5 and passing E-84 at < 25/50, as per tender technical specification, the density of the foam should be not less than 25-30kg/m3 and the maximum thermal conductivity K should be 0.032W/mK@ 23 Deg C , the permeability resistance factor u shouldn't be less than 14000.

Case I – Supply & Return both ducted in conditioned space

Supply Duct 25 mm

Return Duct 19 mm

Case II – Supply ducted & return through ceiling

Supply Duct 19 mm

Case III – Supply & Return both ducted & exposed to atmosphere

Supply Duct 32 mm

Return Duct 25 mm

PIPE INSULATION

COPPER PIPE INSULATION –

Up to 20 mm dia. pipe 13mm & above 20mm consider 19mm thick Insulated with "O" class closed cell Fire-resident thermal XLPE Crosslinked Polyethylene insulation (-20 deg C to +105 deg C) with anti-microbial and anti-fungal properties along with multilayer alufoil composite lamination cladding (280 microns thickness) suitable for outdoor application and alupet foil for indoor application shall be applied and provided along entire length of refrigerant pipes to be laid inside the building, inside shafts and on the terraces etc

CHILLED WATER PIPES, CONDENSATE DRAIN PIPE INSULATION-

Chilled water pipes shall be insulated with suitable material & thickness, external exposed pipes shall be Crosslinked Polyethylene insulation with ultra-tough multilayers composite lamination cladding for protection from UV and physical impacts.

Condensate Drain Pipe Insulation with suitable material & thickness, i.e., GI / uPVC drain pipe with insulation up to 50mm dia. pipe with 13mm thick and above 50mm dia. pipe 19mm thick insulation of XLPE Crosslinked Polyethylene insulation.

In addition to above properties the insulation material for ducts shall be anti-microbial. Microbiological growth on insulation surface shall be in accordance with ASTM G-21 and bacterial resistance to ASTM2180.

The Material shall comply to ISO 5659 / BS 6853 / ABD 0031 for smoke density and toxicity values. The thermal conductivity of insulation material shall not be effected by aging as per DIN 52616 standard.

Preferably the insulation shall be with self-adhesive for ducting and piping and available in roles / sheets.

Thickness of the insulation shall be as specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer’s test certificate for density and thickness. Samples of insulation material from each lot delivered at site may be selected by Engineer. Adhesive used for sealing the insulation shall be non-flammable and with low VOC content (maximum 850 gm/l as per IGBC guide lines) strictly as per manufacturer’s recommendations.

Direct contact between pipe and hanger shall be avoided. Hangers shall pass outside the saddle. Manufacturer shall supply PUF saddles with pre-laminated insulation sheet of both side (PUF saddle sandwich between insulation material on both side) so that the insulation material is joint with insulation material on both side and the weight of pipe is transferred to the PUF saddle in the center.

All insulation work shall be carried out by skilled workmen specially trained

and certified by manufacturer in this kind of work. All insulated pipes shall be labeled (S.R. or R.R.) and provided with 300 mm wide band of paint along circumference at every 1200 mm for colour coding. Direction of fluid shall also be marked. Un-insulated MS pipes shall be painted throughout and direction of fluid marked. All painting shall be as per relevant BIS codes.

Protective Coating / Vapour Barrier Over Insulation: All ducts and pipes (On the roof / outside) exposed to UV rays shall be covered with two coats of UV paint / epoxy.

5A405.3 Duct Acoustic Lining

Open Cell Nitrile Rubber:

Duct acoustic lining material shall be Nitrile Rubber open cell foam. Thermal conductivity of the insulation material shall not exceed 0.047 W/m degree K at an average temperature of 20-degree C. Density of the nitrile rubber shall be 140 – 180 Kg/m3. The material should withstand maximum surface temperature of +85 degree C and minimum surface temperature of -20-degree C. The material should conform to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & HBF, HF 1 & HF 2 in accordance to UL 94, 1996.

Insulation should have antimicrobial product protection, and should pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180. The insulation should pass Asir Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).

Thickness of the material shall be 15 mm thick specified for the individual application and with noise absorption proprieties as per IS: 8225 / ISO 354 / ASTM423C. The insulation should be installed as per manufacturer's recommendation.

5A405.4 Pump Insulation

Chilled water pump shall be insulated to the same thickness as the pipe to which they are connected and application shall be same as above. Care shall be taken to apply insulation in a manner as to allow the dismantling of pumps without damaging the insulation.

5A406 Annexure-I

5A406.1 List of Abbreviations

ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
AMCA	Air Movement and Control Association
ATS	Automatic Transfer Switch
BIS	Bureau of Indian Standards
BEE	Bureau of Energy Efficiency

CD	Compact Disk
CAD	Computer Aided Drawings
CFM	Cubic Feet per Minute
dB	Decibel
IEC	International Electro technical Commission
ECBC	Energy Conservation Building Code
EFL	Electrostatic Fusible Link
FPM	Feet Per Minute
ESP	Electrostatic Plate
GA	General Arrangement
GI	Galvanized Iron
GRP	Glass Reinforced Plastic
GSS	Galvanized Sheet Steel
HDPE	High Density Polyethylene
Hz	Hertz
IP	Ingress Protection
ISO	International Organization for Standardization
IGBT	Insulated Gate Bipolar Transistor
LED	Light Emitting Diode
MCC	Motor Control Centre
MVAC	Mechanical Ventilation and Air Conditioning
NFPA	National Fire Protection Association
NPT	National Pipe Thread
NEMA	National Electrical Manufacturers Association
NRV	Non-Return Valve
NPSH	Net Positive Suction Head

PLC	Programmable Logic Controller
RPM	Revolutions Per Minute
SS	Stainless Steel
TEFV	Totally Enclosed Fan Ventilated
UV	Ultraviolet
UL	Underwriter Laboratories
UPVC	Un Plasticized Polyvinyl Chloride

5A407 Annexure-II

5A407.1 List of Bureau of Indian Standards and Other Codes

BIS- 277-1992	Galvanized steel sheet (Plain and Corrugated) wire for fencing.
BIS-655-1963 (Reaffirmed 1991)	Metal air ducts.
BIS-659–1964 (Reaffirmed 1991)	Air conditioning (Safety Code)
BIS-660-1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety Code)
BIS-694-1990 (Reaffirmed 1994)	PVC insulated (HD) electric cables for working voltage upto and including 1100 volts.
BIS-732-1989	Code of practice for electrical wiring.
BIS-822-1970 (Reaffirmed 1991)	Code of procedure for inspection of we

BIS-1554-1988 (Part – I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
BIS-1897 - 1983 (Reaffirmed 1991)	Copper bus bar / strip for electrical purposes
BIS-2379 - 1990	Colour code for the identification of
pipelines. BIS- 2551 - 1982	Danger notice plate
BIS -3043 - 1987	Code of practice for earthing
BIS- 3103 - 1975 (Reaffirmed 1999)	Code of practice for Industrial Ventilation.
BIS-3837-1976 (Reaffirmed 1990)	Accessories for rigid steel conduit for Electrical wiring.
BIS-4894-1987	Centrifugal Fan.
BIS-5133-1969 (Part-I) (Reaffirmed 1990)	Boxes for the enclosure of electrical Accessories.
BIS-5216-1982 (Part-I) (Reaffirmed 1990)	Guide for safety procedure and Practices in electrical work
BIS -5424-1989 (Reaffirmed 1994)	Rubber mats for electrical purposes.
BIS-5578 and 11353-1985	Marking and identification of conductors
BIS-8623-1993	Low voltage switchgear and control gear Assemblies (Requirement for type / partly type tested assemblies)
BIS-8828-1996	Circuit Breakers for over current protection For house hold and similar installation.
BIS-9537–1981 (Part II)	Rigid Steel Conduits for electrical
wiring BIS : 10810 - 1988	Methods of test for cables.
BIS : 13947-1993 (Part-I)	General rules for low voltage switch gears and control gears

BIS-13947-1993 (Part-II) IEC 947 -2 Circuit Breakers

BIS-13947-1993 (Part- III) Switches, disconnectors and fuse for low voltage switch gear and control gear

BIS : 13947 - 1993 (Part- IV) Low voltage switch gear and control gear for contactors and motor starters

BS : EN:779 – 1993 Filters

ASHRAE Hand Books American Society of Heating Refrigeration and Air Conditioning.

Fundamentals

Systems and Equipment Applications Refrigeration

ASHRAE Indoor air quality Sections Standard 62.1

ASHRAE 90.1

ASHRAE 55

ASHRAE 52.1 and 52.2

ASHRAE 170

IEC	Relevant Sections.
(ECBC,2017)	Energy Conservation Building Code of India -2017

PLUMBING & FIREFIGHTING WORKS

5A417 Internal Plumbing

5A417.1 General

5A417.1.1 The Plumbing, Sanitary, water supply, soil& waste and Drainage Systems for all facilities to be constructed, at all the various sites/locations, shall be fully and competently designed by the contractor keeping in view the following:

5A417.1.2 Compliances with local regulations and Relevant Bureau of Indian standards.

5A417.1.3 Adequate and uniform pressure availability of cold and hot water lines in all Toilets, Kitchen and all designated areas are achieved and suitable pressure and flow rate of water shall be available at each fixture (user Point).

5A417.1.4 Potable water supply: The RO water and hot water shall be distributed via dedicated Hydro pneumatic pump. Water distribution shall be regulated and maintained throughout the project to meet acceptable levels as recommended by IS Code Standards; minimum 150 kPa and maximum 350 kPa at water outlets in the toilets, kitchen and other area as required. To maintained the required pressure the water supply system to be designed in multiple zones.

5A417.1.5 Non-Potable water supply: The flushing water shall be transfer to overhead tanks through water transfer pumps with automatic control and from there shall be supplied through gravity.

5A417.2 Concept of the System

5A417.2.1 The following services are envisaged for this project

5A417.2.2 Potable water supply: The domestic cold supply will be supplied by the overhead domestic tank by gravity system for the complete building except for top three floors and booster pumps shall be provided for top three floors to meet the pressure requirement and the overhead domestic water tank will fill through transfer pumps located in plumbing pump room. The RO (Reverse Osmosis) and hot water shall be distributed via dedicated Hydro pneumatic pump. Water distribution shall be regulated and maintained throughout the project to meet acceptable levels as recommended by IS Code Standards; minimum 150 kPa and maximum 350 kPa at water outlets in the toilets.

5A417.2.3 Non-Potable water supply: The flushing water shall be transfer to overhead tanks through water transfer pumps and from there shall be supplied through gravity.

The site has daily hot water requirement for patient rooms, operation theatres, labs, Laundry, kitchen, HVAC System etc.

The heat pump shall be used for centralized hot water system.

5A417.2.4 As per the notification of Ministry of Environment and Forest of India, hot water requirement of minimum 20% capacity (Capacity of solar panel shall be based on output at 60 Deg C with temperature difference of in and out water shall be 45 Deg C) shall be met through Solar Hot Water System which should be integrated with the main Hot Water system.

5A417.2.5 Sewage and Sullage collection system based on BIS: 1742 standards for domestic drainage.

5A417.2.6 Storm / Rain water drainage system from various levels of the building and disposal to external storm water disposal drain lines. Terrace rain water irrigation storage and use for flushing and cooling tower make up after required treatment and the system to be integrate accordingly.

5A417.2.7 The treated effluent shall be used for flushing water requirement, cooling towers make up water and for gardening / irrigation purpose.

5A417.2.8 The waste water from the buildings will have to be collected in STP/ETP plant and over flow shall be connected to the external sewerage lines. Effluent from labs, Operation theatres, and blood banks, nuclear medicine area, radioactive area ,active toilets and other infected area shall be carried through a separate network of waste line and manholes up to neutralization chamber of ETP cum STP.

5A417.2.9 HSD/PNG fired Steam boilers shall be provided in accordance to the steam requirement of the Laundry, kitchen, including all piping, PRVs stations, traps and other required accessories etc. and other associate work as per the Laundry & kitchen, requirement.

5A417.2.9 Basement cap parking and Plant room drainage system including sump pumps, sumps riser and drain pipe. All piping shall be GI C class.

5A417.3 Water Storage and Distribution System

5A417.3.1 Water Requirement

The estimated requirement of water demand per day for the developments shall be based on the number of beds and users.

5A417.3.2 Source of Water

The daily domestic water requirement for the project shall be met through the underground water tank which have in let connection as municipal water supply. The flushing, irrigation and hvac system water requirement shall be met through the treated water of STP/ETP.

5A417.3.3 Water Quality

Domestic Water Requirement: The domestic water required for the project will be from the municipal source of water supply.

Recycled Water from STP: Water recovered from sewage treatment plant shall be used for flushing, gardening and for hvac / DG cooling tower.

5A417.3.4 Water Distribution

The water distribution for hot and cold (Domestic, RO, Flushing) water supply for the developments shall be designed to ensure availability of adequate residual head at user outlets and hot water return system and balancing system shall also consider to maintained proper hot water at all outlets without any time delay and water return to be considered from each user outlet and Provision of pressure reducing station and non-return valve, balancing valve, air release valves etc. shall be made for effective and efficient water distribution in the designated areas.

Appurtenant

Following components shall be included in the water supply system for efficient functioning:

a. Isolation valves at strategic locations.

b. Non-Return valves for back flow prevention.

c. Automatic air vent at each of the highpoints.

d. Drain valve at each of the low points.

e. Pressure reducing valve where abnormally high pressure is to be reduced.

f. Pressure Gauge.

g. Balancing valve to be considered in hot water distribution system as required balancing the flow.

h. Water meters for all hospital buildings and these water meters will be connected to BMS installed in the pump house by the Contractor.

5A417.4 Sewage, Sullage and Storm Water

The soil and waste shall be carried down in separate independently vented pipes. Two pipe drainage systems shall be adopted as per NBC (Part-IX). Provision of Anti syphon pipe vertical vent shall also be made for hygiene, safety consideration and to avoid foul smell entering through traps in WC and Urinals. All internal solid waste piping shall also be done with proper vent as per NBC (Part IX).

5A417.4.1 Design Limitations

The system is to be designed considering the following:

a. High thrust developed at soil and waste pipe connections.

b. Termination of vent cowl at terrace level.

c. Provisionofadequateslopeforhorizontalheaderpipesforachievingself-cleaningvelocity in the pipes.

d. Provision of cleanout plugs and Rodding eyes.

e. Minimum diameter of Soil and Waste pipe as 100mm.

f. Sewage from active toilets.

g. All pipe size to be design as per the guidelines provided in NBC-2026 and applicable BIS.

5A418 <u>Sanitary Fixtures and Chromium Plated Fittings</u>

5A418.1 Fittings

5A418.1.1 Scope

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of following items:

a. Sanitary appliances and fixtures for toilets.

b. Chromium plated brass fittings

c. Stainless steel sinks
d. Accessories in Stainless Steel (SS) material e.g., towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.
e. Hand driers (SS) etc.
f. Towel racks
g. Other accessories

Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures all fixing devices, nuts, bolts, screws, hangers etc. as required to provide a fully functional and complete facility and meeting all Employer's requirements.

All exposed pipes within toilets and near appliances/fixtures shall be of chromium plated brass unless otherwise specified.

5A418.2 General Requirement

5A418.2.1 Sanitary appliances and fixtures for toilets, chromium plated brass fittings, stainless steel sinks, bathroom accessories like towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails coat hooks etc. and mirrors shall be supplied after acceptance of Engineer. Electrical geysers with required fittings shall be provided (wherever required). The selection of all the sanitary fixtures shall be covered in the architectural specification &All Plumbing fixtures shall be low flow fixtures as per the GRIHA guidelines latest amendment till date.

5A418.2.2 All appliances, fixtures and fittings shall be provided with all such accessories are required to ensure that all accessories, equipment in all buildings at all sites, are in working condition as required and as per the Contractor's final approved drawings and specifications etc.
Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces.

5A418.2.3 The sanitary fixtures and fittings shall be installed at the correct assigned position and as per the contractor's approved drawings and shall fully meet with the aesthetic and symmetrical requirements as demanded by the Engineer/Employer.

5A418.2.4 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as approved by the Engineer/Employer. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

5A418.2.5 Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

5A418.2.6 Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

5A418.2.7 All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions.

5A418.2.8 Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulation or terrace shall be made good by the Contractor at his own cost. Fixtures shall be mounted rigid, plumb and true to alignment.

5A418.2.9 All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

5A418.2.10 Wall flanges shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pierce through them. These wall caps shall be or chromium plated brass fittings and the receiving pipes and shall be large enough to cover the punctures properly.

5A418.2.11 Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards as following:

a. The Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over(The original protective wrapping shall be left in position for as long as possible).

b. Theappliancesshallbeplacedincorrectpositionormarkedoutinorderthatpipeworkc an be fixed or partially fixed first.

c. The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.

d. Theappliance shallbesecurelyfixed.Manufacturer'sbracketsandfixingmethodsshal lbe used wherever possible. Compatible rust-proofed fixings shall be used. Fixings hall be done in manners that minimize noise transmission.

e. Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. ceramic unit)

f. Pipeconnectionsshallbemadewithdemountableunions.Pipeworkshallnotbefixedi na manner that it supports or partially supports and appliance.

g. Appliances shall be fixed true to level firmly fixed to anchors or supports provided by the manufacturer and additional anchors or supports where necessary.

h. Sizes of sanitary fixtures given in the specifications are for identification with reference to the catalogues of make considered. Dimensions of similar models of other makes may very within +/- 10% and the same shall be provided and no claim for extra payment shall be entertained NOR shall any payment be deducted on this account.

i. The Contract or shall fix all plumbing fittings such as water faucets, shower fittings, mixing valves, angle valves, S.S braided EPDM lined flexible connector with required length, Extension pieces etc. in accordance with manufacturer’s instructions and connect to piping system.

   The Contractor shall supply all fixing materials such as screws, rawl plugs, unions, collars, Extension pieces, compression fittings etc. as required.

j. Joints/gaps between all sanitary appliances /fixtures and the floor/ walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of color and shade to match that of the appliances / fixture and the floor / wall to the extent possible.

5A418.3 Water Closet

5A418.3.1 Water Closet shall be wash down or siphonic wash down type floor or wall mounted set, as approved by Engineer, designed for low volume dual flushing from 3-6 liters of water, flushed by means of a flushing cistern or an exposed type 32 mm size CP

brass flush pipe. Flush pipe / bend shall be connected to the WC by means of a suitable rubber adaptor.
Wall hung or floor mount WC shall be supported by CI floor mounted chair/bracket which shall be fixed in a manner as approved by the Engineer.

5A418.3.2 Each WC set shall be provided with approved quality of seat, rubber buffers and chromium plated hinges. Seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

5A418.3.3 Each WC shall be provided with 110 mm dia. (OD) PVC Pan Connector connecting the ceramic outlet of WC to PP pipe.

5A418.3.4 Orissa W.C

a. Orissa W.C shall be glazed vitreous china white or color of size specified. The W.C shall be provided with a 100 mm white vitreous chinaware P or S trap as required.

b. Each W.C. shall be provided with an exposed or concealed type flushing cistern of approved material and make.

c. Each WC shall be provided with 110 mm dia. (OD) PVC Pan Connector connecting the ceramic outlet of WC to HDPE downtake pipe.

5A418.3.5 Anglo Indian W.C

a. Anglo Indian W.C shall be in glazed vitreous china white or colour of size specified. The W.C shall be provided with a 100mm white vitreous chinaware or Strap as required.

b. Each W.C shall be provided with an exposed or concealed type flushing cistern of approved material and make.

c. Each WC set shall be provided with approved quality of seat, rubber buffers and chromium plated hinges. Seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

d. Each WC shall be provided with 110 mm dia. (OD) PVC Pan Connector connecting the ceramic outlet of WC to HDPE downtake pipe.

5A418.3.6 Urinals

a. Urinals shall be lipped type half stall with glazed vitreous China.

b. Half stall urinals shall be provided with 15mm dia. CP spreader, 32mm dia. CP domical waste and CP cast brass bottle trap with pipe and wall flange and shall be fixed to wall by

CI brackets, CI wall clips and CP brass screws as recommended by manufacturer complete as directed by the Engineer.

c. Flushing for urinals shall be by means of hand/ Sensor operation, Each urinal shall be provided with one flush valve unit.

d. Flush pipes shall be GI pipes concealed in wall chase but with chromium plated bends at inlet and outlet.

5A418.3.7 Urinal Partitions

a. Urinal partitions shall be white glazed vitreous china or as approved by Architect.

b. Porcelain partitions shall be fixed at proper heights with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer.

5A418.3.8 Cisterns

Low level flushing cistern (exposed or concealed) shall be provided for WC in specified toilets. The Contractor shall install cistern in accordance to the manufacturer's specification to the satisfaction of the Engineer.

5A418.3.9 Wash Basin

a. Wash basins shall be white glazed vitreous china.

b. Each basin shall be provided with painted CI brackets and clips and the basin securely fixed to wall/counter slab. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint. Brand and colour as approved by the Engineer.

c. Each basin shall be provided with 32 mm dia. CP waste with overflow, pop-up waste or rubber plug and CP brass chain.

d. Hot and Coldwater mixing fitting in wash basins shall be provided as required.

5A418.3.10 Kitchen Sinks

a. Kitchen Sinks shall be stainless steel.

b. Each kitchen sink shall be provided with painted CI brackets and clips and securely fixed. Counter top kitchen sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer. Each kitchen sink shall be provided with 40mm dia. CP waste and rubber plug with CP brass chain as given. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and color as approved by the Engineer.

c. Sanitary fittings for kitchen sinks shall be deck mounted or wall mounted CP Swivel faucets with or without hot and cold water mixing fittings as specified.

5A418.3.11 Shower Set

Shower set shall comprise of two CP brass concealed stop cocks or Concealed Divertor, four/five-way auto-diverter, adjustable type over-head shower with CP shower arm, all with CP wall flanges of approved quality. Bath spout, hand showers and popup wastes shall also be provided wherever, specified.

Wall flanges shall be kept clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

5A418.3.12 Flow Control Device

Approved / rated flow control fitment in brass body, chrome outer cover, rated for flow / discharge of the fixture.

5A418.3.13 Toilet Paper Holder

a. Toilet paper holder shall be stainless Steel.

b. stainless Steel toilet paper holder shall be fixed by means of screws/capping having finish similar to the toilet paper holder in wall/temper partitions with rawl plugs or nylon sleeves.

c. Towel Rail

d. Towel rail shall be of stainless steel

e. Towel rail shall be fixed with screws/ capping having finish similar to the towel rail in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required.

5A418.3.14 Janitor's Sink

a. Janitor's sink shall be stainless steel, single bowl type of required size, provided with painted CI brackets and clips and securely fixed. Each sink shall be provided with 40 mm die CP waste. Fixing shall be as directed by the Engineer.

b. The supply fittings for Janitor's sink shall be wall mounted type.

5A418.3.15 Liquid Soap Dispenser

a. Liquid Soap Dispenser shall be wall/counter mounted suitable for dispensing liquid soaps, lotions, detergents. The cover shall lock to body with concealed locking arrangement, opened only by key provided.

b. Liquid soap dispenser body and shank shall be of high impact resistance material. The piston and spout shall be stainless steel with 1 litre capacity polyethylene container.

5A418.3.16 Toilets for the disabled

a. Where specified, in washroom facilities designed to accommodate physically disabled, accessories shall be provided as directed by the Engineer.

b. Stainless steel garb brass of required size suitable for concealed or exposed mounting and opened non-slip gripping surface shall be provided in all washroom. The flushing cistern shall be provided with chromium plated long handles.

5A418.3.17 Mock-up and trial assembly

a. The installation of the sanitary fixtures and fittings shall be as per the shop drawings approved by the Engineer.

b. The Contractor shall have to assemble at least one set of each type of sanitary fixtures and fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc. which will be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Engineer.

c. The fixtures in the mock-up / trial assembly can be re-used for final installation

without any additional payments for fixing or dismantling of the fixtures.

5A418.3.18 Supporting and fixing devices

The Contractor shall provide all the necessary supporting and fixing devices to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly appearance in the final assembly. Nut Bolts and screw, where the location demands, the Engineer may instruct the Contractor to provide chromium plate door other similarly finished fixing devices. In such circumstances, the Contractor shall arrange to supply the fixing devices and shall be installed complete with appropriate vibration isolating pads, washers and gaskets.

5A418.3.19 Final installation

a. The Contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on approved shop drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All union sand flanges shall match in appearance with other exposed fittings.

b. Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Over flows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

5A418.3.20 Protection against damage

a. The Contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the time of handing over, the Contractor shall clean, disinfect and polish all the fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

b. Cost for all items under specifications shall be inclusive of cutting holes and chases and making good the same, CP screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning and making good to the satisfaction of the Engineer.

5A418.3.21 Testing and acceptance

a. All appliances, fixtures and fittings shall be tested be for and after installation. Water seals of all appliances shall be tested. The Contractor shall block the ends of waste and ventilation pipes and shall conduct an air test.

b. Eachfixtureshallbeinspectedforscratchesorchippingsandalignmentbeforeacceptance.

c. All tests shall be conducted at each and every fixture which shall be at the lowest and highesttestconnectionstobemadeoneachriser/downtake.TheContractorshallmakethe temporary valve connections which shall be plugged with a brass plug after validation.

5A419 WATER SUPPLY (COLD AND HOT)

5A419.1 Scope

5A419.1.1 The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal services as follows:

a. Plant room piping.

b. Potable Water Supply

c. Flushing/Irrigation Water Supply

d. RO water supply

5A419.1.2 The Contractor shall make all necessary application and arrangements for their work to be inspected as required by the Local Authorities.

5A419.1.3 The Contractor shall be solely responsible for obtaining the authority approvals, as required for their works prior to the handing over of the complete water supply / distribution installation. All fees related to statutory approval shall be borne by the Contractor.

5A419.1.4 Hot water supply shall be made available in kitchen, toilet and other designated area through heat pump with centralized hot water system.

5A419.2 Piping Materials

5A419.2.1 Piping system shall consist of the following:

5A419.2.2 CPVC for flushing and GI for irrigation water supply in plant room, sump risers and Basement vertical drain pipes

5A419.2.3 CPVC pipes SDR-11 concealed in wall / floor, shaft schedule 40 above 50mm diameter and terrace schedule 40 with insulation etc. after proper chases for Domestic(Cold) and flushing water supply.

5A419.2.4 Copper for complete hot water supply and return system with insulation, SS 316L EN-10312 for Central RO water supply in all building, riser, down comer, external with insulation, in pump room etc., either exposed, concealed or buried directly in ground.

5A419.3 CPVC Pipes and Fittings

5A419.3.1 The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot and cold water supply piping system with pipes as per CTs SDR -11. Working pressure of 320 PSI at 23 deg. C and 80 PSI at 82 deg. C. Joints shall be using solvent welded CPVC fittings i.e. Tees, Elbows, Couples, Unions, Reducers, Brushing etc. including transition fittings (connection between CPVC and Metal pipes / GI) i.e. Brass adapters (both Male and Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-493. Clamps / structural metal supports shall be installed as required /directed at site including cutting chases and fitting the same with cement concrete / cement mortar

as required,

Including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction, and in accordance with, manufacturer requirements/recommendations.

Table 7C422.3.1-1: CPVC Pipe Details

Outside Diameters and Wall Thickness for CPVC 4120, SDR 11 Plastic Pipe									
Nominal Size		Outside Diameter, in. (mm)		Wall Thickness, in. (mm)		Pressure Rating. PSI (Kg/Cm2)			
(in.)	(mm)	Average	Tolerance	Minimum	Tolerance	73.4°F	(23°C)	180° F	82°C
½	(15)	0.625 (15.9)	±0.003 (±0.08)	0.068(1.73)	+0.020 (+0.51)	400	(28.1)	100	(7.0)
¾	(20)	0.875 (22.2)	±0.003 (±0.08)	0.080(2.03)	+0.020 (+0.51)	400	(28.1)	100	(7.0)
1	(25)	1.125 (28.6)	±0.003 (±0.08)	0.102(2.59)	+0.020 (+0.51)	400	(28.1)	100	(7.0)
1 ¼	(32)	1.375 (34.9)	±0.003 (±0.08)	0.125(3.18)	+0.020 (+0.51)	400	(28.1)	100	(7.0)
1 ½	(40)	1.625 (41.3)	±0.004 (±0.10)	0.148(3.76)	+0.020 (+0.51)	400	(28.1)	100	(7.0)
2	(50)	2.125 (54.0)	±0.004 (±0.10)	0.193(4.90)	+0.023 (+0.58)	400	(28.1)	100	(7.0)

Outside Diameters and Wall Thickness for CPVC SCHEDULE 40 (AS PER ASTM F 441)								
Part No.	Nom (in.)	Size (mm)	Average OD (inch)	Average OD (mm)	Min. Wall Thick	Min. Wall Thick	Max. work Pre. At 27°C PSI	Max. w Pre work At. 27°C (kg/cm2)
FP40-212	2 ½”	65	2.875	73.02	0.203	5.16	300	21.09
FP40-003	3”	80	3.500	88.90	0.216	5.49	260	18.28
FP40-004	4”	100	4.500	114.30	0.237	6.02	220	15.47
FP40-006	6”	150	6.625	168.28	0.280	7.11	180	12.66

The outside diameters and wall thickness for CPVC schedule 40 shall be as per ASTM F441- Joining Pipes and Fittings.

5A419.3.2 Cutting:

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

5A419.3.3 Deburring / Beveling:

Burrsandfittingsshouldberemovedfromtheoutsideandinsideofpipewithapocketknifeo r file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.

5A419.3.4 Fitting preparation:

Cleandryrag/clothshouldbeusedtowipedirtandmoisturefromthefittingsocketsandtubi ng end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

5A419.3.5 Solvent Cement Application:

Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and at in coat inside the fitting socket, otherwise too much of cement solvent can cause clogged waterways.

5A419.3.6 Assembly:

After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to setup.

An even bead of cement should be evident around the joint and if this bead is not continuing remake the joint to avoid potential leaks.

5A419.3.7 Set and Cure times:

Solventcementsetandcuretimesshallbestrictlyadheredtoasperthebelowmentionedtabl

e. Minimum Cure prior to pressure testing at 150 PSI

Table 7C422.3.7.2-1 : Solvent Cement Cure Time

Ambient Temperature during Cure period	Pipe Size	
	½ " - 1"	1.¼" - 2"
Above 15 deg. C	1 hr.	2 hrs.
4-15 deg.C	2 hrs.	4 hrs.
Below 4 deg C	4 hrs.	8 hrs.

Special care shall be exercised when assembling CPVC pipe systems in extremely low temperature (below 4°C) or extremely high temperature (above 45°C) In extremely hot temperatures, make sure that both surfaces to be joined are still wet with cement solvent when putting them together.

5A419.3.8 Testing

Once an installation is completed and cured as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi (10

Bar) for one hour. During pressure testing, the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using couplers.

5A419.3.9 Transition of CPVC to Metals

When making a transition connection to metal threads, special Brass / plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque Hard tight puts one half turn should be adequate.

5A419.3.10 Threaded Sealants

Teflon tape shall be used to make threaded connections leak

5A419.3.11 proof. Solvent Cement

Only CPVC solvent cement conforming to ASTMF 493 should be used for joining pipe with fittings and valves. CPVC cement solvent shall have a minimum shelf life of 1 year. Aged cement solvent will often change color or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company's seal and tightly close the seal after using in order to avoid its freezing. The freeze cement solvent should be discarded immediately and fresh one should be used. The CPVC solvent cement usage should be adhered to as given in table below:

Table 7c422.3.11.1-1: No Of Joints From Cement

Diameter of pipe in inch	½"	¾"	1"	¼"	1½"	2"
Approx. nos. of joints which can be made per litre of solvent cement.	200 No	180 No	150 No	130 No	100 No	70 No

5A419.3.12 Hangers and supports

e. For Horizontal runs, support should be given at 3 feet intervals for diameters of one inch and below and at 4 feet intervals for larger sizes.

f. Hangers should not have rough or sharp edges which come in contact with the tubing.

Supports should be as per the below mentioned table:
TABLE 7C422.3.12.2-1: HANGER SUPPORT DISTANCE

Size of Pipe	21°C	49°C
Inch	Ft.	Ft.
½"	5.5	4.5
¾"	5.5	5.0
1"	6.0	5.5
1¼"	6.5	6.0
1½"	7.0	6.0
2"	7.0	6.5
SCHEDULE – 40 Recommended support spacing(n feet)		

Nom. Pipe Size		Temperature 0C		
(In)	(mm)	23	38	49
2 ½	65	7 ½	7	7
3	80	8	7	7
4	100	8 ½	7 ½	7 ½
6	150	9 ½	8	8

5A419.4 Galvanized Iron Pipes and Fittings

5A419.4.1 The pipes shall be galvanized mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of BIS: 1239.

5A419.4.2 The pipes under this standard are designated by their nominal bore and are further classified as Light, Medium and heavy depending upon their wall thickness and shall be used as per required suitable pressure. Sockets of these pipes are designated by respective nominal bore of the pipe.

5A419.4.3 Joints: The threads of all screwed and socket pipes shall conform to BIS-554. The minimum length of thread in 'heavy grade' pipe shall be 80 percent of specified in BIS-554. Each tube shall be supplied with one socket.

5A419.4.4 Length: The tubes shall be supplied in random lengths of 3 to 6 m.

5A419.4.5 Galvanizing: When tubes are required to be galvanized, the Zinc coating shall conform to BIS 4736. (Hot dip zinc coatings on steel tubes).

5A419.4.6 Manufacturing Process: Tubes are made from tested quality of steel manufactured by any approved process Electric Resistance Welded (ERW),

5A419.4.7 The hot dip zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the pipe.

5A419.4.8 The fittings shall be malleable iron and comply with all the requirements of the pipes.

5A419.4.9 Hydraulic test: Each pipe shall be hydraulically tested at manufacturer's work to withstand a test Pressure of 5 M pa.

5A419.4.10 Marking: The different classes of pipes shall have 75 mm color bands when arrived on site.

5A419.4.11 The following color bands shall be provided.

Light	----------	Yellow
Medium	----------	Blue
Heavy	----------	Red

5A419.4.12 The fittings shall be malleable iron screwed fittings and shall conform to BIS: 1879.

5A419.4.13 The fittings are classified as Light, Medium and Heavy. The sizes of pipes and fitting are specified in the drawings.

5A419.4.14 The Contractor shall design to lay down the pipes in various types of wall and slabs

constructed by various methods (RCC/Precast/Aluminum form profile/Aeriated Automotive Concrete)

5A419.4.15 Hydraulic Test: Each tube shall be hydraulically tested at manufacturer's works to withstand a test pressure of 5 Mpa

The Dimensions and Nominal Weight of Black Steel Tubes (HEAVY) shall be as per BIS: 1239.

Table 7c422.4.15-1: Permissible Working Pressure of M S Tube

12	Working Pressure					
	Light		Medium		Heavy	
	Ibs/sq.in	Kg.cm2	Ibs/sq.in	Kg.cm2	Lbs/sq.in	Kg.cm2
15	150	10.55	300	21.09	350	24.61
20	150	10.55	300	21.09	350	24.61
25	150	10.55	300	21.09	350	24.61
32	125	8.80	250	17.58	300	21.09
40	125	8.80	250	17.58	300	21.09
50	100	7.03	200	14.06	250	17.58
65	100	7.03	200	14.06	250	17.58
80	100	7.03	200	14.06	250	17.58
100	100	7.03	171	12.02	228	16.03
125	-	-	171	12.02	213	14.79
150	-	-	142	9.98	171	12.02

Pipe Flanges

PipeFlangesshallconformtoBritishStandards10(Specification for flange sand bolting for pipes, valves and fittings). The following table gives specification of Pipe Flanges and Sleeves.

Table 7c422.4.15-2: M S Pipe Sleeve and Flange Details

S. No	M S Sleeve			M. S. Flange		Bolting			M.S. Puddle	
	Sleeve Nos	N.B. Of Pipe	Thickness Of Pipe	Diameter	Thickness	PCD	Dia of Bolt	No. of Bolt	Size	Thickness
			mm	mm	mm	mm			mm	mm
1	S1	15 DIA	3.25	100	10	70	15	4	50 x 50	6
2	S2	20 DIA	3.25	100	10	75	15	4	50 x 50	6
3	S3	25 DIA	4.05	120	10	90	15	4	50 x 50	6
4	S4	32 DIA	4.05	135	10	100	15	4	100 x 100	6
5	S5	40 DIA	4.05	140	15	125	15	4	100 x 100	6
6	S6	50 DIA	4.05	165	15	105	15	4	150 x 150	6
7	S7	65 DIA	4.05	185	15	150	15	8	150 x 150	6
8	S8	80 DIA	4.85	200	15	165	15	8	200 x 200	6
9	S9	100 DIA	5.4	225	20	200	15	8	200 x 200	6
10	S10	150 DIA	5.4	300	25	260	20	12	300 x 300	6
11	S11	200 DIA	6.0	370	25	325	20	12	350 x 350	6

5A419.5 Laying and Jointing of GI Pipes

5A419.5.1 The galvanized pipes and fittings shall run in shafts or ceiling or as specified for the precast or aluminum formwork methodology buildings. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 cm clear of the wall to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Engineer, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipes shall be laid in layer of sand filling and for additional protection wrapping with suitable sheet.

5A419.5.3 Galvanized iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion. The pipes shall be made from Steel plates or strips by butt welding longitudinally or spirally. The pipes shall be butt welded by employing any of the methods such as a) Electric Resistance Welding and b) Electric Fusion Arc welding.

5A419.5.4 The Joints shall be a) Plain or be velled ends for field butt welding and b) Joints with sleeve joints or swelled and plain ends for welding.

5A419.6 Piping Installation Support (Valid for GI Piping Only)

5A419.6.1 Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

5A419.6.2 Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

5A419.6.3 Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanized steel sections.

5A419.6.4 Pipe hangers shall be provided at the following maximum spacing:

Table 7C422.6.4-1: Pipe Hangers Support Distance

Pipe Dia. (mm)	Hanger Rod Dia. (mm)	Spacing between Supports (m)
Up to 25	6	2
32 to 50	8	2.7
65	10	2.7
80 to 100	10	2.7
125 to 150	10	3.6

5A419.6.5 Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14-gauge metal sheets shall be provided between the insulation and the clamp, saddle or roller, extending at least 15 cm. on both sides of the clamps, saddles or roller.

5A419.6.6 All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies' work, so that area can be carried out in one stretch.

5A419.6.7 Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

5A419.6.8 The Contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified. The piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

5A419.6.9 All pipes shall be accurately cut by the pipe cutting machine to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

5A419.6.10 All buried pipes for cold water supply shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400micron polythene sheet coating.

5A419.6.11 Automatic air release valves shall be provided at all high points in the piping system for venting. All valves shall be of 15 mm pipe size and shall be associated with an equal size isolation ball valve.

5A419.6.12 Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

5A419.6.13 Pressure gauges shall be provided as required and shall be reflected in the shop drawing. Care shall be taken to protect pressure gauges during pressure testing.

5A419.6.14 Air release valve shall be installed as required and shall be reflected in the shop

5A419.6.15 drawing. Table for Commonly Adopted Size of Air Valves

Table 7C422.6.15-1: Air Release Valve Size

Size of Main mm	Type of Valve	Size of Air Valve mm
80	Single air valve	20
100	Double air valve	40

5A419.6.16 These valves shall be closed by water pressure, automatically open when the pressure is reduced to slightly below atmosphere, allowing large amount of air to enter the pipe thus effectively preventing the creation of vacuum.

5A419.6.17 Non-Return: These are manufactured in three types. (a)Swing check type cast iron valves for general duty conditions, (b) Gunmetal non-return (check) valves and (c) Cast steel valves for severe duty conditions.

5A419.6.18 (a) Swing check-type Valves (Cast Iron) single door pattern, conforming to BIS:5312 (Part I) and for

(b) Swing Check Valves, cast carbon steel conforming to BIS: 1868 or ASA Standard are added below for ready reference.

(c) Swing Check-Type Valves (Cast Iron): (Non-return valves) Single Door Pattern BIS: 5312 (Part I)

5A419.6.19 General: The body, door, cover and hinge shall be of cast iron to BIS: 1210 Gr 20. Body ring, door faces, bearing bushes are of gun metal, hinge pins, door pins and door suspension pins shall be of high tensile brass or chromium steel (minimum 12 % chrome) and air release plugs galvanized cast iron. Reflux valves shall be designated by nominal pressure (PN) defined as maximum permissible gauge pressure.

5A419.6.20 Note: By pass valves upto 40 mm size shall be of gun metal to BIS: 778 and sizes above 40 mm shall be cast iron to BIS :780, flanges faced and drilled to BIS: 780, flanges faced and drilled to BIS :1538, unless specified otherwise.

5A419.6.21 Gun Metal Non-Return (Check) Valves

For use in mild steel pipes, gun metal non-return valves are available in two designs, Lift type and Swing type. Swing type check valves are for application in horizontal or vertical upward flow whereas vertical life check valves are used in vertical upward flow. Gun metal vertical check valves, manufactured to BIS:778 are tested hydraulically to 20kg/cm2 for body and 17.5 kg/cm2 for seat.

5A419.6.22 Pressure Relief Valves:

a. Pipelinesshallbeprovidedtowithstandthemaximumpressurelikelytodevelopinitunder normal working conditions, maintaining a certain factor of safety. Due to quick closure of valve, sudden stoppage of pump etc. the surge wave created shall be taken care of by providing pressure relief valves.

b. Pressure relief valve shall be concussion relief valve which is a spring loaded valve with single beat ring angled valve, body made of finest cast iron, seat and spindle of gun metal and spring of best quality steel. These valves shall be set for the maximum pressure that could be allowed to develop within the pipe line. When the pressure inside the pipe line exceeds the pre-set value the spring works the valve shall open and allows the water to flow through an out let opening provided on the valve and thus releases the excessive pressure. When the pressure is reduced, the

valve moves back in its closed position and the flow through the pipe is restored to its normal condition.

c. Construction Details: These valves are available in sizes ½" (15 mm) to 3" (80 mm) in angle type enclosed discharge or straight type open discharge. The maximum set pressure for which these valves shall be supplied is 150 PSI (10.54kg/cm2).

d. Theseshallbewithscrewedorflangedends.Screwedvalvesarethreadedmaleatinletand female at outlet. Valves for flanged construction are as per BS-10, table H.

e. When relief valves are installed on pipelines, the valve should be one size smaller than the pipe line. All valves should be installed with their spindle in vertical up right position.

5A419.6.23 Pressure Gauges and Recorders:

Pressure gauges shall be installed on the main and also in distribution system, pressure gauges with recorder are fixed. The service pressure to the instrument shall be selected between 40 to 60 per cent only, for more accurate performance of the instrument.

5A419.7 COPPER PIPES AND FITTINGS FOR PLUMBING: FOR HOT WATER SUPPLY AND RETURN LINE.

Copper tubes conforming to EN:1057 in ft. length and thickness as per Table 'X'. Dimension shall be strictly as per EN:1057 & Chemical Composition of copper pipes to be as follows:

Copper% - 99.9%

Phosphorus% -0.015% to0.040%

Forsizes15mm and above, hard drawn tubes will be used. The tubes shall be totally cylindrical and of uniform thickness free from flaw, pinholes, cracks and other skin defects. The maximum working and burst pressure of tubes shall be as EN:1057. All tubes shall be eddy current tested to ensure the tubes are free from any internal blow holes / flaw or eccentricity. Tubes from manufacturers who do not have eddy current testing facility shall not be accepted. The buyer / user reserves the right to inspect the facility of the manufacturer to ensure that eddy current testing facility is prevalent and being done. Carbon film or Carbon content test must be conducted on Copper Tubes as per EN:1057.

The sizes and dimensions for Table "X" are as follows:

TABLE 'X'

Tube Size	Outer Diameters		Thickness	Inner dia	Calculated Burst pressure		Maximum Working Pressure	
	Max.	Min.						
(mm)	(mm)	(mm)	(mm)	(mm)	(bar)	(PSI)	(bar)	(PSI)

15	15.045	14.965	0.7	13.6	240	3480	58	841
22	22.055	21.975	0.9	20.2	215	3117.5	51	739.5
28	28.055	27.975	0.9	26.2	165	2392.5	40	580
35	35.07	34.99	1.2	32.6	175	2537.5	42	609
42	42.07	41.99	1.2	39.6	145	2102.5	35	507.5
54	54.07	53.99	1.2	51.6	110	1595	27	391.5
67	66.75	66.60	1.2	64.6	105	1522.5	20	290
76.1	76.30	76.15	1.5	73.1	100	1450	24	348
108	108.25	108.00	1.5	105	70	1015	17	246.5
133	133.50	133.25	1.5	130			14	203
159	159.50	159.25	2.0	155			15	217.5

SinceTubesizeof89mm is not manufacture standard product, the sizes and dimensions for the same are Vendor based only. Hence this size of tube / pipe will be used only after the approval of the technical data of the vendor by the consultant / project manager.

The fittings shall confirm to BS 864 Part 2 and shall be as follows:

a. Internal Solder Ring (ISR) fitting: For pipes from 15 mm to 35 mm dia.

b. Index Fittings: For pipes from 42 mm to 54 mm dia.

c. End braze Fittings: For pipes from 67 mm dia and above.

Fabricated fittings in No case shall be allowed. Fittings of all types such as Tees, Crosses, Elbows, Reducers, Unions, Off Sets etc. shall be used on the pipes. Suitable fittings of approved type and make shall be used for jointing copper pipes to GI pipes and for jointing copper pipes to CP fittings etc. Use of DZR fitting shall be made for all connections.

5A419.7.1 LAYING AND JOINTING OF COPPER PIPES AND CAPILLARY FITTINGS FOR HOT WATER SUPPLY AND RETURN LINE.

The copper pipes and fittings shall run in wall chase or ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5cm clearof the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts, etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative / Architect, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in wall or floor sit shall be covered protective tape round the pipes and fittings.

Copper pipes shall be jointed with approved above mentioned fitting conforming to BS 864 Part

2. Care shall be taken to remove any burr from the end of the pipes after cutting. Only fittings of the size suitable to the pipe shall be used. The end of the tube shall be cut to the correct size using a tube cutter or a fine blade hacksaw. Care shall be taken to ensure that the ends of the tube are cut perpendicular to the axis of the tube and that the ends remain undamaged and free of burrs. Any burrs remaining shall be removed with as moth file. Clean the outside surface of the tube that shall going to the fitting. Flux shall be applied on the pipe surface ensuring even and uniform application. Insert the tube into the fittings and push home until the stop is reached. Wipe off excess flux with a soft cloth. Now the assembled joint shall be heated with a blow to chorine similar appliance that emits clean, blue, soot free flame. The heat shall be turned off once a complete ring of solder has appeared around the mouth of the fitting.

For Solder ring fittings (ISR) , the solder must be soft solder and lead free with melting temp. of 230 deg. C (approx..). Enough amount of solder shall be provided in the neck of the fitting itself to ensure proper capillary action. The solder must be capable of melting with an ordinary blow lamp and shall form the complete leak proof joint to cover the annular space in between the tube and fitting from socket of fitting to outside of the fitting. Solder must confirm to BS 219/ BS EN 29453 specification.

Endexorendfeedfittingsdonotcontainintegralsolderi.esolderwirehastobeprovidedfrom outside.

Solder to be used with the settings must be soft solder capable of melting at approx.230deg.C and must confirm to BS 219/EN BS 29453.Copper tin or silver tin solder is acceptable only.

End braze fittings require brazing rod to be used for making the jointing. The brazing temperature is in the range of 700 deg.C.The brazing material shall confirm to BS 1723.

Thejointshallbeallowedtocoolwithoutdisturbance.Anyexcessfluxorresiduesshallbewiped off after the joint is called.

All copper pipes to G.I. pipe and connection with the valves and faucets shall be with De-zincified Resistance fittings (DZR).

INSULATION OF HOT WATER PIPE-
Nitrile Rubber Insulation Material

Thermal insulation material for hot water Pipe insulation shall be factory fitted woven glass cloth(GC)coating for mechanical and UV protection closed cell Elastomeric non Polar-Anti Microbial-UV resistant – UL94 – Class O and Nitrosamine free, Nitrile Rubber of Thermal conductivity as per BS 874 part 2 – 86 (DIN 52613 52612) of the insulation material shall not exceed 0.038 W/moK or 0.212 BTU / (Hr-ft2-oF/inch) at an average temperature of 30oC. Density of the nitrile rubber shall be 40-60 Kg/m3. The product shall have a temperature range of –40 oC to 105oC. The insulation material shall be fire rated for Class 0 as per BS 476 Part 6 : 1989 for fire propagation test and for Class 1 as per BS 476 Part 7, 1987 for surface spread of flame test. Water vapor permeability shall be not less than 0.024 per inch (2.48 x 10-14 Kg/m.s.Pa i.e. μ>7000: Water vapor diffusion resistance) as per DIN 53122 part 2, DIN 52615. The insulation shall be with self-adhesive for ducting and piping.

Product shall be FM Global approved.

The thickness of the insulation shall be as specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer's test certificate for thermal conductivity values, density, water vapor permeability and fire properties. Samples of insulation material from each lot delivered at site may be selected by Owner's site representative and gotten tested for thermal conductivity and density at Contractor's cost. Adhesive used for sealing the insulation shall be non-flammable, vapor proof adhesive strictly as per manufacturer's recommendations.

Pipe insulation thickness shall be as per table below: -

Ducting position	Thickness for non-coastal places
Pipe up to 100mm	Minimum 13mm
Pipe abive 100mm	Minimum 19mm

HOT WATER MIXING TANK FOR HEAT PUMPS AND SOLAR PANEL –

SS-316L. Vertical hot water storage tank suitable for operating pressure as per the system requirement. And a test pressure of 1.5 times of working pressure at 80 Dec C. Tank shall be provided with flow meter at inlet (approved by department of weights & measures), Inlet/outlet, overflow/drain connection with M.H. cover (550 mm I.D.), fabricated out of SS 316L plate & dished end of suitable plate shall complete temperature and pressure relief valves, thermometers & pressure gauge at inlet/outlet. Tank shall be mounted on 450 mm high steel structural supports with access ladder or as per site requirement & painted with 2 coats of red oxide paint. Tank shall be insulated with 50 mm thick resin bonded rock wool (density 48 Kg/cum) or 50mm thick fiberglass insulation (density 24 Kg/cum). Insulation shall be covered with 500 g polythene sheet & 24 gauge aluminium sheet cladding giving proper overlaps & sealing the joints with suitable adhesive compound. including 15 mm dia testing spout with valve. (Inlet temperature to hot water storage tank 75-80 degree C). (Tank shall be fabricated as per unfired pressure vessel code IS 2825 - 1969, IS 226/IS 2062). Inlet and hot water outlet piping shall be done in such a way as to prevent stratification of water within the tank including valve, check valve & accessories.

Solar Water Heating

Introduction

Water heating accounts for a substantial portion ofenergy use at many residential, commercial, institutional, and federal facilities. Nationwide, approximately 18% of energy use in residential buildings and 4% in commercial buildings is for water heating. Solar water heating systems, which uses the sun's energy rather than electricity or gas to heat water, can

efficiently provide up to 80% of the hotwater needs—without fuel cost or pollution and with minimal operation and maintenance expense. Solar currently represents 1% of the water heating market (about 3% of buildings have solar and it provides about 1/3 of the energy for each). In 2003 11.4 million sq. ft. of collector area were delivered by 27 manufacturers. Most of these were unglazed collectors for swimming pools, a very cost-effective application.

Solar water heating systems can be used effectively throughout the United States at residences and facilities that have an appropriate near-south-facing roof or nearby unshaded grounds for installation of a collector. They are most cost-effective for facilities with the following characteristics:

- Water heating load that is constant throughout the year (not vacant in summer);
- Water heating load is constant throughout the week (to utilize solar heat every day);
- Cost of fuel used to heat water is high (more than $10/Mm btu or 40.034/kWh), such as electricity, which represents 46% of the water heating market, or propane which represents 2% of the market in remote locations; and/or

- A sunny climate helps but is not required. In 2003 the three largest markets were Florida, California, and New Jersey. Examples include swimming pools, residences, hotels, laundries, prisons, and kitchens.

Description

Solar water heating is a reliable and renewable energy technology used to heat water. Sunlight strikes and heats an "absorber" surface within a "solar collector" or an actual storage tank. Either a heat-transfer fluid or the actual potable water to be used flows through tubes attached to the absorber and picks up the heat from it. (Systems with a separate heat-transfer-fluid loop include a heat exchanger that then heats the potable water.) The heated water is stored in a separate preheat tank or a conventional water heater tank until needed. If additional heat is needed, itis provided by electricity or fossil-fuel.

energy by the conventional water-heating system.

Although solar water heating systems all use the same basic method for capturing and transferring solar energy, they do so with three specific technologies that distinguish different collectors and systems. The distinctions are important because different water heating needs in various locations are best served by certain types of collectors and systems.

Materials and components used in solar water heating systems vary depending on the expected operating temperature range.

Small sample of unglazed low temperature solar collector showing flow passages and header pipe. Low-temperature systems (unglazed) operate at up to18 F° (10 C°) above ambient temperature, and are most often used for heating swimming pools. Often, the pool water is colder than the air, and insulating the collector would be counter-productive. Low-temperature collectors are extruded from polypropylene or other polymers with UV stabilizers. Flow passages for the pool water are molded directly into the absorber plate, and pool water is circulated through the collectors with the pool filter circulation pump.
Swimming pool heaters cost from $10 to $40/ft² [2004]. Mid-temperature systems produce water 18 to 129 F° (10 to 50 C°) above outside temperature, and are most often used for heating domestic hot water (DHW). However, it is also possible to use mid-temperature solar hot water collectors for space heating in conjunction with fan-forced convection or radiant floors.

Mid-temperature collectors are usually flat plates insulated by a low-iron cover glass and fiberglass or polyisocyanurate insulation. Reflection and absorption of sunlight in the cover

glass reduces the efficiency at low temperature differences, but the glass is required to retain heat at higher temperatures. A copper absorber plate with copper tubes welded to the fins is used. In order to reduce radiant losses from the collector, the absorber plate is often treated with a black nickel selective surface, which has a high absorptivity in the short-wave solar spectrum, but a low-emissivity in the long-wave thermal spectrum. Mid-temperature systems range in cost from $90 to $120/ft² [2004] of collector area. Small sample of mid-temperature flat plate collector showing cover glass, insulation, and copper absorber plate and flow passages.

High-temperature systems utilize evacuated tubes around the receiver tube to provide high levels of insulation and often use focusing curved mirrors to concentrate sunlight. High temperature systems are required for absorption cooling or electricity generation, but are used for mid-temperature applications such as commercial or institutional water heating as well. Due to the tracking mechanism required to keep the focusing mirrors facing the sun, high-temperature systems are usually very large and mounted on the ground adjacent to a facility. Evacuated tube collectors themselves cost about $75/ft², but use of curved mirrors and economies of scale get this cost down for large system sizes to a relatively low cost of $40-70/ft² [2004].

A. Components of a Solar Water Heating System Fig. 3. Close-up view of an evacuated glass tube with black copper absorber plate inside.

Solar Collectors—Solar collector efficiency is plotted as a straight line against the parameter (Tc-Ta)/I, where Tc is the collector inlet temperature (C), Ta is the ambient air temperature (C), and I is the intensity of the solar radiation (W/m²). Notice that inexpensive, unglazed collectors are very efficient at low ambient temperatures, but efficiency drops off very quickly as temperature increases. They offer the best performance for low temperature applications, but glazed collectors are required to efficiently achieve higher temperatures.

In addition to solar collectors, all solar hot water systems have thermal storage, system controls, and a conventional back-up system.
Thermal storage—Storage is generally required to couple the timing of the intermittent solar resource with the timing of the hot water load. In general, 1 to 2 gallons of storage water per square foot of collector area is adequate. Storage can either be potable water or non-potable water if a load side heat exchanger is used. For small systems, storage is most often in the form of glass-lined steel tanks.

Controls—Active systems have a "delta T" (temperature difference) controller to start and stop the pumps. If the temperature in the solar collector outlet exceeds the temperature in the bottom of the storage tank by a set amount (say6 C°), the controller starts the pump.

When this temperature difference falls below another set value, say 2 C°, the controller stops the pumps. The controller will also have a high-limit function to turn off the pumps if the temperature in the storage tank exceeds a third setting, say, 90 C°. Due to the simplicity and low cost of a delta T controller, it is wise to keep controls independent of any whole-plant energy management system, although it is desirable to include some indication of system performance, such as output from a Btu meter or preheat tank temperature in the building control system.

Conventional Back-Up Heater—Solar water heaters save energy by preheating water to the conventional heater. Solar DHW systems are usually designed to meet 40% to 70% of the water-heating load. A back-up, conventional heater is still needed to meet 100% of the peak hot water demand for cloudy days or for when the solar system is down for service.

B. Types of Solar Water Heating Systems
Solar water heating system types are classified as follows:
• Active—requires electric power to activate pumps and/or controls.

• Passive—relies on buoyancy (natural convection) rather than electric power to circulate the water. Thermosiphon systems locate a storage tank above the solar collector, while integrated-collector-storage collectors place the storage inside the collector.

• Direct—heats potable water directly in the collector.

• Indirect—heats propylene glycol or other heat transfer fluid in the collector and transfers heat to potable water via a heat exchanger.

C. Design of a Solar Water Heating System

Solar water heating systems should be designed to minimize life-cycle cost. It is never cost-effective to design a system to provide 100% of the load with solar because of the excessive investment in collector area and storage volume. Minimize life-cycle cost by designing a system that meets 100% of the load on the sunniest day of the year. Such a system will usually produce about 70% of the annual load. Other design considerations include maintenance, freeze protection, overheating protection, aesthetics of the collector mount, and orientation. Also, utility rebate programs may impose additional design requirements. For example, a solar water heating system must meet 90% of the load in order to qualify for Hawaiian Electric Company rebates.

Steps in designing a solar water heating system include:

1. Properly locate the solar collectors—The best annual energy delivery is achieved by facing toward the equator with a tilt up from the horizontal equal to the local latitude. Recent studies show that adequate performance may be obtained with tilt angles and orientations that vary from this considerably. In the continental United States, for maximum performance, collectors should be rotated within 30° of true (not magnetic) south. Also, optimize the tilt of the collecting array.

Surfaces tilted up from the horizontal at an angle of latitude minus 15° maximize summer solar gains, but reduce winter gains. Surfaces tilted up at latitude plus 15° maximize winter solar gains, and result in a solar delivery that is uniform throughout the year. A tilt angle equal to the local latitude maximizes year-round solar gains and is usually appropriate for solar water heating. It is usually acceptable to mount the collectors flush on a pitched roof close to the optimal orientation as possible in order to reduce installed cost and improve aesthetics. Resource maps and tables of solar resource information throughout the U.S. are posted at the Solar Radiation Resource Information Center.

2. Protect against freezing—Damage can be caused if water freezes in the collector flow passages or connecting piping. There are several strategies for prevention of freeze damage. The most common is to circulate a solution of propylene glycol (never use toxic ethylene glycol) and water in the collector loop of an indirect system. Another strategy is to drain the water from the collector back into a small drain-back tank. This drain-back configuration has the added advantage of protecting the system from excessive temperatures if hot water consumption is reduced due to seasonal use patterns, remodeling, or vacations. Where freezing is uncommon, a controller function that simply circulates water in the collector loop when temperatures approach freezing in conjunction with freeze protection values may be adequate.

3. Provide a tempering valve and bypass capability—The tempering valve is very important to assure consistent temperature water is delivered at the taps. Bypass piping and valves allow the conventional system to provide hot water if the solar heating system is down for any reason.

4. Provide periodic maintenance for all systems—Check for obvious damage such as broken

collector glazing or wet pipe insulation. Check pH and freeze point of heat transfer fluid. Check control temperature sensors against thermometers to be sure sensors are functioning. Check proper pump operation, etc. For a simple comprehensive test, check the preheat tank temperature—it should be hot after a sunny day. See Building Commissioning and Reliability-Centered Maintenance (RCM).

PLATE HEAT EXCHANGER (AHRI Certified)

Scope

1.1.1 This specification covers the requirements for design, materials, fabrication and testing of Plate Heat Exchangers.

1.2 Definitions

1.2.1 Plate Heat Exchanger - Is a pressure vessel consisting of a set of gasket heat transfer plates supported in a frame capable of easy opening and closing.

1.2.2 Plate Pack - Is the assembly of plates, which form the hot and cold fluid channels.

1.2.3 Gaskets - Contain the process fluids between the plates and direct the fluids into their respective flow channels.

1.2.4 Fixed Plate - Is the stationary end of the exchanger. Customer connection ports should be located on this cover.

1.2.5 Pressure Plate - Is the movable end of the exchanger. This head can be moved away from the plate pack, thus permitting access to the plates for inspection or cleaning.

1.2.6 Ports - Customer connections, which should be studied.

1.2.7 Carrier Bar - Is the top bar from which plates are hung. The carrier bar is supported by the fixed plate, and the pressure plate or end support. Plate sliding surface should be lined with SS-316 strip.

1.2.8 Guide Bar - Is the bottom guide for the plates and movable head. It is attached to the fixed plate, and the pressure plate or end support.

1.2.9 Tie Bolts & Nuts - Hold the plate assembly together between the fixed and movable heads.

1.2.10 End Support - Supports the carrier bar and guide bar for larger units.

1.2.11 Frame - Is the assembly that provides the structural support and pressure containment for the plates. It consists of the fixed plate, pressure plate, carrier bar, guide bar, tie bolts, nuts and end support.

SECTION 2 - GENERAL REQUIREMENTS

2.1 Limits of Supply

2.1.1 Seller shall provide a fully assembled exchanger, requiring no additional on-site assembly.

2.1.2 Items to be supplied by others.

a) Anchor bolts
b) External process piping, nuts etc

2.2 Performance Guarantee

2.2.1 Vendor shall warrant goods against faulty workmanship or the use of defective materials, under normal use and service, and that such goods will conform to mutually agreed upon written specifications, drawings and are guaranteed to meet specified performance requirements, for a period of twelve (12) months from the date of shipment.

SECTION 3 - DESIGN REQUIREMENTS

3.1 Thermal Design

3.1.1 To maintain velocity and reduce fouling, unit shall be sized to provide 20% of the extra area then required. It should be a single pass solution.

3.1.2 The unit shall be designed for future expansion to accommodate a minimum of twenty (20) percent extra heat transfer surface area.

3.1.3 Liquid velocity through the inlet and outlet ports shall be a maximum of 6 m/s, to optimise pressure drop and erosion.

3.2 Mechanical Design – PHE shall be AHRI Certified.

3.2.1 Frame, tie bolts, and supports shall permit the future installation of twenty (20) percent additional plates. This will also allow ease in disassembly and cleaning of the unit as furnished.

3.2.2 Plates

a) Minimum thickness of each plate shall be 0.5 mm.

b) The plate nozzle connections shall be arranged to force each fluid across the plate surface in a parallel path (i.e. inlet & outlet connections shall be on same side and not diagonal).

c) Plate design must be adequate to withstand a hydro test pressure of 1.3 times the design pressure. Each side shall be pressurized independently during testing.

d) Gasket grooves must be designed such that it holds the gasket from three sides.

e) Plates must be supported by the carrier bar. Carrier bar surfaces that are in contact with the heat transfer plates shall be stainless steel. The plate should have provisions for self-aligning outside heat transfer area.

f) The guide bar shall be designed to maintain plate alignment. Guide bar shall not be used for support. Guide bar shall be stainless steel.

g) The first and last plates of the plate pack shall be designed to prevent fluid contact with the fixed or movable heads.

3.2.3 Gaskets

a) Gaskets shall be of the non-glued design.

b) All gaskets must be elastomeric. Inelastic gaskets, such as compressed asbestos, must not be used.

c) Gaskets shall be designed so that the gasket groove on plate is in their metallic contact from three sides.

d) Port holes in each plate must be fully gasket and vented to the atmosphere to force any leaks to the outside. This form of positive venting will eliminate mixing of the process fluids due to gasket failure.

3.2.4 Fixed and Pressure Plates

a) All nozzle connections shall be located on the fixed plate for single pass arrangement.

b) For tie bolts of 1 inch or greater diameter, the fixed and pressure plates shall be provided with slotted holes, to facilitate assembly and disassembly of the unit.

c) The pressure plate shall be supported by the carrier bar and guided by the guide bar.

d) Unit design shall prevent the fixed and pressure plate from contacting the fluids circulated. Metal nozzle liners compatible with the plate material, or nozzle projections shall be provided.

3.2.5 Tie Bolts and Nuts

a) The tie bolt length shall allow the addition of twenty (20) percent more plates.

b) Tie bolts and nuts shall be EN18, zinc plated for improved corrosion resistance.

3.2.6 Ports

a) For units with studded ports, corrosion resistant stud bolts shall be provided by the manufacturer.

b) Metal port liners shall be provided per 3.2.4 above

5A419.8 **SS 316L PIPINGAND FITTINGS**

Stainless Steel Grade AISI SS 316L pipes confirming to EN10312 standard, complete with Press Type fittings (V-Profile) for RO water supply capable to withstand temperature upto 110 degree centigrade at 16 bar pressure including fittings, such as sockets, bends, elbows, tees, reducers, unions, flanges, clamps with hanger at various spacing given in below table. Necessary adapters for CP fittings, jointing, sundries, cutting holes in walls/ floors/ slabs and making good complete. This includes testing of joints complete as per the direction of Engineer incharge.

Technical data

Stainless steel pipes - thin-walled and corrosion resistant Stainless steel pipes. Material no. 1.4404), with 2.3 % Mo for higher durability Black; EPDM (ethylene propylene diene rubber); up to 110 °C;
All pipes must be leak-tested and marked as such Pipe material no. 1.4404:

DVGW approval: DW 8501 BL 0551 (15 – 54 mm), DW 8511 BQ 0245 (64.0 – 108.0 mm)
Pipe material no. 1.4521: DVGW approval:
DW 8501 BS 0376 (15 – 108.0 mm)
15 / 18 / 22 / 28 / 35 / 42 / 54
64.0 / 76.1 / 88.9 / 108.0

d x s [mm]	Volume per cons. metre of pipe [Liter/m]	Weight per cons. metre of pipe [kg/m]	Weight per 6 m length [kg]	Size	Material Press connector
15 x 1.0	0.13	0.35	2.10	Standard	Stainless steel
18 x 1.0	0.20	0.43	2.55		
22 x 1.2	0.30	0.65	3.89		
28 x 1.2	0.51	0.84	5.02		
35 x 1.5	0.80	1.26	7.55		
42 x 1.5	1.19	1.52	9.13		
54 x 1.5	2.04	1.97	11.83		
64.0 x 2.0	2.83	3.04	18.24	XL	Stainless steel
76.1 x 2.0	4.08	3.70	22.20		
88.9 x 2.0	5.66	4.34	26.00		
108.0 x 2.0	8.49	5.30	31.80		

FITTING-

Fittings should be produced from 1.4404 materials and fitted with a “Leak Before Pressed” (LBP) function.
The sizes 12-54 Stainless Steel V Profile fittings are fitted with an EPDM “Leak Before Pressed” (LBP) O-ring . M Profile Fittings in sizes 76.1 -108 are fitted with a standard EPDM O-ring with LBP-function is achieved by means of the special geometry of the fitting. Black; EPDM (ethylene propylene diene rubber); up to 110 °C; not resistant to hydrocarbon solvents, chlorinated hydrocarbons, turpentine, petrol.
Threaded Stainless Steel fittings with inner and outer threads manufactured in accordance with DIN 2999/ISO 7/1.
Hemp or other chloride-free sealants are suitable for the threads of Stainless-Steel fittings. PTFE sealing tape may not be used in conjunction with stainless steel due to the water-soluble chloride ions it contains. With threaded couplings it is recommend that the sealing be executed before the pressing, in
order not to stress the press connection.

O-rings

The standard fittings for potable water and central heating are fitted with EPDM O-rings. The type of O-ring which has to be used depends on the application and the medium. That is why gas press fittings are fitted with (H)NBR O-rings. For special applications, such as media containing oil or high temperatures, an FPM O-ring has to be fitted.

EPDM 'Leak Before Pressed' (LBP) - Black



Temperature	Applications
-20°C to +110°C For short periods at 130°C	For all installations for potable water and treated water, hot water, circulation tubes, cooling, heating, etc.

EPDM - black



Temperature	Applications
-35°C to +135°C Short period 135°C	KTW recommended. For all installations for potable water and conditioned water, hot water, circulation tubes, fire mains, etc.

Pressing

Before starting to press, the press jaws and slings must be checked for dirt, which must be removed if present. Furthermore, the press machine must be in good condition and the instructions for operating the device, maintenance and the manufacturer's instructions must be observed.

In order to create a correctly pressed connection, the groove of the press tool must enclose the press fitting O-ring bead. Once the pressing has started, always complete the press cycle and under no circumstances interrupt the process.

It is not permitted to press a connection more than once.

Making the press connection

Metal pipes 12 – 54 mm

The press connection provides an easy and reliable means of connecting stainless steel pipes.

To make this connection, following are needed-

Pipe cutters or a fine-toothed steel saw

De-burrer and colored pen to mark the insertion depth

Certified press tool with press jaw suitable for pipe diameter

76.1 – 108.0 mm

The press connection provides an easy and reliable means of connecting stainless steel pipes.

Pipe cutters or fine-toothed steel saw

De-burrer and coloured pen for marking

Certified press tool with press jaw suitable for pipe diameter

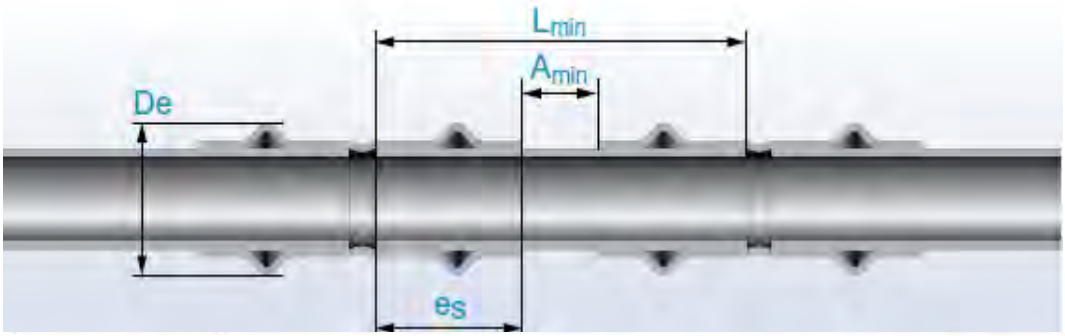
Before assembly, the fitting must be checked to ensure that the O-rings are present and correctly positioned. The tube, fitting and O-ring must be examined for any foreign materials (e.g. dirt, burrs), which must be removed, if present.

Insert the tube carefully into the press fitting up to the marked insertion depth, simultaneously rotating and pushing it in the direction of the axis. The insertion depth marking must remain visible. In the case of fittings without a stop, the fittings should be inserted at least as far as the marked insertion depth Rough and careless insertion of the tube

into the fitting may result in damage to the O-ring. This is therefore not permitted. If assembly is difficult because of the permitted tolerances in size, a lubricant such as water or soap may be used. Under no circumstances may oils, fats or grease be used as lubricants.

Minimum Distance Between Pressing

To optimize the installation time, first assemble a number of connections and then press the various tube connections one after the other. Marking the distance (See Fig.) enables you to check that the tube has not been pushed out of the fitting during the pressing process. Before starting the final pressing process of the various tube connections, it is also important to check the minimum required distances for the installation (see Table).



Dimension Ø [mm]	O-ring size De [mm]	Minimum fitting distance Amin [mm]	Minimum tube length Lmin [mm]	Insertion depth e_s [mm]
12	20	0	36*	18
15	23	0	44*	22
18	27	0	44*	22
22	32	0	46*	23
28	38	0	48*	24
35	45	25	75	25
42	54	30	102	36
54	66	35	117	41
66.7	83	30	130	50
76.1	95	55	165	55
88.9	110	65	191	63
108	133	80	234	77

** When connecting two fittings directly to one another, it is essential to respect this minimal tube lengths.*

Minimum required working space
The tables below give the minimum required working space so that the fittings can be pressed correctly using the appropriate press tools. These distances relate to the general installation configurations that are schematically shown in Figures.

Ø [mm]	X [mm]	Y [mm]
12	31	60
15	31	62
18	31	65
22	31	69
28	31	72
35	31	76
42	75	115
54	85	120
66.7	110	145
76.1	110	140
88.9	120	150
108	140	170



FIGURE 5: INSTALLATION AT A WALL

Ø [mm]	X [mm]	Y1 [mm]	Y2 [mm]
12	35	44	69
15	35	44	71
18	35	44	73
22	35	44	77
28	35	44	81
35	35	44	86
42	75	75	115
54	85	85	120
66.7	100	100	145
76.1	115	115	165
88.9	125	125	185
108	135	135	200



FIGURE 6: INSTALLATION AT A FLOOR

Insulation
Depending on the application and pipe material, the insulation, laying and fastening of the pipes according to the technical regulations is necessary for the following reasons
The following regulations apply to the insulation of potable water piping systems:
• Cold water lines must be protected against condensation and overheating in accordance with DIN 1988, Part 200.
• Hot water lines must be insulated to prevent heat loss in accordance with the Energy-Conservation Act (EnEG).
The soluble chloride content in the insulation materials used must not exceed 0.05% by weight in accordance with DIN 1988, Part 7.
Prevention against External corrosion due to contact with mortar, droplets or covering materials that contain or cause chlorides to be created. Ensure that the outer insulating layer of the tubes and fittings is continuous and that, if necessary, sufficient corrosion-protective insulation tape is applied. Correctly applied closed cell insulation is an effective protection against corrosion.
The pipes must be located a sufficient distance away from heat sources such as hot pipes, chimneys, heating installations. If this is not possible, cold water pipes must be insulated to prevent impairment of drinking water quality as a result of heating.

Guidelines for distances of mounting brackets
Support Bracket (Pipe clamps) suitable for plastic pipes with protective inserts can be used in accordance with DIN 1988 – Part 200

Ø tube diameter [mm]	Max. distance [m]
12 x 1.0	1.00
15 x 1.0	1.25
18 x 1.0	1.50
22 x 1.2	2.00
28 x 1.2	2.25
35 x 1.5	2.75
42 x 1.5	3.00
54 x 1.5	3.50
64 x 1.5	4.25
66.7 x 1.5	4.25
76.1 x 2.0	4.25
88.9 x 2.0	4.75
108 x 2.0	5.00

Observance of the above distances between attachment points is not sufficient in itself. Heat expansion also needs to be appropriately compensated for in horizontal stretches and, therefore, the distances above may need to be adjusted.

Mounting tubes

When securing the tubes, it must be borne in mind: The load-bearing capacity of the mounting brackets must correspond to the weight of the pipelines and also withstand expansion and torsion forces. Mounting brackets, such as fixed mounting points and clips, must therefore be correctly placed and assembled.

Attachment points may only be fitted onto straight tube sections. Mounting directly onto fittings is not allowed.

Pressure test

As soon as a tubing system has installed, it must be checked and undergo a pressure test for leaks before being covered up, insulated, painted or concealed in order to be certain that there are no leaks. . With potable water and heating installations, the pressure test can be carried out with water, air or inert gases. As a rule of thumb, a pressure of 1.5 times the operating pressure is used for pressure tests with water. The test medium and the results of the pressure test must be documented in a so-called pressure test report.

Pressure test with water

The medium used for the pressure test with water must be of potable water quality (free of oil and other impurities) in order to avoid any contamination of the piping system. After being filled with pure water, the pipe must be properly bled.

Pressure test with air

Pressure Test with Air or Inert Gases", (at 100 l tube capacity a leak tightness test at 110 mbar for at least 30 minutes. For every additional 100 l, the time must be increased by 10 minutes. After the leak tightness test, the strength of the connection is to be tested during 10 minutes at: a maximum of 3 bars up to DN50, maximum of 1 bar >DN50). For safety reasons, the maximum test pressure is set at 3 bars. This maximum test pressure applies also for gas piping.

Pressure test for heating systems and cooling systems

As a rule, the pressure test for tubing that has already been laid is carried out with water

in accordance with DIN-VOB 18380.

• The test pressure at each point of the system must be 1.3 times the operating pressure and at least 1 bar overpressure.
• Immediately after the cold water pressure test, the water must be heated up to the highest hot water temperature on which the calculations were based in order to be certain that the system remains tight at high temperatures.
• During the test there must be no drop in pressure.
• The pressure test must be adequately documented.

Pressure test of sprinkler systems
The tubes of the sprinkler system must be subjected to a pressure test in accordance with valid guidelines for at least two hours. A pressure (measured at the alarm Valves) corresponding to 1.5 times the permitted positive operating pressure – but of at least 15 bars – must be maintained during the test. This pressure test is a check of both the strength and tightness of the system. The system must be monitored for 24 hours for any pressure drop due, for example, to temperature changes. Dry sprinkler systems must also be tested pneumatically to a pressure of not less than 2.5 bars for at least 24 hours. Any leakage, which occurs and results in a pressure drop of more than 0.15 bar over the 24 h, must be corrected. Any faults identified, such as permanent deformations, ruptures or leakages must be corrected and the pressure test repeated.

Flushing the network
Each tubing system must be flushed thoroughly before being put into use so that any foreign matter is removed from the inside of the tube surface and so that hygiene problems and corrosion damage are largely prevented. Potable water tubing must be flushed as soon as possible after installing the pipelines and after the pressure test. The cold and hot water pipelines should be flushed separately,
intermittently and under pressure with an air-water mixture (EN 806, Part 4). Installation regulations, such as the Potable Water Act and worksheets, must be followed. In exceptional cases, it may be necessary to flush the system with a disinfecting substance.
When flushing with a disinfectant substance, special care must be taken to ensure that no chlorides remain on the inside of the tubes. Always make sure to flush with clean potable water.

Fire protection
If pipes are fed through ceilings and walls in different fire zones, suitable action must be taken which delays the fire from spreading for a definite period of time. Shafts with pipes insulated with rockwool, together with layer of poured concrete in the gaps and floor level have proven effective. This allows for a professional separation of the pipes from the rest of the construction. Also, there are no prescribed minimum distances between the insulated pipes, it is recommended to leave at least 20 mm for the boring of holes. The same is true for an open shaft closed by the pouring of a concrete sealant.

Internal corrosion
Stainless tubes and press fittings are completely passive when in contact with potable water and, therefore, not at risk from corrosion. Potable water is considered to be water with properties that comply with current regulations on physical-chemical tolerances.
The tubes and fittings also react in a safe and problem-free manner as regards a water chlorine content if 1.34 mg/l is added for disinfection purposes. In potable water installations with stainless steel fittings and tubes, the content of water-soluble chloride ions may not exceed 250 mg/l. The Stainless system can also be used for all water treatment plants for domestic purposes (e.g. for water softeners). It is corrosion-resistant as regards demineralized and distilled water, and water containing glycol. Hygiene problems regarding heavy metal contamination do not occur with Stainless Steel. Point or crack corrosion can only occur if
the maximum values for the water chloride content, as defined in the applicable

regulations, are significantly exceeded.

External corrosion
External corrosion of the Stainless-Steel components can only occur when wet potable water tubes come into contact with mortar, droplets or covering materials that contain or cause chlorides to be created. Ensure that the outer insulating layer of the tubes and fittings is continuous and that, if necessary, sufficient corrosion-protective insulation tape is applied. Correctly applied closed-cell
insulation is an effective protection against corrosion.

Storage and transportation
Stainless steel pipes are thin-walled welded pipes made from material 1.4401 compliant with EN 10088.
To prevent damage impairing hygienic characteristics, the following information must be taken into account when transporting and storing pipes
Do not remove protective foils and protective caps until immediately before use.
Do not store the pipes on hard floors without protection.
Do not stick protective foils or similar to pipes.
Do not pull pipes over loading sills.
Only use a stainless-steel cleaning agent to clean the surfaces of pipes.

5A419.9 Piping Arrangements (Layout)

5A419.8.1 The Contractor shall follow the following guidelines for making piping arrangement drawings. The general rule in piping layout is that the lines should be located in as neat and orderly manner (in groups wherever possible) as is consistent with commercial design, pressure loss considerations and satisfactory supporting arrangements. In exceptional cases where it is intended to run the piping overhead, providing 2 m or more of clear head room over walk ways and platform is necessary.

5A419.8.2 All piping equipment requiring regular attention of the operating and maintenance personnel should be readily accessible.

5A419.9 Water Meters

5A419.9.1 Water meters of approved make and design shall be supplied for installation at water supply entry of each Building. The water meters shall meet with the approval of local supply authorities. Suitable valves and chambers or wall meter box to house the meters shall also be provided along with the meters. These water meters will be electromagnetic type and water meters of all towers will be connected to SCADA installed in the pump house.

5A419.9.2 The meters shall conform to Indian Standard BIS: 779 and BIS: 2373. Calibration certificate shall be obtained and submitted for each water meter.

5A419.9.3 Provision shall also be made to lock the water meter. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be a diameter not less than 4 mm. The water meter shall be suitable for connection to remote monitoring for efficient flow and status monitoring.

5A419.9.4 Installation of Water Meter and Stop Cock

The G.I. / SS 316 L / CPVC pipelines shall be cut to the required lengths at the position where the meter and stop cock are required to be fixed. Suitable fittings shall be attached to the pipes. The meter and stop cock shall be fixed in a position by means of connecting

pipes, jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. The meter shall be installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter.

Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fitting the meter.

5A419.10 Testing

5A419.10.1 The Contractor shall notify the three days in advance of any test so that the Engineer can witness the tests if he so wishes.

5A419.10.2 All water supply systems shall be tested to hydrostatic pressure test of at least one and a half (1.5) times the maximum pressure but not less than 10 kg/cm2. for a period of not less than 8 hours. All leaks and defects in joints revealed during the testing shall be rectified and approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner.

5A419.10.3 The system may be tested in sections and such sections and shall be entirely retested as a system on completion.

5A419.10.4 The Contractor shall make sure that proper noiseless circulation of fluid is achieved through the entire piping network of the system concerned. In case of improper circulation, the Contractor shall rectify the defective connections and shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required.

5A419.10.5 In addition to the sectional testing carried out during the construction, the Contractor shall test the entire installation or pumping system or mains. And shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

5A419.10.6 After commissioning of the water supply system, the Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

5A419.10.7 A test register shall be maintained and all entries shall be signed and dated by the Contractor and Engineer.

5A419.11 Disinfection of Piping System

5A419.11.1 Before commissioning the water supply system, the Contractor shall arrange to disinfect the entire system as described below.

5A419.11.2 The pipes shall first be filled with water and thoroughly flushed out. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.

5A419.11.3 If ordinary bleaching powder is used, the proportions will be 150 gm of power to 1000 litres of water. If a proprietary brand of chemical is used, the manufacturer shall specify the proportions. Each tap shall be closed when the water discharged begins to smell of chlorine. Finally, the pipes shall be thoroughly flushed out before any water is used for domestic purpose.

5A419.11.4 The pipe work shall be thoroughly flushed before supply is restored.

5A419.12 Sterilization of Main

After the pipe work has been tested and approved, but before it is coupled, it shall be sterilized with a solution of chloride of lime. This shall be coordinated with the Engineer prior to execution to address interface with the main trunk water distribution system.

5A419.13 Cutting Chases in Masonry Walls

5A419.13.1 Cold water distribution pipes to fixtures and equipment exposed to view in the bathrooms, kitchens and sanitary compartments (shall be chased into walls or floors) or placed in wall cavities. The Contractor shall be responsible for cutting all notches, chases, and recesses in walls and floors and only a diamond cutter shall be used. The maximum size of conduit or pipe permitted to be concealed in floor slabs shall be 32 mm diameter unless otherwise approved by the Engineer.

5A419.13.2 The chases up to 7.5 x 7.5 cm shall be made in the walls for housing GI pipes etc. These shall be provided in correct positions as per in the approved shop drawings. Chases shall be made by chiseling out the masonry to proper line and depth. After the pipes etc. are fixed in chases, the chases shall be filled with cement mortar 1:2:4 or as may be specified, and made flush with the masonry surface. The concrete surface shall be roughened with wire brush to provide a key for plastering.

5A419.13.3 Where, and if, pipes pass through beams or structural walls, subject to the approval of the Engineer, the Contractor shall ensure that sizes and locations of openings required are formed in when the relevant beams or walls are cast.

5A419.14 Valves

5A419.14.1 All valves (gate, globe, check, safety, Butterfly etc.) shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified and all valve shall be rated for minimum pressure rating of PN-16 or 1.5 times of working pressure whichever is higher. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard BIS: 776 and non-return valves to BIS: 5312.

5A419.14.2 Sluice valves

Sluice valves, where determined required by the Contractor’s design team, shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be gunmetal. They shall generally have non-rising spindle and shall be of the particular duty and design as specified. The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fiber gaskets. Sluice valves shall conform to Indian standard BIS: 780 and BIS: 2906.

5A419.14.3 Butterfly valve

a. The butterfly valve shall be suitable for waterworks and rated Pressure requirement.

b. The body shall be of cast iron to BIS:210 in circular shape and of high strength take the water pressure. The disc shall be heavy duty cast iron with anti-corrosive epoxy or nickel coating.

c. The valve seat shall be of high-grade last over or nitrile rubber. The valve is closed position shall have complete contact between the seat and the disc throughout the

perimeter. The last over rubber shall have along life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

d. The valve shall be fitted between two flange so neither side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

5A419.14.4 Ball valve

a. The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

b. The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

c. The handle shall be provided with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.

d. The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

5A419.14.5 Gun metal valve

a. Gun metal Valves shall be used for smaller dia. pipes, and for threaded connections. The Valves shall bear certification as per BIS:778.

b. The body and bonnet shall be of gun metal to BIS:318. The stem gland and gland nut shall be of forged brass to BIS: 6912. The hand wheel shall be of cast iron to BIS:210.

c. The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non-rising type. Valve shall be suitable for waterworks and rated Pressure requirement

5A419.14.6 Non-return valve

Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to BIS: 5312.Valve shall be suitable for waterworks and rated Pressure requirement

5A419.14.7 Pressure Reducing Valve Set

a. Each pressure reducing valve set shall be complete with pressure reducing or pressure regulating valve, isolating valves, pressure gauges (fix with symphonic check) on in let and outlet, pressure relief valve on outlet and filter on inlet.

b. Each pressure reducing valve shall contain loading neoprene diaphragm and a full floating, self-aligning, ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. The valve shall fail safe to the low pressure.

c. Valves shall be capable of operating at the maintaining automatically the respective delivery pressure and flow rates as indicated and shall not be liable to creep. Valves shall also be capable of maintaining the pre-set downstream pressure under static condition.

d. The filter one a chin let to a pressure reducing valve shall be of replaceable porous in tere metal type. Valve shall be suitable for waterworks and rated Pressure requirement.

5A419.14.8 Pressure Relief Valves

a. Each pressure relief valve shall be of the fully enclosed type and fitted with hand easing gear.

b. Each pressure relief valve in a pressure reducing station shall have a flow capacity equal to that of the pressure reducing valve.

c. Pressure relief valves in locations other than reducing stations shall have flow capacities equal to that of the associated equipment.

5A419.14.9 Pressure Gauge

a. The pressure gauge shall be constructed die cast aluminum and stove enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type pressure gauge with a scale range from 0to16kg /cm2 and shall be constructed as per BIS: 3524. Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by Ball Valve.

b. Calibration certificate shall be obtained and submitted for each pressure gauge.

5A419.14.9 Balancing Valve

c. The balancing valves up to 80 mm Dia shall be orifice type of gunmetal screwed type confirming to BS: 5154 or equivalent specifications.

d. The valve shall be cast gunmetal ASTM B-62 and complete with non-rising spindle. PTFE disc seal cast metal hand wheel.

e. The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

f. The valve shall be complete with two ports for connections to a mercury manometer, to measure the pressure drop, as well as a drain port.

g. The spindle shall have a shielded screw to set the flow at the desired level.

h. The valve up to 100mm Dia should be suitable for 16 kg/Sq.cm working pressure. And Valve above 100mm Dia should also be suitable for 16 kg/Sq.cm.

5A419.15 Water Fittings

Unless otherwise specified all Gunmetal fittings such as gate, globe, check and safety valves shall be fitted in pipeline in work man like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak- proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone

5A419.16 Paint

a. Use paints and coatings that comply with the following limits for VOC content and the following chemical restrictions:

b. Non-Flat Paints and Coatings: VOC not more than 150g/l.

c. Anti-Corrosive Coatings VOC not more than 250 g/l.

d. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

e. Paints and coatings shall not contain any of the following:

f. Acrolien

g. Acrylonitrile

h. Antimony

i. Benzene

j. Buty benzyl phthalate

k. Cadmium

l. Di (2-ethylheyl) phthalate

m. Di-n-butyl phthalate

n. Di-n-octy phthalate

o. 1,2-dichlorobenzene

p. Die thy phthalate

q. Dimethyl phthalate

r. Ethylbenzene

5A419.16.1 Painting:

a. Water supply pipes in exposed, in shafts shall be painted with two or more coats of ready mix Low-VO Coil paint to give an even shade before painting all dust and extra neo us matter shall be removed.

b. Paint shall be of approved quality and shade. Where directed by the Engineer pipes shall be painted in accordance with approved pipe color code.

c. Pipe in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with synthetic enamel paint after removing dust and extra neo us matter.

d. Water supply pipes below ground and covered in cement concrete shall not be painted.

5A419.17 Pipe Protection (for Water Pipes Buried in Trenches/Ground/Earth)

a. All buried pipes shall be cleaned with zinc chromate primer and bitumen paint, wrapped with three layers of fiber glass tissue, each layer laid in bitumen and placed on concrete blocks with PUF saddles dipped in bitumen at every 2 meters. The pipes where laid under floor shall be encased with 100 mm thick good quality, river sand all around in addition to protective coating as described above.

b. Alternatively, wrapping of bituminous-based anti-corrosion tape minimum 2 layers, each 2 mm thick, for protection of pipe would also be acceptable as per final approval of Engineer.

5A419.18 Thrust Blocks

In case of bigger pipes (80 mm dia. and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Engineer.

5A419.19 Masonry Chamber

a. All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per approved shop drawings.

b. The excavation for chambers shall be done true to dimension and level indicated on plans.

c. Concrete shall be of cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 40 mm nominal size.

d. Brick shall be of class designation 75 in cement mortar 1:5 (1 cement: 5 fine sand)

e. Inside Plastering not less than 12 mm thick shall be done in cement mortar 1:3 (1 cement: 3 fine sand) finished with a floating coat of neat cement.

5A420 Internal Drainage (Soil, Waste, Vent And Rain Water Pipes)

5A420.1 Scope

5A420.1.1 The scope of this section comprises the supply, installation, testing and commissioning of internal drainage services. All fees related to statutory approval shall be borne by the Contractor.

5A420.1.2 Work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required.

5A420.2 Basic Piping System

5A420.2.1 Soil, waste and vent pipes in shafts and in concealed areas i.e., false ceilings, inside the wet areas etc. complete in all respect. Shall consist of HDPE pipes and fittings compliant with international standards (EN/DIN/ISO), including those suitable for building drainage (EN 1519/ EN 12056) and pressure applications (EN 12366/ ISO 4427)

5A420.2.2 The soil pipes shall be circular with a suitable nominal diameter. Pipes shall be fixed by means of stout GI clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Engineer. All bends, branches, swan neck and other parts shall conform to the requirement and standards as described for the pipes. Pipes shall be rested against the walls on suitable wooden cradles. Local authority regulations applicable to the installations shall be strictly followed.

5A420.2.3 Where indicated, the soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the height shown in the drawings. Soil pipes shall be painted as provided under `painting'. All vertical soil pipes shall be firmly

fixed to the walls with properly fixed clamps, and shall as far as possible be kept 50 mm clear of wall.
Waste pipes and fittings shall be of HDPE. Pipes shall be fixed, jointed and painted as described in installation of soil, waste and vent pipes.

5A420.2.4 Every Vertical Waste pipe shall be terminated / discharged into a Horizontal waste pipe with proper P-Traps. The Contractor will ensure that this requirement is adequately met with.
Wherever floor traps are provided, it shall be ensured that at least one wash is connected to such floor traps to avoid drying of water seal in the trap. Ventilating pipes shall be of HDPE, conforming to the requirements laid down earlier. Anti-syphon vent pipes/relief vent pipes were called for on the drawings shall be of HDPE pipes as specified. The pipes shall be of the diameter as per NBC (Part-9, 2026) and Contractor shall design all pipes including vent based on fixture unit load as per guidelines provided in NBC (Part-9, 2026).

5A420.2.5 All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75 mm or more than 300 mm from their highest part and on the side nearest to the soil pipe or waste pipes.

5A420.2.6 Access doors for fittings and clean outs shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the civil structure, false ceiling or marble cladding etc. shall be clearly reported to the Engineer in the form of shop drawings so that other agencies are instructed to provide the same.

5A420.2.8 Where soil, waste and ventilating pipes are accommodated in shafts ducts, adequate access to cleaning eyes shall be provided.

5A420.2.9 Head (starting point) of drains and sewage / waste water sumps (as and where applicable) having a length of greater than 4 m up to it connection to the main drain or manhole shall be provided with 80 / 100 mm vent pipe.

5A420.30 Piping Materials
High Density Polyethylene (HDPE) Pipes:

HDPE PIPE for soil, waste water

installation conforming to EN 12056 or EN 1519 or EN 12366 cut to required lengths, All pipes must have been passed throgh tempering process which give the test result for heat revision of pipes as radial dimension: < 0.6 % & axial dimension: < 1.0 % when tested accordance to DIN 8075, 6.5. All pipe to pipe and pipe to fittings should be Butt welded as per requirement. HDPE Pipe need to supply along with necessary fittings such as, 45 deg. Or 88.5 deg. bends, Tees, Ys, access pipe and reducers. confirming to EN 12056 and cut to required lengths. Pipes and fittings must be produced with High Density Polyethylene (HDPE), Pressure classified as PE 80 in accordance to DIN 8075. Density - 0.95 g/cm3.all necessary fittings and specials such as Bends, junctions, offsets & vent cowl. Fixing at wall/ceiling level supported by rubber line bracket & hangers etc.

Clamps over pipe joints and for support of pipe shall be of same make as per fraunhoffer certificate for sound level provided by manufacturer.

Supply, Fixing, jointing and testing in position the HDPE Electro Fusion Coupling for soil,waste water installation conforming to EN 12056 or EN 1519 or EN 12366, All required joints should be welded by Electroweld Sleeve coupling with yellow indicator to confirm the complete fusion welding process

Supply, Fixing, jointing, testing of HDPE necessary fittings and specials such as SOVENT along with required threaded connector end with screw cap confirming to EN 12056 oe EN 1519 or EN12366 having discharge capacity of 12 Literes per second.

Supply, Fixing, jointing, testing of HDPE necessary fittings and specials such as Expansion Socket confirming to EN 12056 or or EN 1519 or EN 12366.

Supply, Fixing, jointing, testing of HDPE necessary fittings and specials such as Ring seal Socket confirming to EN 12056 or EN 1519 or EN 12366.

Fixing in position 75 /100mm HDPE Multi Floor Trap with 50 mm water seal conforming to UPC - I,EN 12056 or EN1519 or EN 12366. Trap grating, joining, embedding in concrete etc. complete. Rate to include making of opening in floor, marble / tiles, for fixing grating.

For the connection of PE pipes and fittings, the proportion of electrofusion couplings, electrofusioncouplings with integrated thermal fuse and butt-welding connections is provided in the material list.Pipe brackets, ring seal sockets, electrofusion couplings and butt-welding connections are written outseparately in the specifications. Scraps, as well as fastenings and incidentals, are to be factored into thestandard prices or accounted for separately.

5A420.7 UPVC Pipes and Fittings (for rain water in vertical shafts)

5A420.7.1 The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to BIS: 4985-1981. The pipes shall be of Class-III; 6 kg/sq.cm pressure rating. or type B.

5A420.7.2 Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to BIS: 14735.

5A420.7.3 Laying and Jointing

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively, plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

5A420.7.4 Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and ‘O’ rubber ring for vertical line. The type of joint shall be used as per site conditions / direction of the Engineer. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with GI adopter for insertion in the RCC slab for a water proof joint complete as directed by Engineer.

5A420.7.5 Supports

UPVC pipes require supports at close intervals. Recommended support spacing for un-plasticized uPVC pipes is 1400 mm for pipes 50 mm dia. and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps,

hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for the structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

5A420.7.6 Repairs

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs shall be made by replacement of the damaged section. If any split or chip out occurs in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

5A420.9 Pipes Hangers, Supports and Clamps

5A420.9.1 All vertical pipes shall be fixed by galvanized clamps and galvanized angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

5A420.9.2 Horizontal pipes running along ceiling shall be fixed on galvanized structural adjustable clamps of special design shown on the approved shop drawings. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully reset on them.

5A420.9.3 The Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building the Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

5A420.9.4 All pipes clamps, supports and hangers shall be galvanized. Factory made prefabricated clamps shall be preferred. The Contractor may fabricate the clamps of special nature and galvanize them after fabrication but before installation. All nuts, bolts, washers and other fasteners shall be factory galvanized.

5A420.9.5 Clamps shall be of approved design and fabricated from MS flats rubber lined inside 2 mm thick (which shall be galvanized after fabrication) of thickness and sizes as per drawings or the Contractor’s shop drawings. Clamps shall be fixed in accordance to manufacturer’s details/shop drawings to be submitted by the Contractors.

5A420.9.6 When required to be fixed on RCC columns, walls or beam they shall be fixed with approved type of galvanized expansion anchor fasteners (Dash fasteners) of approved design and size according to load.

5A420.9.7 Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per the Contractors shop drawings shall be galvanized after fabrication. All nuts, bolts and washers shall be galvanized.

5A420.9.8 Galvanized slotted angle/channel of approved sizes supports on walls shall be provided wherever shown on shop drawings. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with anchor fasteners mentioned above. The spacing of support bolts on support members fixed horizontally shall not exceed 1 m.

5A420.10 Installation of Soil, Waste and Vent Pipes

5A420.10.1 Soil, waste and vent pipes in shafts under the floors / suspended below slab shall consist of cast iron pipes as described earlier. Waste pipes from bottle trap to floor/urinal traps for wash basin, urinal and sink shall be HDPE pipes and fittings.

5A420.10.2 All Horizontal pipes running below the slab and along the ceiling shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for in the drawings. The pipes shall be laid in uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means of stout clamps in two sections, bolted together, built into the walls, wedged and neatly jointed. The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using HDPE pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc. suitable allowance shall be provided for any movements in the pipes by means of expansion joint etc. such that any such movement does not damage the installation in any way.

5A420.10.6 Rainwater Pipes

a. All open terraces shall be drained by rain water down takes.

b. Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground storm water drainage system of the area.

5A420.10.7 Balcony / Planter drainage

Wherever required, all balconies, terraces, planters and other frontal landscape areas will be drained by vertical down takes or other type of drainage system shown on the drawings.

5A420.11 Traps

5A420.11.1 Floor Traps

a. Floor traps where specified shall be siphon type full before P or S type HDPE material having a minimum 50 mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size). The Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth.

5A420.11.2 Floor Trap Inlet /Hopper

Bath room traps and connection shall ensure free and silent flow of discharging water. Where specified, the Contractor shall provide a special type of floor inlet fitting fabricated from GI pipe, with one, two or three inlet sockets welded on side to connect the waste pipe. All joint between waste hopper and HDPE inlet socket shall be drip sealed. Inlet shall be connected to a HDPE “P” trap. Floor trap inlet and the traps shall be set in cement concrete blocks where buried in floors without extra charge. Floor trap for the shower cubicle shall suit site and as per the approval of Engineer. All fabricated hopper shall be hot dip galvanized.

5A420.11.3 Floor Trap Grating

Floor and urinal traps shall be provided with 100 – 150 mm square or round stainless-steel gratings, with frame and rim of approved design and shape or as approved by the Engineer

5A420.12 Cleanout Plugs

5A420.12.1 Floor Clean Out Plug

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, "Y" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor level. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be cast brass suitable for the pipe dia. With screwed to a GI socket. The socket shall be drip seal joined/ Lead Caulked to the drainpipes.

5A420.12.2 Cleanout on Drainage Pipes

Clean out plugs shall be provided on head of each drain and in between at locations indicated on plans or directed by Engineer. Clean out plugs shall be of size matching the full bore of the pipe but no exceeding 150 mm dia. HDPE Cleanout plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

5A420.12.3 Floor cleanout plugs shall be cast brass.

Cleanouts provided at ceiling level pipe shall be fixed to a HDPE flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanized sheets and angles with hinged type doors with fly nuts, gasket etc. as per approved shop drawing.

5A420.13 Pipe Sleeves

Pipe sleeves, next larger diameter than pipes shall be provided wherever pipes pass through walls and slabs and annular space filled with fiberglass and finished with retainer rings. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matter.

5A420.14 Drainage Pipe Penetrations

Pipes shall be fixed and tested as building proceeds. The Contractor shall provide all necessary holes, cutouts and chases in structural members as building work proceeds, or as per Precast or ALF construction methodology requires. Wherever, and if, holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1cement: 2 coarse and: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand). Cured and the surface restored to original condition.

5A420.16 Testing

5A420.16.1 Testing of drainage pipes shall be done in accordance with BIS: 1172 and BIS: 5329 except as may be modified herein under.

5A420.16.2 Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. The Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work tests,

5A420.16.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

5A420.16.4 Before use at site all HDPE pipes shall be tested by filling up with water for at least 30 minutes. After filling, pipes shall be struck with a hammer and inspected for cracks.

All defective pipes shall be rejected and removed from the site within 48 hours.

5A420.16.5 Soil and waste drainage pipes shall be tested in sections after installation, by filling up the stack with water. All openings and connections shall be suitably plugged. The total head in the stack shall be 4.5 m at the highest point of the section under test. The period of test shall be minimum for 30 minutes or as directed by the Engineer. If any leakage is visible, the defective part of the work shall be cut out and made good.

5A420.16.6 On completion of the work the entire installation shall be tested by smoke testing machine. The test shall be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging the outlets with bellow plugs. Apply dense smoke keeping the top of stack open and observe for leakages. Rectify or replace defective sections.

5A420.16.7 After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. rectify and replace where required.

5A420.16.8 A test register shall be maintained and all entries shall be signed and dated by the Contractor and the Engineer.

5A420.16.9 All drainage pipes in wall chase or meant to be encased or buried shall be hydro tested before the chase in plastered or the pipe encased or buried.

5A420.17 Piping Material

5A420.17.1 Testing shall be done in accordance with BIS: 1172 and BIS: 5329 except as may be modified herein under.

5A420.17.2 Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. The Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work tests,

5A420.17.3 All materials obtained and used on site must have manufacturer’s hydraulic test certificate for each batch of materials used on the site.

5A420.17.4 Before use at site all CI pipes shall be tested by filling up with water for at least 30 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours. Pipes with minor sweating may be accepted at the discretion of the Engineer.

5A420.18 Fully Automatic Grease Separator (For Kitchen Waste):

Grease separator Easy Clean free Mix & Pump according to EN1825 / certification Z-54.1-474

Tank Manufactured from virgin, non-recycled polyethylene, for free standing installation in frost protected areas, with integrated sludge trap, sloped interior base improves cleaning and reduces disposal time, inlet flow calming system and outlet flow regulation device, inlet and outlet interchangeable, slanted twin access covers with quick release odor tight snap closures, inspection window with interior cleaning arm, 75 mm OD PN 10 pressure disposal pipe, with integrated fork lift grips at base of separator, low weight - compact design, 100 % corrosion free polyethylene body construction (20 year warranty).Mix & Pump version -cleaning and refilling system at the touch of button, maintenance free macerating pump (stainless steel blades) for separator cleaning and disposal, includes closure valve for easy pump removal, pump

floor mount included with installation hardware and anti-vibration matt, - pumping capacity 3.0 kW, 5 m cable length, top mounted water jet(s) for grease layer breakup and water spray nozzles for interior wall cleaning during disposal, 1 inch -valve for water refill, 1 inch interior threaded refill inlet with air gap with Control Unit with LCD display control settable in English, and mains power safety on/off switch, with BMS connections Nos. and capacity of grease trap shall be as per actual selection based on the kitchen waste.

Sump Pump (Parking Basement & Plant rooms)-

Supplying, installation, testing and commissioning of automatic submersible drainage pump set with level controller and dry running protection and electrical panel with starter giving a discharge as specified below, working at 440V, three phase, 50 cycles A.C. supply suitable motor including 10m cable as per manufactures specification including the supply and fixing of electrical panel board, 3 phase indicating lamps, incoming and outgoing switches suitable size wiring, earthing etc. as per electricity rules, the pump shall have provision for sequence operation and to operate both the pumps together, complete in all respects with solid handling capacity of 40mm.

a) Casing: Aluminum alloy / C.I

b) Impeller & Shaft: S.S. 410

c) Solid Handling Capacity: 40 mm

d) Length of water proof cable with each pump: 10 meters.

e) Length of GI lifting chain with each pump: 5 Meter.

And Cutter type automatic submersible pumps shall be considered for sewage sumps with same specification as mentioned above. And sump will have minimum 2 pumps (one working + one stand by)

5A421 EXTERNAL SEWAGE AND STORM WATER DRAINAGE:

5A421.1 SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of external drainage & sewage disposal and rain water harvesting (Rain water harvesting as per MOEF and as per local norms).

5A421.2 General Scheme

The General Contractor shall install a drainage system to effectively collect; drain and dispose all soil and waste water from various parts of the buildings, appurtenances and equipment. The piping system shall finally terminate and discharge into the STP. All piping shall be installed at depth as per layout. The disposal system shall include construction of gully traps, manholes, intercepting chambers as indicated. The piping system shall be vented suitably at the starting point of all branch drains, main drains, the highest/lowest point of drain and at intervals as shown. All ventilating arrangements shall be un-obstructive and concealed. The work shall be executed strictly in accordance with BIS: 1742. The sewage system shall be subject to a smoke test for its soundness as directed by the Project Manager. Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Project Manager.

Without restricting to the generality of the foregoing, the drainage system shall inter-alia include:

Sewer lines including earth work for excavation, disposal, back filling and compaction,

pipelines, manholes, drop connections and connections to the municipal or existing sewer.

Storm water drainage, earth works for excavation, disposal, backfilling and compaction, pipelines, manholes, catch basins and connections to the existing municipal storm water drain or connected as indicated by the Project Manager.

5A421.3 General Requirements

All materials shall be new and of quality conforming to specifications and subject to the approval of the Client's site representative. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect / Consultant / Client's site representative.

Drainage lines and open drains shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal bye -laws. General Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, etc. shall be got confirmed by the Project Manager before the actual execution of work at site. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager in writing. All material shall be rust roofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic)corrosion.

5A421.4 Piping Material

- SN-8 Double Wall Corrugated HDPE pipes rain water system above extended basement and basement periphery.
- RCC NP-2 or NP-3 or NP-4 pipes as per loading for external storm water drainage system but for road crossing minimum NP-3 or NP-4 and RCC Box culvert as per design.
- SN-8 Double Wall Corrugated HDPE pipes for external sewage water system.

Double Wall Corrugated HDPE pipes (SN8)

Double Wall Corrugated HDPE pipes (SN8) for external storm water drainage. pipes rain water system above extended basement and basement periphery and complete external swage system.

Double Wall Corrugated HDPE pipes (SN8) for external sewage drain.
(Manhole to manhole connection).

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by internal diameter.

5A421.5 Fittings

Fittings shall be of the same make as that of pipes, injection molded and shall conform to Indian Standard.

5A421.6 Laying in Trenches

HDPE DWC pipes shall be laid on cement concrete bed of width 300mm over the outside diameter of pipe, and 150 mm thickness. Fine sand shall be carefully filled around the lower half of the pipes so as to buttress them to the sides of the trench.

The filling shall then be continued to 150mm over the top of the pipe using fine sand, watered and rammed on both sides of the pipes. The process of filling and ramming with fine handpicked material shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated to maintain an equal pressure on both sides of the pipe line. All around pipe 150 mm thick PCC with bed concrete should be done in loading areas like road crossings etc. & Pipe shall be laid as per recommendation of pipe manufacturer guidelines, all around PCC detail for pipe shall be follow as per NBC-Part-IX 2026.

Double Wall Corrugated HPDE Pipes conforming to EN-13476-3/16098 (Part 2) Pipes for Drainage System and road crossings as well.

5A421.7 Double Wall corrugated pipes shall be used for external Sewage system.

Double wall corrugated HDPE pipes shall be high strength to weight ratio, long metallurgical life expectancy, structural integrity, hydraulic capability, favorable chemical properties and socio environmental benefits (saving enormous time for project implementations). Higher flexibility and flexural strength ensure its capability to sustain greater over burden Aswell Slive load impact. DWC pipes save around 50 - 65% of total costs for raw material in comparison to solid wall plastic pipes and are far lighter in weight as well. All-around pipe 150 mm thick PCC with bed concrete should be done in loading areas like road crossings etc. & Pipe shall be laid as per recommendation of pipe manufacturer guidelines.

5A421.8 Fittings

Pipes are manufactured with online integrated couplings or simple offline couplers to make it very convenient for installation and to minimize any leakages in the system, jointing is as simple as push to fit using an elastomeric sealing ring to ensure leak proof joints with no possibility of infiltration or ex-filtration.

5A421.9 Laying in Trenches

Pipes shall be laid on cement concrete bed of width 300mm over the outside diameter of pipe, and 100 mm thickness. Fine sand shall be carefully filled around the lower half of the pipes to buttress them to the sides of the trench.

The filling shall then be continued to 150mm over the top of the pipe using fine sand, watered and rammed on both sides of the pipes. The process of filling and ramming with fine handpicked material shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated to maintain an equal pressure on both sides of the pipeline. All-around pipe 150 mm thick PCC should be done in loading areas like road crossings etc. & Pipe shall be laid as per recommendation of pipe manufacturer guidelines. All around PCC detail for pipe shall be follow as per NBC-Part-IX 2026.

RCC PIPE NP-2, NP-3 &NP-4-

- RCC NP-2 or NP-3 or NP-4 pipes as per loading for external storm water drainage system but for road crossing minimum NP-3 or NP-4 and RCC Box culvert as per design.

Reinforced cement concrete pipes-

All underground storm water drainage pipes where specified shall be centrifugally spun S & S RCC NP-2 for non-loading area or in green and NP-3 or NP-4 in loading area pipes. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

Laying

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as required. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.

Jointing

After setting out the pipes the socket shall be centered over the spigot and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe on both sides of the collars neatly.

Testing

All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above. the smoke test shall be carried out by the Contractor, if directed by the A test register shall be maintained which shall be signed and dated by Contractor/ Project Manager.

Excavation

Measurement for excavation of pipe trenches shall be made per linear meter under the respective category of soil classification encountered at site and specified in the tender.

a) Ordinary soil

b) Hard soil (hard moorum & soft rock)

c) Hard rock requiring chiseling

d) Hard rock requiring blasting.

Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth up to 1.5 m or as given in the Schedule of Quantities.

Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth up to 1.5 m.

Timbering and Shoring

Timbering and shoring as described above shall be measured per sqm and paid for as per the type of timbering of shoring done at site and as per the relevant item in the Schedule of Quantities. Rate for timbering and shoring shall be for all depths and types of soil classifications including saturated soil.

Saturated Soil

No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, or sieves and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation in saturated soil for pipe trenches above average depth of 1.5 m. No payment is admissible for water collected from surface sources and broken pipe lines or sewers.

Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within a lead of 200 m

5A421.10 uPVC Gully Trap

uPVC gully traps with minimum seal of 50 mm. The size for the gully trap shall be 150 X 150 mm. The grating on top of gully trap shall be DI (150 X 150mm).

5A421.11 Fixing of Gully Trap

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Project Manager /Consultant / Architect. The gully traps shall be fixed on cement concrete foundation 65 cm square and not less than10 cm thick. The mix for the concrete will be 1:4:8. The jointing of gully outlet to the branch drain shall be done like the jointing of
S.W. Pipes described earlier. After fixing and testing gully and branch drain, a brick work of specified class in cement mortar 1:5 shall be built with a half brick masonry work round the gully trap from the top of the bed concrete up to ground level. The space between the chamber and trap shall be filled in with cement concrete 1:3:6. The upper portion of the chamber i.e.

above the top level of the trap shall be plastered inside the cement mortar 1:3 finish with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off to slope towards the grating.

DI cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The finished top cover shall be to prevent the surface water from entering the gully trap.

5A421.12 Measurements

Gully traps shall be measured by the number and rate which shall include all excavation, foundation, concrete, brick masonry, cement plaster inside and outside, D I grating and sealed cover and frame.

5A421.13 Construction of Manhole

Where manholes are to be constructed, the excavation, filling back and ramming, disposal of sur plus earth, preparation of bottom and sides etc. shall be carried out as described earlier under trench excavation. Manhole shall be sized, and depths as called for in the drawings and Bill of Quantities.

The manhole shall be built on a base concrete 1:3:6 of 150mm thickness for manholes up to 1500mm depth and 250mm thickness for manholes from 1500 to 2500mm depth and 300mm thickness manholes of depth greater than 2500mm. Reinforcement as shown shall be provided in the base slabs.

The walls shall be of brick work of thickness as shown in drawings built in cement mortar 1:5. The joints of brick work shall be raked and plastered internally in cement mortar 1:3 (at least 12 mm thick) and finish with a coat of neat cement, external plaster shall be rough plaster in 1:3, PCC benching & semi-circular channels of the same Dia meter as the pipes shall be provided and finished with neat cement coating.

Above the horizontal diameter, the sides of channel shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given. All manholes/sumps shall be provided with polypropylene coated steel reinforced footrest. The polypropylene shall confirm to ASTM D-4101 specification, injection molded around 12 mm Dia IS-1786

grade FE-415 steel reinforcing bar. The serungs shall be set at 30 cm sinter valin two vertical runs at 380 mm apart horizontally. The toprungshallbe450mmbelowthemanholecover.Unlessotherwisementioned,manholessh all be constructed to the requirements of Indian Standard BIS:4111 (Part I). All manholes shall be constructed to be watertight under test. All angles shall be rounded to a 75mm radius with cement plaster 20mm thick. The benching at the side shall be carried out in such a manner to provide no lodgment for any splashing in case of accidental flooding. Manhole cover with frame shall be of cast iron of an approved make. The covers and frame shall generally be double seal as specified in the Standard details drawing.

Manhole cover for surface storm water manhole is SFRC perforated grating or without perforated and manhole size 560 mm Dia Heavy Duty.

Manhole cover for sewer application is D.I cover size 560 mm Dia Heavy duty.

5A421.14 Measurements

Manhole shall be measured in numbers as indicated in the Bill of Quantity. The depth of manhole shall be measured from invert of channel to the top of manhole cover. Manhole with depth greater than specified under the main item shall be paid for under` Extra Depth' and shall include all items as given for manholes depth will be measured to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

The following are inclusive in the cost of manhole viz;

i. Bed concrete

ii. Brick work.

iii. Plastering (inside &outside)

iv. R C C top slab, benching and channeling including drop connections.

v. Supply and fix footrests.

vi. Keeping holes and embedding pipes for all the connections.

vii. Excavation, refilling, necessary de-watering and disposing off surplus soil to a place asdirected by Project Manager.

viii. Curing.

ix Cost of angle frame and embedding the frame in concrete

bed. x Testing.

xi De-watering of chambers.

5A421.15 Road Gully chambers

The chamber shall be of brick masonry with Bricks of class designation 75 in cement mortar 1:5 (1 cement : 5 coarse sand) and shall have a PCC/SFRC/D.I gully grating with frame fixed in 150mm thick cement concrete 1: 2 :4 (1 cement : 2 coarse sand : 4 hard stone ballast 20mm nominalsize)ontop.Thesizeofthechambershallbetakenastheclearinternaldimension.The brick walls on the top of the bed concrete 1:4:8 (1 cement: 4 coarse sand: 8 hard stone ballast 40mmanddowngauge)ofthechambershallbeplasteredwith12mmthickcementplaster1:3 (1 cement: 3 coarse sand) internally and externally and finished with a floating coat of neat cement. The excavation shall be done true to dimension and level shown in the drawing.

5A421.16 Masonry Drains

Brick masonry drains shall be of a minimum width of 30cms for depth up to 45cm and a maximum width of drains shall be 45cms for depths beyond 45cms. However, in special cases where the depth is very high, the width of drain shall be in proportion of 1:5 with the depth. Brick masonry drains shall be constructed in brick masonry in cement mortar 1:5 in cement concrete foundations. Wherever specified, masonry drains shall be plastered with cement mortar inside. The outer surface shall be flush pointed without additional charge.

AllbrickmasonrycovereddrainsshallbeprovidedwithSFRCgratingH.Dandsizeis600mm x 300 mm wide. All drains shall be plastered with cement mortar 1:4, 12mm thick with a coat of neat cement. All finished work shall afford specified gradient to ensure free and efficient discharge.

5A421.17 Making Connections

GeneralContractorshallconnectthenewsewerlinetotheexistingmanholebycuttingthewall s benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. General Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

5A421.18 Testing

All rights of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out

pressure will, however, not exceed 6 meters head at any point. The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.

5A421.19 Sewer lines shall be tested for straightness by:

i. Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball shall roll down the invert of the pipe and emerge at the lower end.

ii. Means of a mirror at one end a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.

iii. The General Contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the Client's site representative.

iv. A test register shall be maintained which shall be signed and dated by General Contractor and Client's site representative.

5A421.20 Rain Water harvesting System:

Rain water harvesting shall be design and provided as per latest guidelines of MOEF and per local authority requirement.

5A422 WATER TREATMENT PLANT

5A422.1 BASIS OFDESIGN

5A422 WATER TREATMENT PLANT

5A422.1 BASIS OFDESIGN

The contractor shall ensure domestic water of potable water standard after the treatment system. The acceptable standard of potable water shall be in accordance to SP:35 S & T: 1987 as per acceptable limits.

The Outlet parameters of treated water will be as per IS:10500 parameter.

The water treatment plant will be designed as per the raw water test parameters;

The scheme will be decided/approved by the engineer-in-charge or consultant after actual raw water

test report.

Adequate storage of water in underground raw + treated domestic water tanks.

The execution of works and materials used shall be as per the latest relevant IS specifications.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any edition of such specification being mentioned in the specifications.

5A422.2 CONCEPT OF THESYSTEM

The incoming main from municipality / bore well water supply line shall be led into fire water tanks from where it will be allowed to overflow into raw water tanks. From raw water tanks, it will be allowed to filled the domestic water tanks through a set of complete filtrations.

Water Treatment System for meeting the domestic water quality requirement with chemical parameters in acceptable limits as per SP:35 which is considered safe for human consumption, and other standards.

5A422.3 WATER STORAGE &DISTRIBUTIONSYSTEM

5A422.3.1 Water Requirement

The water requirement for the project is proposed to be based on the provisions of IS:1172 and prevalent practice. The estimated requirement of water per day for the Complex is based on the number of users and other services.

5A422.3.2 Source of Water

It is expected that part of the daily domestic water requirement for the Complex shall be through municipal/other sources mains supply. Since it is unlikely that municipality would be able to meet the entire daily requirement. Provision of tanker water fill feasibility shall also be made.

5A422.3.3 Water Storage

The total water storage in raw & domestic water tanks is approx. 2 days.

5A422.3.4 Water Quality

Domestic Water Requirement: The basic water treatment plant shall comprise of activated carbon filter & dual media filter, softener, iron removal plant, RO Plant if required as per latest water test report and Hypo dosing's.

Disinfected Water: It is proposed to provide online UV units for water consumption points for direct consumption for Domestic and flushing water.

5A422.3.5 Appurtenant

Following components shall be included in the water treatment system for efficient functioning:

i. Automatic air vent at each of the highpoint.

ii. Drain valve at each of the low point.

iii. Pressure Release valve where abnormally high pressure is to be reduced.

iv. Flowmeter.

v. Pressure Gauge.

vi Anchor block / thrust block.

The Water distribution System shall consist of Dedicated Variable speed Hydro-pneumatic pumps for domestic and RO water distribution and transfer pumps for flushing with all accessories complete with all controls, and monitoring system, electrical panels, earthing, cabling and interfacing and control from BMS etc.

Variable speed hydro-pneumatic pumping system:

Variable speed hydro-pneumatic system consisting of vertical multistage centrifugal pumps having stainless steel (AISI 316L) impellers, shaft and housing, C.I. Base & head, TEFC motor (with mechanical seal) Vendor to submit performance curves, dimension detail and technical catalogue of the proposed model for review and approval.

Panel mounted microprocessor PID controller and variable frequency drives (VFD) one dedicated to each pump transferable from one to other integrated in a single body

or as separate components with pressure transducer minimum two lined LCD display, diodes to indicate pump ready, pump running and fault and capable to communicate with other controllers following MODBUS-RTU or BACNET Class-2 protocol through RS485 port, sequencing for alternate running. All alarms should be displayed in the controller. System should be equipped with dry running protection along with necessary cable & cable tray.

(Quantity of VFD = 1 No. with each pump (And minimum 2 working + 1 Stand By pumps to be considered in one set for each water supply zone)

Pre-charged MS powder coated diaphragm pressure vessel of required capacity with replaceable bladder suitable for 15 kg/sq.cm working pressure, connected to outlet header with necessary flanges, gaskets, isolating valves, nuts/bolts etc. complete (size of pressure vessel shall be of suitable pressure).

Set of accessories such as pressure switches, pressure transducers, (butterfly valve, NRV of PN 16.00 rating) Vibration Isolator with unit control, GI "heavy class" suction & delivery header & interconnection piping, level controller, dry running protection, pressure gauge, epoxy coated base frame complete with Vibration pads of required quantities.

Transfer Pumps-

Vertical, inline multistage centrifugal pump set with cataphoretic coating for cast iron parts,

suction and discharge casing made of SS 316 impellers, stage casing, pump spacer sleeve as per IEC standards and unbalanced bellow type mechanical seal design for maintenance free operation to withstand pressure up to 25 bar. Pump should be tested for performance as per ISO 9906

Gr. 3B/Clause 4.4.2 and hydrotested for 1.5 times of design pressure (37.5 kg/cm2) for minimum 10 minutes. With minimum efficiency index MEI≥0.70 connected to TEFC induction motor suitable for 415 Volts, 3 phase, 50 Hz, Enclosure IP55, AC supply with suitable RPM. Pump and motor shall be from single manufacturer

5A422.4 WORKMANSHIP

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Client’s Site Representative. All materials and/or Workmanship which in the opinion of the Client’s Site Representative / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

5A422.5 MATERIALS

All materials shall be best of their kind and shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and origins approved by the Client’s Site Representative /Consultants.

As and when required by the Client’s Site Representative/Consultant, the tenderer shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or un sound by the Client’s Site Representative/Consultant, the tenderer shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Client’s Site Representative / Consultant. To prove that the materials used are as specified the tenderer shall furnish the Client’s Site Representative with original vouchers on demand.

5A422.6 WATER TREATMENT SYSTEM&ACCESSORIES

5A422.6.1 Scope

This section of the contract involves the design, supply, installation, testing and commissioning of the complete pumps, Water Treatment plant for domestic water.

All installation work shall comply with the latest rules and regulations.

The work embraced by these specifications covers the design, submission to authorities, supply, delivery on site, installation, testing, commissioning and maintenance of the Water treatment system installation of the building.

The scope of work shall include the following (list is indicative and not exhaustive):

- Complete Raw Water Treatment System. The Contractor shall be responsible for carrying out water analysis for the raw water from borewell / tanker/other supply and design all system components/equipment so as to achieve the potable water quality as per specified Standards SP:35 (S&T 1987) & IS10500.

- The Raw Water Treatment System as a minimum shall consist of feed pumps, filters with back wash provisions with all accessories complete with all controls, U/V Treatment System, PH automatic control and monitoring system, electrical panels, cabling etc.

Feed Pumps-

- Horizontal volute casing pump, single- stage, with ratings and main dimensions to EN 733, with bearing bracket, in close-coupled design. Axial suction nozzle, discharge nozzle pointing radially upwards. Shaft fitted with a replaceable shaft sleeve in the shaft seal area. Volute casing and impeller with replaceable casing/impeller wear rings. Impeller matched to the operating point for saving energy. The pump motor shall be suitable for 415 + 10% volts, 50 cycles, 3 phase power supply meeting and high efficiency IE3 motor.
- Material of construction: Casing: CI; Impeller: Bronze & shaft: SS 410
- All the pipework between the raw water tanks, treated water tanks and all the interconnecting pipework amongst the Water Treatment pumps and other equipment.
- Electricalequipmentandinstallationworkincludingthenecessarywiringetc.inControlpanel.
- Painting and labelling of pipework and equipment;
- Provision of all hold down bolts, spigots struts and the like required to be built in during construction;
- Provision of potential free contacts to BMS indicating the status of the pumps and pressure vessel in form of hardware interfacing panels inside each control panels of all pumps.
- Provision of all level switches, flow switches and other sensing devices for status indication.
- All interfacing work with other trades.
- Testing and commissioning and balancing of the complete Water Treatment system;
- Provision of twelve (12) months maintenance and break down services;
- Provisions of operating instructions and maintenance manuals;
- Provision of mandatory spare parts;
- Training of the employer's staff for proper operation of the entire systems;
- Liaison with Local Authorities to obtain all necessary certificates and approvals, including the completion of all submission drawings, forms and payment of any fees

and charges. All the costs for all the tests required by Local Authorities shall be included. To attend to any Authorities inspection regardless of whether this inspection is carried out after the defect liability period;

- Provisions of the necessary installation which include pumping works, conduit and control wiring, etc. to form a workable system required.
- All other works and systems as specified in the Contract document and or shown on the drawings.

5A422.6.2 General

Equipment offered for supply and installation shall include the following:

All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installations in accordance with the true intent and meaning of this Specification.

All necessary safety devices for the protection of personnel against injury and the protection of plant and equipment against damage including relief valves, belt guards, fan inlet and/or discharge guards, safety railing, effective earthing of electrical components, electrical interlocks, warning lights and alarms.

Readily accessible, dust- Proof lubricating facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning.
Clearly visible and robust manufacturer's name-plates permanently fitted each and every item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw etc.

The Contractor also shall allow provision for the inspection of all plant and equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

5A422.7 Filtration

5A422.7.1 Scope

The scope of this section comprises the supply, installation and commissioning of FRP vessel/MSEP filter.

5A422.7.2 FRP Vessel Filter

The filter shall be constructed of FRP/MSEP material with inner shell of integrated polyethylene, polypropylene and other material as per manufacturer's standard.

The inter distribution system and the underbed draw off system shall be of Hub & Lateral type of polypropylene material. The filter shall be provided with manhole cover, hand hole, flanged outlet for piping / valve connection and adequate tripod with skid self-supporting structure for making the installation completed. The filter shall also be provided with vacuums breaking connection / accessories to avoid any collapse of internal lining. All filters shall be provided with lifting lugs. The filter bed depth shall be 1500 mm.

5A422.7.3 Face Piping

Each filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash complete with valves.

5A422.7.4 Accessories

Each filter shall be provided with following accessories: -

a. Air release valve with connecting piping.

b. 100mmdiadialbourdentypegunmetalpressuregaugeswithbrassisolationballvalve and connection piping on inlet and outlet.

c. Sampling valves (ball valves) on raw water inlet and filtered water outlet.

d. Individual drain connection with brass full way ball valve for each

5A422.7.5 filter. Filter Media

The filter media shall comprise of gravel / silica/Resin/birm of various grade in varying thickness. The cut- section of the filter along with filter media detail shall be subject to approval by the Consultant.

5A422.7.6 Test Kits

Provide one test kit with initial requirement of reagent:

a) PH meter (electronic)

b) Turbidity meter

Detail of equipment with technical literature shall be supplied with the

5A422.7.7 tender. UV UNIT

UV unit shall be complete with reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lamp out alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV Dosage should be > 30,000 uW
– Sec / sq.cm. The lamps should be selected based upon the flow requirement of respective unit. It will be either localized or centralized.

RO Plant

Reverse Osmosis based water treatment system must be designed for min. 2000 TDS, however in case the TDS exceeds 2000 the system should be designed as per actual TDS based on the water report of the site to be done before design of the system & approval of the same by consultant. Recovery of the system should not be less than 85% & flux on membrane should not be more than 20 to 30 GFD. Membrane life to be considered with projection must be not less than 3 years & provision should be kept for dosing of Anti-scalent, Chlorine, SMBS, PH Correction in permeate water line, Acid Dosing in raw water feed line. There should be instrumentation for PH monitoring in feed & Treated water, ORP monitoring in feed & Treated water, Conductivity monitoring in feed & Treated water, Low Pressure Switch & High Pressure Switches, Raw water feed pumps (1W + 1 SB), High Pressure Pumps (1W + 1 SB), Micron Cartridge Filters of suitable flow rate as per feed water in SS 316 Housing for 10 & 5 micron, PLC based completely automated system with auto flushing system, Separate system for CIP with SS 316 pump & Cleaning tank should be provided & separate micron cartridge to be provided for CIP circuit. In case WTP is in line with RO then MGF & ACF can be considered as common however in case there is an intermediate storage tank in between then MGF & ACF separately have to be provided with RO also. Specifications for the MBF & ACF will remain same as for WTP units.

5A422.8 WATERQUALITY

The domestic water treatment basis of design is as per raw water analysis. Contractor shall get the raw water analysis done at his own expense (in accordance to IS:10500 prior to submission of the water treatment scheme.

The contractor shall ensure domestic water of potable water standard after the treatment system. The acceptable standard of potable water shall be in accordance to SP:35 S & T: 1987 as per acceptable limits.

5A422.9 FLOATLESS TYPE LEVEL SWITCH IN WATERTANKS

The Contractor shall supply and install float less type switch probes in the water tanks as indicated below and shown on the drawings.

Raw Water Tanks in Plantroom

Low level alarm;

- Low level cut-out for raw water pumps;
- Earthing probe. Treated Water Tank in Plantroom
- Low level alarm; Low water level cut-out for the hydropneumatics pumps;
- Earthing probe.

Each probe shall be of the correct length for the particular application and tank location. Electrodes shall be of polished stainless steel 20 mm OD. Electrode holders shall be weatherproof in all respect.

The earthing probes shall be connected and wired to the building earth systems of the building.

The level switch set shall operate with a stepped down voltage at 24V maximum. Stepped down transformers shall be provided for each set of control probes and shall

Be installed inside centralized control cubicles inside pump room. The necessary length of control cable shall be included.

MOTORIZED BUTTERFLY VALVE WITHACTUATOR

Thebutterflyvalveshallconsistofcastironbodypreferablyintwopiececonstruction.Thedis c shall consist of disc pivot and driving stem shall be in one piece centrally located. The valve seat shall be synthetic material suitable for water duty. It shall line the whole body. The disc should move in slide bearings on both ends with ‘o’ ring to prevent leakage. The handle should have arrangement for locking in any set position. The valve should be suitable for 12 Kg/cm2 working pressure.

The actuators of motorized butterfly valve shall be BMS compatible. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator. Actuators shall provide the minimum torque required for proper valve close- off against the system pressure for the required flow. Two- position or open/closed actuators shall accept 220 V AC power supply. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

5A422.11 CONTROL OF DUTY / STANDBYPUMPS

Operation of the duty and standby pumps shall be carried out by the following method:

Manually by means of a local start/stop push buttons on pump local motor control panel and emergency stop switch.

When the level drops to the pre-determined level, a signal will be sent to the pump local motor control panel to start the pump.

Automatic controls shall be operated by electronic, float less type level

5A422.11.1 switches. PUMP INDICATOR

The following audible and visible indication shall be provided at the pump local control panels as applicable:

a. Red "overflow level" indicator with buzzer for the associated water tanks;

b. Amber "extra high-water level" indicator for the associated water tank;

c. Amber "high water level" indicator;

d. Amber "low water level" indicator;

e. Red "pump trip" indicator for each pump;

f. Green "pump on" indicator for each pump;

g. "Pump electrical supply healthy" indicator for each pump;

h. Amber "remote/local" status indicator.

5A423 EFFLUENT CUM SEWAGE TREATMENT PLANT

5A423.1 BASIS OFDESIGN

The capacity/ rating of pumps and equipment etc. shall hold good for the capacity of 450 Lts/BED / day and shall be good for meeting the treated parameters requirement as follows:

a. Permissible limit as prescribed in IS:2490 (Part-I) – 1974 and environment (Protection)Rules1986.

b. Water (Prevention and Control of Pollution) Act, 1977 &1978.

c. Environment (Protection) Act,1986.

d. Environment (Protection) Rules,1986.

e. Hazardous Wastes (Management & Handling) Rules,1989.

f. Manufacturer, Storage and Import of Hazardous Chemicals Rules,1989.

g. Manufacturer use import and storage and hazardous Micro-Organizers, Genetically Engineered organizations or Cell Rules,1989.

h. Manual on sewage & sewage treatment -CPHEEO

i. The Public Liability Insurance Act,1991.

j. All standards as laid down by Central Pollution Control Board and any other relevant statutory authority. All standards as laid down by local Municipal Authority.

k. Recycle of waste water to meet 100% requirement and removal of sludge in cake from, no untreated wastewater to be discharged outside to the premises.

5A423.2 GENERAL

The sewage treatment plant (STP) system outlined in this section specifies the system design, manufacture, supply and installation Testing & Commissioning of a standard MBR based system. The General Contract or may propose alternatives to this type of system, but the se must be to a standard acceptable to Water and Sanitation Authority Requirement, Local Pollution Control Board Norms, World Health Organization Guidelines, the local Environmental and Pollution Control Authorities and subject to the approval of the Project Manager The works hall be carried out in a manner consistent with good practice in the local market. The General Contractor shall consider all site conditions in designing the system and selecting the equipment. The General Contractor shall be responsible for engaging a STP specialist to perform the system design and obtain approval from relevant Authorities. A qualified and experienced Engineer shall be engaged for the system design, preparation of system proposal submission, obtaining approval and site supervision.

The General Contractor shall perform the system design based on the criteria/data and component technical requirements specified in this section/drawings and the local Authorities' regulation/requirement. The General Contractor shall furnish system which comprises products of manufacturers who have designed and made these

associated products for a period of at least five years. The General Contractor shall submit complete catalogue information, design calculation and samples complete with full technical data and shop drawings for the entire system, test certificates, etc. for acceptance prior to commencement of installation.

The General Contractor shall submit analytical test reports of effluent water samples after the commissioning or after the system is put into operation or as required by the Project Manager:

First 3 months – 15 days

The report shall contain analysis of all data related to those requirements laid down by the local Authorities.

As a minimum the following items shall be measured and analyzed as indicated under clause following.

5A423.3 DESIGNCRITERIA

It shall be the General Contractor's responsibility to ensure the quality of the treated effluent to comply with the local Authorities requirement and the following characteristics, whichever is stringent.

	Item of Analysis	Units in Milligram per litre or otherwise stated
1	Color	7 Lovibond units
2	pH value	6.0 - 8.5
3	BOD (5 day at 20°C)	05
4	COD	50
5	Total Suspended Solids	<=1
6	Grease and Oil	05
7	Hardness	Commercial zero for soft water (Optional for cooling tower make-up)
8	E-coli	B.D.L (Below Detectable Level)
9	Total Phosphate (PO4)	Less than 4 Mg/l
10	Total nitrogen	Less than 10 Mg/L
11.	Turbidity (NTU / JTU)	< 1

The effluent from the Sewage Treatment Plant shall be suitably treated and the effluent water recovered shall be used for irrigation and Cooling Tower make-up.

5A423.4 Description of Process

The treatment process shall comprise the following

stages: For MBR System

Neutralization	Chamber
Physical treatment:	Coarse& Fine bar-screening
Primary treatment:	Oil & Grease Trap & Grit Chamber
Equalization tank:	Flow equalization with air mixing
Biologicaltreatment:	Aeration With MBR
Disinfection	UV unit within line hypo dosing system as stand by
Digester:	Aerobic digestion with diffused air system
Sludge disposal:	Sludge chemical conditioning and dewatering
Tertiary treatment	ACF and Softener system for HVAC
Monitoring System	Online Monitoring system for the parameter namely

PH, TSS, COD, BOD and Flow meter.

The bio degradable detergent from laundry plant will bed is charging din to the Pre-treatment stream within Sewage Treatment Plant. The General Contractor shall provide the special equipment, etc. and deforming agent for the treatment of the detergent such as providing the froth pump to remote the foam and Fecl3 for phosphate removal.

5A423.5 Performance Criteria of the Plant

RawsewagewillbebroughtintotheSewageTreatmentPlantbyothers.TheGeneralContractor shall receive sewage from this point to the treatment plant for treatment process.

The treatment plant shall be designed to treat the following basic characteristic expected in the raw sewage.

Description	APT
Estimated daily flow	460 m3 /
day Discharge period	20 hrs. /day
Average flow	23 m3 / hr
Peak flow	69 m3 / hr

However, as a specialist in the field, General Contractor may envies size the raw sewage characteristic from his experience and shall decide the treatment standards General Contractor to submit his confirmation on the treatment parameter considered as an Annexure. The plant shall be capable of treating effluent to the following standards as stated in 2.1 above.

5A423.6 Process Description for MBR System

The outfall sewer main from the last manholes, will be let into a screening chamber by gravity flow. Large solids particles shall be intercepted by a bar screen, preceded by a grease trap. The primary clarified wastewater is then further pre-treated by fine screening before entering the bioreactor portion of the MBR process. Fine screening shall be done by proposed fine bar screen.

a. The sewage after screening is collected in a oil & grease trap after that goes-in to grit chamber & finally to the equalization sump for smoothing out peak flows. The provision of aeration

shall be made in this tank to break the solids in suspension and to homogenize the sewage.

b. The homogenized effluent is then pumped into the biological reactor for the removal of BOD, COD, Phosphate and Nitrates. The reactor is equipped to perform suspension growth of microorganism (Mixed Liquor) in 12000-15000 MLSS. The air shall be provided through an air diffusion system all-round the membrane to scour the sludge & for biological treatment of sewage in the reactor.

c. The mixed liquor suspended solids from the bioreactor is then suck through the polymeric reinforced hollow-fibre/flat sheet membrane. The membrane (MBR) tank consists of air diffusion system, permeate water manifold & membrane elements. The Ultra Filtration Membrane shall be reinforced hollow fibre tubular type polymer membranes, having a pore size of not greater than -0.08 micron. The treatedwaterderivedfromUltraFiltrationsystemisthenpassedthroughU.Vunit for disinfection purpose and stored in a treated water tank for further reuse.

d. Depending on the MLSS to be retained in the Biological reactor, the sludge is wasted. The wasted sludge is collected in sludge thicker and aerated with diffused aeration. The sludge is then fed to filter press / centrifuge and dewatered.

5A423.7 EQUIPMENT

The following give the minimum requirements of the different components of the system. The figures indicated are for General Contractor's references. It shall be the General Contractor's responsibility to select equipment for the plant proposed by them so that the capacities and performance of the Sewage Treatment Plant meet with the criteria set out in this specification. All equipment and components of the system shall be of top-quality construction and shall be corrosion resistant.

5A423.7.1 Inlet Screen Chamber

Raw sewage shall flow into the inlet screen chamber by gravity. Large solids particles shall be intercepted by an Coarse & fine screen.

5A423.7.2 Oil and Grease interceptor

A suitable capacity Oil and Grease interceptor shall separate Oil and Grease from the waste water before discharging into tank.

5A423.7.3 Equalization Tank

The equalization tank shall be designed to provide a minimum storage of 4 to 6 hours at peak flow while pumping. Two submersible pumps as per schedule shall be provided with level switch control and automatic cut-in of the standby unit. An aeration system similar to the extended aeration tank shall be provided for mixing and aerating the sewage.

5A423.7.4 Sludge Collectors:

The sludge collectors serve to scrape the settled sludge to the sludge pump pit and a skimmer shall collect the scum. Each shall be of mechanical drivers for full automatic operation. All components such as chain, sprocket, etc. inside the tank shall be made of non-metallic material (such as cast nylon).

5A423.7.5 Air Blowers

Air blowers shall be provided in duplicate (i.e. one duty and one standby). Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V- belt system or direct drive coupling.

The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated. Motor speed shall be 1500 rpm. The size and performance of the air blowers hall be so selected that it can provide a minimum airflow rate 0.5l/sec/diffuserto1l/sec/diffuser maximum, and to maintain a minimum of 2.0mg/ litres dissolved oxygen in the aeration tanks in operation.

5A423.7.6 MBR Tank

Sewage shall be retained in MBR tank subjected to biochemical oxidation by fine bubbles aeration.

Air Diffusers for Equalization, Sludge holding tank

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomer rubber membrane or composed of crystalline fused aluminum oxide with a suitable ceramic bonding material. Membrane endurance shall be more than 180,000 expansion/contraction cycles. Diffuser shall be of self-cleaning, non-clogdiscordome-shaped type. Oxygen transfer efficiency shall not be less than 20% at 3.5m

submergence in clear water. Alternatives may be offered for consideration.Diffuserholddownassembliesshallconsistofaretainerbolt,amatchingwasher and gasket. Sealing gasket shall be composed of solid neoprene rubber and shall be conform to ASTMD-2000andshallbesuitableforwithstandingtheeffectsofwastewaterhightemperature up to 120□C. The General Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

5A423.7.7 Membrane Module

A mechanical fine screen of 2-3mm size rotary drum/rotary arm type will be installed before Membrane module shall be comprising of housing of membranes, aeration diffusers, primate water manifold membrane element. Membrane should be combined into bundles wound a carriercartridgewhichcanallowforhighpressureairscarringfor cleaning.TheUltrafiltration membranes shall be rein formed hollow fibre/flat sheet tubular type polymer membranes. A group of multiple membrane fibres form a module and a group of modules form a rack. The membranes shall have a pore size not greater than 0.08 micron.

5A423.7.8 Disinfection Tank

U.V sterilizer shall be in-line unit installed after tertiary filters. Water shall be passed through UVunitfordisinfection.TheUVshallbeinstalledatanappropriatelocation.Asstandbyhypochloride solution shall be dosed in to the effluent by an electric dosing pump paced according to the sewage inflow.

5A423.7.9 Sludge Thickening / Holding Tank

Excessive sludge shall be stored in the sludge holding tank for final dewatering and disposal

5A423.7.10 Treated water/Permeate Tank

The treated water tank shall hold the treated effluent where it shall be periodically pumped through filters for terminal use.

Sewage feed, sludge transfer & permeate suction

Pumps Working and standby sewage pumps shall be

provided.

Each shall be of non-submersible type centrifugal pump with suction grid and automatic dischargeconnection.Pumpcasingandimpellershallbeofcastironmaterial.Shaftshallbeof CS material. (General Contractor to ensure submission of quote forsame).

5A423.7.12 Chlorination System (Standby System)

A chlorine contact tank with a capacity of not less than 30 min average flow detention shall be furnished.Itshallbeattachedtothesettlingtank.Constructionshallbeliketheothertanksand panels comprising the treatment plant and shall include flow diversion baffles and outlet of the chlorine contact chamber for measuring the waste flow. A chlorine feed system shall be furnished as a complete package assembly for installation in the plant room. Assembly shall includebaseplate,electronicpositivedisplacementtypechemicalfeedpump,fiberglasssolution tank, suction and discharge tubing and fittings. Each chlorine solution dosing pump shall perform to achieve a residue not more than 1 mg/l in the treated effluent. Solution feed pump shallhaveamaximumcapacityof1l/hrchemicalpumpwilloperateon50Hzsupply.Fiberglass solution tank shall be of no less than 200 litre capacity and include suction line fitted with strainer. Control shall be by means of compound loop (i.e. flow proportional and residual measuring).The feed pump shall be of variable speed positive displacement, solenoid-riven diaphragm metering type. The construction material shall be suitable for corrosive nature and asfollows:

5A423.7.13 Tertiary Treatment

Thistertiarytreatmentshallbeprovidedforthe treatedwatertobereusedcoolingtowermake-up. Activated carbon filter with softener with brine tank to achieve hardness less than 5 ppm. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria. Details of the equipment layout proposal shall be submitted for review by the Construction Manager with tender documents.

5A423.7.14 Treated Water Transfer Pumps

Working and standby filter feed and Treated Water Transfer pumps shall be provided. Pump casing and impeller shall be of as per requirement

5A423.7.15 UV Unit / System

UV system for disinfection shall utilize h

igh purity quartz sleeves and high output UV lamps. UVReactorMOCwillbeSS316L.Systemshallbedesignedtoprovideauvdoseof600J/m2 atUVTof65%andTSSlessthan10mg/L.Systemshoulddelivera4logreductionofcoliforms andprovideTCcounttolessthan200CFU/100ml.Theelectricalcontrolsystemshouldutilize high frequency electronic ballasts and provide efficiency of more than 90%. The reactor vessel shall utilize internal baffles to ensure turbulent and plug flow. The UV intensity monitoring system shall be designed in accordance with the German DUGW W294 standard. The sensor shallbeofdrytype andremovablewithoutsystemshutdown.Thetertiarytreatmentplantshall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria. Details of the equipment layout proposal shall be submitted for review by the Project Manager with tenderdocuments.

5A423.7.16 Electrical Control

The operation of the treatment process shall be fully automatic. A completely assembled and prewired control panel with mimic diagram consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timbers, on-off-auto change-over switches and duty selectors for equipment. Proper control sequence shall be designed according to system requirement and manufacturer standards,

5A423.8 PROGRAMMABLE LOGICCONTROLLER:

5A423.8.1 PLC standalone system

General Contractor to consider standalone system for Operating STP plant with following configuration needs to be followed:

TheHMISupervisionsystemwillconsistofmultipledevicesandequipmentassembledinsu ch a way as to form a supervisory and control system and essentially made up of: a) CPU andI/O
b) HMI (Human Machine Interface)

5A423.8.2 Processor / CPU:

The CPU should have Ethernet, RS-485 port and USB port for programming as per the requirement. Processor should scalable up to 50% extras I/O's by putting additional memory forfuturerequirement.Processorshouldbeconnected withtheportableonlineUPSofsuitable rating with batteries back up of minimum 30minutes.

The CPU should have 2MB inbuilt RAM memory for executing the instructions.

The memory shall be field up-gradable up to 16 MB min. for further extension.

The Memory selected by General Contractor shall be such that CPU loading should not exceed 70%.

PLC should not require any batteries for retention of memory. Normal SD memory should be used for program storage.

The CPU should not have any limitation for no. counters, timers and flags, other than memory capacity.

All the I/O racks shall be connected to both the processor racks.

Dual redundant 24V DC power supplies as per requirement shall be independent each with 100% capacity. Power supply should have trip relay to indicate failure of power.

5A423.8.3 Communication:

The communication network shall be as per Architecture given in this tender. The communication between SCADA & PLC shall be Modbus TCP/IP.

Scan time shall be maximum one second and record of scan shall be maximum one minute

All hardware of the Processor shall operate at a temperature of 0 to 60 degrees C with a temperature rating for storage of – 20 to + 85 degrees C.

TheProcessorhardwareshallfunctioncontinuouslyintherelativehumidityrangeof5%to95 % with no condensation.

The Processor system shall be designed and tested to operate in a high electrical noise environment.

TheCPUwithinthesystemshallperforminternaldiagnosticcheckingandgivevisualindicati on Alarm Summary on HMI with complete description of the fault/ diagnosticalarm.

The Controller shall include colour indicators showing the following status information as a minimum:

a. Run mode of thecontroller.

b. The fault status of thecontroller.

c. IO

5A423.8.4 communicationstatus.

Programming

The Programming software for the PLC shall support all five languages ST, LD, FBD, IL, and SFC as per IEC 61131-3. It should be possible to write logic in any of the languages as per customer requirement.

a. The operator should be able to backup entire/selectable data and program logic onto a personal computer/ storage disk/removable storage media,online.

b. Variables within the controller shall be referenced as unique, default or user definedtags.

c. On-line programming and upload / downloads of control programs shall be able to occur over the network.

d. On-line edits shall be possible in the logic. Test function shall be available to check the edits before assembling them in the control program. This function shall facilitate testing ofalleditsonthesubjectsub-program;checkthestatusofthecorrespondingoutputsbefore assembling the same in the program. Once assembled, the edits will become part of the runningprogram.

5A423.8.5 I/O Racks

a. The back plane shall be expandable by adding independent base units via interconnection terminals/cables. The modules shall be mounted on these baseunits.

b. The I/O racks shall be mounted on DIN rails (Field I/O system)/panel backplate.

5A423.8.6 I/O Modules

a. All I/O modules shall be field I/Os as per OEM’s make and from the same family of processor.

b. Each input and output module shall be a self-contained unit. Each potential free contact or other input device shall be connected to only one individual input point at PLCInput.

c. Each control output shall be connected to only one individual output point at PLC output.

d. All I/O modules shall supportthefollowingdiagnosticsasaminimum:

i. Each channel shall have an LED indication to notify the status

ii. Channel level power or function failure detection.

iii. RIUP feature (Removal and insertion underpower):

Under this feature the electronic part of the Module should be removable from the backplane (electrical bus) and reinserted in to the bus without affecting other modules connected into the same I/O sub system under power up condition. The terminal block should be detachable from the electronic before removing the electronic from the backplane (electrical bus) for easy of

wiringmaintenance.Asuitablekeyingfeatureshouldbeprovidedtoensurethatcorrectmodule isplacedafterremoval.Duringthispracticeonlythechannelsonthemoduleunderreplacement shall go down with a suitable alarm to the mainPLC.

e. Over and above, the I/O modules shall have the following features Channel level fault reporting.

- System clock for time-stamping data /faults.
- Open-wire detection for analoginputs
- Latching of intermittent fault data

f. Analog Input Modules should have the following features:-

- 12 bits resolution as minimum.
- Channel levelisolation.
- Scaling should be possible to engineeringunits.
- Over range, under rangedetection.
- Floating point or Integer data selection.
- RIUP (Removal and insertion underpower)

g. Analog Output modules should have the following features:-

- 12 bits plus signresolution.
- Channel levelisolation.
- Rate of changelimiting.
- Selectable fault / idle states / point includes hold-last-state, set to user specified-values.
- Hold for initialization
- RIUP (Removal and insertion underpower)

h. All digital input modules shall be maximum 64-channel,

i. All digital output modules shall be maximum64-channel

j. All analog input modules shall be maximum 08channels.

k. All analog output modules shall be maximum 08channels.

5A423.9 HMI (Human MachineInterface)

5A423.9.1 General

TheOneHMIstationshallbeinstalledinthePLCpanelinsidethecentralcontrolroom.Station willconsistofaliquidcrystalcolormonitorof12”Screen.The HMI shall be theonlyinterface of the operator for the plant and consequently all the commands, set point controls, and the control of the various plant areas and the acquisition of all monitoring signals for the correct operation of the plant must beaccessible.

5A423.9.2 Overview

The HMI system software must allow the full and complete interaction between the plant operators and the plant. It must supply all the plant data from field transmitters and display the values and statuses by the animation of graphic objects and colors in the required number of graphic pages. The transfer between the graphic pages shall be simple and menu driven. The graphic pages will display in real time the following information:

a) Processvariables
b) The statuses of the digital inputs andoutputs
c) Historicaldata
d) Trend plots
e) User fileinformation
f) Alarm indication, listing andrecording

The information will be represented as alphanumeric text, text strings, dynamic symbols, trend plots, as required by the customer. The colors, forms, flashing etc. will be assigned to each dynamic element present on the video. The operator interface will have a sufficient range of security options to impede access to programs, function keys and displays depending on the password supplied.

5A423.9.3 Open System

The system must be able to interface with external systems to exchange data to BMS standard open protocol like MODBUS, BACnet etc.

5A423.9.4 Alarm Handling

Thesystemshallhandlealarmsinrealtimeandthehistoricalviathededicatedvideopagesthat show, apart from the alarm description, the time in format hour, minutes and seconds. The alarms shall be presented in table form that permit identification of new alarms, acknowledged and unacknowledged alarms, and alarms disappeared that have disappeared before being acknowledged, and the historical list of all alarms. It shall be possible to prioritize thealarms.

5A423.9.5 Trending

It shall be possible to display the data as a recording trace in real time and as a history. For the historical trends, it shall be possible to change the time base, the display interval, the baseline level etc.

5A423.10 ENCLOSURES FOR PLCPANEL

All the controllers shall be housed in Lockable Vandal proof boxes IP 55 Housing which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust andverminproofandsuitablefortropicalclimaticconditions.Thepanelshallbemetalenclos ed 14 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all coverstorenderthejointsdustproof.Alldoorsandcoversshallbehingedandlatchedandshall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal. All panels and covers shall be properly fitted and secured with the frame and holesinthepanelscorrectlypositioned.Fixingscrewsshallenterholestappedintoanadequat e thickness of metal or provided with nuts. Self-threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the color decided in consultation with theArchitect/Consultant.

5A423.10.1 Other Equipment

Any other necessary accessories, such as buffer, riser, partition, control panel, collection devices,etc.forallthetanksandpumps(wherenecessary)shallbeprovidedinordertoprovide a fully workingsystems.

5A423.10.2 Piping Materials

GI - Suspended air dispersion grid

SS304 - Submerged air dispersion grid

PVC - FlexibleDroppers

PVCpiping - Pumped effluent, Filter frontal & Softenerpiping

GI(Heavy) - Interconnecting pipe line after delivery header of pump Tank overflow pipeetc.

5A423.10.3 Valves

The General Contractor shall supply and install all isolating valves and control valves as indicatedonthedrawingsandasrequiredfortheproperandefficientoperationandmaintenance of the entire systems. All valves supplied shall be suitable for the working pressure and test pressureofthesystemasspecifiedelsewhereinthisspecification.Regulatingvalvesshallbeof similar materials as that specified for cast iron gate valves. All regulating valves shall be lock shield type. All valves shall be full line size. Each valve shall have a purpose made reference number plate for label engraved or stamped indicating the manufacturer's catalogue number, pressure and temperature ratings. Valves shall be arranged so that clockwise rotation of the spindle will close the valve. Demo labels are not acceptable. Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows. All valves shall bepackedwithanapprovedpackingandthreadsshallbecoatedwithoilandgraphite.Packings should be replaced when found deteriorated on site. Where possible locate all valves at convenient positions of operation from the floor with valve stems upright. Valves that are flangedshallhaveflangestothetablespecifiedforthepipework.Plasticormetalplates(rustles) shallbeprovidedtoindicatetheopen/closestatusaswellastheuseofeachvalveinthepump and tank rooms. Introduce clause of pipe supporthere.

5A423.11 PIPESUPPORTS

5A423.11.1 General Support

Tenderdrawingsindicateschematicallythesizeandlocationofpipes.TheGeneralContractor, ontheawardofthework,shallpreparedetailedworkingdrawings,showingthecross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves,andallpipesupports.Hemustkeepinviewthespecificopeningsinbuildingsandother structure through which pipes are designed to pass. Piping shall be properly supported on or suspended from, on stands, clamps, hangers as specified and as required. The General Contractorshalladequatelydesignallthebrackets,saddles,anchor,clampsandhangers,and be responsiblefortheirstructuralstability.Pipeworkandfittingsshallbesupportedbyhangersor brackets to permit free expansion and contraction. Risers shall be supported at each floor with Galvanized steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanized steel sections. Piping shall be supported from the building structure, which shall support the sum of the load of a water-filled pipe and a minimum of 120 kg applied at the point of hanging. All piping brackets shall be constructed as shown on the standard detail drawings. Vertical pipework shall be supported at intervals of at least one per floor level. Horizontal pipework shall also be supported by adjustable flat iron or

clevistypehangershungbyhotrolledsteelrodsofthefollowingdiametersandspacingsubject to the Architect'sapproval:

NominalPipe Diameterof Size	Distancebetween Supports		Rod	
25 mm		1.8 m		10
32 mm		2.4 m		10
40 mm	2.7 m		10	
50 mm	2.7 mm		10	
65-80 mm	3.0 m		12	
100 mm	3.0 m		16	
150-200 mm	3.6 m		18	

The end of the steel rods shall be threaded and not welded to threaded bolt. Hangers shall be supported by means of approved fasteners. Wood plugs shall not be used. Unless allowed by the structural engineer, power fixings may be used for pipework of diameter less than 50 mm. Expansion fasteners may be used for vertical pipework under 100 mm diameter. All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch. Requirement of Cut-outs in the structural slab or wall for installing the various pipes shall be clearly identified in the detailed shop drawing to be prepared by the STP General Contractor. Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibreglass and finished with retainer rings. The General Contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used. Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves.Dischargefromtheairvalvesshallbepipedthroughapipetothenearestdrainorsump. All pipes shall be pitched towards drain points. Pressure gauges shall be provided as shown on theapproveddrawings.Careshallbetakentoprotectpressuregaugesduringpressuretesting.

5A423.12 INSTALLATION

TheGeneralContractorshallchecktheassociatedcivilworkpriortotheinstallationofanyitem of machinery and advise the Project Manager, in writing, of any deviation of such work from the specified details. The machinery shall be accurately installed to correct dimensions, alignments,levels,etc.,allasindicatedonthefinaldrawings.Themachineryshallbemounted on flat steel packing pieces of thickness suitable to take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machineryshallbealignedandlevelledandthenutsoftheholdingdownboltstightenedwitha spanner of normal length. The base plates shall be packed with grout after the machinery has been run and

checked by the Project Manager for stability and vibration. Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc. The length of all bolts shall be such that when fitted with a nut and tightened the threaded portion of the bolts shall protrude from the top face of the nut by a distance not exceeding half the bolt diameter. Exposed bolt heads and nuts shall be hexagonal. All equipment and materials of the same type shall be products of the same manufacturer. Locally made equipment will not be accepted unless otherwise specified. All similar items of plant and their component part shall be completely interchangeable. Spare parts shall be manufactured from materials similar to the originals and shall fit all similar items of plant. Where machining may be needed beforefitting

renewable parts, the machining fits with their tolerance shall be shown on the drawings accompanying the instruction manuals.
Allmotorsand/orrevolvingpartsshallbetrulybalancedbothstaticallyanddynamicallysothat when running at normal speeds and any load up to the maximum there shall be no significant vibrationduetolackofbalance.Allpartswhichcanbewornordamagedbydustshallbetotally enclosed in dust-proofhousings.

5A423.13 MAINTENANCEFACILITIES

Permanent work platform and cat walk shall be designed by the GeneralContractorandprovided by the General Contractor for access to elevated equipment. The catwalk and platform for access shall allow a minimum width of750mm.
Catwalk to maintenance platform shall be provided with railings and guards designed for safe movement of personnel in a restricted space including provision for gaining access and to accommodatemaintenancepersonnel.HandrailingandguardsshallbedesignedbytheGeneral Contractor and provided by the General Contractor for all concrete tanks to allow safe movement of personnel. Permanent I-beams, lifting eyes, etc. shall be provided by the General Contractor over major equipment which require lifting for overhaul and maintenance. Waterproof power sockets required for servicing shall be provided by the General Contractor. The number and locations shall be proposed by the General Contractor and approved by the ProjectManager/Engineer.Powersupplytothesesocketsshallbetakenfromcontrolpanelof the sewage treatment system. The design of all permanent work platform, hand rails, etc. shall besubmittedtotheProjectManager/Engineerforapproval.Theloadingandfixingmethodof lifting facilitate shall also be submitted to the Project Manager / Engineer for approval and checking within 4 weeks on award of Contract or receipt of letter ofintent.

5A423.14 TESTING

The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve-hour period. The sample shall be taken at periods approximatelytheflowratesspecifiedbytheplant.Thesampleshallbecombined,anda5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.

5A423.15 TRAINING

Provided training facilities courses to ensure that the Client’s staff associated with the project mayacquirefullknowledgeandappreciationofallaspectsofthedesign,day-to-dayoperation, breakdown and routine maintenance, and fault diagnosis of all plant, equipment andsystems.

Training to the Client’s staff shall be held as appropriate at the General Contractor’s or manufacturer’s premises and on site. A detailed syllabus for each of the training courses specifiedorproposedandthetimingofthecoursesshallbesubmittedforapproval.TheGeneral Contractor shall recommend the desirable qualifications and experience of the trainees to

optimally benefit from thecourses.

TheGeneralContractorshallbedeemedtohaveincludeinhistenderpricethecostofproviding training facilities as specified.

5A423.16 ElectricalControl

The operation of the treatment process shall be fully automatic. A completely assembled and prewired control panel with mimic diagram consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timbers, on-off-auto change-over switches and duty selectors for equipment. Proper control sequence shall be designed according to system requirement and manufacturer standards,

5A423.17 Pipe ColourCode:

TABLE 7C423.21-1: PIPE COLOR CODE DETAILS

S. No	Services/Equipment	Ground Colour	First ColourBand	Second Colour Band	Band	
					Width (mm)	Spacing (mm)
A.	WATER					
1.	Raw water	Sea Green	-	-	-	-
2.	Treated Domestic water	Brown	Light Orange	-	25	1500
3.	Domestic Hot water from geysers	Sea Green	Light Grey	-	25	1500
4.	Recycled treatedwater for Flushing	Sea Green	Light Brown	-	25	1500
5.	Fire water	Fire Red	Crimson Red	-	25	-
B.	DRAINAGE					
1.	Soil	Black	-	-	-	-
2.	Waste	Black	White	-	25	1500
3.	Vent	Black	White	-	25	1500
4.	Rain water	Black	-	-	25	1500
C.	EQUIPMENT AND OTHERS					
1.	Pumps and Motors		-	-	-	-

S. No	Services/Equipment	Ground Colour	First ColourBand	Second Colour Band	Band	
					Width (mm)	Spacing (mm)
		Grey/Olive				
2.	Pipe supports	Black or as directed	-	-	-	-
3.	Electric panels	Steel Grey	-	-	-	-

Notes: All colors and code refer to Synthetic Enamel colors. The painting shall be with synthetic enamel paint unless otherwise specified.

5A424 DUAL FIRED STEAM BOILERS (PNG/HSD) & ANCILLARIES

5A424.1 BASIS OFDESIGN

The steam boiler for the project is designed to cater steam load for, Laundry &etc of Hospital block.

The ancillaries have been designed to optimize on energy saving and compliment the over all installation for efficient plant working and smoother operation.

5A424.2 DESIGNCRITERIA

a) Environmental Conditions shall be considered for Cuttacklocation.

b) Boiler Room Condition shall be takenas:-

45oCDB 35oCWB

All equipment, especially electrical components & pumps shall be guaranteed to perform satisfactorily under ambient conditions and under worst conditions without undue deterioration.

c) System voltage shall be 415V + 10%, 3 phase A.C. or 240V singlephase.

5A424.3 BOILER

The boiler design should conform to relevant standards such as:

- Indian Boiler Regulations (IBR).
- BS2790.

- Central Pollution Control Boardguidelines.

Boiler should be a fire tube type fully automatic HSD/PNG fired packaged Boiler developed, tested and proven under rigorous conditions and subject to the strictest quality control procedures.

The boiler should be of genuine three pass flue path with wet back construction and APH with automaticbypassdamperassembly.Fluegasesshouldpassthroughthecorregatedfurnace(first pass)whereassecondandthirdpassesshouldbeformedbynestsofsmoketubes.Attheendof the furnace wet back type combustion chambers is to be provided, which reverses the flue gas anddirectsittosecondpasstubes.Theboilershouldhavefrontplate,rearplate,smokechamber and clear space above the boiler shall be provided with noobjection.

Thefiretubesinthetubenestshouldbeplainwithoutanyrestrictioninside.Thesetubesshould be easily accessible both from inside as well as outside for inspection and maintenance. These tubes are to be tightly expanded in the tube plate. The required number of stay tubes and stay bars are to be fitted theboiler.

Allworkingpartsoftheboilershouldbeaccessibleforeaseofinspectionandmaintenance.On the shell, one elliptical mandoor and one mud hole should be provided. Access to the combustion chamber should be through bolted refractory lined access door whereas tube nest should be exposed through hinged mounted front door and bolted covers on back casingplate.

TheburnershouldbepressurejettypecapableoffiringHSD/PNG.Burnershouldbeofsucha construction wherein all the necessary parts such as FD fan, spark ignitors, oil heater (if required), gear oil pump, flame surveillance system and damper motor assembly etc are a part of the same casing. The entire assembly should be engineered in such a way so as to facilitate tubecleaning.Burnershouldbeofmonoblocsteplessmodulationtypewithturndownratio1:3

Boiler should be complete with all necessary electrical cabling from the control panel till burner / FW pumps etc. The control panel should be a part and parcel of boiler package. It should contain all necessary switchgears, safety alarms/interlocks and burner management system. Amongst the safety features, two numbers of water level controllers should be provided. The waterlevelcontrollersshallhavemagneticlevelswitchesalongwithaseparateoverrideunitis tobeprovided,whichensurespositivelevelshutofffuelsupplytoburnerunderextralowwater level and puts the boiler under lock-out till the fault is rectified. The control panel of the boiler should include burner management sequential controller with self-diagnostic features to help quickly locate faults in boileroperation.

The boiler should be completely insulated in the factory itself and there should not be any site workinvolvedforinsulationandelectricalcabling.Cylindricalshellofboilermustbeinsulated with glass wool / Rock wool mattresses of required thickness to minimise radiationlosses.

Thereshouldbetwocaststeelspringloadedsafetyvalvesprovidedontheboiler.Safetyvalves should be sized as per the IBR regulation and total discharge capacity must exceed the boiler rated capacity.

5A424.3.1 SCOPE

This specification covers design, manufacturing, inspection, testing at works, packing, forwarding,supplyandprovidingperformanceguaranteeofsteamboiler,withotherassociated auxiliariesincluding piping with required accessories up to required points in Laundry, Kitchen and CSSD including connection with Laundry, Kitchen and CSSD equipments. The scope also covers supervision during erection andcommissioning.

Itisnottheintenttocompletelyspecifyallthedetailsofdesignandconstruction;nevertheless, the equipment shall conform in all respects to high standards of engineering, design, workmanship and shall be able to meet all statutory requirements as per the latest editions of relevant codes as describedabove

5A424.3.2 DUTY PARAMETERS

Evaporation Capacity (from & at 100 degree C) with APH	:	Minimum.1.0 Ton 2 Nos. or adequate capacity kg/hr
Operating pressure	:	10.5 kg/cm2 (g) Saturated
Fuel	:	HSD/PNG
Efficiency on NCV at full load	:	92 %
Steam quality	:	Dryness factor 98 % min

5A424.3.3 SCOPE OF SUPPLY

Scope of supply shall include the following but now limited to.

a Pressure

Parts: Boiler

Shell Tube

Plates

FurnaceFlue

Combustion

Chamber Boiler

Tubes

Mud

door

Man

door

Stand Pipes for Stop, Feed check, Safety and Blowdown Valves

Stand pipes for gauge glass and

level Controller

b General Construction Parts :

Front casing with hinged door
Rear casing with removabledoors
Flue outletflange
Insulation and sheeting for boiler shell
Rear access door refractory
Support base frame

c Mountings:

Safety Valves (2 nos)
Main Steam Stop Valve (1 no)
Feed check Stop Valve (2nos)
Feed check NRV (2nos)
Water Gauge Glass (1 set)
Water level controllers (2 sets)
Pressure gauge (1 no)
Inspector’s test gauge connection (1 no)

d Combustion Equipment:

Fully automatic, stepless modulated, modulated, monobloc pressure jet burner fitted with F. D. Fan, ducting, air / fuel ratio adjusting damper, fuel oil pump, pressure gauge, Spark Ignitor and flame surveillance sensor (UV Cell)

e Feed Pumps:

2 nos. electrically driven vertical centrifugal multistage pumps mounted on the boiler frame itself with motor capable of using feed water at temperature of 120 deg C with all SS internals, interconnected pipework between pumps and feed check valves

f Instruments and Control:

Main steam pressure gauge with cock

Level controller for feed pump operation and low water level

alarm Over-ride controller for lockout under extra low water

level alarm. Pressure control switches

Flame surveillance and burner management

controller All switch gears, relay, connectors

Audio / visual alarm in case of unsafe operation for lockout under extreme conditions.

Pressure and temp gauge with thermostat for burner

Control panel housing above instruments and switch gears.

g SafetyInterlocks:

Unsafe condition	Instrument	Action
High water level	Level controller No. 1	Feed water pump trip.
Low water level	Level controller No. 1	Alarm & Burner Shut down
Extra low water level	Level Controller No. 2(Overridingcontroller)	Alarm & lock-out.
Flame failure	UV Cell	Alarm & burner trip
Boiler high pressure	Safety valves	Lift & discharge

5A424.3.4 BURNERS

The fuel burning equipment shall be an integral part of the boiler unit, factory mounted and factory fire tested. The complete boiler unit shall have the approval of the boiler and explosive inspectors for safety. The fuel burning equipment shall include a high limit control, operating control, wind box complete with refractory lining, linkage, electric sparks ignition assemble, forced draft fan with adjustable air inlet vanes, air flow safety switches, key lock switch, modulating motor, auxiliary end switch for low fire start interlock, ignition transformer, modulating operating control, UV cell scanner assembly, control cabinet containing electronic combustion and programming control, manual potentiometer, terminals strips, colour coded internal wiring.

5A424.4 GUARANTEE

5A424.4.1 Mechanical guarantee

a. All the apparatus shall be guaranteed against defective design, poor workmanship and defective materialconstruction.

b. All the equipment/ items shall be capable of performing duties specified in this specification without damage, distortion or failure of anycomponent.

c. Thecontractorshallrepairandreplaceanypartsoftheequipmentsuppliedbythecontract or at his own expenses, in the event of non fulfillment ofguarantee.

5A424.4.2 Performance Guarantee:

Boiler shall be subjected to performance test under contractor supervision at site after one week trouble free operation as per BS 845 Part – I – 1987. Contractor shall guarantee the following:

- Capacity
- Steam pressure &temperature
- Fuel consumption
- Utility consumption
- Automatic capacity control

Should the unit supplied fail to achieve the specified performance under the given conditions, the contractor shall carry out such modifications or replacement of the units as necessary to meet the required performance at his own cost within the time as mutually agreed upon.

5A424.5 STEAMPIPING:

5A424.5.1 Piping

5A424.5.2 Non IBR:

All steam pipes shall be M.S.ERWheavyclasspipesconformingtoIS:1239partIwithheavy class pipe fittings. All fittings shall be weldable type. The pipes shall be properly ground at the endstomakeavee.Thetwopiesbeforebeingweldedshallbeplacedontheveeblock,properly aligned. A gap of 2-3mm shall be maintained between the two pipes and V butt welding done. All welding flux material of the root run shall be removed using metal brushes/

grinders. The final welding shall be done over the root run forming a proper bead of thewelding.

5A424.5.3 IBR:

All pipes shall be C.S. seamless pipe schedule 40 conforming to ASTM A 106 Gr. B with IBR certificates. All elbows / bends shall be made from C.S. seamless pipe schedule 40 conforming to ASTM A 106 Gr. B with IBR certificates

Thepipesshallbeproperlygroundattheendstomakeavee.Thetwopipesbeforebeingwelded shallbeplacedontheveeblockproperlyaligned.Agapof2-3mmshallbemaintainedbetween the two pipes and V butt welding done. All welding flux material of the root run shall be removedusingmetalbrushesandelectricallyoperatedgrinders.Thefinalweldingshallbedo ne over the root run forming a proper bead of the welding. All IBR Steam piping shall be welded byIBRapproved&testedwelderusingapprovedqualityweldingconsumablesonly.WPSsh all be established and PQR shall be done.

5A424.5.4 Flanges

All CS flanges shall be weldneck type conforming to class ASA 300#.

5A424.5.5 Gaskets

The gaskets shall be made out of the fire retardant material. The gasket materials shall preferablybeminimum3mmthickcompressedasbestoscapableofwithstandingminimum600 degree centigradetemperature.

5A424.5.6 Nuts, Bolts & Washers

Allnuts&boltsshallbeofhightensileMS.Thelengthoftheboltsshallbesuchthatabouthalfaninchofboltshallprotrudeoutsidethefaceofnuts.Inallnut&boltjoints,washersofsuitable sizes shall be used on the bolts as well as nutsside.

5A424.5.7 Valves

All valves used for steam piping shall be globe / gate valves. All valves shall be of Cast steel / Forged Steel / bronze / cast iron body.

5A424.5.8 Steam Traps

The steam traps shall be either thermodynamic or inverted bucket type or float trap depending upontheapplicationfordrainingthecondensatefromthemainsteamlineorbranchline.Steam trapsshallalsobeprovidedwithstrainerandbypassarrangement.Thebodyofinvertedbucket steam trap shall be of either cast iron or caststeel.

5A424.5.9 Safety Valves

Safety valves shall be of tight lift type with casing & lever for manual flow. The material shall be of bronze/cast steel

5A424.5.10 Pipe Line Supports & Pipe Layouts

Pipe line supports shall be installed in a manner so that the pipe line is free to move as a result ofexpansionorcontraction.Steamlinesshouldbearrangedwithafallinthedirectionofflow. A fall of around 40mm in 10 m shall generally be provided. Drain points shall be provided at every 30 to 50M interval. Drain points shall also be provided at any low points where condensate can collect. Branch connections should always be taken from the top of anymain.

Drainpointsshallpreferablybeprovidedwhereverpipeworkchangesdirection,whendrainage has to be provided in a straight length of pipe then a large bore pocket should be provided. Concentric reducers shall be avoided and eccentric reducers shall beused.

5A424.5.11 Allowance For Expansion

Wherever there are long runs of straight pipe, provision for expansion must be kept. Horse shoe or lyre loop/sliding joints must be used to take care of expansion.

5A424.5.12 Steam / Condensate Piping Insulation

a) Steam piping insulation shall consist offollowing:

b) Application of heat resistantpaint.

c) Application of LRB/ Rock wool of thickness as specified and having density not less then 144 Kg/CubicM.

d) Covering the insulation 24 gauge ribbed aluminium sheet cladding and fixing in position with self tapping screws at 150mm centre. All joints shall be overlapped by 50mm and arranged to shedwater.

5A424.6 VALVES:

5A424.6.1 Ball Valve:

All ball valves shall be heavy duty of approved make. Valves shall be lever operated PTEFE seating and shall be suitable for test pressure of 25 Kg/cm². Ball valves shall conform to the following specifications.

Size	Construction	Ends
15to40mm	ForgedBrass	Screwed

5A424.6.2 Butterfly Valve:

Allbutterflyvalvesshallbeheavydutycastironwafertypeofapprovedmake.Thevalvesshall conform to IS 210 Gr. FG 200 and shall be suitable for 15 Kg/Sqcm. Test pressure & shall conform to the followingspecifications:

Size	Construction

50mmandabove Cast iron /steel

5A424.6.3 Non-Return Valves:

Allnon-returnvalvesshallbeprovidedasshowninthedrawingsconformingtorelevantIndianStandards and in accordance with the following specifications:

Size	Construction	Ends
Upto 40mm	Gun Metal	Screwed
50mm and above	Cast iron	Flanged

Non-return valves shall be of approved make. Wafer type non-return valve shall be used & tested to 15 Kg/Sq.cm pressure.

5A424.6.4 Drain Valves:

All valves shall be suitable in all respects for the class of service and function.

Drain valves shall be provided at low points of all water risers and mains to ensure that all sections of pipework and plant can be drained.

Drain valves for piping 50mm or smaller shall be 15mm ball valve, and for piping 65 mm and above shall be 20mm ball valve.

5A424.6.5 Piston Valves:

All piston valves shall be heavy duty of approved make. Valves shall be hand wheel operated suitable for steam, superheated steam application shall be suitable for 1232ubular1232ng1232n in vertical as well as horizontal line and operating temperature of 427deg. C. Piston valves shall conform to the following specifications.

Size	Construction	Ends	Max. Working Pressure
15 to 40mm	Forged Steel	Screwed	78 bar
50 mm	Cast Steel	Flanged	77 bar

5A424.7 EQUIPMENT:

5A424.7.1 Strainers:

Strainers shall be installed in all pump suctions, PRVs and tanks. The strainers shall be of pipeline “Y” type and suitable for use in the appropriate system.

The perforated screen shall have □ 0.75 mm hole sizes, and be stainless steel. The following area should be at least 4 times the cross sectional area of the pipe.

40mm and smaller strainer shall have bronze bodies with screwed connections while 50mm strainers and larger shall have cast iron bodies and flanged connections. The cap of the strainer shall be provided with a □ 20 drain plug.

5A424.7.2 Water Meters:

Watermetersshallbeofmulti-jetmagneticdrive(turbinetype),displacementandaccumulative reading type, conforming to the Metropolitan Water Works Authority Standard with working pressure corresponding with the pipingsystem.

5A424.7.3 Pressure Gauges:

Pressure gauges shall be of the bourdon type, stainless steel casing, round type of 100mm dia and scale range of approximate 150 percent of the normal operation (accuracy 1%). Pressure reading shall be in dual scale with psi and kg/sq.cm.

Theneedlevalveandstainlesssteelsiphonwithworkingpressurecorrespondingwiththepiping system shall be provided for each pressuregauge.

Pressure gauges, subjected to corrosive liquid, shall be of the chemical type with diaphragm liquid separator.

5A424.8 MEASUREMENT ANDRATES:

5A424.8.1 M.S. Pipe

M.S.Pipesabovegroundshallbemeasuredperlinearmetre(tothenearestcm)alongthecentre line of the pipe and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, flanges, etc. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings,

5A424.8.2 Valves, Strainers, Moisture Separators

Valves shall be measured by numbers. However, wherein these items are included as integral part of an assembly and described as such in the B.O.Q., these will not be prescribed and paid for separately.

5A424.8.3 Flanges For Nozzles:

Flanges for nozzles shall be measured by numbers and the quoted rate shall include welding of the flanges to the pipe nozzles.

5A424.9 PIPING / PIPE PROTECTION /INSULATION:

Unless otherwise specified painting / Pipe protection / Insulation for pipes shall be measured and paid for separately. These shall be measured per linear meter along the Centre line of the pipe over the finished surface and shall include all valve sand fittings for which no special rates shall be applicable.

5A424.10 BOILER CHIMNEY –STEEL LININGTYPE

a) Plates andSections:-

i) Steel plates used in the construction of chimneys shall comply with the requirements for grade 43A of IS.4360:1972.

ii) Of 6 mm thickminimum.

iii) Supporting of steelwork and ancillary fittings shall comply with the requirements of IS:4 for dimensions and with not less than grade 43A or 50B in IS. 4360: 1972 for quality.

b) Bolts andnuts:-

i) Mild steel: All mild steel bolts and nuts shall have a tensile strength of not less than 400 N/mm2 and a minimum elongation of 17%, as defined in I.S.4190:1984.

ii) High tensile steel: structural quality. The material used for the manufacturer of high tensile steel bolts, nuts and washers, for which permissible stresses are given in IS:1149:1982, shall have a minimum tensile strength of 580 N/mm2 and other mechanical properties appropriate to grade 50B of IS. 4360:1972.

iii) Friction grip bolts. Friction grip bolts, nuts and washers shall comply with the requirements of SP 6: Part4 : 1969, and shall be used in accordance with the requirements of B.S. 4604: Part1.

c) The use of structural steel for the shell and other components of steel chimneys shall beinaccordancewiththerequirementsoftherelevantclausesofIS:1149:1982andIS : 961:1961.

d) The minimum thickness of the load-bearing chimney shell, in single or multiple shell constructions shall be the calculated thickness obtained from stress and deflection considerations plus the corrosion allowance, but shall not be less than 6.0 mm of the outside diameter of the chimney at the sameheight.

e) Angle flanges. The minimum thickness of jointing angles to chimney flanges shallbe 6.0 mm.

f) Where large apertures are cut in the shell plates, as for inlets or inspection panels, a structural analysis of the stresses shall be made and compensation material provided, asrequired,toensurethatthestressesspecifiedinthestandardarenotexceeded.

Apertures in the shell plates, other than flue inlets, shall have the corners radius to a minimum of 10 t, where t is the thickness of the plate.

g) The base plate and holding-down bolts shall be adequate to take the loads, bending moments and reactions between the shell and the supporting structure or foundations, thepositionofholding-downboltsandbasegussetsorstoolsbeingtakenintoaccount. Holding-down bolts shall be adequately tightened, with appropriate precautions to prevent the stripping of threads, and the baseplate shall be properlygrouted.

h) Wherebasegussetsorstoolsareused,theyshouldpreferablybeevenlydisposedround the chimney shell. Smaller secondary gussets may be provided between the main gussets. Base gussets shall be of ample height and shall extend to the edge of the baseplate. The angle of the sloping edge of any gusset to the horizontal shall be not less than 60o. The minimum thickness of the gusset shall be 6.0mm.

i) Allflangeboltsinthestructuralshellshallbepositionednotmorethanfivediameters betweencentres,withamaximumof150mm.Accountshallbetakeninthedesignof the bolts for the eccentricity due to the boltpositions.

j) Where the chimney is mounted against building structure, adequate allowance for expansion and guide brackets shall be provided.

Expansion joints in chimney shall be provided to compensate for lateral and vertical expansion contraction.

k) Chimney shall be provided with light in garrestor

l) The chimney shall be provided with a suitable cowl on top.

m) Weldingjointsofchimneyshallbecarriedoutinaccordancewiththerequirementsof IS: 15326:2003 –

i) Procedure approval test. Before the Contractor is permitted to weld chimneys in accordance with the requirements of the Indian Standard, he shall adequately and successfully test his several procedures, and complete records of such tests shall be available for the Architect/ Consultant/ Project Manager as specified in I.S. 7307: Part1:1974.

The Contractor shall be exempt from making procedure tests in accordance with the requirementsofthisclausewhenhecanshowthat,forthepreviousthreeyears,hehas successfully undertaken the welding of steel chimneys to a quality equivalent to that required by I.S. 7307:Part1:1974 in the procedures from which he seeks exemption.

ii) Welder approval tests. Welders employed in the manufacture and erection of steel chimneys made in accordance with the requirements shall have been tested using an approved procedure. Complete records of such tests shall be available for inspection by the Architect/Consultant/Project Manager, or his representative as specified in B.S. 7310: Part 1: 1974. The welder who completes satisfactorily the procedure approval test is thereby exempt from further welder approval tests involving the same range of procedures.

iii) Anadequateandproperly-supportedworkingplatformshallbeprovidedtoenablethe welder to stand and move comfortably in the position he normally adopts at ground level to carry out thewelding.

iv) Welding area and working platform shall be protected adequately from the weather.

v) Surfacestobeweldedshallbefreefrommoisture.Precautionsshallbetakentopreve nt the descent of moisture (i.e. rain and condensation) on to the welding area from the structure above the point of welding.

vi) Parts being connected by welding shall be attached firmly to each other by bolting, clamping or other mechanical means until welding is complete in thearea.

vii) All electric welding on site shall be carried out with the minimum practical length of weldingcablebetweenthepowersourceandtheworkingarea.Thesupplyofwelding currentinrespectofvoltageandamperageshallbeadequateforthewelding procedure beingemployed.

viii) Protective treatment to boiler flue:-

- Immediately before applying any protective treatment to the exterior surface of the chimney shell, the surface shall be cleaned by chipping, scraping and wire brushing, or by other means, to remove all dirt, loose scale, grease, rust or other deleterious materials.

- Immediately after the surface preparation has been completed, the exterior surface shall be given a coat of suitable priming paint followed by one coat of a special high temperature resistant paint applied in accordance with the recommendations of the manufacturers of the particularpaints.

n) The horizontal flue shall connect to the vertical chimney section at an angle of 15o to 30o to horizontal, with expansion joint immediately at the entrysection of the vertical chimney.Thecompletechimneysectionshallbeproperlygradedtoallowfreedraining of condensate after boiler shutdown.

o) Provided with the following accessories:-

i) A removable flanged tundish piece with drain taps at bottom of vertical chimney.

ii) Hinged access door adjacent to drain.

iii) Connection for temperature and pressure sensors and tap off for smokesensor.

p) The flexible connector shall be: -

i) Asbestos free construction suitable for the operatingtemperature.

ii) Constructed of stainless-steel reinforced fabrics combined with mineral and ceramic wools with flange connection.

q) Chimney Insulation

- Insulation shall be of 100 mm thick fibre glass white wool 1240ubular1240ng with density not less than 48 kg / cum. The insulation shall be fixed in MS ring at interval of 1 m. The frame will be welded all around the chimney. The insulation shall be tied with galvanizedchickenwiremesh(0.5mmx15mm). Provision of heat resistantadhesive shallbemadeasdescribedaboveandinaccordancetomanufacturerrecommendation.

- Theinsulationshallbeprovidedwith24GGIcladdingscrewedtothesteelframewith cadmium coated self tappings crews.

5A424.11 PUMPS –GENERAL

a) All pumps shall be selected for use with speed not exceeding 2,900 rpm, unless otherwise specified.

b) Pumps offered shall be selected for minimum vibrations and noise level during operation.Shouldthesebeexcessiveandnotwithinnormallyacceptablestandards,the Contractor shall be responsible for provision of further acoustical and anti-vibration treatment as necessary at no extracost.

c) Pumps shall be selected for maximum efficiency and minimum power consumption.

d) Pumps shall have relatively non-overloading characteristics. Special attention should be given to selection of NPSH to eliminate occurrence of cavitation.

e) Horizontal pumps shall be mounted on common C.I. bedplate directly coupled to totally enclosed fan cooled squirrel cagemotor.

f) Vertical pumps shall be driven by “in-line” TEFC squirrel cage motor. Motor shall be properly fitted to the pump casing and permanentlyaligned.

g) Pump base shall be machine finished, accurately aligned and bolted onto heavy concrete plinth or boiler frame with anti-vibration mounting asspecified.

Pumps shall be installed as per manufacturer’s recommendations. Pump set shall be mounted on M.S.foundation which in turn shall be mounted on cushyfoot mountings or any other equivalent vibration isolation fittings. Concrete foundation will not be possible on structural slabs.

Pumps sets shall preferably be factory aligned. Whenever necessary, site alignment shall be done by competent persons. Bedplate levels and alignment results shall be submitted.

h) All pumps supplied shall be constructed to meet the maximum required working condition, water temperature and test pressure as required for the system 1241ubular1241n& workingcondition.

i) Adequate pump guards shall be provided at pumpcouplings.

j) Provided with the following accessories:-

5A424.12 FEED WATERTANK

Feed water tank shall be: -

a. Mildsteelplateconstructionwith1241ubular1241finishesofonecoatofheatristant aluminium paint.

b. Tank shall have external finish of two coats of heat resistant blackprimer.

c. Volumeoftanktobecalculatedandfloatvalve/overflowlevelstobesetasfollowsto prevent waste:-

Feed Water Tank:-

1/3 of the volume specified shall be maintained in the tank when water in the system has reached the design temperature. This shall be the level controlled by the solenoid valve.2/3ofthevolumespecifiedshallbeusedtoabsorbapparentwaterexpansionon systemshutdownwithwatertemperaturerisingto40oC.Thisshallbethelevelsettin g of theoverflow.

d. Cost of the tank shall be inclusive of providing the followingnozzles:

1. Side mounting type level indicator
2. Drain
3. Overflow
4. QuickFill
5. Make-upwater
6. 2 Nos. outlet
7. Condensatereturn
8. 600 mm dia manholecover
9. Vent
10. Level controllerprobe.

5A424.13 PIPEINSULATION

Pipe Insulation

All pipes for steam / condensate utility and other requirement operating at higher than ambient temperature shall be insulated in the manner specified hereinafter.

Insulating material shall be rigid preformed sections of mineral wool having density of 144 Kg/M3 minimum with ‘K’ value of not more than 0.038 W/MK at 100 Degree C mean temp. The insulation section shall be split on one end and shall be slip on type.

No insulation shall be applied until the pipe is satisfactorily pressure tested.

Thickness of insulation shall be 50mm for all steam and hot water pipes.

Pipe insulation shall be applied as follows:

a) Pipesshallbethoroughlycleanedwithawirebrushandrenderedfreefromallrustand grease and applied with two coats of anti-rustpaint.

b) Pipes in Shaft/Exposed:

i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential)

ii) The insulation shall be tied w`ithaluminium band not less then 6mm wide (24 gauge 4 bands per meter) using G.I sheet clamp crimped at thejoints.

iii) Theinsulationshallbecoveredwith24gaugealuminiumcladdingscrewedatthejoints with cadium coated self-tapping screws. Joints shall be overlapped minimum 12mm wide.

All valves, fittings, strainers etc. shall also be insulated in the same manner as piping.

Insulation of Feed Water Tank:

Feed Water tanks shall be insulated as follows:

The insulation shall be 75 mm thick slab of 1244ubular1244ng crown bonded with heat 1244ubular1244n binder of `K' value not more than 0.60 Kcal/cm/sqmt/Hr/Deg C at 95OC mean temp and suitable for temperature upto 540OC and of density not less than 24 Kg/M3. Insulation shall be applied in two layers. The slab shall be fixed with the help of suitable heat resistant adhesive. First layer shallbeinsertedin80mmx80mmx3mmthickM.Sframeofsize600mmx600mm.Theframe shall be welded to the tank sides, bottom and top. The second layer shall be inserted and fixed to the first layer with the adhesive. The insulation shall be covered with 24 gaugealuminium cladding screwed to the M.Sframe.

5A424.14 FUEL OILPIPING

5A424.14.1 Scope

The scope of this section comprises the supply and laying of pipes, pipe fittings and valves testing and balancing of all HSD piping required for the complete installation and as shown on the drawings. All piping inclusive of fittings and valves shall follow the applicable BIS Codes.

a. Pipes shall be MS class 'C' & fittings shall be welded type fittings conforming to relevant BIS codes. All jointing in the pipe system shall generally be by welding / flanges, unless otherwise mentioned or directed at site. All welding shall be done by qualified welders andshallstrictlyconformtoBIScodeofprocedureformanualmetalarc weldingofmildsteel.

b. All pipes and their steel supports shall be thoroughly cleaned and given on primary coatofredoxidepaintbeforebeinginstalled.Allweldedpipingshallbesubjecttotheapproval atsite.

c. Threadjointfittingsshallbemalleablecastingofpressureratingsuitableforthepipin g system. Fittings used on welded piping shall be of the weldabletype.

d. Tee-offconnectionsshallbethroughequalorreducingteesother-wiseferruleswelded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

e. Valves, conforming to the following specifications, shall be provided as shown on drawings.

Size	Construction	Ends
15 to 65 mm	Gun Metal	Flanged
75 mm over	Body cast iron spindle and valve seat of bronze or gun metal	Flanged

All valves shall be heavy duty.

f. Flanges shall be approved make. The supply of flanges shall also include supply of bolts and nuts and suitable asbestos fibre / rubber insertion gaskets (minimum 3 mmthick).

g. Non-return(check)valvesshallbeprovidedasshownonthedrawings,conformingto relevant BIS codes and in accordance with the followingspecifications:

Size	Construction	Ends
15 to 65 mm	Gun Metal	Flanged
75 mm over	Cast Iron / Gun Metal	Flanged

Swing check valves shall normally be used in all services. Lifts type valves may be used in horizontal runs.

h. The strainers shall be of cast iron body with gunmetal or bronze mesh for fine filteration of theoil.

i. All piping and fitting shall be pressure tested, then painted and shall be provided with additional weather proof treatment for buriedpipes.

j. All piping shall be painted as specified herein. After piping has been installed, tested and run for atleast three days of eight hours each, all exposed piping and pipe supports shall be given two finish coats, 3 mils each, of approved paint, conforming to relevant BIS codes. The direction of flow of fluid in the pipes shall be visibly marked with identifyingarrows.

5A424.15 COMMISSIONING &GUARANTEE

5A424.15.1 SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Tenderer shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Tenderer shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before 1247ubular1247ng any test. Complete results of adjustments shall be recorded and submitted.

Tenderer shall ensure proper balancing in the pipe line by valve operation. The tenderer shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rotameters. Tenderer shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Architect / Consultant/ Project Manager.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

5A424.15.2 STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

AsandwhennotifiedinwritingorinstructedbytheArchitect/Consultant/ProjectManager,the Tenderer shall submit drawing and attend all tests and inspections carried out by IBR, CCOE, andotherStatutoryAuthorities,andshallforthwithexecutefreeofchargeanyrectificationwork ordered by the Architect as a result of such tests and inspections where these indicate non- compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Tenderer shall make all allowances in this respect.

TheTendershallberesponsibleforthesubmissionofallnecessaryformsanddrawingstothe Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by theseAuthorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Architect for checking before submission.

The Tenderer shall notify the Architect/Consultant/Project manager at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed datefortestandinspectiontheTenderershallinformtheArchitect/Consultant/ProjectManager withoutdelay.

5A424.15.3 FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Tenderer shall carryout final acceptance tests in accordance with a programme to be agreed with the Architect/Consultant/ProjectManager.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Tenderer shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shallbecarriedoutbytheTendererpriortotheissueofCompletionCertificatetotheacceptance of the Authorities.

5A424.15.4 REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, and erection or on completion at site may be rejected by the in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect/Consultant/Project Manager so as to comply with the Authority's requirements and theintentoftheSpecificationshallbecarriedoutbytheTenderer athisownexpenseandtothe satisfaction of the Architect/Consultant/ ProjectManager.

After works have been accepted, the Tenderer may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Consultant/Project manger.

5A424.15.5 WARRANTY AND HANDOVER

The Tenderer shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to theClient.

5A424.15.6 HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Tenderer to the entire satisfaction of the Architect/Consultant/Project Manager and all testing and commissioning documents shall be handed over to the Architect/Consultant/Project Manager.

The Tenderer shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Architect/Consultant/Project Manager.

5A425 Annexure-VII

5A425.1 Abbreviations

A.R.V.	Air ReleaseValve
C.O.P.	Clean OutPlug
CPVC	Chlorinated Poly VinylChloride
C.I.	CastIron
FT	FloorTrap
FD	FloorDrain
F.C.O.	Floor CleanOut
F.W.S.	Flushing WaterSupply
G.I.	Galvanised Iron
UPVC	Unplasticised Poly VinylChloride

P.W.S. Potable Water

Supply UT UrinalTrap

VOC Volatile OrganicCompound

WC Water Close

5A426 Annexure-VIII

5A426.1 List of Bureau of Indian Standards and OtherCodes

Pipes and Fittings

BIS:458 Specification for precast concrete pipes (with and without reinforcement)

BIS:651 Salt glazed stone ware pipes and fittings.

BIS : 1239(Part1) Mild steel, tubes, 1250ubular and other wrought steel fittings: Part 1 Mild Steel tubes.

BIS : 1239(Part2) Mild Steel tubes, 1250ubular and other wrought steel fittings: Part 2 Mild Steel 1250ubular and other wrought steel pipefittings.

BIS:1536 Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.

BIS:1538 Cast Iron fittings for pressure pipes for water, gas and

sewage. BIS:1879 Malleable cast iron pipefittings.

BIS:3468 Pipenuts.

BIS:3989 Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.

BIS:4346 Specifications for washers for use with fittings for

waterservices. BIS:4711 Methods for sampling steel pipes, tubes

andfittings.

BIS:6392 Steel pipeflanges

BIS:782 Specification for caulking lead (3rdrev.)

BIS:110221 Code of Practice for coating and wrapping of U.G

M.SPipelines BIS:3114 Code of Practice for laying C.I Pipes (2nd rev.)

(Amendment 2) Valves

BIS:778 Specification for copper alloy gage, globe and check valves for water works purposes.

BIS:780	Specificationforsluicevalvesforwater workspurposes(50mmto 300 mmsize).

BIS:1703	Specificationcopperalloyfloatvalves(horizontalplungertype)for water supplyfittings.
BIS:3950	Specification for surface boxes for sluicevalves.
BIS : 5312(Part1)	Specification for swing check type reflux (non-return) valves: part 2 Multi doorpattern.
BIS : 5312(Part2)	Specification for swing check type reflux (non-return) valves: part 2 Multi doorpattern.
BIS : 12992(Part1)	Safety relief valves, spring loaded
:Design BIS:13095	Butterfly valves for generalpurposes.
Sanitary Fittings	
BIS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.
BIS:774	Specificationforflushingcisternforwaterclosetsandurinals(other than plasticcistern)
BIS:775	Specification for cast iron brackets and supports for wash basins and sinks
BIS:781	Specification for cast copper alloy screw down bib taps and stop valves for waterservices.
BIS : 2548(Part2)	Specification for plastic seats and covers for water closets: Part 1 Thermoset seats and covers.
BIS : 2556(Part1)	Specification for vitreous sanitary appliances (Vitreous china): Part 1 Generalrequirement.
BIS : 2556(Part2)	Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down waterclosets.
BIS : 2556(Part4)	Specification for vitreous sanitary appliances (vitreous china): part 4 specific requirements of washbasins.
BIS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china): part 6 Specific requirements of urinals, section 2 half stall urinals.
BIS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china): Part 6 specific requirements of urinals, section 4

partition slabs.

BIS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 5 waste fittings.

BIS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china): Part 6Specificrequirementsofurinals,section6waterspreadersforhalf stallurinals.
BIS : 2556(Part7)	Specification for vitreous sanitary appliances (vitreous china): Part 7 Specific requirements of half roundchannels.
BIS : 2556(Part8)	Specification for vitreous sanitary appliances (vitreous china): Part 8 Specific requirements of siphoning wash down waterclosets.
BIS : 2556(Part11)	Specification for vitreous sanitary appliances (vitreous china): Part 11 Specific requirements for shower rose.
BIS : 2556(Part12)	Specification for vitreous sanitary appliances (vitreous china): Part 12 Specific requirements of floortraps.
BIS : 2556(Part15)	Specification for vitreous sanitary appliances (vitreous china): Part 15 Specific requirements of universal waterclosets.
BIS:2963	Specificationsforwasteplunditsaccessoriesforsinksandwash basins.
BIS:3311	Specification for waste plug and its accessories for sinks and wash basins.
BIS:5961	Specification for cast iron gratings for drainagepurposes.
BIS:2082	Specification for storage type electric
waterheater(geyser)	Water QualityTolerance
BIS : 3025 (Parts 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water.
BIS:10500	DrinkingWater
.	Pumps andVessels
BIS:5600	Specification for sewage and
drainagepumps	General
National Building Code of India 2016	Part IV and Part IX
Uniform Plumbing Code of India 2008	SP:35 Water supply

BIS:554	Dimensionsforpipethreadswherepressuretightjointsarerequired on thethreads.
BIS:779	Specification for water meters (domestictype).

BIS:782	Specification for caulkinglead.
BIS:800	Code of practice for general construction insteel
BIS:1172	Code of Basic requirements for water supply drainage and sanitation
BIS:1726	Specification for cast iron

manhole covers andframes. BIS:1742 Code of

practice for buildingdrainage.

BIS:2064	Selection, installation and maintenance of sanitary appliance code ofpractice.
BIS:2065	Code of practice for water supply inbuildings.
BIS:2104	Specification for water meter

for boxes (domestictype) BIS:2373

Specification for eater meter

(bulktype)

BIS:2379	Color code for identification of pipelines.
BIS:2527	Code of practice for fixing rainwater gutters and down pipes for roofdrainage.
BIS:3114	Code of practice for laying of cast ironpipes
BIS : 4111(Part1)	Code of practice for ancillary structures in sewerage system: Part1 manholes.

BIS:5329

Codeofpracticeforsanitarypipeworkabov

egroundforbuildings. BIS:5455 Cast iron steps for

manholes.

BIS:7558	Code of practice for

domestic hot waterinstallations. BIS:8321

Glossary of terms applicable

to plumbingwork.

BIS:9842	Preformed fibrous pipeinsulation.
BIS:9912	Coaltarbasedcoatingmaterialsandsuitableprimersforprotecting iron and steel pipelines.
BIS:10446	Glossary of terms relating to water supply andsanitation.
BIS:11149	Rubber Gaskets
BIS : 12183(Part1)	Code of practice for plumbing in multistoried buildings: Part 1 water supply.
BIS:5572	Code of practice for sanitary pipework.

Note:Ifanyitemsaremissingintheabovelist,theContractorshallsubmitthemanufacturer’s technical submittals for prior approval of Engineer.

FIRE FIGHTING SYSTEM

SCOPE OF WORK

5A428.1.1 The scope of this section consists of but is not necessarily limited to supply, installation,
testing and commissioning of the firefighting Wet Riser System as per BI3844/N.B.C.(Latest editions), sprinkler system will be as per N.B.C 2026 (Latest
5A428.1.2 editions).

A firefighting system shall be installed at all buildings and its associated over all sites. The
contractor shall fully understand and familiarize himself with all residential block internal &
5A428.1.3 external site fire requirements and, thereby, fully develop the provided concept drawings and
specification to produce full, complete and thorough designs and specifications which will
meet all references. The system shall be consisting of the following key components:

Internal & External Hydrant system consisting of Landing Valve, fire hoses, hose reel, branch connection and nozzles as per BIS 3844/N.B.C. And sprinklers system consisting of sprinklers ,electrically operated flow indicating switches system sensor, inspecting & testing assembly,installation control valve as per BIS 15105/N.B.C (Latest editions)

Portable Fire Extinguishers.

5A428.1.5 The minimum residual pressure available in the farthest and topmost hydrant shall be 3.5 kg/cm2for hydrant system and. Pressure in the Hydrant installation piping shall not exceed 7 bar and pressure at the most remote sprinkler at any level shall not be less than

0.5 bar and also not more than 5 bar. Density of application shall not be less than 5 lpm/m2 and Pressure reducing valve stations shall be required to maintain allowable pressures within the installation piping everywhere.

5A428.1.6 The maximum pressure in the landing valve outlet is limited to 7 kg/cm2.

5A428.1.7 Portable fire extinguishers has to be provided as per BIS 2170. Minimum number of portable Fire Extinguisher to be provided at each fire point to be made near or in the vicinity of each entry / exit point of each floor / buildings.(a) 1 Number Fire Extinguisher DCP type 4 Kg capacity, IS 15683 (b) 1 Number Fire Extinguisher Water (stored pressure type) 9 Ltrs. capacity, IS 15683.One additional fire point for each electrical and lift machine room shall be provided. The fire point invariably shall comprise 2 numbers Fire Extinguisher DCP type 4 kg capacity and 1 number Fire Extinguisher CO2 type (light weight squeeze grip type) 3 kg capacity as per IS 15683. The Selection, installation and maintenance of first aid fire extinguishers shall be as per BIS:2190.HSD (High Speed diesel) Tank area shall be provided with extinguisher

(25 Liters CO2/Mechanical foam with Trolley).

5A428.1.8 The Contractor shall fully design and after approval of Engineer display near each staircase landing at floor levels, a glass covered framed floor plan clearly showing the locations of all landing valves, hose reels, hand appliances, as well as the DO's and DON'T's for the personnel and the exit direction in case of an emergency. The dimensions of the floor plan, its scale, lettering size, color scheme etc. shall be as directed by the Engineer. The landing valve signaling switch to initiate the signal on operation of landing valve and transmit the same signal to main fire control panel located at main fire station. The main fire control panel should show the location of landing valve (building no, landing valve no and floor).

5A428.1.9 All the necessary NOC and clearances at various stages of works. The Contractor shall take the clearance from "Center for explosive and environment safety".

5A428.1.10 The portable extinguishers shall be provided at each landing and at places marked in drawing and complying the code requirements covering all areas. Contractor shall provide the extinguishers as Per BIS 2190 latest edition and local norms.

5A428.1.11 The contractor's design shall ensure that required flow and pressure is always available in the firefighting lines.Electrical MV main distribution panel and lift panelsshall be provided with CO2/inert gas flooding system for all panel compartments with a cylinder located beside the panel." As per NBC-2026.

5A428.2 Pipe Work

5A428.2.1 General Requirements

5A428.2.2 All materials shall be of the best quality conforming to the specifications and subject to the approval of the Engineer.

5A428.2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

5A428.2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps and supports (galvanized after fabrication) at intervals specified. Only approved type of anchor fasteners shall be used for RCC slabs and walls / floors etc.

5A428.2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

5A428.2.6 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

5A428.2.7 Pipe accessories such as gauges, meters, control devices, etc. shall have the same working pressure rating as the associated pipe work. All pipe work shall be free from burrs, rust and scale and shall be cleaned before installation. All personnel engaged on welding operations must possess a certificate of competence issued by an acceptable / recognized authority.

5A428.2.8 Piping

5A428.2.9 Pipes of following types are to be used:

Internal fire fighting system Piping (inside the Building)

5A428.2.10 Mild Steel(M.S.) pipes as per BIS: 1239 heavy grade (Class-C) (for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion.

5A428.2.11 Mild Steel(M.S.) up to 150 mm dia. shall be as per BIS: 1239, Part-I (heavy grade, Class-C) while pipelines above 150 mm dia. shall be as per BIS.3589 (heavy grade, Class-C).

External fire fighting system Piping (out side the Building)

5A428.2.10 Galvanized iron pipes as per BIS: 1239 heavy grade (Class-C) (for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion. G.I. pipes buried below ground shall also be suitably be wrapped with 4 mm thick protection coating over 2 coats of primer.

5A428.2.11 G.I. pipelines upto 150 mm dia. shall be as per BIS: 1239, Part-I (heavy grade, Class-C) while pipelines above 150 mm dia. shall be as per BIS.3589 (heavy grade, Class-C).

5A428.2.12 All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanized before use at site. Welding of galvanized clamps and supports shall not be permitted.

5A428.2.13 Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

5A428.2.14 Hangers and supports shall be thoroughly galvanized after fabrication. The selection and design of the hanger and support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor braces, dampener, expansion joint and structural steel to be attached to the building/structure trenches etc. shall be provided.
Hangers and components for all piping shall be approved by the Engineer.

5A428.2.15 The piping system shall be tested for leakages at 2 times the operating pressure or 1.5 time shut-off pressure, whichever is highest including testing for water hammer effects for a period of 4 hour minimum.

5A428.2.16 Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

5A428.2.17 For pipes underground installation the pipes shall be buried at least one meter below ground level and shall have 230 mm x 230 mm masonry or concrete supports at least

3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand: 8 stone aggregate) of size 380x380x75 thick resting on firm soil.

5A428.2.18 Mains below ground level shall be supported at regular intervals not exceeding 3.0 metres and shall be laid at least 2.0 metre away from the building.

5A428.2.19 Piping Installation and Support

5A428.2.20 Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

5A428.2.21 Piping shall be properly supported or suspended from on stands, clamps, hangers as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

5A428.2.22 Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor, where applicable, with Galvanised steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanised steel sections.

5A428.2.23 Spacing of pipe supports shall not be more than that specified below:

Nominal Pipe Size (mm)	Spacing (m)
20 and 25	2.0
32 to 125	2.50
150 and above	3.00

Table 7C430.2.3.4-1: Pipe Hanger Support Distance

5A428.2.24 The end of the steel rods shall be threaded and not welded to the threaded bolt.

5A428.2.25 All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

5A428.2.26 Cut-outs in the floor slab for installing the various pipes area are indicated in the approved shop drawings. The Contractor shall carefully examine the cut-outs

provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

5A428.2.27 Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibre glass and finished with retainer rings.

5A428.2.28 The Contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Engineer.. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

5A428.2.29 All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

5A428.2.30 Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15 mm pipe size and shall be associated with an equal size gate valves.

5A428.2.31 Discharge from the air valves shall be piped through a pipe to the nearest drain. All pipes shall be pitched towards drain points.

5A428.2.32 Digital Pressure gauges shall be provided as shown on the approved shop drawings. Care shall be taken to protect Digital pressure gauges during pressure testing.

5A428.2.33 Pipe Fittings

5A428.2.34 Pipe fittings mean tees, elbows, couplings, unions, flanges, reducers etc. and all such connecting devices that are needed to complete the piping work in its totality.

5A428.2.35 Galvanized Iron screwed type forged fitting shall be used for pipes of 50 mm dia. and below.

5A428.2.36 Fabricated fittings used on pipe size 65 mm and above shall be fabricated, welded in workshops.

5A428.2.37 Procedure for Pipe Protection Application

5A428.2.38 Surface Preparation - The pipe surface shall be cleaned by a wire brush.

5A428.2.39 Application of Primer - Primer is to be applied on pipes immediately after cleaning. This is to prevent any further accumulation of rust on the pipe. This is a cold applied primer and is applied by brush.

5A428.2.40 Application of 4 mm bitumastic Tape - After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, it is advisable to gently heat the primer coated pipe by a run of LPG removing the bottom polyethylene from the tape before wrapping better adhesion between the tape and pipe is obtained. Overlaps are maintained with a minimum of 15.0 mm.

5A428.2.41 Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding and testing methods of the joints is completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

5A428.2.42 A final coat of white wash with water based cement paint is done immediately over the entire coated pipe.

5A428.2.43 Jointing

5A428.2.44 Welded

Joints:

5A428.2.45 Joints between pipes and fittings shall be butt joint made with the pipes and fittings having “V” groove and welded with electrical resistance welding in an approved manner. But welding without “V” groove shall not be permitted.

5A428.3 Air Cushion Tank

Every wet riser shall be provided with an air cushion tank 250 mm dia. at its top most point. The air cushion shall be provided with an automatic air release cock, 20 mm dia. drain pipe, drain valve and shut off valve. (ACT will be on top of each riser).

5A428.4 Fire Brigade Connection

5A428.4.1 Each building at all sites under the scope of work shall be equipped with a Fire Brigade Connection. The fire brigade inlet connection shall be provided near the entry of building with a 150 mm fire brigade connection. The connection shall be fitted with stop valve in a position approved by the Engineer.

5A428.4.2 The fire brigade connection shall be fitted with two numbers of 63mm instantaneous inlets in a glass fronted wall box at a suitable position at street level, so located as to make the inlets accessible from the outside of the building. The size of the wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken. Each box shall have fall of 25mm towards the front at its base and shall be glassed with wired glass with ”FIRE BRIGADE INLET” painted on the inner face of the glass in 50 mm size block letter. Each such box shall be provided with a steel hammer with chain for breaking the glass.

5A428.4.3 Two way collecting head with two numbers 63 mm instantaneous type inlets shall be connected to the hydrant header, so that fire brigade may pump to the fire hydrant header during the fire pump failure. The fire brigade pump shall charge the risers in this event. The connection shall be fitted with sluice valve. Location of this valve shall be as approved by Engineer. All other details shall be as described above.

5A428.5 System Drainage

The system shall be provided with suitable drainage arrangement with drain valves complete with all accessories.

5A428.6 Valve Chambers

Provision of suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 20 mm nominal size) with 15 mm thick cement plaster inside and outside finishedwithaplasterinsideandoutsidefinishedwithafloatedcoatofneatcementinsidewith cast iron surface box including excavation, back-filling complete shall bemade.

5A428.7 Valves

5A428.7.1 Sluice Valves

5A428.7.2 Sluice valves shall be double flanged valves with cast iron body. The spindle, wall seat and wedge nuts shall be of gun metal. They shall generally have non-rising spindle and shall be of the particular duty and design called for.

5A428.7.3 The valves shall be supplied with suitable flanges, non- corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian Standard BIS: 14846 with PN 16 pressure rating or the rating of the valves shall be minimum 1.5 times(150%) of the working presuure of the system whichever is higher.

5A428.7.4 Butterfly Valve

5A428.7.5 The butterfly valve shall be suitable for waterworks and shall be rated for PN 16 pressure rating or the rating of the valves shall be minimum 1.5 times (150%)of the working presuure of the system whichever is higher.

5A428.7.6 The body shall be of cast iron to BIS: 210 in circular shape and of high strength to take the water pressure. The disc shall be heavy duty cast iron with anti-corrosive epoxy or nickel coating.

5A428.7.7 The valve seat shall be replaceable of high grade elastomer EPDM or nitrile rubber with hard backing. The valve is closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

5A428.7.8 The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

5A428.7.9 Ball Valve

5A428.7.10 The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

5A428.7.11 The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

5A428.7.12 The handle shall be provided with PVC jacket. The handle shall also indicate the direction of ‘open’ and ‘closed’ situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.

5A428.7.13 The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

5A428.7.14 Gun Metal Valves

5A428.7.15 Gun metal Valves shall be used for smaller dia. pipes, and for threaded connections. The Valves shall bear certification as per BIS: 778

5A428.7.16 The body and bonnet shall be of gun metal to BIS: 318. The stem gland and gland nut shall be of forged brass to BIS: 6912. The hand wheel shall be of cast iron to BIS: 210.

5A428.7.17 The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non-rising type.

5A428.7.18 Flap Type - Non-Return Valve

5A428.7.19 Non-Return valves shall be cast iron double flanged with cast iron body and gun metal internal parts conforming to BIS: 5312 with PN 16 pressure rating rating or the rating of the valves shall be minimum 1.5 times(150%) of the working presuure of the system whichever is higher.

5A428.7.20 Pressure Relief Valve

5A428.7.21 Each system shall be provided with a Pressure Relief Valves and same shall be UL/FM approved. The valve shall be spring actuated and set to operate as per field requirement. The valve shall be constructed of bronze and provided with an open discharge orifice for releasing the water. The Valve shall be open lift type. And Valve shall be PN 16 pressure rating rating or the rating of the valves shall be minimum 1.5 times(150%) of the working presuure of the system whichever is higher.

5A428.8 Digital Pressure Gauge with RS 485 and BMS Compatable

Digital Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves. Digital Pressure gauge shall be 100 mm dia. gunmetal bourdon type with gunmetal isolation ball valve, tapping and connecting pipe and nipple. The Digital pressure gauge shall be installed at appropriate height for easy readability.

5A428.9 OrificePlates

5A428.9.1 For restricting pressure at lower levels in the hydrant system, orifice plates of appropriate sizes shall be fitted at the branching points from Riser Main, wherever required in the system.

5A428.9.2 The diameter of such orifice shall not be less than 50% of the dia. of pipe into which it is to be fitted, which shall not be less than 50 mm dia. These orifice plates must be of stainless steel-304 with plain central hole without burrs, and the thickness shall be

3 mm for pipe size up to 80 mm, 6 mm for pipes from 80 to 125 mm dia. and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag.

5A428.9.3 The orifice plate shall fitted not less than two pipe internal diameters downstream of the outlet from any elbow or brand.

5A428.9.4 The Contractor shall submit the design and identify location on drawing before installation.

5A428.10 Painting

5A428.10.1 All Hydrant pipes shall be painted with post office red color paint. All G.I. pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO.1" etc.

5A428.10.2 Painting shall be expertly applied; the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

5A428.11 Fire Hydrants and Sprinkler

5A428.11.1 Internal Hydrants

The Contractor shall provide on each landing and other locations as shown on the approved shop drawings single headed gunmetal landing valve with 80 mm dia. inlet as per BIS: 5290, with shut off valves having cast iron wheels. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.

Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.

The Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with gunmetal male and female instantaneous typecouplingmachinewouldwithGIwire(hosetoBIS:636type2andcouplingstoBIS:903 with IS certification), fire hose reel, gunmetal branch pipe with nozzle to BIS:903.

TheContractorshallprovidestandardfirehosereelsof20mmdia.highpressuredunloprubber hose 36 m long with gunmetal nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall conform to BIS: 884 and shall be mounted vertically.

Eachinternalhydranthosecabinetshallbeprovidedwithadraininthebottomplate.Thedrain point shall be lead away to the nearest general drain.

Each internal hydrant hose cabinet containing items as above shall also be provided with a Fireman’s Axe. The cabinet shall be recessed in the wall as per approved shop drawings.

Each hose cabinet shall be conspicuously painted with the letters “FIRE HOSE”.

5A428.11.1 Sprinkler

Sprinkler heads shall be quartzite bulb type with a temp. rating of 68deg. C, K-80 for all areas and 141 deg.C K-80 only for kitchen with gunmetal body UL/FM approved

and having working pressure 175PSI and current certification laboratory (UL) and under the approved certified list of the Fire Office Committee (FOC) of U.K. or NFPA of USA. Any one of the certification as acceptable to the local fire authorities obtained prior to the procurement and approved and accepted by the Project Manager. If higher K Factor is required by Local Fire Authority approval, then same shall be provided.

5A428.12 Testing

5A428.12.1 Check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replaced by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

5A428.12.2 Check air cushion tanks on the terrace for proper functioning.

5A428.13 Fire Pumps

5A428.13.1 The Fire Pump room is located at basement level with direct access. Independent electrical motor driven fire pumps shall be provided for Sprinkler and Hydrant System. The Head of pumps shall be in compliance with NBC requirement of minimum pressure of 3.5 kg/cm2. This will also meet minimum pressure requirement of 0.50 Bars (0.50 Kg/cm2) at farthest and remotest sprinkler. The discharge density of both system pumps shall follow NBC Codes. The diesel engine driven fire pumps shall be common for sprinkler and hydrant system in compliance with codes.

5A428.13.2 Following pumps shall be provided: -

5A428.13.3 Hydrant and Sprinkler system shall be provided with independent pumping system and shall be comprising of separate electric motor driven main fire pump and jockey pump for each system. The diesel engine driven fire pumps shall be common for both systems.

5A428.13.4 Capacity & No of Pump will be as per NBCS 2026.

5A428.13.6 The Head of hydrant system pumps shall follow NBC requirement of minimum pressure of 3.5 kg/sq.cm at remote & Highest landing valve. This will also meet minimum pressure requirement of 0.50 Bars (0.50 Kg/cm2) at farthest and remotest sprinkler.

5A428.13.7 At 150% of rated discharge capacity, the pump shall develop at least 65% of its rated head and shall not exceed 140% of the rated head at zero capacity.

5A428.13.8 The jockey pump operation (start-stop) shall be automatic whereas the main pumps of both systems and common engine pump shall have auto start but manual shut down.

5A428.13.9 OS&Y Gate Valves with supervisory switches shall be provided on main suction header from tank and on individual suction and delivery pipes. And valve shall be PN 16 pressure rating rating or the rating of the valves shall be minimum 1.5 times(150%) of the working presuure of the system whichever is higher.

5A428.13.10 Check valve shall be provided on each delivery side of pumps.

5A428.13.11 Fire Pump test connection shall be provided by means of flow measuring station and

provide piping to re-circulate the pump's discharge to water supply tank or to the pump's suction.

5A428.13.12 Fire Brigade inlet and collecting head shall be provided for taking water from tank and for filling of Underground Fire tank.

5A428.13.13 The fuel tank capacity shall be maximum 990 litres.

5A428.14 Hose Reel

Hose reel shall conform to BIS : 884, heavy duty, 20 mm dia. length shall be 36 meter long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing up to 170 degree with wall brackets of cast iron finished with red and black enamel complete.

5A428.15 Fire Hose

All hose pipes shall be of 63mm diameter RRL as required , conforming to BIS:636. The hose shall be provided with copper alloy delivery coupling.The hose shall be capable of with standing a bursting pressure of 35.7 Kg/Sq.cm without undue leakage or sweating. Hose shall be provided with instantaneous spring-lock, type couplings.

5A428.16 Branch Pipe, Nozzle

Branch pipes shall be of gun metal with loaded tin bronze ring at the discharge and to receive the nozzle and provided at the other with a leaded tin bronze ring to fit into the instantaneous coupling. Nozzle shall be of spray type of diameter of not less than 16 mm and not more than 25 mm. Nozzle shall be of loaded tin bronze branch pipe and nozzle shall be of instantaneous pattern conforming to BIS: 903.

5A428.17 Hose Cabinet

Hose cabinet shall be provided for all internal fire hydrants. Hose cabinets shall be fabricated from16gaugeMSpowdercoatedsheetoffullyweldedconstructionwithhingeddoublefront door partially glazed (2 mm glass panel) with locking arrangement, stove enamelled fire red paint(shadeNo.536ofBIS:5)with"FIREHOSE"writtenonitprominently.Cabinetsurface s in contact with the walls shall not be powder coated but instead given two coats of anti- corrosive bitumastic paint.

5A428.18 Internal Hose Cabinet

- Hosecabinetshallbeglass(4mm)frontwithhingeddoorandlock.Thecabinetshall be made of 16 gauge thick MS sheet and spray painted to shade no 536 of BIS:5Landing Valves (Single headed)
- Hose pipe (2 length of 15m)
- Hose reel (36.0m)
- Branch pipes, nozzles (1sets)
- Fire man's axe and hand appliances

5A428.19 External Hose Cabinet

- The hose cabinet shall be of size to accommodate the following:
- Single/ yard hydrant valve
- Hose pipe (2 length of 15m)
- Branch pipes, nozzles (one set)
- Fire man's axe

5A428.20 Sprinklers

15 mm Chrome plated gunmetal sprinkler head with quartz bulb and set to operate at specified temperature pendent/upright/ side wall ,Temperature of operation 68 deg..C K-80 with 175 PSI operating pressure.

5A428.21 Flexible pipe for Sprinklers

UL/FM approved flexible Joint of 25mm diameter, consisting of - Flexible Tube (SS 304), S.S. Slip nut, Isolated Ring & O Ring - for Sprinklers Drop, which shall include necessary supports with a maximum working pressure of 16kgf/cm2 and temperature rating of 225oF. The length of Flexible Sprinklers Pipe shall be 900mm/1200mm/1500mm or as required.

5A428.22 Flow indicating switch for Sprinklers

Electrically operated flow indicating switches system sensor in sprinkler branch line on each floor with necessary junction box installed in accessible place. (Wiring from flow switches to monitor module)

5A428.23 Installation Control Valve

UL/FM approved Gunmetal installation valve with turbine type automatic alarm to be connected with control valve ,drain valve ,test valve and piping as per manufacturer's specifications complete in all respects. For all sprinklers riser and located at the entry of the building as per BIS-15105-2021.

5A429 Hand Held Fire Extinguishers

5A429.1 Hand Appliances

5A429.1.1 Scope

5A429.1.2 Work under this section shall consist of furnishing all labor, materials, appliances and equipment necessary and required to install fire extinguishing hand appliances as per relevant specification of various authorities.

5A429.1.3 Without restricting to the generality of the foregoing, the work shall consist of the following:

5A429.1.4 Installation of fully charged and tested fire extinguishing hand appliances of A B C powder type as required.

5A429.1.5 General Requirements

Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

Distribution / installation of fire extinguisher to be in accordance to BIS: 2190.The minimum one number DCP type 4 Kg capacity and one number Water (stored pressure type) 9 Ltrs capacity Fire Extinguisher shall be provided in each landing/fire points marked in drawing. One additional fire point each for electrical and lift control room/machine room shall be provided. The fire point invariably shall comprise of two

number DCP type 4 kg capacity and one number CO2 type Fire Extinguisher 3 kg capacity. However if NBC 2026 recommend more than that the contractor shall provide the same without extra cost to employer. Each LV room shall be provided adequate number CO_2 Fire Extinguisher.

5A429.1.6 ABC Type Dry Powder Extinguisher

The Extinguisher shall be filled with ABC grade 90, Mono Ammonium Phosphate 90% from any approved manufacturer.

The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per BIS: 14609, Part II, shall be 4 Kg +/-2% or 9 Kg +/- 3%.

The distribution of fire extinguishers in to be as per BIS 2190.

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shallhaveasafetyclip,fittedwithapin,topreventaccidentaldischarge.Itshallbepressurized with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15Kg/cm2

Body shall be of mild steel conforming to relevant BIS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body shall be forged brass or leaded bronze,whilethespindle,springandsiphontubeshallbeofbrass.Thenozzleshallbeofbrass, whilethehoseshallbebraidednylon.Thebodyshallbecylindricalinshape,withthedishand dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

The Neck Ring shall be externally threaded, the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzles shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents up to a throw of 4 m, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia. internally for 5 Kg capacity and 12 mm for 10 Kg capacity. It shall have a pressure gauge fitted to the valve assemblyorthecylindertoindicatepressureavailableinside.Theextinguishershallbetreate d withanti-corrosivepaint,anditshallbelabelledwithwordsABC2.5cmlong,withinatriangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 kg/cm2 for a minimum period of 2minutes.

5A429.2 Water Type Extinguisher (Gas Pressure Type)

5A429.2.1 The Extinguishing medium shall be primarily water stored under normal pressure, the discharge being affected by release of Carbon Dioxide Gas from a 120 gms cylinder.

5A429.2.2 The capacity of Extinguisher, when filled up to the indicated level, shall be 9 ltr +/- 5%.

5A429.2.3 The skin thickness of the Cylinder shall be minimum 4.0 mm, fabricated from Mild Steel sheet, welded as required, with dish and dome, being of same thickness, and of size not exceeding the diameter of body. The diameter of body to be not less than 150 mm and not exceeding 200 mm. The neck shall be externally threaded up to a minimum depth of 16 mm, and leaded tin bronze.

5A429.2.4 The cap shall be of leaded tin bronze, and screwed on the body up to a minimum of 1.6 cm depth, with parallel screw thread to match the neck ring. The siphon tube to be of brass or
G.I. and the strainer of Brass. The cartridge holder, knob, discharge fittings and plunger to be of Brass/Leaded tin bronze, and plunger of stainless steel, spring of stainless steel. The cap to have handle fixed to it. The discharge hose shall be braided nylon, of 10 mm dia. and 600 mm long, with a nozzle of brass fitted at end.

5A429.2.5 The extinguisher shall be treated for anti-corrosion internally and externally, and externally painted with Fire Red paint. The paint shall be stove enameled / powder coated. Thecartridge shall be as per BIS, and have 60 gm net carbon dioxide gas for expelling. The extinguisher, body and cap shall be treated to an internal hydraulic pressure of 25 Kg/cm2. It shall have external marking with letter A, of 2.5 cm height, in block letters within a triangle of 5 cm each side. The extinguisher shall be upright in operation, with the body placed on ground and discharge tube with nozzle held in one hand to give a throw of not less than 6 m, and continue so for at least 60 secs. The extinguisher body shall be clearly marked with ISI stamp (BIS:15683).

5A429.3 Carbon DioxideExtinguisher

5A429.3.1 The Carbon Dioxide Extinguisher shall be as per BIS: 15683.

5A429.3.2 The body shall be constructed of seamless tube conforming to BIS: 7285 and having a convex dome and flat base. Its dia. shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

5A429.3.3 The discharge mechanism shall be through a control valve conforming to BIS: 3224. The internal syphon tube shall be of copper aluminum conforming to relevant specifications.

5A429.3.4 Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm2 and shall be approximately 1.0 meter in length having internal dia. of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn shall be insulated with Rubber of appropriate thickness.

5A429.3.5 The gas shall be conforming to BIS: 307 and shall be stored at about 85 kg/cm2. The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and the total discharge time (effective) shall be minimum 10 secs and maximum 25 secs.

The extinguisher shall fulfill the following test pressures:

5A429.3.7 Cylinder: 236 Kg/cm2

5A429.3.8 Control Valve: 125 Kg/cm2

5A429.3.9 Burst Pressure of Hose: 140 Kg/cm2 minimum

5A429.3.10 It shall be an Upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear BIS marking.

5A429.3.11 The Extinguisher including components shall be BIS marked.

5A430 Drencher System

5A430.1 Electrically Operated Deluge System

5A430.1.1 Electrically operated Deluge System shall be supplied and installed.

5A430.1.2 Deluge system shall utilize a 90 degree pattern or straight-through pattern type of Deluge Valve. Deluge valve shall be of Ductile iron construction rated to 250 Psi and is UL approved. Deluge valve shall employ a positive vent on the priming line to ensure that the Deluge valve will not prematurely reset. Deluge valve shall incorporate a pressure operated relief valve (PORV) to positively vent the priming water chamber.

5A430.1.3 An electric solenoid valve shall be utilized to release the priming chamber water pressure. The solenoid valve shall be 24VDC.\

5A430.1.4 Deluge system shall be fitted with open window sprinklers or open nozzles and provided with a manual release and automatic release. The automatic release shall be operated by a fire detection system opening deluge valve.

5A430.1.6 Drencher/Water curtain system shall be designed to provide protection for vertical openings, to separate an area of high fire risk such as car park, for exposure protection, and to provide protection for refuge and fire check floors to meet local fire authority approval.

5A430.1.7 Drencher/Water curtain system shall be designedto provide a discharge of at least 35 lpm for every linear metre of openings (intended to be protected) and it shall be ensured that each sprinkler (Water curtain Nozzles)discharges at least 55-80 lpm at 1.4 bar pressure depending upon spacing between nozzles which shall not exceed 2.5 m.Accordingly K- factor of window sprinklers or open nozzles to be calculate.

5A430.1.8 The pump flow shall be designed on the basis of flow required for the largest zone. This shall be checked and verified both by hydraulic calculation and on site verification.

5A430.1.9 Deluge valve shall be UL listed Ductile Iron body conforming to relevant ASTM standards. The system designed shall comply with the local fire authority code of standard.
Drencher/Water curtain system shall be actuated by an automatic detection system. A manual release with operating instruction shall be supplied and installed near the

deluge valve.
Where the drencher/water curtain system is used to separate an area of high risk for life safety protection or to protect a compartment forming part of an escape route as indicated or where specified, the drencher system shall be actuated by smoke detection system. Detectors shall be arranged in cross zone operation. The detectors shall be arranged each on either side of the drencher heads. The activation of one detector shall energize an alarm with audio and visual indication on the control panel. The activation of any two detectors arranged in coincidence connection shall operate the drencher installation. Where required by local fire authority and approved by the Architect, activation of the detectors provided solely for the drencher system shall not energize the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter.

5A430.1.10 The drencher head shall be designed to provide a flat 180 degree fan-shaped spray pattern to protect the vertical surface. Drencher head to be UL approved with minimum operating pressure of 7 Psi (0.50 kg/cm2). Drencher head body to be of Brass UNS-C36000 construction.

5A430.1.11 Water curtain nozzle will be made in brass IS: 319 / ASTM- B16 with natural brass finish .It will have and effective working pressure of 1.4 to 3.5 bar with maximum working pressure of
12.3 bar. The end connection of the nozzle will be ½ inch BSPT.

5A430.1.12 Contractor shall calculate the number of drencher heads, select the types of drencher heads and arrangement to provide an even flow of water over the entire vertical surface of the openings protected by the drencher system. Contractor shall consider the effect of wind and air movement in surrounding environment of the protected area in the design and selection of equipment for drencher system.

5A430.1.13 Contractor shall submit the network analysis & Pump head calculation with the help of standard approved software and decide optimum head for fire fighting pumps for Drencher system.

5A430.1.14 Contractor shall check and verify the sizing of pipework by hydraulic calculation and submit fully calculated results to the local consultant for approval. Contractor shall calculate and check size of water storage tank which shall be adequate for not less than an hour of operation of all drencher installations that are required to be operated simultaneously.

Note: The Integration of deluge valve / Drencher system with Fire Alarm System shall be carried out by Fire Alarm System Contractor.

5A431 FIRE PUMPS AND ALLIED EQUIPMENTS

5A431.1 Scope

5A431.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and dieseldriven pumps and as required by drawings and specified hereinafter or given in the schedule of rates.

a. Electrically operated pumps with motors and diesel engine driven pumps with

diesel engine, common base plates, coupling, coupling guard andaccessories.

b. Automatic starting system with all accessories, wiring and connections and pressure switches.

c. Motor controlcenter with reqired cables, cable tray, earthing and other required accessories.

d. Annunciation system with all accessories wiring andconnections.

e. Pressure gauges with isolation valves and piping, bleed and blockvalves.

f. Suction strainers andaccessories.

g. Vibration eliminator pads and foundationbolts.

h. Leak-off drain shall be led to the nearest floordrain.

i. Flow Meter for test line(for Hydrant, Sprinkler and Water curtain pumps) /multi-jet magnetic drive (turbine type) water meter conforming to IS : 2373/ECC/ISO Standard with direct reading dia in Kilo-liter with all internal part in Gun metal or brass, strainer, flanged distance pieces for easy removal, 100 mm dia burden type pressure gauge with isolation cock including necessary test certificates. (For Test line)

j. Air Cushion Tank of 450mm diameter,Shell Thickness: 10 mm,Dish Ends: 12 mm,Height : 2000 mm,Finishing: Two coats of red enamal paint over primer outside and two coats of epoxy coating inside.Material of construction: M.S,Test Pressure: 20 kG/SQ.CM.Size of Inspection flange:450 mm dia ,Height of supporting legs: 400 mm, (No of Pressure vessel will be as per actual requirements of NBC & relevant codes.) Pressure Vessel to be installed in pump room.

5A431.2 General Requirements

5A431.2.1 Pumps shall be installed true to levels on suitable concrete foundations. Base plate shall be firmly fixed by properly grouted foundation bolts.

5A431.2.2 Pumps and motors shall be truly aligned by suitably instruments. Record of such alignment shall be furnished to the Project Manager.

5A431.2.3 All pump connections shall be standard flanged type with number of bolts as per relevant standard requirement for the working pressure. Companion flanges shall be provided with the pumps.

5A431.2.4 Manufacturers' instructions regarding installation, connections and commissioning shall be strictly followed.

5A431.2.5 Contractor shall provide necessary test certificates, type test certificates, performance curves and NPSH curves of the pumps from the manufacturer when called for. The contractor shall provide facilities to the Project Manager & Consultant for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Project Manager or Consultant.

5A431.2.6 Seismic isolation and clamping for each pump and flexible connection on the suction as well as the discharge side shall be provided.

5A431.2.7 The contractor shall submit with this tender a list of recommended spare parts for three years of normal operation.

5A431.2.8 The contractor shall submit the network analysis & Pump head calculation with the help of standard approved software and decide optimum head for firefighting pumps for Hydrant, Sprinkler system and flow rate and headfor Drencher / Water Curtain system as per BIS-15105 Latest Edition.

5A431.3 Electric FirePump

5A431.3.1 General

5A431.3.2 The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A.C. system. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel type or cast iron type. The fire pump efficiency shall be inacceptable range of 65 – 70%.

5A431.3.3 The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided.

5A431.4 FirePump

5A431.4.1 The fire pumps 2nos.(one pump for Hydrant and one pump for Sprinkler system) shall be horizontally mounted multistage & multioutlet centrifugal type. It shall have a capacity to deliver 2850 lpm as specified ofeach pump or as per local fire authority which ever is higher, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet.

The water Curtain pumps 1nos.shall be horizontally mounted single/multistage & single outlet centrifugal type. pump shall have a capacity to deliver as required, and developing adequate head so as to ensure a minimum pressure of 1.4 Kg/Sq.cm at the highest and the farthest water curtain nozzle. Pump Capacity shall be designed by Contractor as per BIS: 15105, latest edition or as per local fire authority requirement.

5A431.4.2 The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

5A431.4.3 The pump casing shall be of cast iron to grade FG 200 to IS: 210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of gland packing seal shall also be made.

5A431.4.4 Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entryof dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

5A431.4.5 Provision of Jockey Pumps. shall be made. The pump shall be multistage & multi outlet type and of detail. Contractor shall verify that the capacity of the Jockey pump shall not be less than 3% (Minimum 180 LPM) and not more than 10% of the installed pump capacity.

5A431.4.6 The motor shall be squirrel c

age A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55. The class of insulation shall be F. The synchronous speed shall be 1500 RPM as specified. The motor shall be rated for continuous duty and shall have a horse power rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head. The motor shall conform to I.S.325-1978.

5A431.4.7 The motor starter shall be as per detail in MCC. The unit shall include suitable current transformer and ammeter of suitable range on one line to indicate the current. The starter shall not incorporate under voltage, no voltage trip overload or SPP.

5A431.4.8 The starter assembly shall be suitably integrated in the power and control panel for the wet riser system & sprinkler system.

5A431.5 Diesel FirePump

5A431.5.1 The diesel pumps set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common base plate.

5A431.5.2 The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500 RPM as specified.

5A431.5.3 The fire pumps will be as per NBC 2026 requirment or recommended and approved by local fire authority. It shall be horizontally mounted centrifugal multi stage&multi outlet. It shall have a capacity to deliver as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet. The pump shall be single/ multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head.
The shut off head shall be within 120% of the rated head.

5A431.5.4 The pump casing shall be of cast iron to grade FG 200 to IS 210 and parts like impeller, shaft sleeves, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be stainless steel. Provision of mechanical seal shall also be made.

5A431.5.5 The pump casing shall be designed to withstand 1.5 times the working pressure.

5A431.5.6 Bearing of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

5A431.5.7 Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater, plugs etc.). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled with heat exchanger with pressure reducing valves etc, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump.
Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and the after correction for altitude, ambient temperature and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and major overhaul shall not be required before 3000 hours of operation. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended up to date.

5A431.6 Engine Accessories - The engine shall be complete with the following accessories: -

5A431.6.1 Fly wheel dynamically balanced.

5A431.6.2 Direct coupling for pump and coupling guard.

5A431.6.3 Corrosion Resistor.

5A431.6.4 Air cleaner.

5A431.6.5 Fuel service tank support, and fuel oil filter with necessary pipe

5A431.6.6 work. Elect. starting battery (2X12 v).

5A431.6.7 Exhaust silencer with necessary pipe work.

5A431.6.8

Governor.

5A431.6.9 Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).

5A431.6.10 Necessary safety controls.

5A431.7 Fuel System–

5A431.7.1 The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on bracket. The fuel filter shall be suitably located to permit easy servicing.

5A431.7.2 All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

5A431.7.3 The fuel tank shall be of welded steel construction (3 mm. thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary wall mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediments into the fuel line to the engine.

5A431.7.4 As semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of supply.

5A431.7.5 Lubricating Oil System- Forced feed Lub. Oil system shall be employed for positive lubrication. Necessary Lub. oil filters shall be provided, located suitably for convenient servicing.

5A431.7.6 Starting System- The starting system shall comprise necessary batteries (2x12v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Bi metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

5A431.7.7 The capacity of the battery shall be suitable for meeting the needs of the starting system.

5A431.7.8 The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

5A431.7.9 The scope shall cover all cabling, terminals, initial charging etc.

5A431.7.10 Operation Logic Fire Fighting Panel shall have operation in Auto/ Manual mode.

5A431.7.11 Control shall be done through AMF DC unit mounted in Fire Panel and having protection of LLOP,HWT and fail to start condition.When system gets fire signal and Electrical pump is not able to start or maintain required water pressure, a potential free contact provided in the electrical pump feeder shall energies the Diesel Pump control module.

5A431.7.12 In Auto mode, Diesel pump shall be controlled both through pressure switches and interlocking of Electrical pump failure contact. During Low water pressure, potential free contacts of switch complete the starting circuit of DC AMF Unit and Cranking

relay will give start command to engine. After completing extinguishing process or well-maintained water pressure condition, this fire pump shall stop through the same pressure switch contact.

5A431.7.13 InManualModeStartingandStoppingprocessshallbedonethroughpushbuttonsonly.Fail to start condition: When AMF Unit get fails to start Diesel Engine in three attempts, relay shall give output for fails to start and the same shall energies Hooter with indication on annunciator. Fails to start fault shall be accept byoperatormanually and reset by push button mounted onpanel.

5A431.7.14 Engine Fault: In case of Low Lub Oil Pressure, High Water Temperature, a potential free contact shall give signal to the control module of pump panel which shall give annunciation on Panel through control circuit

5A431.8 Exhaust System–

5A431.8.1 The exhaust system shall be complete with silencer suitable for outdoor installation and silencer piping including bends and accessories needed for a run of 15 metre from the engine manifold.(Adjustment rates for extra lengths shall also be given). The total back pressure shall not exceed the engine manufacture's recommendation. The exhaust piping shall be suitably supported.

5A431.8.2 Engine shut down mechanism- This shall be auto/ manually operated and shall return automatically to the starting position after use.

5A431.8.3 Governing System- The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

5A431.8.4 Engine Instrumentation- Engine instrumentation shall include the following:-

- Lub. oil pressure gauge.
- Lub. oil temperature gauge.
- Water pressure gauge.
- Water temperature gauge.
- Tachometer.
- Hour meter.

5A431.8.5 The instrumentation panel shall be suitably resident mounted on the engine.

5A431.8.6 Engine Protection Devices- Following engine protection and automatic shut down facilities shall be provided:-

i) Low lub. oil pressure.

ii) High cooling watertemp.

iii) High lub.oiltemperature.

iv) Over speed shut down.

5A431.8.7 Pipe Work - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub.oil and exhaust systems, M.S. piping of adequate sizes, shall be used for Lub.oil and fuel oil. M.S. piping will be permitted for exhaust.

5A431.8.8 Anti Vibration Mounting- Suitable vibration mounting duly approved by ProjectManager shallbeemployedfor mountingthe unitsoasto minimisetransmissionofvibrationtothe structure. The isolation efficiency achievable shall be clearlyindicated.

5A431.8.9 Battery Charger-Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery in trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

5A431.9 Interlocking

5A431.9.1 The following inter-locking between the two main fire pumps (i.e. wet riser pump & sprinkler pump), the jockey pump and the diesel engine driven pump.

5A431.9.2 Only one category of pumps will work at a time i.e. either jockey pump or main fire pumps (wet riser and sprinkler, both the wet riser and sprinkler can come up at a time) or diesel driven pump.

5A431.9.3 Note: The operation logic ofFire Pumps shall be based on the below table. However the below table only provides basic logic. Contractor shall prepare detailed logic based on testing of Fire Pumps and shall commission the Fire Pump system accordingly.

5A431.10 General

5A431.10.1 As and when notified in writing or instructed by the Engineer, the Contractor shall submit shop drawing and attend all tests and inspections carried out by Local Fire Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered by the Engineer as a result of such tests and inspections where these indicate non-compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

5A431.10.2 The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by these Authorities.

5A431.10.3 The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Engineer for checking before submission.

5A431.10.4 The Contractor shall notify the Engineer at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the Engineer without delay.

5A431.11 Final AcceptanceTests

5A431.11.1 Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Engineer.

5A431.11.2 Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

5A431.11.3 Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

5A431.12 Rejection ofInstallation

5A431.12.1 Any item of system or component which fails to comply with the requirements of this specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Engineer either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Engineer so as to comply with the Authority's requirements and the intent of the specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority.

5A431.12.2 After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Engineer.

5A431.13 Handing Over ofDocuments

5A431.13.1 All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Engineer.and all testing and commissioning documents shall be handed over to the Engineer.

5A431.13.2 The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to Engineer.

5A432 ANNEXURE-X

5A432.1 Abbreviations

ACT Air Cushion

Tank ARV Air

ReleaseValve

B.V. BallValve

B.F.V. Butterfly Valve

C.P. Controlled

Percolated FHC Fire

HoseCabinet

F.D. FireDoor

M.S. Mild Steel

N.R.V. Non-Return Valve

N.B.C. National Building Codes of India

R.R.L. Rubberized Fabric Reinforced Rubber lined

UnderwritersLaboratories

5A433 Annexure-XI

5A433.1 ListofBureauofIndianStandardsandOtherCodes

Pipes and Fittings

BIS : 1239(Part1)	Mild steel, tubes, tubulars and other wrought steel fittings:Part 1 Mild Steel tubes.
BIS : 1239(Part2)	Mild Steel tubes, tubulars and other wrought steel fittings:Part 2 Mild Steel tubulars and other wrought steel pipefittings.
BIS:3468	Pipenuts.
BIS:4346	Specificationsforwashersforusewithfittingsforwater services.
BIS:4711	Methods for sampling steel pipes, tubes and fittings.
BIS:110221	Code of Practice for coating and wrapping of U.G.pipelines. Valves
BIS:778	Specificationforcopperalloygage,globeandcheckvalvesfor water works purposes.
BIS:14846	Specification for sluice valves for water workspurposes.
BIS:3950	Specification for surface boxes for sluicevalves.
BIS : 5312(Part1)	Specification for swing check type reflux (non-return)valves: part 2 Multi door pattern.
BIS : 5312(Part2)	Specification for swing check type reflux (non-return)valves: part 2 Multi door pattern.
BIS : 12992(Part1)	Safety relief valves, spring loaded
:Design BIS:13095	Butterfly valves for generalpurposes.

Fire Fighting and Fire Protection

	Compliance with Local Fire Officer's Provisional NOC
NBC Part– IV	National Building Code of India; Part IV Fire and
LifeSafety BIS:636	Non-percolating flexible firefighting deliveryhose.
BIS:884	Specification for first aid hose reel for fire fighting.
BIS:901	Specification for couplings, double male and double female, instantaneous pattern for fire fighting.
BIS:902	Suction hose couplings for firefightingpurposes.
BIS:903	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner.
BIS: 904	Specification for 2-way and 3-way suction collecting heads for firefighting purposes.
BIS:907	Specification for suction strainers, cylindrical type for fire fighting purposes.
BIS:908	Specification for fire hydrant, stand post type.
BIS:909	Specification for underground fire hydrant, sluice valve type.
BIS:15683	Specification for portable fire extinguisher.
BIS:2190	Selection, installation and maintenance of first aid fire extinguishers – Code ofpractice.
BIS:2871	Specification for branch pipe, universal, for fire fighting purposes.
BIS:3844	Code of practice for installationandmaintenanceofinternal fire hydrants and hose reel on premises.
BIS:5290	Specification for landingvalves.
BIS5714	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.
BIS:3488	Code of practice for fire safety of installation and maintenance of Internal fire hydrant and hose reels on premises.

5A435 TECHNICAL SPECIFICATIONS- ELECTRICAL SYSTEM

5A435.1 General

5A435.1.1 The trunk electrical distribution system shall be designed and constructed by the Contractor,providing supply power to the point of the Sub-Station. The Contractor shall submit after the award of contract and as part of the Contractor's final design process. Schematic design, detailed design, technical data of products and equipment catalogues etc.

The Contractor shall be responsible to install a complete and fully functional electrical distribution system. The electrical system shall include (but not limited to) design,supply, installation, testing and commissioning of the following:

- Provision (civil work for trench with pipe/ Hume pipes) for Incoming 33KV HT Cables from boundary wall to the Meter room and 33KV panel located in service building. The incoming 33KV HT cable along with 33KV HT meter shall be provided by SEB
- Substation equipment like HT Panels, Transformers and LT Panels, Hybrid Panels and all associated works for Substations
- DG Sets for Hospital Block, Residence and Common area services.
- Main Power Distribution Network from Substation to Hospital, Residence & Service Blocks.
- Inverter for emergency lighting.
- UPS for Medical Equipment and fire safety equipment
- Lighting / Lighting automation as per Green Building requirement
- General lighting for Basement, Common Area, Hospital Block and others
- Lightning Protection System as per latest NBC
- Earthing and T-N-S grounding system
- External Lighting
- Vertical Transport system (Elevators & Escalators)
- Fire alarm and detection system & PA System
- CCTV system
- Access Control System
- IPTV
- Nurse Call Station
- Queue Management System
- Master System Integration
- Parking Management System
- AV System
- Data/ voice – Passive Networking
- Fire Suppression System
- All statutory approval for electrical distribution planned and installed shall be responsibility ofthe Contractor. All fees, if any, related to statutory approval shall be borne by the Contractor.

5A436 33/11KV KV PANEL (VACUUM CIRCUIT BREAKER)

5A436.1 33/11KV KV H.V. PANEL (OEM FACTORY PANELS)

5A436.1.1 The Panel board shall be of indoor and expandable type, having the incoming and outgoingVCB, as per IEC 62271-100 for Breakers and – 200 for Panels of switch board. HT panels with accessories shall be designed to conform to the requirements

of the following StandardSpecifications with up to date amendments:

S. No.	Standards	
1.	IEC: 62271 – 1	High-voltage switchgear and control gear Common specificatios.
2.	IEC: 62271 – 100	High-voltage switchgear and control gear - Alternatingcurrent circuit-breakers.
3.	IEC: 62271 – 200	High-voltage switchgear and control gear - AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
4.	IEC: 600441-1	Current Transformers
5.	IEC: 600441-2	Voltage Transformers
6.	IEC: 60529	Classification of degrees of protection provided by enclosures
7.	IEC: 60038	Standard Voltages
8.	IEC: 60255	Measuring relays and protection equipment Part 24: Common format for transient data exchange for power systems.
9.	ANS IEEE C I 37/2 0	Switch gear assemblies including metal enclosed bus.

The degree of enclosure protection shall be IP-4X.

Detailed requirement shall be in accordance with the as per requirement at Appendix-II.

5A436.1.2 Rating

All panels assembled to form a board shall be suitable for the nominal operation voltage and rupturing capacity as specified. They should be rated as specified with a minimum of 630 Amps. and suitable for operation on 33KV or 11 kV, 3 phase 50 Hz system. Type test certificate for the breaking capacity of the panel shall be supplied. A circuit breaker for a givenduty in service is best elected by considering the individual rated values required by load conditions and fault condition.

The Vacuum Circuit Breakers shall be suitable for the following

parameters: Rated System Voltage : 33KV or 11kV, 50Hz,

3Phase AC.Highest System Voltage : 33KV or 11 kV

Rated Current : min 630 Amp.

Rated breaking Capacity : 25 kA for 3 sec at 33KV

or 11 KVRated making capacity : 62.5 KA at 33KV or 11

KV Power Frequency withstand : 28 kV

Impulse withstand : 75kVP

5A436.1.3 Type

The HV panel shall be metal clad, indoor, floor, mounting, free standing type. It shall be totallyenclosed dust, damp and vermin proof with provision of future expansion.

5A436.1.4 General Construction

The switchgear panels shall be suitable for loss of service continuity LSC 2B as per IEC. Separate compartment shall be provided for circuit breaker, bus bars, (relay & instruments andcable boxes, fully and effectively segregating these from one another so that fault in any one compartment do not cause damage to equipment(s) in other compartment(s). HT Panel, vacuuminterrupter and Numerical Relay shall be of same make.

Height on HT section (i.e. up to HV Bus-bar section) shall not be less than 1400mm. this is toensure safety of the personal or operator around the switchgear in-case of any internal arc.

The Circuit Breaker shall be suitable for E2, M2 & C2 (Single capacitor Bank) class duty. Theoffered circuit breaker should have valid type tests to support the afore mentioned duty class.

The panels shall be bolted together to form a continuous flush front switch gear suitable forfront operation of board and for extension at both ends.

It shall be possible to have all operations under closed door.

5A436.1.5 General Design Aspects

The HV panel board shall be designed such that the switchgear, instruments, relays, Bus bars,small wiring etc. are arranged and mounted with due consideration for the followings: -

Facility for inspection, maintenance and repairs of testing terminals and terminal boards for ease of external connection. Minimum noises and vibrations. Risk of accidental short circuits and open circuits. Secured and vibration proof connections

for power and control circuits. Risk of accidental contact and danger to personnel due to live connections. Mounting at approachable height.

5A436.2 CIRCUIT BREAKER

5A436.2.1 General Arrangements

a. The circuit breaker panels shall be complete with the following: - (a) Racking in / Rackingout mechanism.

b. Isolating plugs and sockets.

c. Mechanical inter-locks and safety shutters.

d. Mechanical ON/OFF indicator.

e. Minimum of 4 NO and 4 NC Auxiliary contacts directly operated by the circuit breaker.Additional NO & NC contacts can be provided with auxiliary contactors.

f. Anti-condensation space heaters suitable for operation on 240V, 1 Φ 50 Hz A.C. for eachpanel.

g. Suitable tripping arrangement.

h. Mechanical counters to assess the total number of operations of the breaker.

i. VCB arms shall be casted with epoxy to have positive segregation without use of any FRPbarriers for better insulation.

5A436.2.2 Type

The circuit breaker shall be horizontal isolation, horizontal draw out pattern.

Panel shall be of sheet steel construction not less than 2mm thickness for load/non load bearingsection with CRCA/Aluzinc sheet.

Each circuit breaker shall be mounted on a withdrawable truck which shall roll out horizontallyfrom service position to isolated position with ease and it shall also be possible to take out thebreaker truck from cubicle smoothly on to the floor without use of any separate handling equipment.

All the HV compartment design i.e. Busbar compartment, VCB compartment and Cable compartment.

Panel should ensure conformity to IEC 62271- 100 &200, STC 25kA for 3 sec and must betype tested individually for Internal Arc Test for AFLR 25kA for 1s at individual compartments
i.e. Busbar, VCB and cable compartment.

Vacuums Interrupter shall be tested for min. 50nos. operations at full short circuit.

5A436.2.3 Breaker Truck

The breaker carriage shall be fabricated from steel, providing a sturdy vehicle for the circuit breaker and its operating and tripping mechanism. The carriage shall be mounted on wheels, moving on guides, designed to align correctly and allow easy movement of the circuit breaker and for removing the carriage for inspection and maintenance purposes. The drive mechanismshall preferably be provided with facility for pad locking at any position namely, "SERVICE", "TEST" AND "FULLY ISOLATED". It should be possible for testing the circuit breaker for its operation without energizing the power circuit in the "Testing" position. The contacts shallbe made only after the breaker is inserted into service position. Interlocking should prevent contacts from being disconnected if circuit breaker is tried to be moved from service position.

5A436.2.4 General Features

Single break contacts are provided in sealed vacuum interrupter.

5A436.2.5 Rating

The circuit breaker shall be continuously rated as specified with a minimum rated current asper schedule with voltage rating and breaking capacity as per requirement at Appendix-II.

5A436.2.6 Operating Mechanism

The operating mechanism shall be one of the following as specified;

Manually operated spring charged/ motor wound spring charged with both mechanical andelectrical release for closing. The operating mechanism shall be trip free.

5A436.2.7 External auxiliary supply shall be made available for charging motors & heaters operation.

5A436.3 BUS BAR SECTION

5A436.3.1 General Requirement

The switch board shall be single bus bar pattern with air insulated encapsulated bus bars housedin a separate compartment, segregated from other compartments. Bus bar sleeve indicating therelevant phase color code.

5A436.3.2 Material

The main bus bar shall be flat, rectangular of high conductively electrolytic copper rated as specified with a minimum rated current of 630 Amps. The bus bar shall be sized for carrying the rated current of 630 Amps. The bus bars shall be sized for carrying the rated and short circuit current without over-heating. Maximum bus bar temperature shall be as per IEC over an ambient temperature of 40 degrees.

Bus bar joints shall be minimum 4 bolts and shall be shrouded and support in such a way that it can withstand the electro-magnetic stress developed during any short circuit.

The switch board shall have a continuous copper earth bus bar of adequate size throughout itslength and provision to connect this earth bar to the external earthing system shall be kept. Each door and part of the switch gear panel shall be connected to this earth bus.

5A436.4 CURRENT TRANSFORMER

5A436.4.1 General Requirements

Accommodation shall be provided in the circuit breaker panel to mount one set of three numbers dual core dual ratio CTs for metering and protection purposes. Access to the CTs forcleaning, testing or changing shall be front, back or top of the panel.

5A436.4.2 Rating

Cast resin cast Dual core & dual ratio CTs of suitable burden (but not less than 20 VA forincomer and 10 VA for outgoing feeder) shall be preferred with 5 Amps secondary.

Note: CT ratio shall be compatible with the loading pattern on HV side.

The CTs shall conform to IEC: 600441/relevant Indian Standards. The design and constructionshall be robust to withstand thermal and dynamic stresses during short circuits. Secondary terminal of CTs shall be brought out suitably to a terminal block will be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5 P 10 of IS 2750- Part III- 1992 (latest edition).

The metering CTs shall conform to the metering ratio and accuracy class 0.5 of IS 2750-1992for incomer and class 1 for outgoing Panels.

5A436.5 VOLTAGE TRANSFORMER

5A436.5.1 General Requirement

The PTs shall conform to IEC: 600441/relevant Indian Standards. The design and constructionshall be robust to withstand thermal and dynamic stresses during short circuits. A voltage transformer of burden not less than 100 VA and of proper ratio as specified shall be provided at the incoming panel. The accuracy class for the VT shall be class 0.5 as per IS 3156 parts I to III for incomer and class 1 for outgoing Panels.

5A436.6 PROTECTION AND TRIPPING ARRANGMENT

5A436.6.1 Protection

The offered relays shall be multifunction numerical type only. The aux relays for lockout, transfer fault indication etc. shall be draw out electromechanical type. All

Numerical relays shall have MIMIC (Graphical) display and minimum following features.

Relay shall be native IEC 61850 compliant, Numerical & suitable for 1A and 5A secondary CT current & 110 Volts secondary supply.

5A436.6.2 Relays

The relay should be modular and flush mounted type. It will be installed on the top of the switchgear panel. Standard terminal blocks should be located at the rear of the relay providingconnections for all input and output circuits.

The number and relays shall be as per requirement

a. Relay shall have thermal overload protection.

b. Relay shall have negative sequence over current protection.

c. Relay shall have adoptive & creative logics for meeting the requirement

d. Relay shall have 4 shots auto reclose function built-in

e. Relay shall be with under and over voltage protection elements provided at Incomer level

f. Relay shall have under frequency protection facility at least two stages.

Details are given below separately:

- Built in MIMIC (Graphic) display is required to view various measurements in single window, bay diagrams and status of equipment (Open or Close) and preferably with control of breaker through the relay itself.

5A436.6.3 Digital Inputs and Output relays:

They should provide at least 14 optically isolated inputs and at least 8 programmable outputs. They should be arranged in response to any or all of the available functions by suitably settingthe output relays. The protection and control function to which these relays respond should beselectable via the menu system of the relay. One output relay shall be permanently assigned for self-supervision.

Relay shall support customer-defined programmable logic for Boolean signals. It shall be possible to form equations using AND, OR, NOT gates.

Monitoring Functions Breaker monitoring needed Trip and close circuit supervision needed for detecting any anomalies in the circuit with the open or close.

5A436.6.4 Oscillography data recorder

All the units should needed an Oscillography data recorder with the next characteristics,

Each Record comprises the samples from analog signals and

the status of 32 selectable digital signals o 16 or more samples per cycle. o Configurablepickup.

Records in nonvolatile memory.

5A436.6.5 The disturbances are collected and exported.

Event Recording:

The relay should store minimum 2000 numbers or more last events in a nonvolatile memory, which can retrieved from a PC with the following data,

Date and time of the Event.

Descriptive text of Event.

Values of Electrical parameters.
A queue of minimum 8 disturbance records of 2 sec is stored in the nonvolatile memory.

Fault Recorder o Minimum 5 or more faults are stored in the nonvolatile memory, with the following data

Date and time of the fault pickup, beginning and end.

Pre fault and fault values ofelectrical parameters.

Duration and Type of Fault.

Level of Electrical parameters at the faults occurrence time.

Time synchronization via communication/via demodulated IRIG-B

5A436.6.6 input / Via Digital Input

Setting Group Independent setting groups should be available.

Communication Ports as indicated above.

5A436.6.7 Other technical characteristics

Self-diagnostic feature and watchdog output.

Front RS232/485 port/USB port and rear Redundant port remote communications. The communication shall be on IEC61850

Closed terminal needed for 4 current inputs and a 4 voltage input.

Have programmable minimum of 14 digital Inputs, minimum of 8 digital outputs, minimum of 8 numbers programmable LED.

Necessary latest version /communication software should be supplied free of cost for configuration, setting modification, event analysis, and SCADA communication.

Programmable system frequency should be 50 Hz and operating range should be FN = +/-5HZ.

The contact of the relay shall have the following Minimum rating.

Make and carry continuously: 5A

Make and carry for minimum 1Sec.: 30A

Current balancing transformers, shall form a part of the relay. The successful Bidder shall furnish sufficient data to prove stability of the equipment up to 10 times full load through fault current.

Interposing CTs if necessary for current balancing shall be within the scope of supply. I.CTs shall be of universal type of setting different ratios.

5A436.6.8 Arc Flash Fault Protection:

Relay should have integrated feature sensing any ARC produced in any of the 3 chambers i.e.Breaker, Cable and Busbar apart from Protection features. In case integrated offer is not available, separate module to be considered without compromising on the tripping time. Necessary sensors to be supplied along with the relay and it should have supervision of these sensors. Relay should operate due to ARC such that overall relay trip time should not exceed 18-20 ms.

In case separate module is considered, then main protection relay and module should be supplied from the same manufacturer.

To avoid any nuisance tripping for ARC, relay should work on principle of detecting Light and Current both to take decision. In no circumstance, only light detection technique shall be considered.

5A436.6.9 The protection and tripping arrangement of 33KV or 11 kV incoming outgoing 18-20 ms.

breaker shall be as mentioned as per requirement.

- Additional min. protection, auxiliary trip and alarm relay for Dry Type transformer protection.

Additional min. protection, auxiliary trip and alarm relay for dry type transformer protection. Auxiliary trip and alarm relay for transformer protection such as Winding temperature relay Alarm & Trip (49WA, 49WT)

Differential protections relay (87T) shall be only provided for distribution Transformer.

5A436.7 SMALL WIRING

The small wiring shall be carried out with minimum 1.5sq. mm FRLS/HFRS insulted copper conductor cables. CT wiring shall be done with minimum 2.5sq mm wires with color code: RYB, Gray for auxiliary DC circuits and Black for auxiliary AC circuits. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification tags shall be fitted to all wire terminals to render identification easy facilitate checking in accordance with IS 375. Necessary terminal block and cable entries shall be provided for RTD relay wiring, power supply etc.

5A436.8 METERING INSTRUMENT, PANEL ACCESSORIES (DIGITAL)

5A436.8.1 Metering

Digital Multifunction Meter with Front display of approved make shall be provided on the incomerfeeder with RS485& Dual Ethernet port for SCADA/EMS/BMS.

5A436.8.2 Specification of the Power Analyzer meter shall be as follows:

Digital Multifunction Meter, accuracy class 0.5, with 7 LED display of Max Demand Load, I;V; Hz; Active, Reactive , Apparent Power & Energy; Power factor; % unbalance of current & voltage; calculated neutral current ;%TDH , individual harmonics up to 15th level (complying with IEC61557-12) with RS 485 & Ethernet port and protection MCBs. and required accessories to complete the system PT’s shall be provided on each the bus sections (incomers) with individual metering on each incomer.

5A436.8.3 Instrument Panels

The instrument panel shall form part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the tenderer. They shall be preferably of flush mounting type at a maximum height of 1800 mm.

5A436.8.4 Indication:

a. The panel assembly shall also take care of the following requirements:
b. Lamp indication shall be provided to indicate ON/OFF (BY red/green respectively) of switch gear.
c. 18 watt LED illumination lamp ON/OFF with limit switch.
d. Mechanical indication for spring charged status. If possible an indicating lamp could be provided.
e. Lamp indicating tripping at fault status.
f. Clear lamp for Trip Circuit healthy supply and Trip Circuit fails indication.
g. Separate fuses/ MCBs shall be provided for lamp, heaters, voltmeters and other instrumentationetc. on each panel if specified.
h. Anti- condensation space heater shall be provided, and shall be suitable for operation on 240 V, 1 phase, 50 Hz A.C. for each panel is specified.
i. Where there is more than one incomer and bus sections, these shall be castle key interlocked as well as electrical interlocked as per interlocking scheme as specified.
j. Lamp indication shall be provided to indicate R, Y, B for each line.
k. DC control supply healthy & fails indication lamps
l. Lockable type Trip/Neutral/Close Switch (TNC)
m. Breaker Control Switch
n. 6/16 Amps Switch socket outlet
o. Control Terminal as required
p. Auxiliary contacts for electrically & mechanically interlocking as required.

5A436.9 CABLE BOXES

Cable boxes shall be situated in a compartment at the rear/ side of the housing as specified.

5A436.9.1 Cable Entry

Provision for bottom side entry shall be made as per requirement with sufficient head room for cable termination. 3mm thick removable gland plate shall be provided for cable termination of suitable size of cable, as mentioned in Electrical SLD.

5A436.9.2 Earthing

The earthing of the breaker body and moving portion shall be so arranged that the earthing of the non-current carrying structure to the frame earth bar is completed well before the main circuit breaker plugs enter the fixed house sockets. The entire panel board shall have a common tinned copper earth bar of suitable section with 2 earth terminals for effectively earthing metallic portion of the panels.

5A436.9.3 Installation

The installation work shall cover assembly of panels lining up, grouting the unites etc. In the case of multi panels switch boards after connecting up the bus bar all joint shall be insulated with HV insulation tape or with approved insulation compounds. A common earth bar shall be run preferablyat the back of the switch board connecting all the sections for connecting the earth system. All protection, indication & metering connections and wirings shall be completed. Where trip supply battery is installed the unit shall be commissioned, completing initial charging of the batteries. Allrelay instruments and meters shall be mounted and connected with appropriate wiring. Calibrationchecks of units as necessary and required by the licensee like CTs, VTs Energy Meters etc. shall becompleted before pre-commission checks are undertaken.

5A436.10 TYPE TESTS

5A436.10.1 The Manufacturer should submit the Type test report for MV Panel test conducted earlier on similar equipment's/Panels carried out from CPRI/NABL/International accredited Laboratory/ Govt. Recognized test house or Laboratory on the tendered Items as per relevant IS/ IEC-62271-200 and IEC-60694 Standard &Tender Specification

The following type tests have been performed and available if required

a. Test to verify the insulation level of the equipment's

b. Tests to prove the temperature rise of any part of the equipment's and measure of the resistance of the circuit (see 6.5 and 6.4).

c. Tests to prove the capability of the main and earthing circuits to be subjected to the rated peak and the rated short time withstand currents (see 6.6)

d. Test to prove the making and breaking capacity of the included switching device.

e. Test to prove the satisfactory operation of the included switching devices and removable parts.

f. Test to verify the protection of persons against access to hazardous part and the protection of the equipment's against solid foreign objects.

g. Tests to assess the effects of arcing due to an internal fault (for switchgear and control gear classification IAC).

h. Panel shall be tested for environmental aging to ensure extended life.

5A436.10.2 Routine Tests

Routine tests shall be carried out in accordance with IEC 62271-200 standards. These tests shall ensure the reliability of the unit.

Below listed test shall be performed as routine tests before the delivery of units;

a. Withstand voltage at power frequency

b. Measurement of the resistance of the main circuit

c. Withstand voltage on the auxiliary circuits

d. Operation of functional locks, interlocks, signaling devices and auxiliary devices

e. Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism

f. Verification of wiring

g. Visual inspection

Tests shall be performed in the presence of client's representatives. The Contractor shall give at least fifteen (15) days advance notice for witnessing the tests. Copies of certified reports of all testscarried out at works shall be furnished. The equipment shall be dispatched from works, only after receipt of client's written approval of the test reports.

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

5A436.11 DRAWING AND LITERATURE

a. Triplicate copies of the following drawings and literature shall be submitted along with the order copy: -

b. Principal dimension details of each unit cubicles, complete assembly

c. of panel and proposed arrangement of the Panel in a Control Room.

d. Front and rear views of the Panel with instrument and device positions marked.

e. Pictorial views of the Control Switches Terminal Blocks, Indication Instruments, Test Blocks and exploded views of draw out type instructions and Fuse Blocks.

f. Schematic Wing Diagram for Test Terminal Block.

g. Illustrative, descriptive literature, General Technical Data &S pacification of Devices.

h. Make, type, particulars, literatures of each and every relay (protective & auxiliary), meters, annunciators, switches, lamps, TBS, TTBS etc. along with bill of material in line with specification.

5A436.12 TESTING AND COMMISSIONING

Procedure for testing and commissioning of panel shall be in general accordance with good practice.Commissioning checks and tests shall include in addition to checking of all small wiring connections, relays calibration and setting tests by secondary injection method and primary injection method. Primary injection test will be preferred for operation of relay through CTs. Before panel board is commissioned, provision of the safety namely fire extinguishers, rubber mats and danger board shall be ensured. In addition all routine megger tests shall be performed. Checks andtest shall include following.

a. Operation Checks and lubrication of all moving parts.

b. Interlock function checks.

c. Continuity checks of wiring, fuses etc. as required.

d. Insulation tests.

e. Trip test and protection gear tests.

f. The complete panel shall be tested with 5000V megger for insulation between poles and polesto earth. Insulation test of secondary of CTs and VT to earth shall be conducted using 500V megger.

g. Any other tests as may be required by the Licensee/ Inspector shall be conducted.

h. Where specified, the entire switch board shall withstand high voltage test after installation.

Any other test required by the consignee/ inspecting officer

5A437 <u>33 /0.433 KV DISTRIBUTION TRANSFORMER & CSS WITH ON</u> <u>LOAD TAP CHANGER TRANSFORMERS)</u>

5A437.1 General

The step down double wound core type transformers shall be suitable for a voltage ratio of

33000/433 volts Delta/Star configuration. The transformer shall comply with the regulations of Indian Standard IS: 2026-1977 (Part I to IV) Specification for Power Transformers IEC 60076-11 & ECBC-2024

5A437.2 Standards

The transformers shall conform to the following Indian standard specifications with up-to date amendments:

IS	2026 part-I to V	Transformers
IS	10028	Installation & maintenance of Transformers
IS	2099	Bushings
IS	2070	Method of Impulse Voltage Testing
IS	3637	Transformer fittings & accessories

5A437.3 Transformer Detailed Specifications

5A437.3.1 **33 or 11/0.433kV OLTC Transformer**

Supply, install, testing, & commissioning outdoor type step down transformer having no load voltage ratio at rated voltage **33/0.433kV,** oil immersed, naturally cooled 3 phase 50 Hz, vector group DYN-11 and ON Load Tap Changer with AVR & RTCC +5% to -15% in step of 1.25% tap changing switch on HT side to very secondary voltage, connected internally and hand operated ON Load tap changing switch, star Delta connected internally with HV coil, copper double wound, LV side provided with 3 phase and neutral with the temperature rise not exceeding 50 degree C by thermometer in oil and 55 degree Celsius by resistance with first filling of oil as per IS grade 335 and transformer conforming to IS:2026(Part-1)-2011"class A" all as directed and specified. The following fittings and accessories including first fill of transformer oil necessary mounting on PCC floor mounted as per manufacturer's recommendations and specifications;

(a) Lifting lugs, Top cover lugs & jacking Pad.
(b) Earthing Terminals.
(c) Conservator with oil gauge Glass, Oil filling hole with plug and drain plug.
(d) Transformer Drain valve
(e) 04 Nos Bi-directional plain/Flat rollers
(f) Explosion Vent with Diaphragm
(g) Thermometer Pocket
(h) Air Vent Plug
(j) First Fill Silica get Breather
(k) Rating & Diagram Plate, Inspection cover,. Terminal Making Plate
(l) Cooling Radiators
m) HT Termination - Bare Bushing.
n) Provision of LT Termination box for connecting LT output through rated cables etc.
(o) LV Neutral Bushing brought out for external earthing.
(p) First Fill of EHV grade Transformer Oil
(q) Buchholz Relay with Contracts for Alarm & Trip Contacts
(r) Oil Temp indicator with Alarm & Trip Contacts
(s) Winding Temperature indicator with Alarm & Trip Contacts
(t) Marshaling Box

5A437.3.2 Transformer Material

The material used in the manufacture of the transformer shall be of the best quality of their respective kind available as per standard specifications.

5A437.3.3 Core Material

The magnetic iron core shall be made of high grade alloy, low loss grain oriented cold rolled steel stampings (CRGO) The maximum flux density at any point in core and yoke shall not exceed 1.6 tesla on the normal rated Voltage and Frequency and 1.76 Tesla at 110% rated voltage & frequency.

5A437.3.4 Core Windings

The high voltage and low voltage windings shall be of copper conductors.

5A437.3.5 Insulation Class

The insulation material used shall be insulation class 'F'.

5A437.3.6 Transformer Tapping

The tapping shall be arranged on the high voltage windings and OFF circuit tap changing with rotary links on HV side. The tapings shall be provided for variation on HV side from +5% to -15% in steps of 1.25 % each of rated voltage at constant KVA output.

5A437.3.7 Transformer Characteristics

The no load voltage ratio of the transformer shall be 33000 or 11000 /433 volts and the percentage impedanceshall be as per IS.

5A437.3.8 Enclosure

The transformer shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP 23 and suitable thickness of enclosure shall be provided with mild steel CRCA sheet powder coating finish after rigorous cleaning and surface treatment.

5A437.3.10 Transformer Terminations

The transformer shall have cable boxes with suitable glands and cable sockets for receiving 33,000/11,000-volt grade XLPE cables on the H.V. side as required.

5A437.3.11 On the L.T. side the transformer shall have a suitable terminal arrangement with extended bus bars to receive 415 Volt Bus Duct with aluminum bus bars as specified.

Temperature Rise Parameters

Thermistor sensors shall be embedded in the low voltage winding for warning and tripping, for temperature control. The temperature detectors shall be suitable for 24 volts D.C. Temperature rises shall not exceeding 90 deg. C corresponding to Class “F" over the ambient of 50oC. Transformer losses should be as per latest ECBC.

5A437.3.12 Transformer Fittings

The transformer shall be manufactured in accordance with the requirements as specified in the Standards stated above and shall be fitted with:

a. Diagram and Rating plate

b. Lifting Lugs.

c. Two earthing terminals on either side of the tank.

d. Four bidirectional rollers on the under carriage for movement.

e. Winding Temperature Indicator with alarm contacts for alarm and trip circuits.

f. Externally operated tapping switch with locking arrangement.

g. Terminal marking plate.

h. Jacking Lugs.

i. H.V. cable box for 3 core XLPE cable as required.

j. L.V. cable box suitable for bus duct as required
k. LV Neutral Bushing

l. Winding temperature indicator with alarm and trip contacts (xiii) Other standard accessories asper IS.

m. Digital type thermometer and electrical contacts for electrical alarm at high temperature

5A437.3.13 Transformer Guaranteed Technical Particulars

The following guaranteed technical particulars of the transformer shall be intimated.

a. Core loss

b. Load loss

c. Percentage Impedance

5A437.3.14 Transformer Testing

Prior to acceptance and dispatch of the transformer, the client reserves the right to witness the routine tests at manufacturer's works.

The transformer shall be subjected to the following routine and type tests prescribed in IS-2026 (I- IV) and SI: 11171 shall be carried out at the manufacturers Works before dispatch of transformer in the presence of inspecting officer. The test certificates shall be submitted to the client for approval prior to dispatch.

Test Certificates

a. Following test certificate shall be submitted by the agency: -

b. Test Certificate for the routine/acceptance tests.

c. Test Certificate for the type tests

d. The tests must have been performed in accordance with IEC 60076-11 for C2 climatic class and IEC 60076-16 for E2 environmental class.

e. Transformers will be of class F1 as defined in IEC 60076-11. F1 class will be indicated on therating plate.

ROUTINE TEST

a. Measurement of Winding Resistance

b. Measurement of Voltage ratio and check of voltage vector relationship

c. Measurement of impedance of voltage, short circuit impedance and load loss

d. Measurement of no load loss and current

e. Separate source voltage withstand test

f. Insulation resistance

g. Induced over voltage withstand test

TYPE TESTS

Type test certificate of CPRI/or other approved test house for similar rating of transformer to be submitted along with approval of drawings.

a. Measurement of Winding Resistance

b. Measurement of Voltage ratio and check of voltage vector relationship

c. Measurement of impedance of voltage, short circuit impedance and load loss

d. Measurement of no-load loss and current

e. Separate source voltage withstand test

f. Induce over voltage withstand test

g. Lightning impulse test

h. Temperature rise test

5A437.3.15 Installation

The transformer shall be installed as per the manufacturers instruction manual and shall conform tothe requirements of IS 10028 - code practice for installation and maintenance of transformer.

Following shall be the part of the installation works

a. Assembling different sections/ units when sent separately.

b. Positioning of the units as per the drawings/ site requirements

c. Alignment checks

d. Grouting/ securing to the floor/ base channels etc for stable installations.

e. Taking all necessary safety precautions for the equipment as well as personnel.

f. Touching up damaged painting portions.

g. Making earth connection of the unit.

h. Interconnection with marshaling box etc.

i. Connecting and ensuring efficient termination of cables/ bus ducts as applicable using proper size cable lugs, glands and appropriate size GI/ zinc passivized hard ware with spring washers and plate washers at appropriate locations (smaller size bolts not to be used for bigger holes incables lugs / switch gears to avoid weak electrical connections).-[scope of cable termination and bus duct connection is covered separately and shall be measured and paid accordingly].

j. Ensuring proper tightness of all joints, connections.

k. Providing proper supporting / protection arrangement to the cables/ units etc to avoid undue stress on the termination/ joints.

l. Providing required instruction/ information/ caution / name plates for easy operation and maintenance.

m. Provision of interlocks where needed.

n. Obtaining requisite statutory approval, (CEA clearance) licenses etc. where applicable.

5A437.3.16 Site Tests

In addition to the tests at manufacturer's premises, all relevant pre-commissioning checks and testsshall be done at site before energizing the Transformer.

The following tests are to be particularly done before cable jointing or connecting the bus duct.

a. Physical inspection for breakages/damages/orderliness.

b. Insulation test between HV to earth and HV to MV with 5000 volts Megger.

c. Insulation test between MV to earth with 500 volts Megger.

d. On commissioning of the transformer, the following readings shall be taken

e. H.T. side voltages at all tap settings

f. Temperature rise under no load conditions

5A437.3.17 All test results are to be recorded and reports should be submitted to the department.

Painting

All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required, to produce a smooth surface free of scales, grease and rust.

The steel surfaces after cleaning shall be given a coat of high quality red oxide or yellow chromate primer followed by final coats.

The internal surfaces in contact with insulating oil shall be painted with heat resistant insulating varnish which shall not react with and not soluble in the insulating liquid used.

The transformer shall be finished with two coats of synthetic enamel paint.

The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

Where the painting is damaged during transit, installation etc., touch up painting shall be done at site.

5A437.3.18 Drawings/Documents

The following drawings/documents (3 sets) shall be furnished along with the transformer.

Foundation details, if any.

a. Installation, Operation & Maintenance manuals

b. General layout including the dimensions

c. Details of after-sales service
d. Electrical drawings

e. Others, if any, as per site requirements.

5A437.3.19 Name Plates/Labels

This nameplate shall be in addition to the 'rating & diagram plate' mounted on the transformer body. This nameplate shall be fixed near the transformer on the wall / fencing or at a suitable place that attracts immediate attention giving the following details.

Transformer Number…… Location……

KVA rating

Voltage ratingMake

Sl no:

Date of manufacture.

Date of commissioning.

5A437.4 SPECIFICATIONS OF TRANSFORMER 33 /.433KV

Description	Unit	Data
Name of Manufacturer		
Reference Standards		IS: 11171
Rated Power	kVA	As per requirement
No Load Volts Ratio	kV	33KV/.433KV
No. of Phases	Nos.	**3**
Frequency	Hz.	**50**
Vector Group		Dyn 11 with Neutral brought out
Type of Cooling		**ONAN**
Impulse withstand voltage/ Power Frequency withstand voltage	kVp/ kVrms	**28/75**
Impedance Voltage (Tolerance +/-IS)		% 7.15 as per /IS
Tapping, OFF LOAD , HV		% +5% to -15%
No Load Losses at rated Frequency KW as per IS and 100% rated voltage		As per IS
Load Losses at Normal Ratio, Rated KW as perIS Current and at 75 deg. C		As per IS
Insulation Class		As per IS

Termination Arrangement

HV side (Cable box)	3CX 33 KV XLPE
LV side	Bus Duct from top/ bottom.

COMPACT SUBSTATION OIL TYPE TRANSFORMER, 33 KV / 0.433V

SCOPE

The provisions of the *Indian Electricity Act*, 2003 and the Rules and Regulations framed there under have to be necessarily complied with.

The information contained in this Section is largely based on the following Indian Standards/Special Publication:

The Electrical system design is based on the requirements of the following Standards:

- National Building Code 2026.
- Indian Standards.
- Energy Conservation Building Code 2017.
- Indian Electricity Act 2003 with latest amendments.
- Central Electricity Authority 2010 and latest amendments.
- The energy conservation act 2010 and latest amendments.
- National Electric Code-2011 (IS. SP 30:2011).
- International Electrotechnical Commission.
- British Standards.
- Institute of Electrical and Electronics Engineers.
- ECBC norms

All standards, whether given herein above or cross-referred to in the main text of this Section, are subject to revision. The parties to agreement based on this Section are encouraged to investigate the possibility of applying the most recent editions of the standards before execution.

SCOPE

Compact Sub-station shall consist of 33kV VCB Insulated compact switch-gear with VCB as protection to Transformer, Transformer and LT, Switch-gear with all connection accessories, fitting & auxiliary equipment in a per-fabricated enclosure to supply Low- voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a sub-station plinth (base) as Out sub- station. The Vacuum Circuit Breaker shall be used to control and isolate the Distribution transformer. The transformer's LT side shall be connected to LT Switchgear. The connection cables to consumer shall be taken out from the LT switchgear(s).

The pre-fabricated compact sub-station shall be designed for Compactness, Fast installation, Maintenance free operation, Safety for worker/ operator & public.

OUTDOOR ENCLOSURE

The enclosure shall be made of Galvanized Sheet Steel or such other material tropicalized to meet Indian weather condition.

The base of the enclosure shall ensure rigidity for easy transport &installation.
The structure of the substation shall be capable of supporting the gross weight of all the equipment &the roof of the sub-station compartment shall be designed to support adequate loads.

There shall be proper/adequate ventilation inside the enclosures that hot air inside
enclosure is directed out by help of duct. Louvers apertures shall be provided so that there is circulation of natural air inside the enclosure.

The complete design shall be modular in design i.e. small sheets shall be joined together to make a big sheet. This helps in avoiding skewing, bending, bending of the single sheets on doors and sides due to its own load under service. The doors shall be provided with proper interlocking arrangement for the safety of operator.

PUBLIC NUISANCE PROTECTION

There shall be no bolting arrangement on the doors and sides (periphery) so that there is no access of water, dust inside. This also ensures that unit is well protected from outside from public nuisance owing to its being located in a crowded and compact places. Hinges and locks on the door shall be so designed that they are either not accessible to public from outside or cannot be tampered with.

INTERCONNECTION

The connection of HT switchgear to Transformer shall be with the help of suitable size of cables, from Transformer to LT switchgear with the help of suitable size of Copper/ Aluminum bus bars. The interconnection inside the unit shall be the responsibility of the supplier.

INTERNAL FAULTS

Failure within the unitized sub-station due either to a defect, an exceptional service condition normal-operation may initiate an internal arc. Such event may lead to the risk of injury, if persons are present. It is desirable that the unit shall be tested for Internal Arc fault test as per latest IEC61330.

COVERS AND DOORS

Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. Additional wire mesh may be used with proper Danger board for safety of the operator. All covers, doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least 90° & bee quipped with a device able to maintain them in an open position. The top cover shall be slightly inclined so that there is no accumulation of water during rainy season or otherwise. Proper padlocking facility shall be provided for doors of each compartment.

EARTHING

All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal in tended for connection to the earth system of the installation, by way of flexible jumpers/strips & lg arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be

connected to the earth system shall include:

The enclosure of sub-station,

The enclosure of high voltage switchgear & control gear from the terminal provided for the purpose, The metal screen & the high voltage cable earth conductor,

HT & LT switchgear compartment shall be IP54 & degree of protection of transformer compartment of the enclosure shall be minimum IP23D.

The transformer tank or metal frame of transformer, The frame &/or enclosure of low voltage switchgear.

INTERNAL ILLUMINATION

There shall be arrangement for internal lighting activated by associated switch on doors for HV, Transformer & LV compartments separately.

LABELS

Labels for warning, manufacturer's operating instructions etc. & those according to local standards & regulations shall be pasted/ provided inside and shall be durable and clearly legible.

PAINTING AND FABRICATION PROCESS

The paints shall be carefully selected to withstand tropical heat & rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. For this purpose poly-urethane (or such other suitable) paint shall be used.

Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.

The fabrication process shall ensure that there are no sharp edges on the GI sheets used. For modular structure the two smaller units shall be joined together by Clinching Technology so that there is no piercing of the material being joined. This type of joint shall ensure robust mechanical strength to the complete structure so made.

33KV SWITCHGEAR

H.V. PANEL

The switch-gear should be as per IS: 13118-1991 of VCB, IEC: 62271-100 for Breakers and -200 for Panels/ IS: 3427 of switch board. The degree of enclosure protection shall be IP-55.

RATING

All panels assembled to form a board shall be suitable for the nominal operation voltage and rupturing capacity as specified. They should be rated as specified with a minimum of 1250 Amps and suitable for operation on 33kV, 3 phase 50-60 Hz system. Type test certificate for the breaking capacity of the panel shall be supplied. A circuit breaker for a given duty in service is best selected by considering the individual rated values required by load conditions and fault condition.

TYPE

The HV Panel Board shall be metal clad, outdoor, floor mounting, free standing type. It shall be totally enclosed dust, damp and vermin proof.

GENERAL CONSTRUCTION

Separately earthed compartments shall be provided for circuit breakers, bus bars, relay & instruments, CT&PT, and cable boxes, fully and effectively segregating these from one another so that fault in any one compartment do not cause damage to equipment(s) in other compartment(s).

The housing shall be of bolted construction to ensure compact and rigid structure, presenting a neat and pleasing appearance. The sheet steel used should not be less than 2 mm thick.

The panels shall be bolted together to form a continuous flush front switchgear suitable for front operation of board and for extension at both ends.

GENERAL DESIGN ASPECTS

The HV panel board shall be designed such that the switchgear, instruments, relays, bus bars, small wiring etc. are arranged and mounted with due consideration for the following:

Facility for inspection, maintenance and repairs of testing terminals and terminal boards for ease of external connection.

Minimum noise and vibrations.

Risk of accidental short circuits and open circuits.

Secured and vibration proof connections for power and control circuits.

Risk of accidental contact and danger to personnel due to live connections.

Mountings at approachable height.

CIRCUIT BREAKER

GENERAL ARRANGEMENTS

The circuit breaker panels shall be complete with the following:

Racking in / Racking out mechanism.

Isolating plugs and sockets.

Mechanical inter-locks and safety shutters.

Mechanical ON/OFF indicator.

Minimum of 4 NO and 4 NC Auxiliary contacts directly operated by the circuit breaker. Additional NO&NC contacts can be provided with auxiliary contractors.

Anti-condensation space heaters suitable for operation on 240V, 1*f*50Hz A.C. for each panel wherever specified.

Suitable tripping arrangement.

Mechanical counter to assess the total number of operations of the breaker (if asked for specifically).

TYPE

The circuit breaker shall be of horizontal/ vertical isolation, horizontal draw out pattern.

BREAKER TRUCK

The breaker carriage shall be fabricated from steel, providing a sturdy vehicle for the circuit breaker and its operating and tripping mechanism. The carriage shall be mounted on wheels, moving on guides, designed to align correctly and allow easy movement of the circuit breaker and for removing the

carriage for inspection and maintenance purposes. Vacuum interrupters shall be hermetically sealed and shall be designed for minimum contact erosion, fast recovery of dielectric strength, maintenance free vacuum interrupter, suitable for auto-reclosing. The drive mechanism shall preferably be provided with facility for pad locking at any position namely, “Service”, “Test” and “Fully Isolated”. It should be possible for testing the circuit breaker for its operation without energizing the power circuit in the “Testing” position. The contacts shall be made only after the breaker is inserted into service position. Interlocking should prevent contacts from being disconnected if circuit breaker is tried to be moved from service position.

GENERAL FEATURES

Single break contacts are provided in sealed vacuum interrupter.

RATING

The circuit breakers shall be continuously rated as specified with a minimum rated current of 1250 Amps. with voltage rating and breaking capacity as specified.

OPERATING MECHANISM

The operating mechanism shall be one of the following as specified: -

Manually operated spring charged/motor wound spring charged with both mechanical and electrical release for closing. The operating mechanism shall be trip free.

External auxiliary supply shall be made available for charging motors & heaters operation.

BUS BAR SECTION

GENERAL REQUIREMENT

The switchboard shall be **single busbar pattern** with air insulated encapsulated bus bars housed in a separate compartment, segregated from other compartments.

MATERIAL

The bus bars shall be of high conductivity electrolytic copper rated as specified with a minimum rated current of 1250Amps. The busbars shall be sized for carrying the rated and short circuit current without over-heating. Maximum busbar temperature shall not exceed 95-degreeC.

CURRENT TRANSFORMER

GENERAL REQUIREMENTS

Accommodation shall be provided in the circuit breaker panel to mount one set of three numbers dual core dual ratio CTs for metering and protection purposes. Access to the CTs for cleaning, testing, or changing shall be from the front, back or top of the panel.

RATING

Resin cast bar primary dual core & dual ratio CTs of suitable burden (but not less than 15 VA) shall be preferred with 5 Amps secondary. The ratio shall normally be one of the following as specified:

400/200/5/5 (b) 300/150/5/5

200/100/5/5 (d) 100/50/5/5

such other as required.

Note: CT ratio shall be compatible with the loading pattern on HV side

The CTs shall conform to relevant Indian Standards. The design and construction shall be robust to withstand thermal and dynamic stresses during short circuits. SecondaryterminalsofCTsshallbebroughtoutsuitablytoaterminalblockwhichwill be easily accessible for testing and terminal connections.

The protection CTs shall be of accuracy class 5P15 of IS: 2705- PartIII-1992.

The metering CTs shall be of accuracy class 0.5 of IS: 2705-Part-III-1992 for incomer and class 1 for outgoing panels.

Th e CT's shall confirm the following characters:

Short Time Rating	:	20kA for 1.0 Sec.
Dynamic Stability	:	47kA Peak

Insulation Level

Impulse withstand voltage : 70kV Peak

PF withstand voltage : 170kV RMS

Thermal Overload Capacity	:	120% Continuous

VOLTAGE TRANSFORMER

GENERAL REQUIREMENTS

The Voltage transformer shall be built up of CRGO electrical steel. The voltage transformers shall be resin cast dry type. The PTs shall be 3 nos. of single-phase type of suitable ratio and burden

RATING

Resin cast, natural air-cooled dual core and dual ratio PTs of suitable burden (but not less than 100 VA) shall be preferred with 110 Volts secondary. The ratio shall normally be one of the following as specified:

(a)

$$\frac{33kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$$

The protection PTs shall be of accuracy class 1.0 of IS: 3156.

The PT's shall confirm the following characters:

- Insulation Level

Impulse withstand voltage	:	170kV Peak
PF withstand voltage	:	70kV RMS

- Thermal Overload Capacity : 120% Continuous

Thetransformershallbeofcastepoxyresinconstruction.Itshallbefixed/withdraw able type. HRC fuses/ MCBs shall be provided on both HV and LV sides.

PROTECTION AND TRIPPING ARRANGEMENT

PROTECTION

The Relays shall be microprocessor based numerical relays with O/L, E/F and S/C protection Tripping relay shall be used for tripping signal to the Shunt Trip Coil of Circuit Breaker operating on 24 V/ 30 V D C supply / Power pack / 110 V VT supply

Note: - 24V/30V DC shall be provided through 2 No. SMF batteries of 12/15V of minimum 26AH capacity with a battery charger as per recommendation of manufacturer both for protection as well as indications.

Alternatively, Power Pack converters fed through PT/230V externally could be provided with 2 Nos., 12/ 15-volt, 7 AH SMF batteries (Power pack with condenser/ capacitor backup are also available which do not need batteries, these should not be used) for tripping. In cases where tripping is fed through PT, VA burden of PT shall be suitably increased (say 200 VA) as recommended by the manufacturer depending upon the number of panels and connected controls.

In addition, external 24 volt / 30-volt DC supply shall be provided for indications etc. through 2No. SMF batteries of 12/15Vs of minimum 26AH capacity with a battery charger as per recommendation of the manufacturer.

RELAYS

Over current Relays shall have adjustable setting for current from 50% to 200% and earth fault from 10% to 40% or 20% to 80%. These should be of manual reset type. All relays shall have a LED indicator which will indicate operation for each function. It shall be possible to reset it only by manual operation. The number and types of relays shall be as specified.

SMALL WIRING

The small wiring shall be carried out with minimum 2.5 sq. mm FRLS/ HFFR insulated copper conductor cables. CT wiring shall be done with minimum 4.0 sq.mm wires with colour code: RYB, Gray for auxiliary DC circuits and Black for auxiliary AC circuits. The wiring shall be securely fixed and artfully arranged to enable easy tracing of wires. Identification tags shall be fitted to all wire terminals to render identification easy and to facilitate checking in accordance with IS: 375. Necessary terminal blocks and cable entries shall be provided for RTD relay wiring, power supply etc.

METERING INSTRUMENT, PANEL ACCESSORIES (DIGITAL)

METERING

Energy metering shall be done either on the incomers or on the feeders as specified in IS: 1248.

VOLTAGE SELECTION SCHEME

Where a bus coupler is incorporated and only one incomer feeder (out of two available) is intended to be operated at a time, a VT Transfer Relay shall be incorporated to provide necessary potential for metering. This will be necessary when energy metering is done on

individual feeders or where VT supply is used for trip circuits. Alternatively, PTs shall be provided on both the bus sections (incomers) with individual metering on each incomer.

INSTRUMENTS PANELS

The instrument panel shall form part of the housing. Relays, meter, and instruments shall be mounted as per general arrangement drawings to be submitted by the tenderer. They shall be preferably of flush mounting type at a maximum height of 1800 mm.

INSTRUMENTATION

A voltmeter of class 1.0 accuracy as per IS: 1248 shall be provided at each incomer panel, with selector switch. The instrument shall be calibrated for the ranges specified.

Energy meters of class 1.0 conforming to IS: 722 (Part IX) and power factor meter of class of accuracy of 2 shall be provided, if specified.

Ammeter of specified range of class 1.5 accuracy as per IS: 1248 shall be provided at both incomer and outgoing panels along with necessary selector switches.

The panel assembly shall also take care of the following requirements:

Lamp indication shall be provided to indicate ON/ OFF (by red, green respectively) of switch gear.

Panel illuminating lamp.

Mechanical indication for spring charged status. If possible, an indicating lamp could be provided.

Lamp indicating tripping at fault status.

Healthy trip supply shall be indicated by clear lamp.

Separate fuses/ MCBs shall be provided for lamps, heaters, voltmeters, and other instrumentation etc. on each panel.

Anti-condensation space heaters shall be provided, and shall be suitable for operation on 240 V, 1 phase, 50 Hz A.C. for each panel if specified.

Where there is more than one incomer and bus sections, these shall be castle key interlocked as per interlocking scheme as specified.

CABLE BOXES

Cable boxes shall be situated in a compartment at the rear / side of the housing as specified.

CABLE ENTRY

Provision for top (bus ducts preferred for top entry) / bottom or such other side entry shall be made as per requirement with sufficient head room for cable termination. 3 mm thick removable gland plate shall be provided for cable termination.

EARTHING

The earthing of the breaker body and moving portion shall be so arranged that the earthing of the non-current carrying structure to the frame earth bar is completed well before the main circuit breaker plugs enter the fixed house sockets.

The entire panel board shall have a common tinned copper earth bar of suitable section with 2 earth terminals for effectively earthing metallic portion of the panels. The frame earthing of panel shall be in accordance with Section 7 of this specifications.

GENERAL REQUIREMENTS

The transformers shall be of first class quality and design for continuous satisfactory operation as continuity of supply is of prime consideration. The design shall be allow all necessary precaution for the safety of operation and maintenance personnel. The transformers shall operate satisfactorily under variations of load, voltage or short circuit or other conditions which may occur on the system provided that these variations are within the assigned rating of the apparatus. All the equipment shall be designed to obviate the risk of accidental short circuit.

TEMPERATURE

The reference ambient temperatures assumed for the purpose of this specification are as follows:

Maximum ambient air temperature	:	50°C.
Maximum daily average ambient air temperature	:	40°C.
Maximum yearly weighted average ambient temperature	:	32°C.
Minimum yearly weighted average ambient temperature	:	(-) 5°C.
Class of insulation	:	F

The temperature rise limit at the above conditions and at the altitude not exceeding 1000 meters shall be as specified.

If the site conditions indicated for a particular job is more severe than the referred ambient temperature mentioned above, the temperature rise above ambient shall be suitably scaled down such that the hot spot temperature shall not exceed the values for the reference conditions 90°C (F class insulation).

TAP CHANGING DEVICE

Preferred tapping range is +5% to -15% in steps of 1.25% no. of tapping position should be 17, by means of off load tap changing links or tap switch. The device shall be provided on HV for HV Voltage to keep LV Voltage constant.

Tap changing shall be carried out by means of an externally operated manual-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

WINDING CONNECTION AND VECTOR

The primary winding shall be connected delta and the secondary winding star [vector. symbol Dyn 11 in accordance with IS 2026 (Part-4): 1977-1, so as to produce a positive phase displacement of 30“ from the primary to the secondary vectors of the same phase. The neutral of the secondary winding shall be brought out to a separate insulated terminal.

VOLTAGE RATIO

Unless otherwise specified, the transformer shall be suitable for a voltage ratio of 33kV/415V.

HV BUSHING

The bushing shall be made in two parts. The outer bushing shall be of porcelain. The dimensions of the outer bushing shall conform to IS 3347 (Part 3/Set 1) : 1972. The internal bushing shall be of either porcelain or tough insulating material, like epoxy and shall have embedded stem. Metal portion of the internal HV bushing inside the tank shall remain dipped in oil in all operating conditions.

NOTE -Dimensions of internal bushings are under consideration.

LV BUSHING

Where provided, these shall be of porcelain.

Suitable bimetal connectors (clamp type) shall be provided on both HV and LV side for making sound terminations.

The design of internal bushings shall be such as to provide adequate creepage distance in accordance with 7.1 of IS: 2099-1986 and minimum clearance as given below:

	HV SIDE		LV SIDE	
	Internal	External	Internal	External
Phase By Phase	127mm	255mm	45mm	75mm
Phase To Earth	76mm	140mm	20mm	40mm

INSULATION LEVEL

The transformer shall be capable of withstanding the power frequency and impulse test voltage for the appropriate voltage class as given in IS: 2026 (Part 3) : 1981.

TOLERANCE

The tolerance on electrical performance (excluding losses) shall be as given in 11 of IS: 2026 (Part 1) : 1977.

VECTOR GROUP

In case of step-down transformers, the winding connections shall conform to vector group Dyn 11 unless otherwise specified.

In case of step-up transformer, the vector group unless otherwise specified shall be star / delta.

ACCESSORIES

The transformer shall be with enclosure or without enclosure with HV and MV terminations as specified both on HV and MV side. The HV side shall be suitable to receive cable size 3C-300sq.mm and MV side suitable for bus bar trunking.

FITTINGS

The transformer shall be complete with the following fittings: -

Remote tap changing controller or tap switch.
RTD temperature controller.
Lifting lugs for all transformers.
Bi-directional / Unidirectional Rollers to be specified.
Rating diagram and terminal marking plate for all transformers.
Additional Neutral separately brought out on a bushing for earthing for all transformers.
Earth terminals (2 Nos.) for body earthing for all transformers.
Necessary hardware, clamps, lugs etc. for termination on HV/MV etc. for all transformers.

RATING PLATES

Each transformer shall be provided with a non-detachable rating plate of weatherproof material, fitted in a visible, showing the information given in 15.2 of IS: 2026 (Part-1): 1977. The entries on the rating plate shall be indelibly marked (for example, by etching, engraving or stamping).

JOINTS AND GASKETS

Gaskets shall be made of synthetic rubber or synthetic rubberised cork resistant to hot transformer oil.

TESTS

TESTS AT WORKS

All routine and other tests prescribed in IS:11171-1985 shall be carried out at then manufacturer's works witnessed by Client/ Engineer-in-charge and appointed consultant before the dispatch of the transformer in the presence of inspecting officer. Copies of the test certificates shall be furnished to the department. In addition to the prescribed routine tests, temperature rise test shall be invariably done on one transformer of each design. A copy of the impulse test certificate done on the same type/design of the transformer shall be furnished in accordance with IS 11171:1985 for purpose of record. If no impulse test was done in an earlier unit of the same design and type, one transformer will be subjected to impulse test in consultation with the Inspector at the firm's cost. Copies of the certificates of type test for short circuit shall be supplied to the Department.

The following type of tests should be carried out:

Type Tests:

Measurement of winding resistance.

Measurement of voltage ration and check of voltage vector relationship.

Measurement of impedance voltage, short circuit impedance and load losses.

Measurement of no load losses and current.

Measurement of insulation resistance.

Separate source voltage withstand test.

Induced overvoltage withstand test.

Lightning impulse test. o

Temperature rise test. o Short

circuit test.

Air pressure test.

Permissible flux density and over fluxing.

Routine Tests:

Measurement of winding resistance

Measurement of voltage ratio and check of voltage vector relationship.

Measurement of impedance of voltage, short circuit impedance and load loss.

Measurement of no-load loss and current.

Separate source voltage withstand test.

Induced over voltage withstand test.

Separate-Source voltage withstand test.

Air pressure test.

- Special Tests:

Partial discharge measurement.

Measurement of acoustic sound level.

Short circuit test.

Internal arc test.

TESTS AT SITE

In addition to tests at manufacturer's premises, all relevant pre-commissioning checks and tests conforming to IS code of practice No. 10028 shall be done before energization. The following tests are to be particularly done before cable jointing or connecting up the bas bar trunking.

Insulation test between HV to earth and HV to MV with a 5000 volts Megger.

Insulation test between MV to earth with 500 volts Megger.

All test results are to be recorded and reports should be submitted to the department.

INSTALLATION AND COMMISSIONING

The transformer shall be installed in accordance with IS 10028-Code of practice for Installation and maintenance of transformer. Necessary support channels shall be grouted in the flooring.

The transformer shall be moved to its location and shall be correctly positioned. Transformer wheels shall be either locked or provided with wheel stoppers.

Wiring of devices shall be carried out as per drawings; Earthing of neutral and body of the transformer shall be done in accordance with section (7) of these specifications.

All devices shall be checked for satisfactory operation.

All tests specified in 3.2.14 of these specifications shall be carried out by the contractor in the presence of inspecting officer/ consignee free of cost.

MAXIMUM ALLOWABLE POWER TRANSFORMER LOSSES

Power transformers of the proper ratings and design must be selected to satisfy the minimum acceptable efficiency at 50% and full load rating as per ECBC norms. In addition, the transformer must be selected such that it minimizes the total of its initial cost in addition to the present value of the cost of its total lost energy while serving its estimated loads during its respective life span.

MV PANEL

This Section covers the detailed requirements of medium voltage switch panel for 433 V, 3 phase 50 Hz 4 wire system. These shall be branded and/or assembled/ fabricated from a factory of repute. The panel shall be of Form4 type. All switchgears shall be fully rated at an ambient of 40°C.

TYPE OF PANEL

The medium voltage switch board panel shall comprise of any one of the following types of switchgears or combination thereof as specified.

Air Circuit breakers draw out type.

Switch Disconnector Fuse Units fixed type, MCCBs of suitable Ics ratings. MCCBs shall invariably be Current Limiting type. Features like Double Break, Positive Isolation functions shall be preferred.

The Panel shall be outdoor type having incoming sectionalization and outgoing switchgears as specified. The design shall be cubical type. The degree of enclosure protection shall be IP 42 as per IS 13947(Part-I).

MV PANEL

GENERAL CONSTRUCTION

The switchboard shall be floor mounted free standing totally enclosed and extensible type. The switch board shall be dust & vermin proof and shall be suitable for the climate conditions as specified. The design shall include all provisions for safety of operation and maintenance personnel. The general construction shall conform to IS 8623:1993 for factory assembled switchboard.

CUBICAL TYPE PANEL

Cubical type panels shall be fabricated out of sheet steel not less than 2mm thick. Wherever necessary, such sheet steel members shall be stiffened by angle iron frame work. General construction shall employ the principle of compartmentalization and segregation of form-4 type for each circuit. Unless otherwise approved, incomer and bus section panels or sections shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the front accessible type panel shall have hinged access doors at the front. Overall height of the panel shall not exceed 2.4 meters.

Operating levers handle etc. of highest unit shall not be higher than 1.7 meters. Multi-tier mounting of feeder is permissible.

The general arrangement for multi-tier construction shall be such that the horizontal tiers formed present a pleasing and aesthetic look. The general arrangement shall be approved before fabrication. Cable entries for various feeders shall be either from top or bottom. Through cable alleys located in between two circuit sections, either in the rear or in the front of the panel. All cable terminations shall be through gland plates.

There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired

circuits when new feeders are added. Cable entry plates shall therefore be sectionalized. In case of single core cables aluminium gland plates shall be provided. The construction shall include necessary cable supports for clamping the cable in the cable alley or rear cable chamber.
Cubicle panels with more than 1000 Amps bus shall be made of tested structural modular sections.

BUS BAR AND CONNECTIONS

The busbars shall be of Copper/ Al of high conductivity electrolytic quality and of adequate section. Current density for copper shall not exceed 160 amps/sq. cm as per calculation provided by panel manufacturer & requirement . The bus bar system may comprise of a system of main horizontal bus bars and ancillary vertical bus bars run in bus bar alleys on either side of which the circuit could be arranged with front access cable entries. In the case of rear access, horizontal bus system shall run suitably either at the top or bottom. All connections to individual circuits from the busbar shall preferably be solid connections; how ever flexible connections shall also be permitted as per recommendations of the Panel Manufacturer. All bus bars and connections shall be suitably sleeved / insulated in approved manner.

INCOMER/TERMINATION

Incomer termination shall be suitable for receiving bus trunking / underground cables. Cable terminations shall in variably be through terminal blocks (Polyamide or superior) or brought out solid terminals.

INSTRUMENTS

All volt meters and ammeters shall be flush mounted of size minimum 96mm conforming to class 1.5 of IS 1248 for accuracy. All voltmeters shall be protected with MCB.

INDICATING LAMPS

On all the incomers of M.V panels, ON/OFF indicating LED lamps shall be provided and shall be suitable for operation on AC supply. Phase indicating LED lamps shall be associated with necessary ON/OFF toggle switch.

SMALL WIRING

All small wiring for Controls, Indication etc. shall be with suitable FRLS/HFFR (halogen free fire retardant) copper conductor cables. Wiring shall be suitably protected within switch board. Runs of wires shall be neatly bunched, suitably supported and clamped. Means shall

be provided for easy identifications of the wires. Where wires are drawn through steel conduits, the works shall conform to CPWD General Specifications for Electrical Works (Part I-Internal), 2023 and IS732 as the case may be. Identification ferrules shall be used at both ends of the wires. All control wiring meant for external connections are to be brought out of terminal board.

OPERATIONAL REQUIREMENT

The outdoor type MV panel shall conform to the following: -

The panel shall comprise of incomers, outgoing feeders and bus coupler as specified.
The incomer shall be either a double break/contact repulsion MCCB or an Air Circuit Breaker. The bus coupler shall be either a circuit breaker or a double break / contact repulsion MCCB or switch disconnectors fuse unit as specified. The outgoing feeders shall be circuit breakers/MCCBs as specified.

Busbars for phase and neutral shall have a rating as specified in the format of Appendix II.

The entire switch panel shall be cubical type generally conforming to IS 8623:1993 for factory assembled switchboard.

The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified either from top or from bottom.

All incoming AIR CIRCUIT BREAKER/ MCCB shall have suitable adjustable tripping current and the time delay settings.

The entire panel shall have a common earth bar of size as specified with two terminals for earth connections.

RATING AND REQUIREMENTS

AIR CIRCUIT BREAKER

All Air Circuit Breakers shall be 3/4 pole with minimum 50 KA breaking capacity (35 MVA at 433V) conforming to IS13947 (Part-II). Rated current shall be as per capacities specified.

The equipment shall be complete with the following: -

Necessary circuit breaker carriage with 3 position (isolate, test, service) draw- out mechanism.

Necessary isolating plugs and sockets.

Necessary mechanism interlock and automatic safe shutters gear with arrangement for padlocking.

Necessary independent manual spring mechanism with mechanical on/Off indication as well as electrical on/Off indication.

Necessary bus bars with bolted type neutral links.
ACB shall be provided with microprocessor-based releases having built in over load, short circuit & earth fault protection. Microprocessor release shall be EMI (Electro Magnetic Induction)/ EMC (Electro Magnetic Compatible) certified.

Necessary set of auxiliary switches.

Necessary set of CTs with ratios as specified.

Necessary identification, metering requirements as specified i/c ON/OFF indication lamps, selector switches, fuses, ammeter, voltmeter etc.

In case of 4 pole breaker neutral shall be fully rated with adjustable settings from 50% to 100% of I.n

ACB terminals shall be suitable/ suitably brought out for direct aluminium termination as per IS 13947Part-II.

MCCB

All MCCBs shall be current limiting type with features of load line reversibility and suitable for Horizontal/ Vertical mounting without any de rating. Beyond 300 Amps capacity MCCBs shall have positive isolation and preferably double break / contact repulsion & double insulation features.

The MCCBs shall invariably be used with terminal spreaders.

Test At Manufacturers Work

All routine tests shall be carried out and test certificates produced to the department.

INSTALLATION

The installation work shall cover assembly of various sections of the panels lining up, grouting the units etc. In the case of multiple panel switch boards after connecting the busbars etc., all joints shall be insulated with necessary insulation tape or approved insulation compound. A common earth bar as per section 7 of these specifications shall be

run inside at the back of switch panel connecting all the sections for connection to frame earth system. All protection and other small wirings for indication etc. shall be completed before calibration and commissioning checks are commenced. All relays, meters etc. shall be mounted and connected with appropriate wiring.

TESTING AND COMMISSIONING

Commissioning checks and tests shall include all wiring checks and checking up of connections. Relay adjustment/setting shall be done before commissioning in addition to routine megger tests. Checks and tests shall include the following: -

Operation checks and lubrication of all moving parts.

Interlock function checks.

Continuity checks of wiring, fuses etc. as required.

Insulation test: When measured with 500 V Megger the insulation resistance shall not be less than 100 mega ohms.

Trip tests and protection gear test.

POWER FACTOR IMPROVEMENT

SCOPE

This section covers the specification for supply, installation, testing and commissioning of 433 volts, 3 phase, 50 Hz capacitor banks and other such devices.

REQUIREMENTS

Capacities of the capacitor banks/ RLC panels shall be indicated in the format vide Appendix II.

CONSTRUCTION

The capacitor banks shall generally conform to IS: 13341-1992, IS:13340-1993.
The capacitor units shall be outdoor type, air-cooled with low viscosity impregnated paper dielectric hermitically sealed. The impregnation used shall be non- inflammable, non- oxidizing, lower freezing point type synthetic compound. Each individual cell shall be provided with pressure sensitive disconnectors /devices.

Main connections from the active element shall be brought out through porcelain bushing. Care shall be taken to solder the bushing to the cover to ensure perfect hermetic sealing.

Capacitor units shall be provided with externally mounted discharge resistors to reduce the residual voltage to less than 50 Volts in one minute of switching off.

Individual unit shall be provided with HRC fuses/ adequate capacity of MCBs/ MCCBs, contactors (capacitor duty) bus bars and terminal chambers to make bank of required KVAR. Terminal chamber shall be suitable for bottom/top cable entry. Two earth terminals shall be provided to each capacitor bank.

TESTS AT MANUFACTURER'S WORK

All routine and type tests as per IS:2834 relevant to capacitor banks as amended up to date shall be carried out at manufacturer's works and test certificates shall be furnished to the department.

INSTALLATION

Capacitor banks shall be installed at least 30 cm away from the walls on suitable metal frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to the main capacitor panel earth bus with 2Nos. 8 SWG copper or 6 SWG GI earth wires.

TESTS AT SITE

Insulation resistance with 500 V DC Megger shall be carried out and test results recorded.

POWER CONDITIONER SAVERS

Recently RLC circuit operated power factor improvement panels (power correction & saver system) are available in the market. These are more suitable for installations with electronic equipment's (computers, servers, medical equipment's, electronic ballasts etc.). Capacitor banks are prone to introduce additional harmonics at such installations and therefore their use should be restricted at such installations.

The equipment's are called power conditioner savers. These are waveform correction and power factor improvement devices using Rapid Instruction Semi-Conductor (RISC) micro controllers / capacitor duty contactor switching. These work on principle of using low loss continuously variable reactance & adjustable phase wise capacitance to provide optimum impedance to the circuit for transfer efficiently.

TECHNICAL FEATURES

A microcontroller & RISC processor.

Intelligent switching operation, fast response, high break relays (imported).

Polarity reversal indication.

Phase wise dynamically re active compensation.

Operating Power Factor

5A439 BATTERY & BATTERY – CHARGER SEALED LEAD –ACID MAINTENANCE FREE BATTERY

5A439.1 CODES & STANDARDS

5A439.1.1 1.1 All standards, specification and codes of practice, referred to herein, shall be the latest editionincluding all applicable official amendments and revisions as on date of opening of bid.

In case of conflict between this specification and those (IS Codes Standards etc.) referred to herein,the former shall prevail. All works shall be carried out as per the following standards and codes:

IS: 266	Specification for sulphuric acid
IS : 1069	Specification for water for storage batteries
IS : 1146	Specification for rubber & plastic containers for lead acid storage batteries.
IS : 1652	Specification for stationary cells and batteries, lead acid type (with plant positive plates)
IS : 3116	Specification for sealing compound for lead acid batteries.
IS : 8320	General requirements and methods of tests for lead acid storage batteries.
IS : 6071	Specification for synthetic separators for lead acid batteries.

Equipment complying with other internationally accepted standards such as IEC, BS, DE etc. will also be considered if they ensure performance and constructional features equivalent or superior tostandards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salientfeatures for comparison.

5A439.2 GENERAL TECHNICAL REQUIREMENTS

5A439.2.1 Scope

The Specifications give details of the Battery Charger suitable for HT/ LT Panels. The Sealed Maintenance free Batteries up to 24V – 180 AH are housed in the Bottom Compartment of the Battery Charge. The Battery Charger is a composite Battery Charger cum DC Distribution Board.

5A439.2.2 General

The Battery Charger shall float cum Boost type, IGBT Controlled. The Charger shall have selectorswitch for Auto Float – Boost/ Manual Float/

Manual Boost Mode of operation. During Auto Float - Boost Mode, Automatic Changeover shall take place from Float Mode to Boost Mode and vice-versa. This means that when the Batteries arefully charged the charging shall automatically change from Boost charge to Trickle charge.

5A439.2.3 Construction Feature

Float cum Boost Charger and DC Distribution Board with all necessary controls shall be housed in Upper Compartment of Sheet Steel Cubicle with Panels of 1.6mm thickness, louvers for ventilation, gland plate will be provided for cable entry from bottom. The Cubicle shall be in Two Compartments Upper & Lower & Painted in Siemens Grey Shade.

The D.C Output Voltage for Float/ Boost Charger shall be stabilized for A.C. Input variation up toof 230V ± 10%, frequency variation of 50Hz ± 5 % and D.C. Load variation of 0 – 100%. The Voltage Regulation shall be achieved by a constant voltage regulator having fast response SCR controlled. The ripple content in output shall be within 3% of D.C. Output Nominal Voltage.

There shall be provision to select Auto Float/ Manual Float/ Manual Boost Modes. During Auto Float mode the Battery charging shall automatically changeover from Boost Mode to Float Boost and vice-versa. During Manual Float/ Boost Modes it shall be possible to set the output volts by separate potentiometers.

The Battery Charger shall have automatic output Current Limiting

feature.

5A439.2.4 Components

- The Battery Charger shall essentially comprise of the followings.
- 1 No. Double Pole "ON/OFF" MCB at A.C. Input. o 1 No. Pilot Lamp to indicate charges"ON".
- 1 No. Main Transformer: Double Wound, naturally air- cooled, having copper wining.
- 1 Set Single Phase full wave Bridge Rectifier consisting of 2 nos. Diodes and 2 Nos. SCR'sliberally with Resistor/ Condenser Network for surge suppression.
- 1 No. Rotary Switch to select Auto Float/ Manual/ Float/ Manual Boost. o 1 Set Solid State constant potential Controller to stabilise the DC Output Voltage of the Float cum Boost charger at ± 2% of the set value for AC Input Voltage variation of 230V ± 5% from50 Hz and simultaneous load Variation of 0 – 100% and also complete with Current Limiting Circuit to drop the Float charger Output Voltage upon overloads to enable the Battery to take over.
- 1 No. Electronic Controller to automatically changeover Battery charging from Boost to Float and vice – versa.
- 1 No. DC Ammeter and Toggle Switch to read charger output current and Battery charge/discharge current.
- 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.
- Set Potentiometer to adjust the output voltage during Manual/ Auto Float and Boost Modes.
- 1 No. Double Pole "ON/OFF" M.C.B. at Charger Output

5A439.2.5 D.C. DISTRIBUTION BOARD

Incoming : 1 No. 63A DP

MCB Outgoing : 7 Nos. 16A DP

MCB

Visual and Audible Alarm with Manual Accept/ Reset Facility shall be provided for the following.

- A.C. Mains Fail.

- Charger Fail.
- Load/ Output Overvolt.

5A439.2.6 RATING

AC Input	:	230v ± 10% ac 50 Hz Single Phase.
DC Output	:	To Float/ Boost Charge 24V – 200 AH Batteries and alsosupply a continuous load.
Current Rating	:	30.0 Amps.
Float Mode	:	27.0 V Nominal (Adjust Between 24 –28.0V)
Boost Mode	:	28.0 V Nominal (Adjust Between 24 – 30.0V)
Ripple	:	Less than 3%

5A439.3 BATTERY & BATTERY CHARGER

BATTERY

For Sealed Lead Acid Maintenance free Battery		
a)	Battery Bank Voltage	24 V
b)	Battery type	Sealed Lead Acid Maintenance free 12V –1.85
c)	Capacity for ten (10) hour rate at 27°C asper IS	200 AH
d)	Nominal discharge voltage per cell/ Battery	1.85 V/ 11.10V for Battery
e)	Float Voltage	2.25V V / Cell/ 13.5V/ Battery

BATTERY- CHARGER

a)	Battery Charger type	SCR Controlled Automatic float cum 1300SI Charger
b)	Input Voltage	230V +/ - 10%
c)	Output float Cum Boost Charge	24V – 200 AH +/- 2%
d)	Load/ Varies	0 – 100%
e)	Battery type	Sealed Lead Acid Maintenance freeBatteries of approved make.
f)	Capacity for five (5)hour rate at 27oC asper IS	200 AH
g)	Type of Enclosure	i) Tow Compartment – House Battery Charger with DC DB Board in upper Compartment and Housing Batteries in Lower Compartment
		ii) In Lower Compartment – HousingBatteries
h)	Charger Control Panel	Incoming – 1 No. 63A DP MCB Outgoing – 7 Nos. 16A DP MCB

5A444 ELECTRICAL DISTRIBUTION SCADA (EDS)

5A444.1 GENERAL

5A444.1.1 The Electrical Distribution SCADA (EDS) System shall consist of a EDS software package, an HMI software package, I/O interfacing software (communication drivers), Servers, required operating systems, standalone PCs and industry standard networking hardware.

5A444.1.2 The SCADA software will read and write data to field controllers, archive and display historical data and provide graphics screens and reports so that operators, supervisors and maintenance personnel can quickly and easily maintain and operate the system.

5A444.1.3 The EDS platform shall facilitate applications in the broad categories of (a) energy performance, (b) power availability, quality and reliability, and (c) sustainability performance. At a high level, the feature-set shall provide functions in:

a. Real-time monitoring.

b. Alarming and event management.

c. Sequence of events analysis

d. Energy cost analysis.

e. Energy, power, and sustainability data analytics and visualization.

f. EDS Software should be able to share required data with IBMS Software.

5A444.1.4 The software platform shall be certified for use as a part of an ISO50001 program and verifiably support compliance. In addition, the functionality shall support ongoing ISO50001programs per the following areas of Section 4 of the ISO standard:

a. Energy review.
b. Energy baseline.
c. Energy performance indicators.
d. Monitoring, measurement, and analysis.
e. Input to management review.

5A444.1.5 The EDS shall verifiably support compliance with EN 16247-1 for energy audits.

5A444.1.6 The EDS shall include Modular, licensable optional applications to expand the basic functionalities of the core platform G. EDS system Should be Complete in all respect.

5A444.2 ELECTRICAL DISTRIBUTION SCADA (EDS)—REAL TIME MONITORING AND CONTROL

5A444.2.1 The EDS shall include the capability to provide screens including realtime data about the electrical infrastructure showing incoming utility feeds, medium voltage, and low voltage distribution. Relevant data from The capability to provide real-time monitoring data within other analytics functions, such as dashboard views, shall also be provided

5A444.2.2 The graphical monitoring and analysis application shall support custom graphics/images andprovide the ability to create graphical diagrams of the Power

Monitoring system, including electrical one-line diagrams, facility maps, plan views, floor layouts, equipment representations, and mimic displays.

5A444.2.3 The graphical monitoring and analysis application shall be capable of displaying electrical network status through real-time electrical one-line diagram animation based on a tag valueexpression.

5A444.2.4 The graphical monitoring and analysis application shall be capable of writing to device registers for applications such as resetting, triggering, toggling, switching, manual waveformcapture, controlling remote devices and equipment, including breakers.

5A444.2.5 The graphical monitoring and analysis application shall allow application and HMI design engineers to create custom diagrams with linkages to device registers even if the devices areoffline / disabled.

5A444.2.6 Web-enabled real-time tables: The system shall have the following capabilities for interactiveside-by-side visualization of real-time measurements:

a. Display a tabular view to compare device readings from multiple meters in the powermonitoring network quickly.

b. Permit users to create, modify, view and share table views through a browser without theneed for a separate software application.

c. Have built-in functions that allow users to easily and instantly filter out measurements whenviewing a table.

d. Support both physical and virtual devices defined in the system.

e. Support exporting real time tabular data into Excel formats.

5A444.2.7 Power monitoring trending: The EDS shall include graphical charts for real-time trending ofpower usage (kW, Volt, Amp, and kWh) or any measurement supported

a. Trend up to 14 measurements on the same chart (limit may be increased if desired).

b. Customize attributes such as color, line thickness, overlays, display name, and display unitsfor each data series.

c. View the trend using an auto-scaling or manual chart axis.

d. Adjust the desired time viewing window for the trend.

e. Inspect the trend by zooming and panning to focus in on key areas of the trend.

f. Provide drill-down detail for the highlighted trend data point to help identify root causes ofconcern.

g. Trend measurements with different units on the same chart using two different axes.

h. Provide calculated values of minimum, maximum, and average values for a trend.

i. Configure a target threshold line for comparison against actual measurements.

j. Configure up to two target bands with visual indicators to identify when a measurement isoutside specified limits.

k. Display real-time data and/or historical data per data series, with optional back-filling ofthe real-time data using historical data.

l. Export trend data to .CSV/Excel format.

m. Access trend data from a web browser or mobile environment.

n. Save specified trends in a library for later use.

o. Share trends with other users or restrict use.

p. Simultaneously view multiple trend charts, or alternatively maximize a selected trend todisplay it in full screen mode.

5A444.3 ELECTRICAL DISTRIBUTION SCADA (EDS)—ALARM AND EVENT ANALYSISAND NOTIFICATION

5A444.3.1 The EDS shall be able to support the following as it relates to alarm performance:

a. Maximum 10s response time from event capture in an IED and display in the EDS alarmviewer

b. Support for GPS time synchronized 1ms time stamp for devices supporting this capability

c. Support for IED onboard alarm logs for devices with supported capability and PC basedalarms

d. Support for multiple alarm types such as:

- Digital Alarms
- Time Stamped alarms
- Analog Alarms
- Advanced Alarms
- Multi-Digital Alarms
- Time Stamped Digital Alarms
- Time Stamped Analog Alarms

5A444.3.2 The EDS shall provide alarm and event annunciation features that include the following:

a. An alarm viewer that provides a summary of the active alarms shall be provided. Theviewer shall:

- Be visible in any screen when logged into the run-time interface of the system.
- Display the total number of unacknowledged alarms, and the breakdown of howmany of those alarms are high priority, medium priority and low priority.
- Provide an audible alarm and a simple means for muting the alarm.
- Allow a simple mechanism to acknowledge alarms for users with appropriate userprivileges.
- Allow a mechanism to sort and group alarms.
- Allow a mechanism to set configurable alarm thresholds, for example, high, medium,and low.
- Allow a mechanism to create a standard, user defined alarm hierarchy views that fituser defined criteria.
- Provide an active alarms view to show alarms currently in the active state.
- Printing support as alarms occur (including sorted/filtered view)

- Ability to visualize time quality flag for GPS time synchronized 1ms time-stampedevents.
- Ability to configure coloring, based on severity of alarms
- Alarms shall be accessible from the single line diagram associated with theequipment or from the detailed view
- Ability to change alarm setpoints from the viewer
- Ability to export alarm set point configuration to CSV or Excel
- Ability to view associated waveforms if the device supports it
- Ability for operator with proper credentials to comment on an alarm record in alarmviewer

b. The EDS shall enable alarm data sharing with a web services to pass alarm data to othersystems.

5A444.3.3 The EDS shall provide an alarm notification system.

a. The alarm evaluation and notification system shall ensure that appropriate staff members are notified of power system events. The system shall collect data, evaluate alarm conditions, and annunciate the alarms to specified users through email or SMS text messages.

b. The alarm evaluation and notification system shall include:

- An alarm evaluation engine.
- An alarm notification/annunciation engine that supports annunciation through emailand SMS text message.
- Flexible alarm scheduling capabilities.
- Web-based configuration tools for notification configuration, log viewing, andfiltering.
- The ability to control alarm flooding by intelligent aggregation through alarmfiltering and consolidation.

Text messaging for cell phones (GSM Modem) Simple Network Management Protocol (SNMP)

5A444.4 ELECTRICAL DISTRIBUTION SCADA (EDS)—DATA ANALYTICS AND VISUALIZATION

5A444.4.1 The EDS shall provide web-enabled dashboards.

a. The system shall have a web client interface that presents interactive auto-updating dashboard views that may contain water, air, gas, electric, and steam (WAGES) energy summary data, historical data trends, images, and content from any accessible URL address.

b. Users shall be able to create, modify, view, and share their dashboards (including graphics,labels, scaling, measurements, date ranges, etc.) using only a browser and without a separate software application.

c. Users shall be able to create with configurable drag and drop gadgets to show the followingdata:

- Images from any web-based content
- Energy consumption
- Energy cost
- Energy comparison
- Energy savings

- Emissions
- Trends

d. The system shall facilitate kiosk displays by assigning individual dashboards to slideshowsto run in unattended mode, scrolling through designated dashboards at a configurable timeinterval.

e. The system shall permit users to create, save, and share an unlimited number of dashboardsand slideshows.

5A444.4.2 The system shall provide a web-enabled reporting platform.

a. The system shall provide a web-enabled reporting tool to view historical data in pre-formatted or user-defined report templates.

b. The system shall support reporting on all supported physical devices and virtual (orcalculated) meters as defined in the device hierarchy.

c. Users shall be able to create, modify, view and share their reports in the web reportsinterface.

d. The reporting tool shall provide standard pre-formatted report templates for:

- Energy cost
- Load profile
- System-wide interactive power quality with CBEMA/ITIC evaluation.
- EN50160 compliance
- EN50160 Edition 4 compliance
- Harmonics compliance (IEEE519-1992)
- IEC61000-4-30
- 100 ms. power quality
- Alarm and event history
- System configuration
- Hourly usage report
- Single and multi-device usage reports
- The reporting tool shall support exporting to the following outputformats: .HTML, .PDF, .TIFF, .Excel, and .XML.

e. The reporting tool shall be capable of subscriptions to facilitate automatic distribution of reports according to a configurable schedule by saving to network locations, email, or print.

f. The system shall support the ability to trigger the generation and delivery of a pre-configured report based on pre-specified event criteria. The system shall be capable of configuring event monitoring detection filters criteria.

g. The reporting tool shall have a framework to support:

- Simple customizations to reports such as colors, image inclusions, turning reportsections on/off, and logo changes without programming.
- Additional more complex report customization through a programming kit.

h. The reporting tool shall be capable of subscriptions to facilitate automatic distribution ofreports according to a configurable schedule by saving to network locations, email, or print.

i. The system shall include features to enhance energy awareness and drive energy conservation and sustainability programs. The features must facilitate the following functions.

- Profiling and trending energy use for all electrical and piped utilities (WAGES)
- Establishing energy baselines
- Comparing and ranking energy use with different entities(buildings, departments etc.)
- Energy monitoring against user-configurable targets

j. The system will facilitate energy awareness through the following capabilities.

- Display energy usage using trend, graph, bar, dial dashboard visualizations.
- Rank selected energy consumption entities or loads in descending order.
- Convert various energy measurements to a common unit.
- Normalize energy usage by typical measurements like area, and compare normalizeddata visually.
- Display energy profiles according to time of use (time of day, week day, holidays,season, etc.) with overlaid energy target lines from other dynamic sources or fixedlimits.

k. The system shall include the following user-configurable report templates to facilitate energy awareness.

- Energy Usage
  Organize and overlay energy usage data from multiple entities (such as load type,departments etc.) in the same graph through common visual cues such as column,bar, pie chart etc.
  Organize and overlay energy usage data from multiple entities vs. common timeintervals such as daily, weekly, monthly etc.
- Consumption Ranking: Visually rank different entities (such as buildings, floor,departments etc.) by energy usage

l. Energy Usage by Time-of-use: Aggregate energy usage by time of-use periods and highlight any exceeded thresholds (targets)

- The system energy awareness report templates report templates will include thefollowing general capabilities.
- Normalize consumption data by a static scalar
- Set different aggregation intervals
- Configure different time periods
- Set upper and lower target lines
- Display data through common visual cues such as column, line, pie chart, gauges etc.
- Display warnings for missing data points

5A444.5 ELECTRICAL DISTRIBUTION SCADA (EDS) APPLICATIONS—POWER QUALITYMONITORING, COMPLIANCE AND ANALYSIS

5A444.5.1 Power Quality Monitoring: The EDS shall provide power quality specific screens and reportsas follows.

a. Device Level Power quality summary screen—the data collected by any compliant PQ- capable metering device shall be summarized to show:

- Voltage disturbances, including the date and time of the last disturbance, the count ofthe number of transient events, and the count of the number of sag/swell events.
- Harmonic measurements, including a link to the harmonics log for the particular device. Additionally, there shall be a link to another screen that shall show the real-time Total Harmonic Distortion (THD) content and the maximum THD.

- Flicker measurements.
- Logged events, including a link to the event log for the particular device.
- Waveform logs, including a link for waveforms captured during transients andsag/swell events.
- Further detailed waveform analysis using a tool shall be natively provided andsupport COMTRADE file format.

b. System Level Power Quality summary screen—the power quality report shall display all power quality events collected in the EDS for one or more measuring points for a given period of time.

- The report shall show a summary table of all the events in a given time period and provide the means to see further details (power quality details report) for any givenevent.
- The summary report shall contain a plot of the Information Technology Industry Council (ITI) (also known as ITIC or CBEMA) curve that displays the worst disturbance from each event listed in the summary table. The summary table shallcontain the following components for each event:
- Event identifier.
- Source.
- Event timestamp.
- Phase identifier for the worst disturbance during this event (ex., "V1").
- Voltage magnitude for the worst disturbance during this event in % of nominal (forexample, "68.80%")
- Voltage magnitude maximum and minimum on phases V1, V2 and V3 for the worstdisturbance during this event in % of nominal.
- Link to waveform report for the worst disturbance during this event.
- Each entry in the summary table shall include a link that provides further details forthe given event. The details to be shown are:
- Disturbance event timestamp.
- Phase identifier.
- Voltage magnitude in % of nominal (for example, "68.80%")
- Voltage magnitude maximum and minimum on phase V1, V2 and V3 in percentageof nominal.
- Duration in seconds.
- Disturbance type.
- ITI (CBEMA) tolerance curve violations (for example, "outside tolerance").
- Link to waveform report.
- Each entry in the summary table shall include a link that shows the waveforms of thegiven event (if any exist). The waveforms shown shall be for both the voltage and current readings of the measuring point.

c. One hundred (100)-millisecond Power Quality Report

a. This report shall display data recorded at 100 millisecond intervals, with a data table forthe measured point and selected measurement containing columns labeled: Timestamp, Source Label, Measurement Label, Measurement Unit, and Data Value.

d. IEEE1159.3 Power Quality Data Interchange Format (PQDIF) Support The system shall provide a mechanism to export power quality data to the non-proprietary standard PQDIF format with support for the following default templates:

- Flicker: Short-term and long-term flicker disturbance data on the voltage inputs.
- Sag/Swell: Sag/swell disturbance data for voltage inputs, including minimum,maximum and average values.
- Sag/Swell Waveforms: Waveform data for voltage sag/swell.

- Steady-state: Steady-state (RMS) data for trending.
- Steady-state Waveforms: Waveform data for steady-state data.

e. Disturbance Direction Detection

f. For power quality compliant devices, the system will indicate the direction of the disturbance within the electrical distribution system in event logs, with associated confidence or certainty rating (for example, “Upstream: Confidence Rating - High”, or “Downstream: Confidence Rating – Medium” etc.).

5A444.5.2 Power Quality Compliance Reporting

a. EN50160 Edition 4 compliance report

- The EN50160 voltage characteristics of public distribution systems compliance report shall display a summary of EN50160 compliance for a set of measuring pointsin the system for a given time period for the following components:
- Power frequency.
- Supply voltage variations. 3) Flicker severity.
- Supply voltage unbalance.
- Harmonic voltage.
- Inter-harmonic voltages.
- Mains signaling voltages.
- Interruptions of supply voltage. 9) Supply voltage dips and swells.
- Additionally, the report shall allow for detailed drill-down for a given
- The IEC61000-4-30 compliance report shall display a summary of the IEC61000-4-30 compliance for a set of measuring points in the system for a given period. The report shall:
- Include the following IEC61000-4-30 components: frequency, supply voltagemagnitude, flicker, supply voltage unbalance and supply voltage THD.
- Provide a means to manually enter a baseline value for each component.
- Display a series of trends for each component listed with each component’s manuallyentered baseline.
- Include a data table that displays all the power quality-related events for the givenreport period including voltage dips, voltage swells, and voltage interruptions.

b. IEEE 519 Harmonics Compliance report

- The IEEE519 harmonics compliance report shall have the following capabilities:
- Provide a mechanism to report on IEEE519 limits.
- Provide a mechanism to report on user defined limits.
- Ability to determine voltage and Isc/I-l ratio directly from the device, where Isc is themaximum short circuit current at the point of common coupling (PCC), and the I-l is the maximum fundamental frequency demand current.

c. For both individual and total harmonic voltage distortion, display the following:

- The allowable IEEE519 limits.
- The % time out of compliance.
- The number of non-compliant three-second intervals.
- The number of total measured intervals.
- Number of missing or invalid intervals.
- Compliance levels of Warning, Out of compliance, or Compliant.
- A maximum value with a time-stamp of when that distortion was measured.

d. For both individual and total harmonic distortion for current, display all the values

specifiedin the previous section for every range of harmonic orders.

e. For each phase, voltage, and current provide a graphical plot of THD versus time stamp.On the same plot, plot the allowable limit to allow for visual comparison of compliance.

f. Provide a graphical plot of “average value of voltage per harmonic” and “average value ofcurrent per harmonic” as a percentage of fundamental frequency, versus harmonic order toallow for visual identification of the worst harmonic problems.

g. For each phase voltage and current, provide a graphical plot of harmonic content versus time stamp with simultaneous plot lines for a set of harmonic orders (for example, h <= 11).This allows the user to identify the harmonic orders associated with the worst problems toenable mitigation measures such as active filtering.

5A444.5.3 Integration with Power Quality Mitigation Equipment

The system shall natively support interfaces with power quality mitigation equipment for power factor correction, harmonic filtering, voltage sag mitigation (UPS), and transient protection to provide end to-end solutions for monitoring, correction and optimization of power quality.

5A444.6 ELECTRICAL DISTRIBUTION SCADA (EDS)—TECHNICAL IN FRASTRUCTURE

5A444.6.1 The EDS shall have an architecture with the following characteristics to support systems witha large number of IO devices and distributed systems Server and client architecture where the client can federate visualization from multipledistributed EDS servers.

a. Distributed processing for IO device data acquisition, alarm and historical data processingfor increased performance and scalability

b. Ability to distribute IO devices data processing to multiple processors to increaseperformance and stability of the system.

5A444.6.2 The EDS system shall function without disruptions (including communications, logging, andalarming) in the following ways:

a. Software components can be installed and available on both primary and secondary nodes.

b. The software components on the secondary system are up but will not process data or requests to avoid double polling of connected devices.

c. Data is mirrored in near real time and both systems will have identical data. Data replicationis typically done through the software’s capabilities. This generally provides a recovery time of a few seconds automatically in case of the primary node being unavailable.

d. The software shall provide the ability to achieve up to eight times device redundancy per IED.

e. Historical data shall be synchronized and backfilled in a data historian following a primarynode failover recovery

5A444.6.3 Cyber Security: The EDS shall adhere to the following security procedures and include these functions and applications to help secure power monitoring and control operations and enablecyber security policies:

a. Must follow Secure Development Lifecycle product development processes

b. Must have undergone a threat model, penetration test and static code analysis

c. Support for Windows Active Directory integration

d. Secure password administration (e.g. scheduling of password updates and enforcingcomplexity rules with Active Directory) and password storage

e. 8 levels of user access privileges to be defined by the user

f. Supports minimum of two-factor authentication. Two-factor or multi-factor authenticationdoes not require Internet access and may be used on an isolated network

g. Application white-listing on the EDS server(s)

h. HMI screen showing a log of user operations (e.g. log-in, log-out and breaker operations)

i. Ability to integrate with a role-based access control domain controller (for hardware andsoftware system)

j. Ability to operate in a network environment with configurable firewalls that perform deeppacket inspection for Modbus communications

5A444.6.4 The EDS shall provide the following operating system and browser support:

a. All associated core components of the EDS software operate as Windows operating systemservices.

b. The web client interface shall support multiple browsers.

5A444.6.5 The EDS shall provide the following data management support:

a. Microsoft SQL Server database engine per supported configurations.

b. All network configuration settings relating to device routing and addressing, communication gateways, distributed I/O servers, and load-distributing application serversshall be stored in the EDS databases.

c. Archiving, trimming, and on-demand or scheduled capabilities shall be supported

d. The capability to view historical data from archived databases shall be included

e. A utility to help migrate older versions of the databases to newer versions

f. The EDS shall be capable of retrieving data from devices in the monitoring network and provide the following abilities:

g. Interrogate and download logs of interval, waveform, and alarm data stored onboard metering devices and related circuit breaker trip units.

h. Interrogate and download logs of interval data generated by the software system (software-based logging).

i. Interrogate and download logs of alarm and event data generated by the software system (software-based alarming).

j. Automatically re-arm the waveform recorders upon upload of information.

k. Detect unknown measurement quantities provided by devices in the network, and automatically generate appropriate database references for those quantities without user intervention.

5A444.6.6 The EDS system shall include an administrative interface, including open format grid styleeditor, with the following management functions:

a. Security: administer groups and user accounts with role based privileges including theability to integrate with Windows Active Directory.

b. Database: initiate backup, archiving, and trimming tasks.

c. Devices: Add or rename devices, map measurements, and communication settings.

d. Connections: Configure connection schedules and manage modem connections.

e. Events: View and manage software system events.

f. Edit and customize project databases including fonts and keyboard key actions.

g. Capability to import and export project databases to CSV or Excel for editing.

h. Ability to centrally store and deploy project databases and other project collateral over asecure HTTPS connection

i. Support for multiple monitor resolutions and multi-monitor configurations for a minimumof 8 monitors.

5A444.6.7 The EDS shall have a native graphics development application with both ANSI and IEC electrical graphics libraries, including circuit breakers, power meters, motors, energy sources such as generators and main utilities and other electrical and process equipment.

a. Graphic objects shall be able to support embedded scripting logic specific for powersystems and grouping of multiple graphic symbols.

b. The electrical graphics objects shall allow the engineer to define electrical sources, destination busbar and metering points to enable electrical network animation

c. The graphics development environment shall include a utility to validate and automaticallycorrect animation logic

d. The graphics development application shall have native graphic page templates to save timeon graphics development time.

5A444.6.8 The EDS shall support the following device support and management features:

1. The system shall include native support for any of the following combination of protocols:

a. Modbus
b. IEC 61850
c. IEC 60870-5-104 (master)
d. DNP3
e. BACNet (master)
f. Simple Network Management Protocol (SNMP)
g. ION

2. The system shall have KEMA certification for IEC61850 Edition 2
3. The system shall include factory-tested native driver support for at least 75 electrical distribution devices (energy and power meters, protection relays, circuit breakers, PLCs, etc.).
4. Native comprehensive device support shall include:

a. Native integration with Schneider Electric equipment such as power and energy meters, circuit breakers and relays and branch circuit meters.

b. Pre-engineered, interactive graphical display screens for viewing and analyzing real-time and historical device data.

c. All registers pre-mapped to standard measurement names without additional mapping of internal device registers.

d. Automatic upload of time-stamped onboard data logs, event strings, and waveform captures without additional configuration.

e. Device type modeling utility to define all variable, alarm and trend tags for a device type and apply to multiple physical devices for bulk tag database population

f. Automatic time synchronization.

g. Dynamic scaling of register values (e.g. the system shall not require a separate register read to perform value scaling for power and energy data)

h. Native support for Modulo10k encoding of a minimum of four 16bit Modbus registers used by power meters for cumulative tag values (e.g. energy – kWh)

5. The system shall support integration with other third party intelligent electronic devices (IEDs) not directly supported natively.
6. The system shall support logical device definitions for user-friendly device and measurementnames for inputs/outputs or channels on devices that represent a downstream device (in the case of PLCs and auxiliary inputs) or an individual circuit (in the case of multi circuit devices). Bulk-import capability to create large numbers of logical devices without manual single-deviceconfiguration shall be supported.
7. The system shall support the concept of hierarchies to organize devices structurally into various levels. Examples include Tenants/Racks/Circuits, PDUs/RPPs/Panels, or Buildings/Floors/Rooms. The systemshall include the ability to:
    a. Aggregate data at any location in the hierarchy.

b. Track hierarchy configuration changes over time.

c. Allow administrators to update names in a given hierarchy at any time (even in the past) toensure accurate reporting of associated data points (for example, report on energy consumption for a Tenant who has re-located, expanded, added, or removed circuits duringthe billing period).

d. Export the hierarchy structure to Excel format.

e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.

5A444.6.9 The EDS shall provide a scripting engine allowing for user defined

customizationThe system shall support extensibility in the following ways:

5A444.6.10 Provide a graphical, object-oriented application logic engine to create system-wide logicmodules with arithmetic, XML data import, PC-based alarming, and logging capabilities.

The application logic engine shall have a comprehensive set of functions to create customized applications programs for functions such as weather or real-time price import, KPI calculations,energy units conversion, data aggregation, data normalization, data comparison, power loss calculations, power factor control, load shedding, etc.

The system shall enable use of .NET objects in a SCADA project

5A444.6.11 The EDS system shall support system integration in the following

ways:Device-level Modbus interoperability.

The system shall be capable of supporting Modbus communicating devices and be capable of functioning as a Modbus master to read/write registers in Modbus devices for monitoring andcontrol applications.

The system shall be capable of Modbus device definition (device drivers) creation to enableintegration of third-party Modbus protocol devices.

System-level OPC interoperability.

The system shall include OPC DA Server and OPC DA Client data sharing applicationsamongst OPC compliant systems.

The system shall include OPC AE Server and OPC Client alarm and event data sharingapplications amongst OPC AE systems.

The system shall provide default OPC Server tag mappings for all natively supported device types without the need to select, configure, or program the mapping of device registers to OPCtags.

The system shall provide a flexible means to add or change OPC mappings and shall supportthe ability to add custom measurements.

Data-level interoperability.

The system shall support the Extract, Transform, and Load (ETL) data log file transfer mechanism to import and export data log files to integrate functions such as manual dataentry, offline device data import, push data to the cloud, or to other systems.

The system shall include a mapping application for specifying log data file import-export mappings and import schedules to facilitate import/export in formats such as

.CSV, .XML,etc.

Web application-level integration.

a. The system shall include:

The capability to integrate other web applications into its web interface through the use of pluggable web content widgets.

The capability to supply content such as dashboards, reports, trends and diagrams to otherexternal web applications through addressable URLs.

Web services integration.

a. The system shall include web services integration capabilities for machine-to-machineinteractions with other application software systems with the following characteristics:

Based on SOAP (Simple Object Access Protocol) protocol specification.

Provide a Web Services Description Language (WSDL), machine-readable

description.Allow access to real-time, historical (i.e., time stamped), and alarm/event

type data.

Provide the ability to acknowledge alarms by authenticated and authorized clients.

Provide digest authentication functionality.

Provide the ability to be enabled or disabled.

5A444.6.12 The system shall support internationalization and regional settings for end user interface localization.

5A444.6.13 The EDS shall support system configuration and advanced analysis tools in the following ways:

1. The system shall include a monitoring and analysis application with a rich set of power tools for water, air, gas, electric, and steam (WAGES) energy analysis, power quality analysis,power system monitoring and control, and include the following capabilities:

Auto-diagram creation capability to create a comprehensive set of linked hierarchical graphical diagrams showing devices and their associated device specific diagrams in the network.

Ability to import custom graphics or images to create electrical one-line diagrams, facilitymaps, plan views, floor layouts, equipment representations, and mimic displays.

Support for power quality analysis.

1) Plot PQ events on an ITIC/CBEMA curve or SEMI F47 curve. 2) Manual waveform capture.

3) Visualization or analysis tools for sinusoidal electrical waveforms including waveform overlay, zooming, and calculations for RMS, peak, delta, harmonics spectrum bar charts, and phasor diagrams.

Ability to write to device registers for applications such as resetting, triggering, toggling, switching, manual waveform capture, controlling remote devices and equipment, including breakers.

Ability to develop custom graphics screens and application logic programs with the devicesbeing offline or disabled to allow for project development in disconnected mode.

N. The system communications infrastructure shall support the following:

Multiple communications network topologies including Ethernet/TCP, serial RS-485/RS-232, and Modem dial-up connections.

The capability to provide time-synchronization signals over an Ethernet network with 16ms accuracy or better.

The capability to communicate simultaneously with multiple devices, including devices on different physical communications channels.

Scalability to greater than a thousand devices.

The ability to automatically retrieve logged data (interval data, event data, and waveform data) from natively supported devices without additional configuration.

The ability to accept or reject duplicate data entries into the database.

The ability to schedule connection times for specific time-periods to conserve bandwidth.

The ability to automatically disconnect modem connections when all device data is database-synchronized (used to minimize long distance phone charges).

Support for modem pooling and assignment of communication sites to specific modems for communications optimization.

5A444.7 TECHNICAL REQUIREMENTS OF RTU

5A444.7.1 General

The Remote Terminal Unit (RTU) shall be installed at each substation to acquire data from Numerical relay, 11kv VCB panel. Main LV panel, Transformer, UPS, Hybrid panel, DC Battery bank/charger, DG Sync PLC etc.

RTU shall also be used for control of 11kv VCBs and incomer of LV panel substation devices from Master station(s). The supplied RTUs shall be interfaced with the substation equipment, communication equipment, power supply distribution boards; for which all the interface cables

5A444.7.2 Design Standards

The RTUs shall be designed in accordance with applicable International Electrotechnical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply. The RTU shall be designed around microprocessor technology. For easy maintenance the architecture shall be strictly DIN rail mounted and shall occupy very less space. The field wiring shall be terminated such that these are easily detachable from the I/O module.

RTU should have following

memory: -Memory as min.: -

Flash 8 MB

Static 2MB

Dynamic RAM 128MB

Backup RAM Mem

Battery

5A444.7.3 RTU Functions

All functional capability described herein shall be provided by the Contractor even if a functionis not initially implemented.

As a minimum, the RTU shall be capable of performing the following functions:

a. Acquiring data through transducer- less modules and the status inputs of devices from the substation, processing and transmitting to master stations.

b. Receiving and processing digital commands from the master station(s)

c. Data transmission rates - 300 to 19200 bps for Serial ports for MODBUS and10/100 mbps for TCP/IP Ethernet ports

d. IEC 60870-5-104 protocol to communicate with the Master station(s), IEC 60870-5-101 for slave devices. & MODBUS protocol over RS485 interface, to communicate with the MFTs/IEDs.

e. RTU shall have the capability of automatic start-up and initialization following restorationof power after an outage without need of manual intervention. All restarts shall be reportedto the connected master stations.

f. Remote database downloading of RTU from master station/SCADA control center

g. Act as data concentrator on IEC60870-5-101/104/MODBUS/IEC 61850 protocols

h. Internal battery backup to hold data in SOE buffer memory & also maintaining the time &date.

i. Support for Analog output in form of standard current loops viz 4-20Ma etc.

j. Support for IEC 60870-5-103, IEC 61850 protocols & ability to act as a gateway for Numerical relays may have to be interfaced in future with numerical relays

k. RTU required to connect to Numerical relays on IEC61850 & it is very critical for the success of the project, RTU should have IEC 61850 KEMA Level A certification compulsory.

l. Have required number of communication ports for simultaneous communication with Master station(s), /MFTs and RTU configuration & maintenance tool.

m. Communication with at least two master stations simultaneously on IEC 60870-5-104

n. Receiving and processing analog commands from master station(s) and Capability of driving analog output card.

o. RTU shall be capable of acquiring analog values through transducers having output as 4-20 mA, 0-10 mA, 0-+10 mA or +/- 5 volts etc using analog input modules.

p. Capability of time synchronization with GPS receiver

5A444.7.4 Communication ports

The RTUs shall have following communication ports to communicate with master station, existing /MFTs and configuration & maintenance terminal.

RTU shall have two TCP/IP Ethernet ports for communication with Master station(s) using IEC60870-5-104.Numerical relays should communicate on IEC 61850.

RTU shall have required number of RS 485 ports for communication with MFTs to be connectedin daisy chain using MODBUS protocol. Minimum 15 analog values (including 4 energy values) to be considered per energy meter. The RTU shall be designed to connect maximum 5MFTs.

RTU as a data concentrator, then RTU shall have additional communication ports Ethernet or serial for IEC60870-5-104/101.

It shall be possible to increase the number of communication ports in the RTU by addition of cards, if required in future. The RTU shall support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port & different database for each master station

5A444.7.5 Master Station Communication Protocol

RTU shall use IEC 60870-5-104 communication protocol for communicating to master station/SCADA.

The RTU communication protocol shall be configured to report analog (except energy values) & status changes by exception to master stations. However, RTU shall support periodic reporting of analog data and periodicity shall be configurable from 2 sec to 1 hour. Digital status data shall have higher priority than the Analog data.

The dead-band for reporting Analog value by exception shall be initially set to 1% (user configurable) of the full scale value. In addition, analog values shall also be reported to Masterstation by exception on violation of a defined threshold limit. All the analog values and status data shall also be assigned to scan groups for integrity check by Master stations at every 10 minutes configurable up to 60 minutes RTU wise. RTU shall report energy values to master station periodically. The periodicity shall be configurable from 5 minutes to 24 hours (initiallyset for 15 minutes) RTU Should have NERC Critical Infrastructure Protection (CIP)

5A444.7.6 Analog Inputs

The real time values like, Active power, Reactive Power, Apparent power three phase Current & Voltage and frequency, power factor & accumulated values of import /export energy values will be acquired RTU from the following in the given manner: 1. MFTs installed in substations

RTU shall also take 4-20 mA, 0-20mA, 0- -10mA, 0-+10mA, 0-5V etc. as analog inputs to acquire transformer tap position, DC power supply voltage, weather transducer etc.

5A444.7.7 Status input

RTU shall be capable of accepting isolated dry (potential free) contact status inputs.

The RTU shall provide necessary sensing voltage, current, optical isolation and de bounce filtering independently for each status input. The sensing voltage shall not exceed 24Vdc. The RTU shall be set to capture contact operations of 20 ms or more duration.

Operations of less than 20 ms duration shall be considered no change (contact bounce condition). The RTU shall accept two types of status inputs i.e. Single point Status inputs and Double point status inputs. To take care of status contact chattering, a time period for each pointand the allowable number of operations per time period shall be defined.

A switching device status is valid only when one contact is closed and the other contact is open. Invalid states shall be reported when both contacts are open or both contacts are closed.

All status inputs shall be scanned by the RTU from the field at 1 millisecond periodicity.

5A444.7.8 Sequence of Events (SOE) feature

To analyze the chronology or sequence of events occurring in the power system, time tagging of data is required which shall be achieved through SOE feature of RTU. The RTU shall have an internal clock with the stability of 10ppm or better. The RTU time shall be set from time synchronization messages received from master station using IEC 60870-5- 104 protocol. SOE time resolution shall be 1ms or better The RTU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the RTU shall be assignable as an SOE point.

Each time a SOE status indication point changes the state, the RTU shall time-tag the change and store in SOE buffer within the RTU. A minimum of 1000 events can be stored in the SOE buffer. SOE shall be transferred to Master Station as per IEC 60870-5-104 protocol. SOE buffer& time shall be maintained by RTU on power supply interruption.

5A444.7.9 Control Outputs

The RTU shall provide the capability for a master station to select and change the state of digital output points. These control outputs shall be used to control power system devices such as Circuit breakers relay disable/enable and other two-state devices, which shall be supported by the RTU.

Each control output shall consist of one set of potential free NO contact. The output contacts shall be rated for at least 0.2 Amp. at 24 Vdc. These output contact shall be used to drive heavy duty relays. In case Control output module of RTU does not provide potential free control outputcontact of this rating, then separate control output relays shall be provided by the contractor. These relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils & shall conform to the relevant IEC requirements.

Heavy duty control output relays

The control output contact from the RTU shall be used for initiating heavy duty relays for to suppress inductive transients associated with energizing and de-energizing of the relay coils. The relays shall conform to the IEC255-1-00 and IEC 255-5 requirements. trip/close ofswitching devices and energizing relays of OLTC raise lower. The contractor shall provide heavy duty relays. Each control output relays shall consist of at least 2 NO contacts. The output contacts shall be rated for at least 5 Amps Continuous at 220Vdc and shall provide arcsuppression to permit interruptions of an inductive load. Relay coils shall be shunted with diodes

5A444.7.10 Control Security and Safety Requirements

The RTU shall include the following security and safety features as a minimum for controloutputs:

Select- check-before-operate operate (SCBO) sequence for control

output. No more than one control point shall be select ed/executed at

any given time.

The control selection shall be automatically cancelled if after receiving the "control selection"message, the "control execute" command is not received within the set time period.

No control command shall be generated during power up or power down of RTU.

5A444.7.11 Contact Multiplying Relays (CMRs)

Contact Multiplying Relays (CMRs) are required to multiply the contacts of breaker, isolators and protection relays etc. The contacts of these relays shall be used to provide status inputs to the RTUs.

The relays shall be DC operated, self reset type. The rated voltage for relay operation shall beon 24/48/110/220V DC depending on the station DC supply.

The relay shall be able to operate for +/-20% variation from nominal voltage.

The relay shall have a minimum of two change over contacts, out of which one shall be usedfor telemetry purposes. The contacts shall be rated to carry minimum current capacity of 5A.

The relay shall conform to following requirement.

Power Frequency withstand voltage–2KV for 1 minute as per IEC

255-5.Insulation Resistance of 100M ohms measured using 500V

DC megger. 5KV Impulse test as per IEC 255-5

The relays coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-enegizing of the relay coils. The relays shall conform to the IEC 255-1-00 and IEC 255-5 requirements or provisions of latest edition or revision of the applicable standardas per Sec-2 Chapter 1 CLAUSE 1.1 of MTS.

The relays must be protected against the effects of humidity, corrosion & provide with a dust tight cover. The connecting terminals shall be screw type & legibly marked. The relays may optionally have a visual operation indicator.

5A444.7.12 Diagnostic Software

Diagnostic Software shall be provided to continuously monitor operation of the RTU and reportRTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the RTU.

The RTU will be powered from a 24VDC power supply system. The RTU shall not place additional ground on the input power source.

The characteristics of the input DC power supply shall be:

Nominal voltage of 24VDC with variation between.(i.e. (+20%/- 15%)

Maximum AC component of frequency equal to or greater than 100 Hz and 0.012times the rated voltage peak-to-peak. The RTU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the RTU internal logic from being damaged and becoming unstable causing mal-operation. The specification for DCPS is given in respective section of MTS.

5A444.7.13 Environmental Requirements

The RTU will be installed in control room buildings with no temperature or humidity control. The RTUs shall be capable of operating in ambient temperature from 0 to +55 degree C with rate of temperature change of 20 degree C/hour and relative humidity less than 95%, non- condensing. For RTUs to be installed in the hilly region with the history of snowfall, the lowerambient temperature limit shall be -5 degree C.

5A444.7.14 RTU Size and Expandability

RTU shall be equipped for the point counts (Basic+20% spare (wired & hardware). It shall be possible to expand the RTU capability for additional 100% of the basic point counts by way ofaddition of hardware such as modules, racks, panels, however, RTU software and database shallbe sized to accommodate such growth without requiring software or database regeneration.

5A444.7.15 RTU Panels

At least 50% of the space inside each enclosure shall be unused (spare) space that shall be reserved for future use. The Contractor shall provide required panels conforming to IEC 529 forhousing the RTU modules/racks, relays etc. and other required hardware.

The panels shall meetthe following requirements:

Shall be free-standing, floor mounted and height shall not exceed 2200 mm. All doors and removable panels shall be fitted with long life rubber beading. All non-load bearing panels/doorsshall be fabricated from minimum 1.6 mm thickness steel sheet and all load bearing panels, frames, top & bottom panels shall be fabricated from minimum 2.0 mm thickness steel sheet

Shall have maintenance access to the hardware and wiring through lockable full height

doors. Shall have the provisions for bottom cable entry

The safety ground shall be isolated from the signal ground and shall be connected to the groundnetwork. Safety ground shall be a copper bus bar.

The contractor shall connect the panel's safety ground of to the owner's grounding network. Signal ground shall be connected to the communication equipment signal ground.

All panels shall be supplied with 230 Vac, 50 Hz, single-phase switch and 15/5Aduplex socketarrangement for maintenance.

All panels shall be provided with an internal maintenance lamp, space heaters and gaskets.

All panels shall be indoor, dust-proof with rodent protection, and meet IP41 class of

protection.There shall be no sharp corners or edges. All edges shall be rounded to

prevent injury.

Document Holder shall be provided inside the cabinet to keep test report, drawing, maintenanceregister etc.

All materials used in the enclosures including cable insulation or sheathing, wire troughs,terminal blocks, and enclosure trim shall be made of flame retardant material and shall not produce toxic gasses under fire conditions.

5A444.7.16 Wiring/Cabling requirements

The RTU panels shall gather all signals from and to the devices located in Control &Relay panels in the substation control room. All wires that carry low-level signals shall be adequatelyprotected and separated as far as possible from power wiring. All wires shall be identified eitherby using ferrules or by colour coding. In addition, cables shall be provided with cable numbersat both ends, attached to the cable itself at the floor plate where it enters the cubicles. Shielded cables shall be used for external Cabling from the RTU panels. The external cables (except communication cables) shall have the following characteristics:

All cables shall have stranded copper conductor.

Minimum core cross-section of 2.5 mm2 for PT cables, 4 mm2 for CT cables, if applicable and 2.5 mm2 for Control outputs

and1.5mm2 for Status inputs

Rated voltage Uo/U of 0.6/1.1KV

External sheathing of cable shall have oxygen index not less than 29 & temperature index notless than 250. Cable sheath shall meet fire resistance test as per IS 1554 Part- I.

Shielding, longitudinally laid with overlap.

Dielectric withstand 2.5 kV at 50 Hz for 5

minutes

External marking with manufacture's name, type, core quantity, cross section, and year

of manufacture. Armoured. Cables shall be used in the area where cable will pass through open area which may experience loading.

The Communication cable shall be of shielded twisted pairs and of minimum

0.22sqmm size.

5A444.7.17 Terminal Blocks (TBs)

Terminal blocks shall be having provision for disconnection (isolation), with full depth insulating barriers made from moulded self-extinguishing material. Terminal blocks shallbe appropriately sized and rated for the electrical capacity of the circuit and wire used. No morethan two wires shall be connected to any terminal. Required number of TBs shall be provided for common shield termination for each cable. All terminal blocks shall be suitably arranged foreasy identification of its usages such as CT circuits, PT circuits, analog inputs, status inputs, control outputs, auxiliary power supply circuits, communication signals etc. TBs for CT circuitsshall have feature for CT shorting (on CT side) & disconnection (from load side) to facilitate testing by current injection. Similarly, TBs for PT circuit shall have feature for disconnection tofacilitate voltage injection for testing.

5A444.7.18 RTU Architecture

Bidder has to offer RTUs having following architectural design:

Centralized RTU design where all I/O modules are housed in RTU panels and communicating with master station through communication port.

5A444.7.19 SCADA INTERFACE PHILOSOPHY

Status/Alarm signals to RTURTU will read all the signals coming from (IEDs MFMs, MFTs, Numerical relays, Transformer relays, Battery Charger) and soft signals on standard protocols.

Commands from RTU

RTU will execute commands from SCADA as soft commands through numerical relays on standard protocol.

Numerical relay integration

Numerical relays should be IEC 61850 compatible. All the hardware required to extend the relay signals to the RTU shall be supplied along with the switchboards. All hardware or protocol converters required for compatibility with SCADA shall be in bidder's scope.

Status/Alarm signals from battery charger controller to

RTUBattery/Charger Load current

Battery/Charger Load

VoltageBattery charger

main fail Battery charger

failure

DC system earth fault

Status/Alarm signals from Transformer monitoring relay

to RTUTransformer Tap Position Transformer WTI

Communication hardware

All hardware like Star coupler, FO glass/plastic, cables, RS 485 Belden class cables and protocolconverters required for interfacing IEDs like protection relays, multifunction

meters, transformer monitoring relays, battery charger controllers etc. to RTU should be included in scope of supply.

Configuration Software and Tools

All software and configuration tools required for configuration of RTU and Network, should beincluded in scope of supply.

Marshalling panel

The Marshalling box to be supplied by the vendor, if

required

5A444.7.20 Ethernet-based Modbus RTU to IP gateway

Ethernet-based Modbus RTU to IP gateway should be Ethernet-based device providing a transparent interface between Ethernet-based networks and field devices. Field devices includemeters, monitors, protective relays, PLCs, trip units, motor controls, and other devices that communicate using Modbus. The Ethernet-based Modbus gateway should use Modbus TCP/IPprotocol to access field device information across a local area network (LAN) or a wide area network (WAN). It should monitor software to access information from devices for data collection, trending, alarm/event management, analysis, and other functions. The EGX300 supports real-time data reporting to many common device types providing several device specific features such as on-board device and circuit summary pages, as well as on-board data logging.

5A445 SANDWITCH INSULATED BUS TRUNKING

5A445.1 Scope

This section covers manufacture, supply, installation, testing and commissioning of sandwich insulated **copper & aluminum bus trunking** for connection between the Transformers to LT panels and DG sync panel to LT panels.

5A445.2 Supply Voltage

For 3 phases, 4 wires, 50 cycles AC supply, operating voltage 415 volts.

5A445.3 Standard for Compliance

IEC 60439- II.- Particular requirement of bus trunking

systemIS: 8623(I & II) / BS: 5486(II)

CPRI /NABL certified

IEC- 60529 – Degree of protection

5A445.4 Construction

The enclosure shall be made from 1.6 mm thickness galvanized sheet steel duly power coated with IP 54 protection. Bus bars would be in 'Sandwitch' construction and the conductors will be individually insulated with layers of insulating film. Inner layer shall be of Glass MICA andouter layer of polyster material having minimum class B . Alternatively, extrusion of Class 'B' material in the form of epoxy insulation may be provided. No drilling of Bus bars is permitted.Length of section will be limited to max 3 Mtrs. Bus bars of one section will be connected to Bus bars of adjacent section by uniblock joint/single bolt joint system removable as separate sub-assembly, so that it can be inserted or removed without disturbing the adjacent sections.

5A445.5 Technical Parameters for Compliance:

5A445.5.1 Copper Bus trunking will be designed to withstand short circuit current of 50 kA for one second.

5A445.5.2 Busbar system should be designed for an ambient temp. of 40 deg C. and temp. rise restrictedto 55 Deg. C max. on conductor above ambient.

5A445.5.3 Temperature rise of the enclosure 40 Deg. C maximum. Temperature rise at terminals 70Deg. C max.

Maximum operating voltage	-	600 / 1000 Volts
Insulation voltage	-	1000 Volts.

5A445.6 Installation

Necessary Vertical / Horizontal Bends/ Tees shall be provided as required.

Bus bars trunking will be rigidly fixed to the side walls or suspended from ceiling by supports as per site requirement. At the termination either on transformer side or on generator end or on switchgear panel, busduct will be provided with flange ends, adopter Box and copper flexible (preferably multi sheet types) to connect Bus bars of busduct to busbars of switchgear panel or transformer terminals or generator terminals.

All the components like Busbars ducting, Bends, Hanger ends, Adopter Boxes etc. will be madefrom galvanized steel sheets. All busduct connections shall be checked through

torque wrench or as per manufacturer recommendations.

5A445.7 Expansion Joints

Expansion joints shall be provided wherever necessary to take care of expansion & contractionof the bus bars under normal operating conditions. This shall be provided after every uninterrupted run of 50 mtrs.

5A445.8 Earth Strip

Earth strip of Aluminium shall be provided, one on each side all along the bus duct of size 50 X 5 mm size Earth strip should be firmly fixed to the body of bus duct at regular intervals.

5A445.9 List of Test to be Carried Out

Type Tests: Copies of the following certificates should be submitted.

a. Verification of Temperature Rise Limits.

b. Verification of dielectric properties.

c. Verification of short circuit strength.

d. Verification of degree of protection.

Routine Tests

a. Verification of insulation resistance.

b. Inspection of assembly, interlocks, locks etc.

c. Check on wiring if provided.

d. Dielectric test.

5A446 APPENDIX – I LIST OF INDIAN STANDARDS (IS)

IS : 374 - 1979 Ceiling fans and regulators (3rd revision)

IS : 694 - 1990 PVC insulated Electric cable for working voltage up to and including

1100 volts.IS : 732 - 1989 Code of practice for electrical wiring and installation

IS : 1255 - 1983 Code of Practice for installation and

maintenance of Power Cables up to and including 33 KV

rating (Second Revision)

IS : 1258 - 1987 Bayonet lamp holders(Third revision)

Three pin plugs and sockets outlets rated voltage up to and IS : 1293 - 1988 including 250 voltsand rated current up to and including 160 amps.

IS : 1554 - 1988 PVC insulated (Heavy Duty) electric cables for working voltages (Part - I)up to and including 1100 volts.

IS : 1646 - 1982 Electrical installation fire safety of buildings (general) Code of

practice.IS : 1651 & 1652 - Stationary cell and batteries, lead acid type

*1*991

IS : 1885 - 1971 Glossary of items for electrical cables and conductors IS : 1913 – 1978 Generaland safety requirements for fluorescent lamps luminaries Tubular.

IS : 2026 – 1977 to Power

Transformer81 (Part-I to IV)

IS : 2071 - 1974 - Methods of high voltage testing 76

IS : 2309 - 1989 Protection of building and allied structures against

lightningIS : 2551-1982 Danger notice plate.

IS : 3043 - 1987 Code of practice for earthing.

IS : 3480 - 1966 Flexible steel conduits for electrical wiring.

IS : 3837 - 1976 Accessories for rigid steel conduit for electrical wiring.

IS : 4146 - 1983Application guide for voltage transformers IS : 4615 - 1968 Switch socket outlets.

IS : 5133 - 1969 Boxes for the enclosure of electrical

accessories.(Part -I)

IS : 5216 - 1982 Guide for safety procedures and practices in electrical work.

(Part-I)IS : 5424 - 1969 Rubber mats for electrical purposes.

IS : 5578 & 11353-Marking and arrangement of bus bars1985

IS : 7098 - 1985 Cross linked polyethylene insulated PVC sheathed cables. For (Part - II) working voltages from 3.3 KV up to and including 33 KV IS : 8130 - 1984 Conductors for insulated electric cables and flexible cords

IS : 8623 -1977 Factory built assemblies of switchgear and control gear for (Part -I) voltagesup to and including 1000 V AC and 1200 V D C.

IS : 8623 - 1980 Bus Bar trunking

system(Part -II)

IS : 8828 - 1996 Miniature Circuit Breakers

IS : 9537 - 1981 Rigid Steel Conduits for electrical wiring

(SecondRevisions)

IS : 10810 - 1988 Methods of test for cables.

IS : 11171 – 1985 Specifications for dry type transformers IS : 12640 - 1988 Earth Leakage Circuit Breakers

IS : 13947-1989 Moulded Case Circuit Breakers

IS : 13947 - 1993 Degree of protection provided by enclosures for LV switchgear and control gear.

IS : 13947 - 1993 General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.

IS : 1651 & 1652 Stationary cells and batteries lead acid type. 1991

5A447 **APPENDIX – II ABBREVIATIONS**

The following abbreviations have been used in the accompanying Specifications, drawingsand as per requirement.

CU Stands for copper.

GI Stands for Galvanized Iron (Mild

Steel)V Stands for Volts

MV Stands for Medium Voltage (110 V ,230 V ,415 V,

600 V)LV Stands for Low Voltage (32 V & Below)

LT Stands for Low Tension

PVC Stands for Polyvinyl

ChlorideAMP Stands for Amperes

KWH Stands for Kilowatt

HoursKW Stands for Kilo Watts

BIS Stands for Bureau of Indian

StandardsIS Stands for Indian Standards

IEE Stands for Institution of Electrical Engineers -

LondonNEC Stands for National Electrical Code

VCB Stands for Vacuum Circuit

BreakerACB Stands for Air Circuit

Breaker

RCCB Stands for Earth Leakage Circuit

BreakerMCB Stands for Miniature Circuit

Breaker MCCB Stands for Moulded Case

Circuit BreakerSP Stands for Single Pole

DP Stands for Double Pole

TP Stands for Triple Pole

TPN Stands for Triple Pole and Neutral

1 Pole Stands for 3 phase and neutral of same capacity

(size)MDB Stands for Main Distribution Board

SDB Stands for Sub Distribution

Board FDB Stands for Final

Distribution BoardMCC Stands for

Motor Control Centre

5A448 LOW VOLTAGE SWITCHGEAR AND TESTED ASSEMBLY

5A448.1 GENERAL

This section covers the detailed requirements of Low voltage switchboard for 415volts, 3 phase, 50 Hz, 4 wire system.

5A448.2 STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice will applyto the equipment and the work covered by the scope of this contract.

Low Voltage Switchgear Assemblies IEC61 439-1 & 2

Low Voltage switchgear & control gear IEC 60 947 /IS 13947:

1993Part I : General rules

Part II : Circuit Breakers

Part III : Switches, disconnectors, switch disconnectors and fuse combination unitsPart IV :

Contactors and Motor starters

Part V : Control circuit devices and switching elements Degree of Protection ofEnclosures for low voltage switchgear. IEC60529 /IS 2147: 1962

Internal arc – IEC 61641 V2

5A448.3 SWITCHBOARDS

The LV switchboards shall be as per the standards IEC 61439-1 & 2. The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc. shall be identical in constructionto the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection.

The designs of the switchboards should be with switchgear manufacturer, and all themechanical drawings must be available in the factory beforehand.

Only OEM design model panels shall only be supplied.

Switchboards shall have a short circuit level withstand as per as per requirement anddrawings.

Panel shall be tested of design as per Seismic Zone 4 of IEC 60068-3-3 requires compliance against 0.4g acceleration

The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

Panel shall also be tested for min. IK 08 Protection against mechanical impacts.

All Main LT Panel shall be ready with Ethernet/ Modbus communication i.e. Switchgears (ACB & MCCB) status (On/Off & Trip) and Multi-function meters (MFM) parameters shall be available

on Ethernet / Modbus communication inside the LT Panel for ready monitoring at BMS/EMS/SCDA level. Panel builder shall includeall necessary hardware as per OEM standards in their scope to make LT panel Ethernet / Modbus ready and submit communication test report during panel testing at shop floor. EMC/EMI certified hardware to be installed in electrical panels.

The switchboard along with ACBs and connections should have been being type tested design at CPRI/NABL/ERDA/Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.

Panel shall be rated for Impulse withstand capability equal to or greater than the switchgears inside the panel i.e. 12KV

For operator safety IP2 X (touch proof) protection to be available even after openingthe feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

Main LT Panel shall be form 4b, for form of separation only metallic covers shall beused, Hylem / PVC sheets shall not be allowed.

5A448.3.1 Switchboard Configuration

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB’s and other equipment as called for in the as per requirement.

The MCCBs shall be arranged in multi-tier formation whereas the Air CircuitBreakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

OEM (Company name) should be mentioned on Top of each all columns of switchboard.

5A448.3.2 Constructional Features

The Switchboards shall be metal clad totally enclosed, floor mounted free standing type of modular extensible design suitable for indoor mounting.

Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shallnot be wired with sections required for feeder. The incomer panel shall be suitable forreceiving bus trunking or MV cable of size specified.

Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

Switchboard shall be readily extensible on both sides by addition of vertical sectionsafter removal of the end covers.

The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as per Cuttack environment. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Metal based neoprene gaskets between all adjacent units and beneath all covers shallbe provided to render the joints dust and vermin proof to provide a degree of protection of IP 42 as stipulated. The unused openings within the switchboards shall be closed using suitable grommets.

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards

Each vertical section shall be provided with a rear or side cable chamber housing thecable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequatesafety for working in one vertical section without coming into contract with any liveparts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness not less

than 2.0 mm and shall be folded and braced as necessary to providea rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm.

All panels and covers shall be properly fitted and square with the frame. The holes inthe panel shall be correctly positioned.

Switchboard shall be provided with “Danger Notice Plate” conforming to relevant Indian Standards.

Internal arc tests as per IEC 61641 V2, (fault level as per requirement) for 0.3 sec shall be conducted at all three chambers i.e. Horizontal Busbar, Vertical Busbar and cable chamber. Copies of the all test certificates shall be submitted along with the tender.

5A448.3.3 Switchboard Dimensional Limitations

The overall height of the switchboard shall be limited to 2400 mm for all the Busbarratings and type of switchboards. Panel should have integral base frame of 75mm, hence total panel height should not be more than 2475mm.

The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

Other dimensional limits if any are specified separately.

5A448.3.4 Switchboard Compartmentalization

For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alloys.

The main board shall be with Form 4b Construction with metallic shrouding only, FRP is not acceptable.

Earthed metal or insulated shutters shall be provided between drawout and fixed portion of the switchgear such that no lives parts are accessible with equipment drawnout. Degree of protection within compartments shall be at least IP 2X.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

For Some MCCB feeders for critical loads like UPS it may be required to have operation only after opening the door, all other facilities like pad lockable rotary handle to be provided for such feeder. It shall be possible to do this change during execution of order

Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in frontof switchgear only.

A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top as per site condition. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley
/ cable chamber.

5A448.3.5 Switchboard Bus Bars

Busbars shall be made of high conductivity, and high strength Aluminum E91 grade Busbars shall be of rectangular cross sections, not more than 6mm thickness better suitable for full load current for phase bus bars and half/ full rated current for neutralbus bar or as stipulated. Busbar shall be suitable

to withstand the stresses of fault levelas specified.

Main Horizontal bus bar and neutral should be in same compartment.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit couldbe arranged with front access for cable entrances

The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of 110O C at regular intervals, to withstand the forces arising from a faultlevel as stipulated. The material and the spacing of the Busbar supports should be same as per the type tested assembly

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequatelysupported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper. Wires.

Clearances between phases should be in line with IEC.

5A448.3.6 Switchboard Interconnection

All connection and tap offs shall be through adequately sized connectors appropriatefor fault level at location. This shall include tap off to feeders and instrument/controltransformers.

For unit ratings up to 250 amps, PVC insulated 105degC withstand, copper conductorwires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all ratingof above 250 amps.

All connections, tapping's, clamping, shall be made in an approved manner to ensureminimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for busbar connections.

5A448.3.7 Draw out Features

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection ofthe wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shallnot be possible to move the breaker from the position unless latch is manually operated.

5A448.3.8 Instrument Accommodation

Al voltmeter, ammeter, MFM and other instruments shall be flushed mounted type ofsize 96 sq. mm. All instruments shall be protected with MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit BreakerCompartment door for which a separate and adequate compartment shall be providedand the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the compartment doors.

The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.

5A448.3.9 Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires.The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm. Runs of wires shall be neatly bunched and suitably

supported and clamped. Means shall be providedfor easy identification of wires. Identification ferrules shall use at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

5A448.3.10 Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5O C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

5A448.3.11 Ventilation Fans

The Switchboard shall be provided with panel mounting type ventilation fans in eachpanel with switchgear rated for 4500 amps and above. The fan shall be interlocked with switchgear operation. The degree pf enclosure protection to be maintained evenwith Fans.

5A448.3.12 Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to beconnected to earth through adequately sized flexible braids.

5A448.3.13 Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process after which a coat of primer paint compactivity with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50-micron thickness, of sheet approved by Engineer-in-charge shall then be provided.

5A448.3.14 Name Plates and Labels

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

5A448.3.15 Type test reports.

Switchboard configurations offered shall be NABL/CPRI

/ERDA/Independent international test house tested for all the tests as per IEC61439- 1 & 2 and internal arc tests. Copies of the type test certificates shall be submitted with the tender.

5A448.3.16 Testing at Works

Panel manufacture has to ensure that OEM shall review, verify & sign-stamp all thedrawings & documents as per OEM design.

Engineer-in-Charge reserves the right to get the switchboard inspected by theirrepresentative at fabricators works prior to dispatch to site to witness the followings.

Physical variation and dimensional checkVerification of

bill of material Functional check

HV testIR test

5A448.4 METERING SYSTEM

5A448.4.1 GENERAL:

Meters must be placed so that they can be read easily by the building operator;typically, in the plant room, main distribution room, or control room.

For advanced and basic metering requirement, meters capable of supportingpredictive demand for better demand management & proactive demand control.

Meters to be used at HT breakers, main LV switchboard breakers (at incomer and outgoing) and sub metering at SDBs, where ever required.

It is recommended to have high accuracy, high sampling rates and power quality parameters i.e., total & individual harmonics, etc. for meters installed at incomer level.

The meters must be able to communicate data for monitoring.

At a minimum, the sub-metering infrastructure should facilitate the aggregation of energy use.

5A448.4.2 General Points:

All meter shall be flush mounted with standard 96x96 dimensions and shall be enclosed in dust tight housing.

Meter shall have universal power supply, 90-415 VAC + 10% and 120-300 VDC + 10%. The meter shall be powered from station DC power source so that meter does not go off in case of power failure.

Operating temperature range: -25 to 70 deg C Humidity: 5% to 95% non-condensing

Meter shall able to measure %Total Harmonic Distortion (THD) with certified accuracy as per IEC 61557-12Meter shall have Modbus RS485 communication port,meters shall be looped and converted to Ethernet communication for ready connectivity to BMS/EMS/SCADA system.

Metering shall be connected in daisy chain and one ethernet gateway shall be used with every 20 MFMs to convert RS485 data into ethernet.

5A448.4.3 Multifunction meter - incoming feeders

Multifunction meter at incomer panel level shall have additional information than mentioned above.

Meter shall have accuracy class 0.5s as per IEC 62053-22 and sampling rate of64sample/cycle.

Meter shall have LCD display and measure per phase and average of all the basic electrical parameters like voltage, current, Power Factor, Hz, KW, KVA, KVAR, %THD I & V, Present and Predictive Demand monitoring with maximum values for KW, KVA and KVAR

At least 2 selectable parameters from KWH, KVAH & KVARH with configurableinterval and duration (e.g. 2 parameters at 15-minute interval for 60 days)

Meter have provision to integrate additional Input/ Output signal as option Meter shall able to

measure and display individual harmonics up to 15th level.

5A448.4.4 Multifunction Meter - Outgoing feeders

Multifunction meter at outgoing feeders Level shall have additional information thanmentioned above.

Meter shall have accuracy class 1.0 as per IEC 62053-21 and sampling rate of64sample/cycle

Meter shall have LED display and measure per phase and average of all the basic electrical parameters like voltage, current, Power Factor, Hz, KW, KVA, KVAR, %THD I & V

Neutral current (calculated value), Demand monitoring

5A448.5 AIR CIRCUIT BREAKERS (ACB)

5A448.5.1 General

The circuit breakers shall be of the air break type, robust and compact design suitablefor indoor mounting and shall comply with the requirement IEC 60947-1 and 2. Rupturing capacity shall be as stipulated. Heat loss per pole shall be low.

ACB shall be with moulded case design to ensure high endurance without maintenance, impulse withstand voltage 12KV and the Ultimate breaking capacity (Icu) = Ics = Icw = (as per requirement) for 1 Sec.

The breaker shall comply with the isolation function requirement of IEC 60 947-2 tobe marked as suitable for isolation / disconnection to facilitate safety of operating personal while the breaker is in use.

ACB should be supplied with both side terminal adaptors Horizontal &Vertical.

The breaker shall provide class II insulation between the front panel and internal power circuits to avoid any accidental contact with the live main current carrying pathwith the front cover open.

ON/OFF/Trip status of all incoming & outgoing ACBs shall be made available on modbus.

Protective devices, metering, CTs, PTs, push buttons and indicating lamps shall be provided as per requirement.

5A448.5.2 Constructional Features

The Circuit Breaker shall be flush front, metal clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housedin a separate compartment enclosed on all sides.

The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate. Mechanical Latch to be provided to identify the isolated, test & service position of breaker to prevent over racking.

All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided foreach pole, and these shall be suitable for being lifted out for the inspection of the mainand the arcing contacts.

The construction of circuit breakers shall be as per pollution degree 3 (as per IEC 60664-1) requirements to sustain harsh environments.

Self-aligning cluster type isolating contacts shall be provided for the Circuit Breaker,with automatically operated shutters to screen live cluster contacts when the Breakeris withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self-aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.

The cubicle for housing the Breaker shall be free standing dead front pattern,fabricated from the best quality sheet steel.

5A448.5.3 Operating Mechanism

The Circuit Breaker shall be trip free with independent manual spring operated or motor wound spring operated mechanism as specified and with mechanical ON/OFFindication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energized. The breaker shall be provided with in built anti pumping mechanism.

The closing time shall be less than or equal to 80 ms to ensure faster closing of the breaker. And tripping time should be less than 30 ms to reduce the let through energyin the event of fault.

The operating handle and mechanical trip push button shall be at the front of the Circuit Breaker.

There shall be mechanical/electrical indicator on the front panel for ‘Ready to close’situation for the breaker by checking all interlocking.

ACB is ready to be closed, after checking all the given conditions (Under Voltage release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in service position) ensuring safety foruser and electrical distribution.

The Circuit Breaker shall have the following four distinct and separate positions which shall be indicated on the face of the panel. The breaker shall get latched in each of three position namely Service, Test and Isolated, operator to de latch before racking in/out to other position "Service" -- Both main and secondary isolating contacts closed "Test" -- Main isolating contacts open and secondary isolating contacts closed "Isolated" -- Both main and secondary isolating contacts open "Maintenance" -- Circuit Breaker fully outside the panel ready for maintenance

5A448.5.4 Circuit Breaker Interlocking

Sequence type strain free interlocks shall be provided to ensure the following:

It shall not be possible for the Breaker to be withdrawn from the cubicle when in the"ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated.

It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.

It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFFposition.

A safety latch shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due to its weight.

Mechanical and electrical anti pumping devices shall be incorporated in the ACB's asrequired.

5A448.5.5 Circuit Breaker Auxiliary Contacts

The Circuit Breaker shall have suitable free / minimum 4 NO/NC auxiliary contacts rated at 10 amps 415 volts 50 Hz. These contacts shall be approachable from the frontfor connecting all external wiring from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

5A448.5.6 Electrical Auxiliaries

All electrical auxiliaries, including the spring charging gear motor shall be installableon site without requiring adjustment or any tools other than a screw driver

The auxiliaries shall be placed in a compartment which under normal operating conditions, shall not contain any conducting parts capable of entering into electricalcontact with the circuit breaker poles. It shall be possible to connect all auxiliary wiring from the front of the circuit breaker.

5A448.5.7 Circuit breaker Releases

The Air Circuit Breaker release shall be with microprocessor type release.

The circuit breaker to be equipped with the microprocessor based release with adjustable

Overload and short circuit protection with adjustable time delay, earth fault protectionwith adjustable time delay.

Release shall have percentage bar graph to show percentage loading of each phase for firsthand information.

The control unit shall have thermal memory throughout the range to store temperaturerise data in case of repetitive overload or earth fault for protecting the cables and loads.

ACB should have built in Zone selective interlocking (ZSI) for logic discrimination to reduce thermal/electrodynamics stresses in the event of short circuit and earth fault.

Individual fault indication LED's (OL, SC & EF) backed by lithium battery to give indications even when the CB is off and electrical fault trip (OL& SC) alarmindication on panel shall be available on trip units for easy & faster identification of cause of fault.

The setting of the ACB should be possible digitally/navigation key/DIP switch setting/dial settings.

On/ OFF, Trip and Ready to close status of each breaker should be available over modbus for SCADA/EMS communication.

Incomer ACB release should have LCD display with phase currents and voltages (running, average & max). It should be possible to store tripping history of last five faults and the type of fault with values.

Outgoing ACB release should have LCD display with phase currents.

5A448.5.8 Earthing

The frame of the Circuit Breaker shall be positively earthed when the Circuit Breakeris racked into the cubicle.

5A448.6 MOULDED CASE CIRCUIT BREAKERS

5A448.6.1 General

The circuit breakers shall comply with the requirement of IEC 60 947 / IS 13947: 1993. MCCBs shall be suitable for nominal voltage of 3 phase 415 Volts AC 50 HZ supply.

The circuit breaker shall comply with the isolation function requirement of IEC 60 947-2 to be marked as suitable for isolation / disconnection to facilitate safety of operating personnel while the breaker is in use.

All MCCBs shall have rated service breaking capacity (Ics) = Icu= 100%) at definedoperational voltage.

Internal power circuits to avoid any accidental contact with the live main current carrying path with the front cover open.

The MCCBs shall be of single/double break rotary contact mechanism, having currentlimiting feature to limit let through energy on the installation.

Thermal magnetic release for MCCB up to 250A should provide with adjustable settings for O/L (70 to 100%) and microprocessor release for MCCB above 250A.

Constructional features

The MCCBs shall be made of halogen free high strength heat resisting and flame retardant thermo setting insulating material.

Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases.

MCCB shall comply with RoHS norms.

The contact tips shall be made of suitable arc resistant sintered alloy. Terminals shallbe of liberal design with adequate clearances

All MCCBs shall suitable for positive isolation and should offer class –II front face/double isolation as per IEC61140 i.e. main current path of the circuit breaker should be isolated from auxiliary section

Suitable arc extinguishing devices shall be provided for each contact.

5A448.6.2 Operating mechanism

The operating handle of the MCCBs shall be quick make / break, trip free type.

The operating handle of the MCCBs shall have suitable, ON, OFF and TRIPPED indicators.

The operating handle and mechanical trip push button shall be at the front of and integral with the circuit

breaker

MCCBs shall be capable of limiting the fault currents. The maximum thermal I2 t shall be indicated by the manufacturer.

MCCBs shall comprise of the mechanism designed to trip the circuit breaker in the event of high value short circuit currents.

The electrical endurance of MCCBs shall be more or equal to that specified by IEC 60 947-2 standard.

MCCBs shall cross bolted/circular type terminals to withstand higher thermodynamicstress. MCCBs shall be invariably be used with spreader terminal.

MCCB shall have minimum 8,000 electrical operations up to 250A and one frame size to reduce inventory.

Earth fault protection if specified should be provided as inbuilt or modular design with time delay and earth fault differentiation, there should be fault differentiation of over current and earth fault on MCCB or panel door.

Where ever MCCB is used as incomer additional earth fault protection shall be used.

There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps

Earth fault module shall have auxiliary contacts for earth fault signaling.

5A448.6.3 Circuit Breaker Interlocking

MCCBs shall be provided with following interlocking devices. Handle interlock to prevent unnecessary manipulations of the breaker.

Door interlock to prevent door being opened when the breaker is in ON position De interlocking device to open the door even if the breaker is in ON position.

5A448.6.4 Circuit breaker auxiliaries

The circuit breaker shall be provided with following accessories, if specified in drawings
Under voltage trip

Continuous rated shunt trip Alarm switch

Auxiliary switch

5A448.7 FINAL DISTRIBUTION SYSTEM

5A448.7.1 MINIATURE CIRCUIT BREAKERS

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 240V/415V, 50Hz supply. The MCB ratings shall be available from 1--63A in 1P/2P/3P/4P versions. The rated short circuit capacity acc to IS/IEC 60898 shall be of 10kA. MCBs shall be offered with B, C or D tripping characteristics as per requirement. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF (to be marked on the MCB in symbolic form)

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment.

(To be mentioned on the MCB as per standards) MCBs shall be line-load reversible with no derating.

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification.

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

suitability for isolation rated insulation voltage pollution degree

rated impulse-withstand voltage 6 kV Discrimination for power continuity

Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit-breakers shall be capable of operation under ambient temperature up to 50

°C, without derating of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

The material used to manufacture MCB shall be 100% recyclable and must RoHS standards.

MCBs shall be suitable for field-fittable Protection auxiliaries (viz. Overvoltage release, Under-voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

5A448.7.2 RESIDUAL CURRENT DEVICES (RCDS):

RCDs shall be of approved design and make and must be tested and validated as perrespective

IS 12640 -1 & IEC 61008 standards for RCCBs IS 12640 -2 & IEC 61009 standards for RCBOs.

It shall carry also CE marking.

RCDs shall be suitable for operation at 240V/415V, 50Hz supply

RCDs shall have IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Basic technical parameters, rating, operating voltage, etc. shall be printed on front face of RCDs for ease of identification.

RCDs shall have clear indication of ‘Tripping on fault’ on front facia. RCDs must be voltage independent and purely current operated.

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping.

The material used to manufacture RCDs shall be 100% recyclable and must comply to RoHS and REACH standards.

RCDs shall be suitable for field-fittable Protection auxiliaries (viz. Overvoltage release, Under-voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

Where ever required, the residual current circuit breakers shall be communication ready to indicate the status of the device (On/Off/Trip), Number of On/Off cycles and Number of Tripping over universally open Modbus protocol, so as to have seamless connectivity with any Energy and Building Management System.

For electrical loads in environment causing disturbance, Super Immunised (SI) type earth leakage

protection range i.e. SI RCDs shall be used, which shall be immune to electrical impurities (viz. Harmonics, pulsated DC components, transient over- voltages).

SI RCD is helps to avoid nuisance tripping and ensures continuity of supply.

It also helps to avoid blinding, that is RCD failing to trip when there is danger of people's safety downstream.

SI RCD shall guarantee the highest continuity of service and electrical immunity.

5A448.7.3 Residual Current Circuit Breakers (RCCBs): RCCBs must conform to IS12640 -1 and IEC/EN 61008 standards.

RCCBs shall be suitable for operation at 240V/415V, 50Hz supply. The RCCB ratings

shall be available from 25A-125A in SPN and TPN versions with the sensitivity of 30mA (for personal protection) and 100/300mA (for Fire protection), as per requirement

RCCBs shall carry ISI marking. The RCCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

RCCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 32A, and 35 sq.mm. for ratings above 32A, to ensure perfect termination of wires and cables. Terminals of RCCBs shall have captive screws.

5A448.7.4 DB (DISTRIBUTION BOARD)

Distribution Boards shall have following features:

PRODUCT DATA SHEET 0 - Recess/ Surface type with integral loose wire box.

PRODUCT DATA SHEET 1 - Phase/ neutral/ earth terminal blocks for termination of incoming & outgoing wires.

PRODUCT DATA SHEET 2 - Din Channel for mounting MCBs.

PRODUCT DATA SHEET 3 - Arrangement for mounting incomer MCB/ RCCB/ RCBO/ MCCB as required.

PRODUCT DATA SHEET 4 - Copper Bus bar

PRODUCT DATA SHEET 5 - Earthing bolts- 2 nos.

PRODUCT DATA SHEET 6 - Wiring from MCBs to phase terminal block.

PRODUCT DATA SHEET 7 - Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.

PRODUCT DATA SHEET 8 - Terminal block shall be made of flame retardant polyamide material.

PRODUCT DATA SHEET 9 - Colour terminal blocks and FRLS wires for easy identification of RYB Phases, Neutral and Earth.

PRODUCT DATA SHEET 10 - Prewired DB shall be provided with a detachable PAN assembly for safe removal of MCBs, RCCBs.

PRODUCT DATA SHEET 11 - The prewired DB shall have have cement spill protector /masking sheet for protection from cement, plaster, paints etc.

during the construction period.

PRODUCT DATA SHEET 12 - Detachable plate with Knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6mm sheet steel, properly pre-treated with 7 tank process and duly powder coated, phosphatized with powder coated finish.

PRODUCT DATA SHEET 13 - DB shall have neutral & earth terminal block on the side, not on top or bottom to provide better wiring space and hear dissipation inside the DB.

PRODUCT DATA SHEET 14 - DBs shall be provided with rotary knob and shall have flexibility

to change to Key lock on field.

PRODUCT DATA SHEET 15 -

PRODUCT DATA SHEET 16 - The Ingress Protection for entire range of DBs must be certified by any neutral testing authority (viz. ERDA / CPRI/NABL/ any govt certified lab) as per standard IS/IEC 60529 for the degree of;

IP43 for DBs for indoor application and IP 54 for outdoor application

PRODUCT DATA SHEET 17 - The Impact Protection for entire range of DBs must be certified by any neutral testing authority (viz. ERDA, CPRI / NABL

any govt certified lab) as per standard IEC 62262 for the degree of; IK08 for DBs with Double Door

Where specified it shall be of double door construction provided with hinged cover in the front.

5A449 LOW VOLTAGE HYBRID COMPENSTATION SYSTEM

LV HYBRID COMPENSATION SYSTEM - (ACTIVE HARMONIC FILTER + CAPACITOR BANK + INCOMER SWITCHGEAR)

5A449.1 STANDARDS & TECHNICAL SPECIFICATIONS STANDARDS

The design, manufacture and testing of the equipment shall be carried out as per latest applicable Indian Standards, Indian Electricity Rules, relevant code of practices and requirement of Chief Electrical Inspectorate of the State Government and International Electro technical Commission (IEC) Standards . However, for ready reference some of the Standards and Code of Practices are given below:

IS 5 : Colours for ready mixed paints

IS 1248 : Electrical indicating Instruments

IS 2147 : Degree of protection provided by enclosures for low

voltage switchgear & control gear IS 2834 : Shunt capacitors for power system IS 3842 : Application guide for electrical relays for AC system

(thermal relays)

IS 5578 : Guide for marking of insulated conductors IS 6875 : Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200V DC.

IS 13947 : Specification for low-voltage switchgear and control gear

IEC 61921 : Power capacitors – Low voltage power factor correction banks. IEC 60076-6 : Power transformers - Part 6: Reactors

IEC 61439-1 : Low-Voltage Switchgear and Control gear Assemblies - Part 1: Type- Tested and Partially Type-Tested Assemblies.

IEC 62208 : Empty enclosures for low-voltage switchgear and control gear assemblies – General requirements

IEC 62262 : Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) IEC 61326-1 : Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements. IEC 61000-6-4: Electromagnetic compatibility – Generic standards

– Emission standard for industrial environments

5A449.2 TECHNICAL SPECIFICATION

5A449.2.1 The Hybrid Compensation System should comprise Active Correction and Passive Correction devices as per requirement. The Active Correction device would filter system harmonics while the Passive Correction device should improve the system power factor.

Operation Philosophy: The Active Correction device (active harmonic filters) shall work on the principle of measurement of harmonic currents and generate actively a harmonic spectrum in opposite phrase to the measured distorting harmonic current there by canceling the original harmonics. Active harmonic filter shall be installed to ensure that the installation is PQ ready from day 1. The harmonic filtering equipment shall be able to reduce harmonic levels as per the local utility regulation. The harmonic filtering equipment shall be able to correct either leading (capacitive) or lagging (reactive) power factors as well. The Passive Correction device (capacitor bank) shall work on the principle of measurement network power factor and shall switch on required number of capacitor stages to improve the power factor of the electrical network

The manufacturer should prove through submission of software simulations that the Total Demand Distortion (TDD) is less than 5%. The Total Harmonic Distortion Voltage (THD V) shall be within the limits as specified in IEEE Std 519-2014 (Standards on IEEE recommended practices and requirements for Harmonic Control in Electric Power System). The point of common coupling (PCC) for such calculations shall be at the transformer incomer secondary (415 V Supply). The simulation software should take into consideration the performance of the de-tuned capacitor bank. The Passive Correction device shall not amplify the existing system harmonics.

To ensure safety, reliability and accountability of component coordination, all the major components such as Active Filters, Capacitor units, De tuning reactors, PF controllers, Circuit breakers, Contactors and the Enclosure system called for in this specification should preferably be from a single manufacturer.

The following is the configuration of the Hybrid Compensation System

(combination of Active Correction & Passive Correction) 415V, 3 phase, 4 wires, 50 Hz, solidly grounded system System fault level 50KA.

Maximum voltage variation + 10% Maximum frequency variation + 5%

Combined voltage & frequency variation: 10%

5A449.2.2 Passive Correction device (Capacitor Bank)

Capacitor banks shall have multiple stages, which shall be switched ON / OFF automatically with the use of electromagnetic contactors. The contactor should be suitable for the type of loads connected to the network. The capacitor banks shall incorporate series de tuning reactors to prevent amplification of system harmonics and prevent resonance.

Rated Voltage of capacitor Unit - 525 V AC The capacitor units shall be suitable for a network voltage of 415 volts and shall be rated at 525 Volts. The de rating shall be due to factors like temperature, voltage rise due to the connection of de-tuned reactors and harmonics. The capacitor unit shall be manufactured in full compliance with and tested to the requirements of IEC 60831, Part-1 and Part-2.

Type of Dielectric : The dielectric film used in the capacitor shall be of the self- healing type utilizing low-loss metalized polypropylene.

Type of unit connection : Delta. The capacitor units shall be internally connected in delta and shall incorporate a 3 phase pressure switch disconnector for protection against internal faults, over pressure, etc. The pressure switch disconnector must isolate all the three phases simultaneously in the event of fault.

Discharge resistance: To be provided between all the phases. The built-in discharge resistors shall not be accessible (factory fitted) and tamper proof. The discharge resistors shall ensure reduction in capacitor voltage to less than 50 volts in 3 minute after switch off.

Series Reactor: 14% de-tuned type (135 Hz) for each capacitor stage. The de-tuning reactors shall be connected in series with each capacitor stage and shall be of iron cored type. The reactor insulation shall be Class “H” rated at 180oC. The maximum temperature of the reactor at maximum continuous RMS amperage shall be no higher than 145oC at a 50oC ambient. The de tuning reactor shall be manufactured in full compliance with and tested to the requirements of IEC 60076-6.

Each stage of the capacitor bank shall also have a suitably rated MCCBs or HRC fuses with an

electronic over-current relay for overload protection. The electronic over- current relay shall be adjusted to trip if the RMS current of the stage exceeds the overload setting. The MCCB shall be manufactured in full compliance with and tested to the requirements of IEC 60947-1,2 & 3.

Stage Contactor: The electromagnetic contactors shall be rated for 660 Volts and shall be 3-pole type and shall be employed for switching 'on' and switching 'off' operations in capacitor banks. The rated voltage of control coil shall be 415V (phase- to-phase). This voltage is subject to a variation of (+) 10% and (-) 15%. The contactor shall be AC3b type. The contactor shall be of certified design confirming to IEC 60947-1 & 4-1.

The power factor controller shall be microprocessor based and shall be able to sense the reactive current requirement of the network and shall switch ON / OFF the required stages of a capacitor bank. The power factor controller should be able to detect and correct abnormalities in wirings such as reversed CT connection, PT on a wrong phase etc. The controller shall be suitable for 1A or 5 A current input and shall have LCD Display.

The controller shall allow the following settings and readings. Automatic initialization and stage rating detection

Any step sequence detection Measurement of capacitance per stage Cap bank over load current ratio THD Voltage

Record of the Max temp internal of the capacitor bank since reset RS485 interface. The controller shall initiate alarms and warnings in the following events.

Temperature limit is exceeded

Insufficient capacitor output / Loss of capacitance Overload current ratio limit is exceeded

Under voltage, Over voltage THDU limit is exceeded

The automatic power factor controller shall be manufactured in full compliance with and tested to the requirements of IEC 61326-1.

The Capacitor bank shall be of certified design confirming to IEC 61921 & IEC 61439-1&2.

5A449.2.3 Active Correction device (active harmonic filter)

The Active harmonic filter (AHF) shall be defined as a power electronic device consisting of power semiconductors known as insulated gate bipolar transistors (IGBT) that switch into the AC lines to modulate its output to mitigate detrimental harmonic current; correct the displaced reactive current (leading or lagging); and balance the current (also known as negative sequence current) for the power source. The AHF shall employ the most efficient, IGBT, 3-Level Inverter Technology.

Spectrum Cancellation: from 2nd to 51st Control response time: 25µs

PCBA protection: Conformal coating on all PCB's

Cooling Architecture: Segregated Cooling (Separate for heat sink and separate for PCB's)

AHF shall analyze the content of the supply current for harmonics from the 2nd to the 51st harmonic and shall determine the reactive current content representing displacement power factor and supply current balancing. AHF shall have a spectrum cancellation from 2nd to 51st, discrete, fully selectable per harmonic order (amplitude and on/off). AHF shall have a Closed Loop Control: Source sense (at mains) CT or Load sense CT for single unit.

AHF shall include an option to achieve optimized unity PF, Leading (capacitive) or lagging (inductive) power factor (Cos) to target THD(v) shall be limited to not more than 5 percent as contributed by the loads at the location of each AHF. THD(v) set point may be set to optimize performance of the AHF and maintain less than THD(v) set point. THD(i) shall be limited to 3% or less as long as AHF is 50% or more loaded and all nonlinear loads have 3% or larger input impedance. A THD(i) set point may be set to optimize THD(i) performance.

AHF shall provide field selection as harmonic filter, reactive current correction, or supply current balancing or any combination of the three modes. All modes shall be required for this project.

AHF shall have up to 30 seconds of logic ride-through in the event of power loss. AHF shall be

designed with a current limiting function to protect the IGBT. AHF shall have automatic restart capability upon power loss return and fault resets. AHF shall monitor the incoming air temperature and invoke a hard trip of the unit at 51°C.

AHF shall have a door-mounted human machine interface (HMI) with touch screen control rated IP65, dust-tight and liquid-resistant. HMI shall provide an oscilloscope feature to display specific parameters. In addition, performance trend curves shall be displayed for load total RMS current, load RMA harmonic current per phase, AHF harmonic current output per phase, AC mains voltage per phase, THDi, TDD, load RMS reactive current, and AHF RMS reactive current output. Bar graphs shall be provided for display of the mains and load harmonic current amplitudes per harmonic order. Selected internal curves shall be provided for diagnostic and performance checks.

HMI shall provide external communications via an RJ45 connectors. HMI shall display a flashing warning screen in the event of a fault. HMI shall download pertinent parameters to a USB memory device to permit remote diagnostic evaluations and to save unit set up parameters. HMI shall include, but shall not be limited to, an on-board commissioning guide with automatic detection features.

The Active harmonic filter shall be of certified design confirming to IEC 60529, CE EMC Certification IEC/EN 61439-1, EN 61000-6-4 Class A, EN 61000-6-2

The Hybrid Compensation System shall be certified for an ambient temperature: 50 degrees Cent. Temperature rise test performed at an independent laboratory should be submitted along with the offer.

5A449.3 DRAWINGS / DOCUMENTS FOR ELECTRICAL EQUIPMENT TO BE SUBMITTED FOR APPROVAL DURING DETAILED DESIGN

Dimensioned drawing showing outline of the Hybrid Compensation System.

Single line diagram showing all the major electrical components. Protection and control schematics of the Hybrid Compensation System.

Details of cable terminations and fittings. Foundation plan, including foundation loading.

Original catalogues for various proposed components.

Type test certificates of the (Active Harmonic Filter, Capacitor Banks and Switchgear) per IEC standards.

Technical Manual giving installation, operation and maintenance instructions

Schedule of recommended spare parts.

5A449.4 INSPECTION & TESTING SCHEDULE AT MANUFACTURER’S WORKS

All routine tests shall be carried out in accordance with IEC 61921 as per the relevant clauses mentioned against each test. Routine tests shall be carried out by the manufacturer on every Low voltage power factor correction banks before delivery.

Inspection of the assembly including inspection of wiring and, if necessary, an electrical operation test (see 7.3.1);

Dielectric test (see 7.3.2);

Checking of protective measures and of the electrical continuity of the protective circuit (see 7.3.3);

Verification of insulation resistance (see 7.3.4).

All routine tests shall be carried out in accordance with IEC 60831 as per the relevant clauses mentioned against each test. Routine tests shall be carried out by the manufacturer on every capacitor unit before delivery.

Capacitance measurement and output calculation

Measurement of the tangent of the loss angle (tan δ) of the capacitor Voltage test between terminals

Voltage test between terminals and container Test of the internal discharge device

Sealing test

All type tests shall be carried out in accordance with the International Electro- technical Commission (IEC) Publication No. IEC 61921 as per the relevant clauses mentioned against each test and all the type test certificates shall be submitted for approval.

Temperature Rise Test) Di-electric Test)

Short-circuit withstand strength Effectiveness of the protective circuit Clearances and creep age distances Mechanical operation

Verification of Degree of Protection

All type tests shall be carried out in accordance with the International Electro- technical Commission (IEC) Publication No. IEC 60831 as per the relevant clauses mentioned against each test.

Thermal stability test

Measurement of the tangent of the loss angle (tan δ) of the capacitor at elevated temperature Voltage test between terminals

Voltage test between terminals and container

Lightning impulse voltage test between terminals and container Discharge test

Ageing test

Self-healing test Destruction test

5A450 UNINTRUPTTED POWER SUPPLY SYSTEM

5A450.1 Scope

This covers Supply, Installation, Testing and Commissioning of UPS for light, power, Data Centre & Airport IT system. Uninterruptible Power Systems (UPS) of the on line type with complete with batteries. The batteries for UPS inside external cabinets/ racks shall be of required capacities to ensure minimum back-up of 30 minutes for light, power load and IT system with the characteristics defined in the “Batteries” section.

5A450.2 System Configuration

VFI (Voltage and Frequency Independent) type UPS to ensure a filtered and stabilized output voltage to loads

Rectifier / DC – DC Converter with IGBT technology as driven power devices operating in pulse width modulation (PWM) to ensure low harmonic distortion of input current

Battery Charger

Inverter using IGBTs as driven power devices operating in pulse width modulation (PWM) and an output filter and regulation by means of a digital signal processor (DSP) Built-in automatic by-pass

Built-in manual by-pass Batteries and battery rack

UPS	Cabinet with operation	Wheels (to facilitate & maintenance)	installation

5A450.3 DC Parameters

Battery voltage; As per OEM Design Permissible DC voltage -As per OEM Design DC over Voltage trip: As per OEM Design DC Under Voltage Trip: As per OEM Design DC Voltage Regulation + / - 1%

5A450.4 Output Parameters Output voltage: 415 V AC

Voltage Regulation: Less than + / - 2% Output Frequency: 50 Hz + / - 0.1%

Transfer Time: 0 millisecond (no delay in synchronized condition) Less than 20 milliseconds (in unsynchronized condition)

Output Voltage Distortion: less than 2% for linear load Less than 5%for non-linear load

Transient Response: For 0-100% load change, voltage variation: Less than 5%

Recovery of variation to normal time within 20 minutes.

5A450.5 Batteries

The stationary accumulator battery shall consist of Sealed Maintenance Free / (Valve- Regulated Lead Acid) batteries. UPS shall be able to handle Nickel Cadmium and open vented batteries.

In order to avoid short circuits between battery strings, when the batteries are housed inside the UPS they shall be subdivided into substrings and housed in a container so as to collect any leakage of acid that may occur. These containers shall be self- extinguishing and able to withstand battery acid corrosion.

The accumulator battery shall ensure generation of the UPS active rated power in the event of the total failure of the mains power supply, the emergency power as or both (as applicable) guaranteeing at least 30 minutes back up.

The batteries shall be connected in two separate and completely independent strings without any points in common and shall the connected to the UPS via a –wire connection. This configuration shall allow the UPS to operate in battery mode and to power the load by means of the inverter should there be a mains failure. While operating in battery mode, even if one of the two battery strings fails (faulty block or interruption in the continuous electric supply from a block), it shall be possible to power at least 70 % of the load using the inverter.

The UPS shall be able to automatically perform tests on the batteries to check their efficiency. The test shall generate an alarm if any faults are detected. It shall also be possible, if certain conditions are satisfied (battery charged, mains present) to perform this test manually, independently of automatic scheduling.

5A450.6 UPS Status Indications

LCD indications on UPS front panel shall be for following.

Input supply & Rectifier. Battery

Inverter

Load on inverter Bypass supply Load on bypass Common alarm

A set of buttons to scroll the menu, for following functions. ESC button

UP button DOWN button

ENTER / OK button

5A450.7 Metering

UPS, on its front panel shall have adequate digital metering to read following: Input voltage –Line to Line

Bypass voltage Bypass frequency Battery voltage

Battery charge /discharge current Battery autonomy

% Battery charge Inverter frequency Output voltage Output Current

% Line Load Output real power

Output apparent power (KVA) Temperature

5A450.8 Protections

UPS shall have the following Protections Input under voltage

DC under and over voltage Input current limit

Battery under voltage

Battery current limit High temperature

Output short circuit protection Output over and under voltage

Output over current / overload Bypass under and over voltage Bypass frequency unhealthy.

5A450.9 Software Options

Comprehensive remote monitoring of UPS from any location connected in network or through Internet through SNMP compatibility. Auto shutdown of servers/ PCs through serial port option as well as through LAN. Remote monitoring of UPS status/alarm. Monitoring of UPS on computer through Open Protocol. The UPS shall also have an RS485 port for interfacing to BAS system or client 's centralized computer network.

5A450.10 Operating Modes

It shall be possible to select any one of the following operating modes: “On Line” mode

High Efficiency mode: “Economy” mode “On Line” Mode

UPS shall be configured a VFI (Voltage and Frequency Independent) type in order to ensure a filtered and stabilized output voltage to loads that is not dependent on the mains power supply

High Efficiency Mode: “Economy” mode

The UPS shall have an “economy”-operating operating mode that can be selected and programmed in order to increase overall efficiency for energy saving purposes. The loads shall be powered by the mains supply through the static by-pass. It shall also be possible to select and programmed specific daily or weekly time intervals when the loads will be powered directly from the emergency mains supply.

5A450.11 Parallel Running of UPS

The system submitted shall allow for a subsequent increase in power achieved by connecting up to 6 units in parallel configuration. The units connected in parallel shall share the output currents equally between them (load sharing).

Parallel operation can also be used in redundancy mode, this ensures that should one of the units connected in parallel fail, the load will continue to be powered by the remaining parallel units (selective disconnection).

Each unit in the system shall have a graphic LCD display used to view and monitor the single unit and, in a hierarchical manner, the entire system. Failure of this device shall not jeopardize the correct operation of the system.

On the UPS unit in parallel configuration it shall be possible to house any chosen communication option or accessory for the supervision and diagnostics of the entire system.

5A450.12 UPS Testing

The Contractor shall perform the following tests, as a minimum, at site prior to handing over, to confirm the functional and the performance specification of the UPS as specified. All required test equipment like Digital Oscilloscope, Voltage Regulator, and Measurement Meters etc. shall be the responsibility of the Contractor without any additional cost.

The Contractor shall demonstrate as a minimum the following features on site by providing all required test equipment, such as power factor improvement, input current THD, output voltage THD, output frequency and all other performance monitoring requirements detailed before as required.

Output voltage: 415 V AC

Voltage Regulation: Less than + / - 2% Output Frequency: 50 Hz + / - 0.1% Transfer Time:0 millisecond

(no delay in synchronized condition) Less than 20 milliseconds (in unsynchronized condition) Output Voltage Distortion:

Less than 2% for linear load Less than 5%for non-linear load Transient Response: For 0-100% load change, voltage variation: Less than 2%

5A450.13 SPECIFICATION FOR UPS SYSTEM

Rating of Ups	:	As Per Requirement
Type	:	ON LINE
Input Voltage	:	415V ± 10% or 230V ± 10%
Frequency	:	50Hz ± 5%
Output Voltage	:	415V ±1% or 230V ± 10% (True sine wav)
Over Load Capacity	:	110% for 05

inutes125% for 05 Minutes 150% for 01 Minutes

Frequency	:	50Hz ± 0.1%
DC Characteristics	:	DC ripple with battery
OperatingTemperature maximum.:	40	Degree centigrade 95%

Cable Entry	: Cable entry provision to be given for bottom entry.	
Bypass	: Manual bypass to be provided.	
Protections & Indications	: Standard protections and indications to be provided as required.	
THD Data Output	: Harmonic distortion shall be less than 2% on linear load 5% on non linear loads as per IEC.	
Crest Factor	:	Crest Factor should be >3:1.
UPS should be		parallel upto six units without using any separate synchronization panel
Batteries	:	Batteries to be sealed maintenance free complete with all the required mounting accessories.
Backup Time	:	30 Minutes as per requirement
Cooling	:	Forced Air.

Battery Charging Current : Manufacturers standard.

Battery Capacity : To be indicated, pacify VAH.

5A451 Internal Wiring

5A451.1 System of Wiring

5A451.1.1 The system of wiring shall consist of PVC insulated multi stranded copper conductor flexible FRLS wires in PVC conduits and shall be concealed as called for. Necessary sleeves or provisions shall be provided for conduits in the precast or aluminum profile buildings. The Contractor shall design to lay down the conduits in various types of wall and slabs constructed by various methods (RCC/Precast/Aluminum form profile/Aeriated Automotive Concrete)

5A451.2 General

5A451.2.1 Prior to laying and fixing of conduits, the Contractor shall carefully examine the working shop drawings prepared by him and approved by the Engineer, satisfy himself about the sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of the Engineer. Any modifications suggested by the Contractor shall be approved before the actual laying of conduits is commenced.

5A451.2.2 In laying of conduits it is important that not more than two right angle bends are provided for each circuit and as far as possible. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

5A451.3 PVC Conduit and Accessories

5A451.3.1 PVC Conduit Conduits and accessories shall conform to latest edition of BIS-9537 part 3 and shall be heavy duty with minimum wall thickness of 2.0 mm rigid tubes which are unscrewed without coupling and with plain ends.

5A451.3.2 All conduits used shall be ISI-marked and shall not be less than 20 mm diameter.

5A451.3.3 Separate conduits shall be used for lighting, power, TV, telephone and data points.

5A451.3.4 PVC conduit shall be used for all concealed installation.

5A451.3.5 PVC Conduit Accessories

5A451.3.6 Accessories used for conduit shall be of an approved type complying with relevant BIS code.

5A451.3.7 Plain conduits shall be joined by slip type of couplers with manufacturer’s standard sealing element.

5A451.3.8 All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and screwed male bushes.

5A451.3.9 Standard PVC circular junction boxes are to be used with conduits for intersection, Tee- junction, angle-junction and terminal. For the drawing-in of cables, standard

circular through boxes shall be used.

5A451.3.10 Samples of accessories shall be submitted for approval prior to installation.

5A451.3.11 All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits.

5A451.3.12 Bends in Conduit

5A451.3.13 Where necessary, bends or diversions may be achieved by means of bends and / or circular cast iron inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with the finished wall surface. No bends shall have radius less than 7.5 cms or three times the outside diameter of the conduits.

5A451.3.14 Fixing of Conduits

5A451.3.15 All conduits shall be installed so as to avoid steam and hot water pipes. After the conduits, junction boxes, outlet boxes and switch boxes are installed in position; their outlets shall be properly plugged or covered so that water, mortar, insects or another foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of heavy gauge GI saddles secured at intervals not more than 1000 mm, but on either side of couplers or bends or similar fitting saddles shall be fixed at a distance of 300 mm from center of each fitting. For conduit fixing suitable PVC/Nylon fasteners shall be used.

5A451.3.16 Recessed conduit shall be done by making chase in the masonry by chase cutter; the conduit shall be fixed in the chase by means of GI hooks not more than 600 mm apart. After fixing ofconduit the chase shall be filled with cement mortar after fixing of chicken mesh and broughtto the original finish level of the surface.

5A451.3.17 Maximum permissible numbers of 1100 volt grade PVC insulated wires that may be drawninto PVC Conduits are given below:

Size of wires Nominal Cross	Maximum number of wires within conduit size(mm)				
Section Area (Sq. mm.)	20	25	32	40	50
1.5	5	10	14	--	--
2.5	5	8	12	--	--
4	3	7	10	--	--
6	2	5	8	--	--
10	--	3	5	6	--
16	--	2	3	6	--

No. Of Wire In Conduit

5A451.3.18 However size of conduit pipe shall be selected considering 25% spare capacity to draw additional wire in future to provide additional points.

5A451.3.19 Switch Outlets and Junction Boxes

5A451.3.20 All outlet boxes for switches, sockets and other receptacles shall be rust proof and shall be of 1.2 mm thick mild steel sheets with HOT dipped galvanizing having smooth external and internal surfaces to true finish. All outlet boxes for receiving plug sockets and switches shall be fabricated to approved sizes. All boxes shall have adequate number of knock out holes of required diameter and earthing terminal screws. Outlet boxes shall be of a minimum depth of65 mm.

5A451.3.21 Inspection Boxes

5A451.3.22 50 mm dia. inspection boxes of cast iron shall have smooth external and internal finish tofacilitate removal and replacement of wires, where required.

5A451.3.23 Fish Wire

5A451.3.24 To facilitate subsequent drawing of wires in the conduit, GI fish wires of 2.0 mm (14 SWG)shall be provided along with the laying of recessed conduit.

5A451.3.25 Conductors

5A451.3.26 All PVC insulated multi stranded flexible copper conductor FRLS wires shall conform in allrespects to Standards as listed under sub-head Regulations and Standards and shall be IS approved and ISI marked. Sample of wire shall be approved by Engineer.

5A451.3.27 Bunching of Wires

5A451.3.28 Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires shall be continuous earth wire along with phase and neutral wires for connecting to the metal parts. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification. Lighting and power circuits shallbe separate.

5A451.3.29 Drawing Conductors

a. The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions. While drawing wires through conduits, care shallbe taken to avoid scratches and kinks which may cause breakage of conductors. There shallbe no sharp bends. Wire reel stands to be used for pulling of wires to avoid kinks.

b. Insulation shall be removed by insulation stripper only. Strands of wires shall not be cut forconnecting terminals. The terminals shall have sufficient cross sectional area to take all strands and connecting brass screws shall have flats ends. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

c. All light points will terminated through a connector. Conductors having nominal cross sectional areas exceeding 10 sq.mm shall always be provided with cable sockets. At all bolted terminals brass flat washer of large area and approved steel spring washer shall be used. Brass nuts and bolts shall be used for all connections.

d. Only licensed wiremen / electrician (Before doing the work or before appointing him on site, the Contractor has to submit his wiring license to Engineer) and cable jointers shall beemployed to do jointing work. All wires and cables shall bear the manufacturer’s label and shall be brought to site in original packing. For all internal wiring, FRLS wires of 1100V grade shall be used. The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors.

e. No wire shall be drawn into any conduit until all work of any nature that may cause injuryto wire is completed. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction.

f. Internal wiring shall be carried out identifying the lighting, power and AC points as follows:

- For light points : 1.5 sq. mm. Copper FRLS wires
- For power points : 4 sq. mm. Copper FRLS wires

5A451.3.30 Mains and Sub-Mains

Mains and sub-mains cable or wires where called for shall be of the rated capacity and approved make. Every main and sub main wires shall be drawn into an independent adequate size conduit. Earthing shall be in conformity with relevant BIS codes and calculations shall besubmitted for verification. An independent earth wire of the proper rating shall be provided forevery single phase sub-main. For every 3 - phase sub-main, 2 Nos. earth wires of proper rating shall be provided along with the sub-main.

5A451.3.31 Load Balancing

Balancing of circuits in three phase installation shall be planned and shall be checked by theContractor before the commencement of wiring and shall be strictly adhered to.

5A451.3.32 Color Code of Conductors

Color code shall be maintained as indicated as per Code requirement for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green shall befor earthing.

5A452 Switches, Receptacles (Modular) and Lighting Fixtures and Ceiling fans

5A452.1 Switches

5A452.1.1 All switches shall be enclosed type flush mounted suitable for 240 volts AC. All switches shall be fixed inside the switch boxes on adjustable flat M S strips/plates with tapped holes and brass machine screws, leaving ample space at the back and sides for accommodating wires. Switch controlling the light point shall be connected to the phase wire of the circuit andload shall be restricted to maximum 800 watts per light circuit and maximum 1500 watts per power circuit. All wiring accessories shall be BIS approved. Perfect alignment shall be maintained while fixing of the back boxes. All switches and sockets are modular type which shall be made of fire retardant; self-extinguish polycarbonate plastic, able to withstand the glow wire test at 850 deg. C.

5A452.1.2 The switches shall confirm BIS 3854:1997. The internal design of terminals and contact shallmake the switch capable of high overload conditions, the switch shall be of flush type with silver inlay contact on pure copper.

5A452.1.3 All switches, sockets, telephone outlets, TV controlling the lights or fans shall be connected tothe phase wire of the circuit. Switches shall be located at 1200 mm above finished floor level unless otherwise indicated on the approved shop drawings.

5A452.1.4 Switches shall be suitable for indoor or outdoor service according to location housed in standardized purpose manufactured galvanized steel boxes completed with conduit knockoutsmade up into single or multi-gang units employing a grid switch system of fully interchangeable components at standardized fixing centers of matching switches of different types and ratings but of identical dimensions, push buttons, neon indicator lamps, blanking units, grids, steel boxes and plates all capable of integration into standard composite assemblies in any combination as required.

5A452.1.5 Grids shall be adjustable for variation in depth of plaster and for squaring errors and of the same type for surface or flush mounting.

5A452.1.6 Switches located on walls shall be mounted in horizontal arrangement in plaster depth steel boxes or in galvanized steel boxes using box suspension straps and cover plates. Countersunk screws shall be provided for fixing to the conduit boxes.

5A452.1.7 Switches for external use shall be of weatherproof construction with IP65 rating unless otherwise specified.

5A452.1.8 Samples of all switches, conduit boxes and back boxes shall be submitted to Engineer forapproval prior to installation.

5A452.1.9 Switches shall be rated for 6 Amps (minimum light switch rating 6A), 16 Amps or 25 Amps (as determined by circuit load). Inductive lighting circuit shall be assessed at twice the steadystate connected load current.

5A452.2 Socket Outlet

5A452.2.1 Socket outlets shall be of 5/6 pin. All sockets shall fully comply with BIS 1293: 2016specifications.

5A452.2.2 Each power circuit can feed following outlets:

- Not more than 2 No. 16A outlets.
- Not more than 4 No. 6A outlets.
- Not more than 1 No. 16A and 2 No. 6A outlets.

5A452.2.3 An earth wire shall be provided along with the circuit wires and shall be connected to earthing screw inside the box. All sockets shall be shuttered type.

5A452.2.4 Every socket outlet shall be controlled by an individual switch unless mentioned otherwise.

5A452.2.5 The switch controlling the socket outlet shall be on the `Live' side of the line.

5A452.2.6 6 amps and 16 amps socket outlet shall normally be fixed at any convenient height above thefloor level as desired by the Engineer. The switch for 6 and 16 amps, socket outlet shall be kept along with the socket outlet. However, in special case, if desired by the Architect the 6 amp socket outlet can be placed at the normal switch level.

5A452.2.7 6 amps socket outlet in the kitchen of the residential buildings shall be fixed at any convenientheight above working platform or as specified in drawings.

5A452.2.8 Switches and outlets shall be planned at a minimum distance of 1.5 metre away from any water supply outlet, so that splashed water may not affect the live installation.

5A452.2.9 Where socket outlets are placed at lower level, they shall be enclosed in a suitable metallic box with the system of wiring adopted or shutter type sockets shall be provided as specified.

5A452.2.10 In an earthed system of supply, a socket outlet and plug shall be of 5/6 pin type; the third terminal shall be connected to earth.

5A452.2.11 Conductors connecting electrical appliance with socket outlet shall be flexible twin cord with an earthing cord which shall be secured by connecting between the earth terminal of plug and the metallic body of the electrical appliance.

5A452.2.12 All switches, sockets, telephone and TV outlets etc. shall be modular.

5A452.2.13 All 6 and 16Amp socket outlet shall be modular type 5/6 pin respectively. Each outlet shall have a switch located beside the socket preferable on the same flush cover plate.

5A452.2.14 The earth terminal of the socket shall be connected to the earth wire.

5A452.2.15 Generally 16A switch socket outlets shall be positioned 300 mm above floor level except in plant rooms, kitchen, etc. where they shall be positioned 1400 mm above floor level or 150 mm above counters or benches as per requirement unless otherwise specified.

5A452.3 Lighting Fixtures and Accessories

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Engineer.

5A452.3.1 Scope

Scope of work under this section shall include inspection at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc. as required.

5A452.4 Light Fittings-General Requirements:

5A452.4.1 Fittings shall comply for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.

5A452.4.2 Fittings shall also facilitate easy maintenance including cleaning, replacement of lamps/ drivers.

5A452.4.3 All fittings shall be supplied complete with lamps. All Outdoor type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes.

5A452.4.4 Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. The internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.

5A452.4.5 All hardware used in the fitting shall be suitably plated or anodized and passivated.

5A452.4.6 Capacity /wattage of light fitting shall be as per schedule of finishes. However, bidder shall submit the detail to the Engineer for approval after detailed design.

5A452.5 Earthing (Electrical Grounding)

5A452.5.1 Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal

5A452.6 Painting/Finish

5A452.6.1 All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.

5A452.6.2 The housing shall be powder coated/stove-enamelled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia. mandrel.

5A452.6.3 Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

5A452.7 Light Fittings – Requirements

5A452.7.1 LED Down Lighter shall be complete with efficient reflector and scientifically designed heat sink for optimum thermal management of LED source ensuring specified life and color quality. The luminaries shall have IP-20 degree of protection. It shall be suitable for recessed mounting in the false ceiling.

5A452.7.2 The driver shall be provided with the luminaries. LED shall be of high efficiency, long life in warm white or cool day light, with excellent CRI. The estimated life time of LED shall be minimum 40,000 burning hours. THD for any LED light fitting, including driver unit, shall be within 10%.

5A452.7.3 LED down lighter should have separate heat sink from the optical compartment made of high purity extruded aluminum (for faster dissipation).

5A452.7.4 Diffuser used should be of Virgin Grade PMMA (polymethyl methacrylate) Acrylic with minimum 3 mm thickness to avoid breakage and avoid yellowing of diffuser.

5A452.7.5 LEDs used in the down lighters should have minimum luminous efficacy of 100 Lumen per watt efficacy.

5A452.7.6 Internal reflector should be made of metal and high reflectivity matt finish powder coating.

5A452.7.7 The LED Driver Surge protection rating should be 2 kV in differential mode.

5A452.7.8 Driver should be constant current type. Driver should be manufactured in India.

5A452.7.9 In case of dimming luminaire offered should be capable to support dimming either on DALI or on Analogue diming (1-10V) type.

5A452.7.10 LED down lighter Driver shall have the following requirements:

a. Operating Voltage Range: 150-270Volts Single Phase A.C.

b. Frequency: - 47Hz-63 Hz (50 +/-3%)

c. Efficiency: 75% at full Load

d. Power Factor: >0.85 at full load and at nominal voltage

e. Confirming to EN61000-3-2, Class C (<25W)

f. Voltage VO: < 30 Volts

g. Output Current Io: 0.72A +/- 7%

h. Short circuit Protection: To withstand continuous short circuit across terminals.

i. Output Overvoltage Protection: Shutdown in event of failure of feedback loop

j. Open Circuit Protection: Open circuit voltage of output within +/- 5% of nominal voltage

k. Isolation (Hipot test): Input and output are isolated

l. A.C. Leakage current: < 3mA to comply EN60950-1

m. Isolated DC Ground and AC Protective Earth

n. MTBF: 300,000 hrs. at 25oC

o. Operating Temperature: 0°C to 50°C

p. Storage Temperature: (-) 20°C to 30°C

q. Relative Humidity: Operating 10 to 85% RH; Storage 5 to 90% RH.

5A452.7.11 LED 2’ X 2 ‘Luminaires

5A452.7.12 LED 2’X2’ Luminaire should be having internal driver and power supply.

5A452.7.13 LEDs used should be of 1W class with minimum luminous (source) efficacy of 100 Lumen per watt efficacy @ 25 deg C

5A452.7.14 1 watt class LEDs should follow binning as per ANSI Standards

5A452.7.15 Luminaire LED lumen pack should be min. 3000 Lumen for CCT 5700° K for 25 watt LED class and 4320 Lumen for CCT 5000° K for 36 watt LED class.

5A452.7.16 Diffuser used should be of Virgin Grade PMMA Acrylic with minimum 3 mm thickness to avoid breakage and avoid yellowing of diffuser.

5A452.7.17 Diffuser should be guaranteed for min 75% transmittance maintenance for operation of 10 years. Driver should be manufactured in India.

5A452.7.18 Driver should be chip based multichannel type with head room control to ensure all strings should have calibrated voltage and current.

5A452.7.19 Driver should be 3 stage galvanic isolated type with Constant current and constant voltage type.

5A452.7.20 Driver should be of APFC type.

5A452.7.21 LED 2’X2’ Luminaires’ Driver shall have following requirements:

a. Operating Voltage Range: 150-270 Volts Single Phase A.C.

b. Frequency: - 47Hz-63 Hz

c. Efficiency: 75% at full Load and Vino

d. Power Factor: ≥ 0.95 at full load and at VNom

e. Confirming to EN61000-3-2, Class C (<25W)

f. Voltage Vo: < 100 Volts

g. Out Put Current Io: < 1 Amp

h. It shall be able to withstand continuous short circuit across terminals

i. Output Overvoltage Protection: Shutdown in event of failure of feedback loop.

j. Open Circuit Protection: Open circuit voltage of output within +/- 5% of nominal voltage.

k. Isolation (Hipot test): Input and output are isolated.

l. A.C. Leakage current: < 3mA to comply EN60950-1.

m. Isolated DC Ground and AC Protective Earth.

n. MTBF: 300,000 hrs. at 25°C

o. Operating Temperature: 0°C to 50°C.

p. Storage Temperature: (-) 20°C to 30°C.

q. Relative Humidity: Operating 10 to 85% RH; Storage 5 to 90% RH.

5A452.8 LED batten

a. High quality LED batten
b. Power Factor: ≥ 0.95 at full load

c. Operating Voltage Range: 150-270 Volts Single Phase A.C

d. THD<10%

e. It shall be able to withstand continuous short circuit across terminals

f. Mounting Surface: wall/ceiling

g. Operating Temperature: 0°C to 45°C.

h. Length shall be maximum 4 ft.

5A452.9 LED Floodlights

a. High quality LED floodlight suited for outdoor area lighting, stadiums, play areas etc. withcontrol gear.

b. Power Factor: ≥ 0.95 at full load

c. Operating Voltage Range: 150-270 Volts Single Phase A.C

d. Extruded aluminum heat sink for effective heat dissipation

e. Luminaire shall have heat resistant toughened glass.

f. THD<10%

g. It shall be able to withstand continuous short circuit across terminals

h. Degree of protection IP65

i. Accessories for Light Fittings Reflectors

j. The reflectors shall be made of CRCA sheet steel/ aluminum /Silvered glass/Chromium plated sheet copper as required. The thickness of reflectors shall be as per relevant standards.Reflectors made of steel shall have stove enameled/ vitreous enameled/epoxy coating finish. Aluminum used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches / blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

5A452.10 Ceiling Fans

5A452.10.1 Ceiling fans including their suspension shall conform to relevant Indian Standards.

5A452.10.2 The Capacity of a ceiling fan to meet the requirement of a room with the longer dimension D meters should be about 55 D m3 /min.

5A452.10.3 The height of fan blades above the floor should be (3H+W)/4, where H is the height of room, is the height of work plane.

5A452.10.4 The minimum distance between fan blades and ceiling shall be 300 mm.

5A452.10.5 When actual ventilated zone does not cover the entire room, the optimum size of ceiling fan should be chosen based on the actual usable area of the room, rather than the total area of the room.

5A452.10.6 The latest amended guidelines from BEE star rating applicable for 5- star ceiling fans shall be f followed.

5A452.10.7 Electronic regulators shall be used to control speed of fans.

5A452.10.8 All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulators, between hooks and suspension rods. There shall be no joint in the suspension rod.

5A453 Inverter

5A453.1 General

5A453.1.1 The inverter shall be used to feed all emergency light fittings etc., in case of power failure in all buildings. When normal supply is available these loads will be directly fed from normal source through inverter. This normal power source shall also be used to keep the inverter batteries fully charged.

5A453.1.2 An LED indicator shall be located on the control panel of inverter to identify various conditions. LED shall display overload, short circuit, inverter status, battery charging conditions, and will have alarms for low battery, low battery pre-alarm, overload and shortcircuit.

5A453.2 Voltage Regulation

The inverter output shall be sine wave and voltage shall not deviate by more than 5% RMS dueto any steady state conditions.

5A453.3 Frequency Control

The inverter output frequency shall be controlled to maintain the frequency as 50 Hz + 2%.

5A453.4 Inverter Current Limit and Overload Capability

The inverter output shall be limited to 110% of rated load current.

5A453.5 Protections:

5A453.5.1 The inverter shall have protections on DC (fuse) and AC sides (MCB). Inverter shall haveoverload, short circuit protections, trip facility for low batteries etc.

5A453.5.2 The inverter shall meet the following specifications in addition to other requirements statedherein:

Ambient operating temperature range	0 to 450.C maximum continuous.
Cooling	Forced cooling using fans
Operating relativehumidity	0-95% RH non-condensing.
Output	Suitable terminals are provided for termination of cables for connecting inverter output to AC distribution board

Inverter Protection Requirement

5A453.6 Battery System

The inverter shall have a battery system to provide a minimum back up of 90 minutes. Battery shall be lead acid type, with a typical recharge time of 10-12 hours. Batteries shall be place to ensure proper ventilation.

5A453.7 Inverter/Battery Cabinet

Inverter and batteries shall be housed in a proper cabinet, resistant to corrosion and spillage from batteries (PPCP or equivalent). There shall be wheels for cabinet to enable ease of movement while carrying the battery.

5A454 HV Voltage 33KV or 11 KV Grade XLPE Cables

5A454.1 Construction

All H.T. Cables shall be of 11KV grade 3 Core XLPE shall be Aluminium Conductor armounred U.G. Cables with electrical purity aluminium conductor, shall be manufactured & tested in accordance with IS: 7098 (Part II). H.T. Cable shall be of earthed, grade and shall be of stranded construction, comply to IS 8130. The conductor screen & insulation screen shall both be of extruded semi conducting compound and shall be applied along with XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interphase. The metallic screen of each core shall consist of copper wires or tape. The method of curing shall bedry curing/ gar curing/ steam curing. Metallic screen shall be suitable for carrying the fault current of minimum 0.6 KA (for combined 3 core) for 1 second 33KV / 11KV. Outer sheath shall be of tough, PVC compound as per IS:5831 and shall be extruded over the armouring. Cables shall be extruded over the armouring. Cables shall be tested for type tested & routine tested in accordance with IS:7098 (Part II). Laying of H.T. cables shall be with all required accessories. The cables shall be inspected in the OEM factory before dispatching.

5A455 Medium Voltage 1.1 KV Grade XLPE Cables

5A455.1 General

5A455.1.1 The MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with approved shop drawings, Specifications, relevant Standard Specifications and cable manufacturer's instruction.

5A455.1.2 The cables and cables jointing and terminating accessories shall comply with the requirements of latest revision of the following codes/standards, unless otherwise specified:

5A455.1.3 The cables shall also conform to the provisions of Indian Electricity Rules and other statutory regulations currently in force in the country. In case Indian standards are not available for any item, standards issued by IEC/IEEE or equivalent agency shall be applicable.

5A455.2 Material

The MV cables shall be cross linked polyethylene (XLPE) insulated PVC inner sheathed and FRLS PVC outer sheath of 1100 volts grade. Cables up to 16 sq.mm shall be with standard copper conductor and above 16 sq.mm shall be with stranded aluminum conductor.

5A455.3 Specifications for XLPE Aluminium / Copper Cable

5A455.3.1 The conductor sizes up to 10 sq.mm the conductor shall be circular and single stranded and non-compacted for IS-1830 and conductor sizes 16 sq.mm and above the conductor shall compacted and multistrand as per IS-8230 standard.

5A455.3.2 Insulation:-The insulation shall be of natural unfilled chemically cross linked polyethylene conforming to BIS 7098. The thickness of insulation shall be as per the relevant codes.

5A455.3.3 It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

5A455.3.4 Laying-up:-Insulated conductors of multi core cables shall be with plastic fibre in the interstices. The phase identification of cores shall be by colored strips.

5A455.3.5 Inner Sheath:-The cores shall be surrounded by either a wrapped or by an extruded PVC sheath. The thickness of the inner sheath shall be as indicated in the relevant codes. The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST 2 compound of BIS: 5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen and armouring.

5A455.3.6 Armouring:-The armouring shall be provided over the inner sheath. Single core cable shall have non-magnetic armouring. Multi core cables shall have flat steel strip. Steel strips for armouring conform to BIS: 3975. The direction of lay of armouring shall be opposite to that of cores.

5A455.3.7 Outer Sheath: -Single and multi-core cables are provided with an extruded FRLS grade PVC outer-sheath. The thickness of the sheath shall be as per BIS: 1554-1988. The PVC compound for the outer sheath shall confirm to Type ST2 of BIS 5831. The color of the outer sheath shall be black with marking at every meter.

5A455.3.8 Current ratings of the cables shall be as per BIS: 3961. The Conductor shall be stranded Aluminum/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation. Repaired cables shall not be used.

5A455.3.9 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground bury installation with uncontrolled back fill and chances of flooding by water.

5A455.3.10 Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.

5A455.3.11 Cables shall be supplied in non-returnable wooden drums as per BIS: 10418.

5A455.3.12 Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

5A455.3.13 The product should be coded as per BIS: 7098 Part-I as follows:

Aluminum Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

5A455.3.14 Control cables shall be multi core XLPE insulated copper conductor and armoured cables.

5A455.4 Inspection

All cables shall be inspected by the Contractor upon receipt at site and checked for any damage during transit. The damaged cables, if any shall be rejected and removed from site.

5A455.5 Joints in Cables

5A455.5.1 The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. Where joints are unavoidable epoxy resin joints shall be made. The location of such joints shall be approved from the Engineer and shall be identified through a marker.

5A455.5.2 All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight joints shall be done in epoxy mould boxes with epoxy resin.

5A455.5.3 All cables shall be joined color to color and tested for continuity and insulation resistance

joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

5A455.6 Cable Terminations

Cable termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type with earthing facility.

5A455.7 Bonding of Cables

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

5A455.8 Installation of Cables

5A455.8.1 Cable shall be laid in a manner as indicated on the approved shop drawings. Generally cables are laid in the following manner.

In the underground masonry trench.

On the cable tray/or on cable ladders.

Buried underground.

Through pipe sleeves.

5A455.8.2 Various installation methods are discussed in the following paragraphs.

5A455.8.3 General

Electrical cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. The cable drums shall be rotated in a direction as indicated by the manufacturer. Care shall be exercised in laying cables to avoid forming kinks. The drums shall be unrolled and cables run over wooden rollers, placed at intervals not exceeding 2 meters.

Cables when laid in ground shall be laid at a depth of 750 mm. A cushion of sand total of 250 mm shall be provided both above and below the cable, joint boxes and other accessories when directly buried in ground.

All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of service.

When cables pass through holes in metal work, precautions shall be taken to prevent abrasion of the cables on any sharp edges.

In every vertical cable ladders, channel or duct or trunking or cable trench containing cables and exceeding three meters in length, internal barriers shall be provided so as to prevent the air at the top of the unit from attaining an excessively high temperature. In every vertical cable shaft, cable trench or any passage of cable through wall, ceiling, floor barriers against spread of fire and smoke shall be provided for compliance with IEE regulations. `Viper' CABLEMASTIC FR 903 fire resistant painting shall be applied on all XLPE power cables as site/factory.

Where cable passes through walls, ceiling, floor, it shall run through sleeve of PVC pipes or hume pipes of adequate diameter. After pulling the cable through sleeve, both the ends of the sleeve shall be sealed water tight with fire resistance material to prevent spread of fire and seepage of water.

Generally along each cable route either in trench or in cable trays/ladders or in pipe separate Two Nos. of earth strips/wires shall run exposed.

with other fixed metal work shall be effectively bonded there to earth so as to prevent appreciable potential difference at such possible points of contact.

5A455.9 Underground Installations

The cables shall be laid in an excavated trench. The depth of the trench shall be minimum 750 mm below the final ground level but shall be decided on the number of cables to be laid in the trench so that the vertical distance between two adjacent layers of cables shall not be less than 350 mm. The width of the trench shall be decided on the number of cables to be laid in the trench so that the distance between two adjacent cables shall not be less than one cable diameter.

5A455.10 Installed In Built-Up Trench

5A455.10.1 The cables laid on the bottom of the structural trenches shall not lay freely upon the trench

bottom. They shall be raised to prevent the possibility of their coming into contact with deleterious materials.

5A455.10.2 The cables laid in the trench shall be laid on angle iron brackets/cable tray/cable ladder/cable troughs/cable racks as indicated on the approved shop drawings, and as approved by the Engineer. Where cables are clamped to the wall a minimum clearance of 100 mm shall be maintained between wall and cable and minimum 150 mm vertical clearance shall be maintained between two cables. Where cables are laid on brackets the brackets shall not be fixed more than 500 mm apart to avoid sag in the cables. Where the cables are laid on cable tray/ladder/troughs /racks, minimum 300 mm distance shall be observed between adjacent tier of tray/ladder/ troughs/racks, and cable shall be fixed minimum 25 mm away from the wall, and minimum of one cable diameter distance shall be observed between two adjacent cables. Cables shall be properly fixed with the tray/ ladder/ troughs/ racks with cable tie or saddles or straps.

5A455.11 Cables Installed Inside the Building

The cables inside the building shall be installed in one of the following manner, as indicated inthe drawing and approved by the Engineer.

5A455.12 Cables on Cable Trays/Ladders under the Ceiling or on Wall

5A455.12.1 Where cables are installed under above suspended ceiling or below ceiling or on wall, they shall be laid on a ladder/perforated G.I. cable tray and shall be run in such positions that they are not liable to be damaged by contact with the floor or the ceiling or other fixtures.

5A455.12.2 The ladder/perforated cable tray shall be properly fixed with channels, angles, tie rod, flats to the ceiling. The metal inserts for fixing channels, angles, tie rod, flats shall be put in place while casting the slab. If insert plates are not placed in position, Anchor fasteners shall be used to support cable trays if required. The cable tray route shall be coordinated with other services to avoid crisscross of all the services. While laying the cables on the tray minimum one cable diameter distance shall be observed between two adjacent cables about 20% space shall be kept spare for any future installation.

5A455.13 Cable Tray Specification

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

5A455.14 Design and Fabrication of Cable Trays / Ladders:

5A455.14.1 The cable trays / ladders shall be fabricated according to the design specified by IEC chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 3 meters						
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)			
			1.5m	2m	2.5m	3m
			Permitted Load (in kg/meter)			
Perforated Cable Tray	35	50 – 300	125	90	50	-

	60	50 – 600	150	100	50	-
	85	100 – 600	175	110	50	-
	110	100 – 550	185	130	75	60
Cable Ladder	45	200 – 600	180	140	100	55
	60	200 – 600	-	225	150	100
	110	200 – 600	-	310	200	140

Safe Working Load For Cable Tray Up to 3 M

Safe Working Load (SWL) with a span length up to 10 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long spandistance	110	200 – 300	160	110	75	-	20	-	-
		400 – 600	200	150	100	-	40	-	-
	160	200 – 300	230	180	140	100	70	-	-
		400 – 600	250	200	160	130	100	-	-
Cable Ladder for long span distance	110	200 – 300	160	110	80	40	-	-	-
		400 – 600	210	150	100	70	-	-	-
	160	200 – 300	230	180	140	100	70	-	-
		400 – 600	250	200	160	130	100	-	-
	200	200 – 600	-	-	300	250	200	140	100

Safe Working Load For Cable Tray Up to 10 M

5A455.14.2 Fabrication of Tray / Ladder and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/Ladder/ accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plasticEND caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

5A455.14.3 Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories.

5A455.14.4 The cable tray and all accessories shall be fabricated from sheet steel and has to be hot dip

galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor andoutdoor applications and should have a Base Perforation Class B according to IEC 61537. Thecable trays shall be supplied in standard lengths of 3000mm and the width of the tray shall be as follows.

5A455.14.5 Width: 50, 100, 150, 200, 300, 400, 500, 600 and 750 mm.

5A455.14.6 All the cable tray accessories like Bend's, TEES's, Cross over's etc. should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories etc. are shown in the enclosed drawings.

5A455.14.7 For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue. For locally fabricated and non-tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter.

5A455.15 Cable Ladder

5A455.15.1 The cable Ladder and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should have a Free Base Area classification Y according to IEC61537. The cable ladders shall be supplied in standard lengths of 3000/6000 mm and the width of the tray shall be as follows. Width: 200 to 1200 mm in multiples of 100 mm

5A455.15.2 Maximum rung spacing in the ladder shall be 300mm. The rungs should be made of C profiles suitable to fix cables by special metal clamps according to the approved shop drawing. The ladder shall be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend's, TEES's, Cross over's etc. should be designed in accordance with IEC 61537 and shall be factory fabricated.

5A455.15.3 The accessories shall be made from the same material as of the ladder and modular type; it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories .etc. are shown in the enclosed drawing.

5A455.15.4 For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the manufacturer's catalogue. For locally fabricated and non-tested

Ladder, thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter.

5A455.16 Cover for Cable Trays / Ladders

5A455.16.1 Cover for trays/ladders to protect the cable insulation from falling objects, water droplets, harmful effects of ultraviolet rays and accumulation of dust, wherever it is required. The cover shall be made either from Hot Dip Galvanized sheet steel or superior quality Double Dip Galvanized Sheets. For Outdoor application, Double dip Galvanized material shall be used.The covers should be fitted properly to the Ladder / Tray by using pre fixed and tested locks which ensure that covers are fitted rigidly to Tray / Ladder. For outdoor application in high wind areas, additional cross over beadings to be used for fixing the cover on tray / ladder of width more than 500 mm.

5A455.17 Mounting Accessories (Supports and Brackets)

5A455.17.1 The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both

indoor and outdoor applications and should be of completely modular type.

5A455.17.2 All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the approved shop drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc. to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

5A455.18 Joints

5A455.18.1 Joints shall be smooth and without projections or rough edges that may damage the cables.

5A455.18.2 Joints shall as far as possible be arranged to fall on supports. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray be means of at least 8 round head bolts, nuts and washers. Splices shall have the same finish as the rest of the tray.

5A455.19 Fixing to Supports

Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened against the tray surface to avoid projections which might damage cables during installation.

5A455.20 Fixing to the Structure

5A455.20.1 Where installed on concrete or brick, the supports for cable trays and ladders shall be securely fixed by means of at least 2 heavy duty, expansion type anchor bolts. Cantilevered trays shall be supported by a minimum of two expansion bolts per support.

5A455.20.2 It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense. The fixing shall take in to account site conditions that prevail during installation.

5A455.20.3 Horizontal trays and ladders shall in general be installed below slabs, ceilings, etc. to facilitateaccess during installation of cables. Multiple runs shall be spaced at least 300

5A455.21 Corrosion Protection

The cable tray / ladder/accessories shall be of HOT DIP Galvanized (ISO 1461-1999) for installations in corrosive atmospheres both indoor and outdoor application. Sample tray / ladder
/ accessories / mounting accessories and supports should be salt spray tested according to ISO 9227 for > 500 hours. (*550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

5A455.22 Testing and Certification of Installation

Cable tray / Ladder bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray and Electrical continuity test according to IEC61537. The cable tray/ladder should not deflect more than 1/100th of the span length at SWL inMid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/20th of the length. The cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray systemshould be - 5 to + 150°C.

5A455.23 Each system Marking, Documentation, Compliance and Inspection

5A455.23.1 Component shall be durably and legibly marked with the manufacturer's or responsible vendor's name or trade mark or identification mark; a product identification mark which may be, for example, a catalogue number, a symbol, or the like. When system components other than cable tray lengths and cable ladder lengths are supplied in a package, the product identification mark may be, as an alternative, marked on the smallest package unit.

5A455.23.2 Marking shall be applied, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers. Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit. Marking made by moulding pressing, or engraving is not subjected to the rubbing test. After the test, the marking shall be legible.

5A455.23.3 If a system component is stored and transported at a temperature outside the declared minimum and maximum temperatures, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits. Compliance is checked by inspection.

5A455.23.4 The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use of the cable tray system and cable ladder system. The SWL and impact resistance is valid for the whole temperature classification declared.

5A455.24 Fire Retardant Cable Paint and Fire Barrier

5A455.24.1 The fire retardant paint / barrier shall be listed by independent test agencies such as UL, FM or OPL and be tested to, and pass the criteria of ASTM E 814 (UL1479) standard test method for fire test through- penetration fire stops and ASTM E 1996 (UL 2079) standard test method for fire resistive joint system

5A455.24.2 Fire Retardant Cable Paint:-The Fire resistant cable coating / painting shall be intumescent / ablative, water based compound, the coating shall expand up to 10 times, supplied in a manufacturer seal container indicating manufacturing and expiry dates. The coating material shall be non-toxic, asbestos free, and halogen free and shall have index of 41%. Coating shall be applied by ordinary paint brush after cleaning the cables ofdust and oil deposition. A minimum textured finish of 3 mm wet film thickness shall be achieved by applying the material in 2-3 layers leaving intervals of 2 to 8 hours dependingupon the moisture and thickness, moisture and temperature hours between each coat.

5A455.24.3 FIRE BARRIER SHEET FOR FLOOR AND WALL SEALING:-The framing and fixing part of fire barrier sheet shall be very simple and directly fixed around walls and floors by help of anchored bolts and washer. For 2 hour fire rating the fire barrier sheet shall be minimum 7.62 mm thick and shall be cut as per the profile of penetration and opening. The small gap left around the penetration shall be closed with fire rated soft and mouldable putty. Fire barrier must be design on the intumescent technology to seal larger penetration through the fire rated walls and floors. Fire barrier must be a composite construction with the quality incorporated with organic/ inorganic fire resistive elastomeric sheet with specific gravity of 1.6 gm/ cm3.

5A455.24.4 Testing of Cables:-Cables shall be tested at works for all routine tests as per BIS which includes the following tests:

a. Insulation Resistance Test.

b. Continuity test.

c. Sheathing continuity test

d. Earth test (in armoured cables)

e. Hi Pot Test.

f. Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer representative.

g. Insulation Resistance Test (Sectional and overall)

h. Sheathing continuity test

5A455.24.5 All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labor for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Engineer, results will be noted and signed by all present and record be maintained.

DIESEL OPERATED LT GENERATOR SET

5A456.1 SCOPE

The scope of this section consists of but not necessarily limited to the following:

a. The contractor shall supply, deliver to site, hoisting into position, install, test and commission the standby power generating set together with the necessary controls and switchboards as specified and indicated in the Drawings. Protection circuits, control wiringand interlock circuits not specified or indicated in the Drawings, but deemed necessary forthe safe operation of the generating system shall be provided without any additional cost tocomplete the system.

Provide manufacturer's factory representative's services, including coordination, start-upand testing supervision at site. Testing (factory and field), start-up supervision, training and providing necessary documentation and tools for operation. Carry out performance test run at site.

5A456.2 SUBMISSION

5A456.2.1 For bidding

The bidder shall submit offer with the following documents in two sets.Schedule

of deviations from technical specifications.

List of proposed makes, for the items listed in the tender.

Technical datasheets indicating overall dimensions & Catalogues of major items, highlightingthe offered models.

Overall GA drawing with Day oil tank details, residential silencer, heat exchanger details (as applicable).

Structural support drawings.To submit

operation logic.

Supporting structure details of pipe lines, chimney etc.Cooling

tower details.

Schematic of cooling water pipelines. Other

documents and comments, if any.

For approval before construction/erection

The Sub-contractor shall submit the following documents.

For all the supplies, the sub-contractor shall submit the following documents in 4 sets for approval.

General arrangement drawings, with all dimensions, showing: space-requirements, weights (for transport and service conditions), requirements of civil works/foundation, fixing and mounting facilities, connection devices, etc..

Electrical drawings, showing: power and control single line and functional/control multi line diagrams, terminal blocks, components' list with make, type, quantity, etc.

Detailed drawing of cooling water system (if applicable) complete with cooling tower and pump sizing calculation, design drawing of residential silencer, AMF/PLC control drawings asapplicable.

Quality assurance plan and bar-chart showing manufacturing schedule.

The sub-contractor shall incorporate all comments and submit revised drawings in stipulated time till all drawings are finally approved for manufacturing.

Final

The sub-contractor shall submit the following documents, reflecting the true final as built situation, in 6 sets, and one soft copy in CD.

The drawings including wiring diagrams as revised and “as built”.

Inspection and preliminary testing certificates and reports and shipping release.

Test certificates of kWh meters from Government approved Lab or Electric Supply Co. of concerned area.

Guarantee certificates.

Instruction & maintenance manuals, Cataloguers etc.

Any other certificate / report as called for by the Client / Consultant.

5A456.3 PRODUCT

5A456.3.1 Diesel Engine

The diesel engine shall be of the 4 stroke cycle, prime rated continuous, multi-cylinder direct injection, compression ignition type operating at a speed of 1500 rpm and shall be silent, vibration free while in operation and comply Center / State Pollution Control Board and shall conform to BS:649/5514.

The engine shall be complete with radiator cooled / heat exchanger type engine, fan, lubricatingoil pump, lubrication oil pressure gauge (or microprocess built-in display), tachometer, digital or electronic type governor, integrated hours-run recorder, over-speed trip and all other necessary auxiliaries.

The brake horse power of the engine with all attached accessories as specified shall not be lessthan that which is required by the full load rating of the alternator at site operating conditions taking into consideration losses, plus a reserve factor of at least 10%.

5A456.3.2 Starting

Starting system of the standby generator shall be of a heavy-duty electric motor complete witha 24 V.D.C. (2x12V) heavy-duty battery of 300 AH or as recommended by the manufacturer. The electric motor shall be capable of cranking the engine to achieve the rated speed in less than10 seconds from the initiation of the starting process. The electric start battery shall be of adequate capacity for 6 successive starts. Time delay relays shall be incorporated to provide a rest period of 1-5 seconds (adjustable) before each successive start and a time lag period of 19-100 seconds (adjustable) before the system lock out due to failure of the 3rd start to crank up the engine.

The generator set shall be provided with a micro-processor based control system which is manufactured to provide automatic starting, monitoring, and control functions for the generatorset. Interface to BMS system according to point schedule on drawings shall be provided.

The control system shall include an engine governor control, which shall function to provide steady state frequency regulation. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications withoutcomponent changes.

5A456.3.3 Speed Regulation

The governor shall be capable of regulating the speed of the engine within the limits approximately 10% of the rated speed and maximum voltage dip of 10% within 4 seconds dueto a sudden application of 0 to 60% of full load in first step and 60 to 100% of full load in nextstep or removal of total full load. The steady load speed shall vary within the limits of approximately 1% of the rated speed.

5A456.3.4 Cooling

The engine cooling system shall be of radiator type or a heat exchanger type system to cool the engine as well as the body to minimise heat radiated into the generator room. The cooling circuit shall exchange heat through a heat exchanger capable to remove the heat generated under continuous full load operation. In case of cooling tower, condenser water from cooling tower shall be provided to exchange the heat to external of the building. The cooling system shall include the heat exchanger, fan, pump etc.

OEM shall specify the water quality standard of cooling tower.

5A456.3.5 Lubricator

The lubricating system shall be by a positive displacement oil pump providing a positive forcefeed to all lubricating points.

5A456.3.6 Exhaust System

Adequate sized piping and fittings shall be installed to carry the engine exhaust discharge into the atmosphere at a height as indicated in the drawings & as per the requirement of Center / State Pollution Control Board or Pollution Control Committee as the case may be.

M.S. epoxy painted structural support and vibration arrestors for D.G. set chimney to specifyalong with drawing for statutory clearance.

Mufflers shall be installed to reduce the engine exhaust noise at the outlet of muffler to noise level as permitted at site as per CPCB requirements. Flexible connection shall be provided between the engine and the fixed piping.

5A456.3.7 Fuel Piping and Fuel Tank Installation

The complete system shall include engineering, supply, installation, testing and commissioningof tank for storage of fuel, pumps, piping, valves and control system.

5A456.3.8 Engine instrument panel

An instrument panel mounted on the engine shall be provided and shall comprise the followingflush-mounted instruments and gauges:

Cooling water inlet and outlet

temperatureLubricating oil pressure

gauge Tachometer, positive driven

Hour counter with hour totalizer.

5A456.3.9 Protection Devices

Warning indication and automatic shut-down shall be provided for the

following:Low oil pressure shutdown and alarm

High coolant temperature alarm

High coolant temperature

shutdownFail to crank shutdown

Over cranking shutdown

Overspeed shutdown
Low & high DC voltage alarm

Low battery alarm

Low fuel-day tank alarm

High and Low AC voltage

shutdown Under frequency

shutdown

Over current and alarm and

shutdownShort circuit shutdown

Earth fault

alarmOverload

alarm

Emergency

stop

Failure indication lights and alarm for all fault conditions shall be provided on control panel forrestoring the operation to normal.

The starting circuit shall be disconnected in the event of any of the above

shutdowns.

5A456.3.10 Alternator

The alternator shall be brush less synchronous drip proof, self-ventilated and screen-protected and directly coupled on to the diesel engine by flexible coupling and shall be continuously ratedfor site operating conditions and conform to BS 5000 (part99) or IS 4722.

The full load output voltage shall be 415 volts, 3 phase, 4 wire, 50 Hz at 0.8 power factor with neutral solidly earth with the frequency maintained at 50 Hertz at all time under any load condition including transient overload due to motor starting etc for LT DG sets.

The rotor shall consist of the main alternator field poles the brushless exciter and its rectifier module, all bolted on a common alternator shaft. The rotor shall be mechanically and electrically balance up to 135% of the rated speed. The insulation of the alternator shall be non-hygroscopic, Class “F”.

The rectifier module of the exciter shall be impregnated with epoxy resin and shall be capable of withstanding without damage or deterioration of the thermal, centrifugal and other stresses that is experienced during normal or short circuit conditions. Rectifiers shall be of silicon type.

The voltage build up shall be of self-excitation using the residual voltage of the alternator through a solid-state voltage regulator. The voltage regulator shall be capable of maintaining the voltage regulation to ± 1% independent of power factor, heating and 5% of speed variation. The voltage output of the alternator shall also be capable of manual adjustable to ± 5% of the rated voltage.

The response of the voltage regulator shall be less than 10 millisecond. The voltage dip shall not exceed 10% when a rated continuous load is supplied to 0 to 60% of full load in first step and 60 to 100% of full load in next step and the correction time shall not exceed 200 millisecond. When the rated load is withdrawn, the voltage overshoot shall not exceed 20%.

The automatic voltage regulator and the exciter shall be manufactured to withstand 50% overload at a constant terminal voltage.

A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of motor current for not more than 10 seconds.

5A456.3.10 Excitation System

a. The alternator shall be provided with a complete rotating diode type brushless excitation system, capable of supplying the excitation current of the generator under all conditions ofoutput from no load to full load and capable of maintaining voltage of the generator constant at one particular value.

b. The exciter shall have class ‘H’ insulation.

c. The excitation system shall comprise a shaft driven AC exciter with rotating rectifiers. Therectifiers shall have in-built protection for over voltage.

d. The exciter shall be fast response type and shall be designed to have a low time constant tominimize voltage transients under severe load changes. The excitation voltage response ratio shall be at least 0.8.

e. The rated current of the main exciter shall be at least 10% more than the alternator rated exciter current and it shall have 40% overload capability for 10 seconds.

f. No external supply shall be required during starting and normal running of the alternator.

5A456.3.11 Automatic Voltage Regulator

a. An automatic high speed, dead band type voltage regulator shall be provided, complete with all accessories. The regulation system shall be provided with equipment for automaticand manual control.

b. The regulator shall regulate the output voltage from generator current and potential signals. Series compounding transformer shall be provided to enable maintaining adequate terminalvoltage in the event of terminal faults. Alternatively excitation system shall be provided with arrangement for field forcing. Contractor shall coordinate suitability of protection relays for generator with the operational characteristics of automatic voltage regulator, specially under short circuit conditions.

c.

d. Voltage regulation and steady state modulation shall be within + 1% of the line voltage.

e. Necessary equipment for field suppression and surge protection shall be provided.

f. The response time of exciter and the generator shall be properly matched to avoid hunting.

g. AVR system shall be provided with equipment for automatic and remote operation / control.

h. Necessary equipment shall be furnished for the following.

To prevent automatic rise of field voltage in case of failure of potential supply.

To initiate transfer from automatic to manual control of excitation on fuse failure on thegenerator potential signal.

5A456.4 MOUNTING ARRANGEMENT

The engine and the alternator shall be coupled by means of flexible coupling and both shall be mounted on the same base frame to ensure perfect alignment of the engine and the alternator with rigid construction to ensure minimum vibration. The base frame shall be provided with lifting facilities and pre-drilled foundation holes for permanent installation on pre-prepared concrete foundation.

Interface with Building Automation System all necessary hardware / software to integrate the Generator microprocessor panel to BAS system shall be provided free of cost by generator manufacturer/supplier.
For the integration of Microprocessor Panel of the generator with the Building Automation System, an Interface Control Document shall be developed by BAS Contractor. It shall be responsibility of Generator Contractor to provide following minimum to BAS Contractor for preparing the interface.

a. Hardware Protocol of Microprocessor panel.

b. Software Protocol of Microprocessor panel.

c. Communication structure relating to collection of message / event information.

d. Description of the formatted packets / blocks of data which construct controller commands / responses.

e. Written permission to BAS contractor to develop the interface without any financial implication.

5A456.5 DG Controller Based Synchronizing and Automatic Mains Failure / Aux. Panels.

5A456.5.1 Scope

The scope of this section comprised of fabrication, supply, earthing, testing & commissioning of Synchronizing, and AMF/Aux. panels. These panels shall be suitable for operation on 3 Phase415 volts, 50 cycles. The degree of protection for enclosure shall be IP-52. All panels shall be CPRI/ERDA/ NABL accredited Lab approved.

Synchronizing panels and AMF/Aux. panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

5A456.5.2 Construction Features

Synchronizing and AMF panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor / wall mounting type and shall be form 3b construction. The Synchronizing / AMF panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket and padlocking arrangement. Panels shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Synchronizing / AMF panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1993 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

Feeders shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Switchgear and busbars shall be arranged to permit future extension at both ends. End of bus bar shall be suitably drilled for this purpose. Panels at extreme ends shall have opening which shall be covered by using screwed plates. Details of drilled holes in bus bar and opening shall be clearly indicated in supplier’s drawing.

Structures including doors and panels shall be capable of withstanding the internal pressure created by faults within the structure (equal to the maximum fault current rating for a specified duration) without danger to operating personnel. The minimum standard required is detailed in IEC TR 61641 and IS 3427. Type test certificate(s) shall be provided with the quotation.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm. Panels with ACB shall necessarily have front and rear access as per requirement whereas panels with all MCCB breaker may be provided with only front access with sufficient clearance.

All components of the switchboard shall be rated for the electrical system characteristics shown on single line diagram. The rating of equipment / component shall take full account of all heat sources

and other de-rating factors , nonlinear loads within enclosures. Special reference is made in respect of enhanced circuit making requirements and the DC component of fault current at breaking.

All metallic non – current carrying parts of the switchgear shall be bonded together and connected to the switchgear earth busbar.

All doors shall be bonded to the main structure by means of a flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.

Withdrawable parts (e.g. circuit breakers) shall be effectively earthed until they are completely withdrawn with all power and control connections disconnected.

Provision shall be made for earthing cable screen and armouring to the earth busbar, near the gland.

All control, instrument and communication cables, if any, shall be earthed suitably to prevent any electromagnetic interference and ensure electromagnetic compatibility.

Each earthing point shall be marked with an E.

Provision shall be made for an instrument clean earth. Bus Bar Connections

5A456.5.3 Bus bar and interconnections shall be of high conductivity electrolytic grade aluminium(>60%)/ copper(>99.99%) as indicated in the bill of quantities complying with requirement of IS : 5082– 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid copper / aluminium strips of proper size to carry full rated current and insulated with heat shrinkable PVC insulating sleeves. Maximum current density for the bus bars shall be 0.8 A/sq.mm for aluminium and 1.4 A/sq.mm for copper bus bars.

Maximum allowable temperature for the Bus bar to be restricted to 85 deg C

5A456.5.4 Temperature - Rise Limit

Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, maximum temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces.

All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram. All Distribution boards shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids

5A456.5.5 Cable Compartments

Cable compartment of adequate size shall be provided in the AMF / Synchronizing panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

5A456.5.6 Earthing shall be provided as per IS:3043. Painting

5A456.5.7 All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint

(Powder coating). The shade of colour of panel inside/outside shall be RAL-7032 of IS Code No.5.

5A456.5.8 Labels

Engraved Aluminums labels shall be provided on all incoming and outgoing feeder. Each panel shall have label indicating

Switchboard Tag Number

System voltage, phases , wires and frequency Rated fault current and duration

Busbar rating

Year of manufacture Purchaser's name Order item no.

Characters shall be 12 mm high

Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel door and covered with transparent plastic sheet. Each circuit shall be fitted with a label giving the following information: -

Equipment tag number and equipment

designationEquipment rating

Characters shall be 5 mm high

Labels shall be fitted on front and back of cubicles. When operating sequence of equipment is not evident e.g. mechanical / key interlocking features , instruction labels shall be provided andfixed near the point of operation.

Labels shall have black characters on a white background and be made of a non – corrodible material. Warning / danger labels shall have white lettering on a red background.
Labels shall be affixed by means of screws or rivets. Use of adhesives shall not be accepted.
Each circuit shall be provided with durable one line synoptic diagram, clearly indicating the specific function of the different compartment when this would not be clear from general layout.

Description	Requirement
Material	Anodised Aluminium
Engraving	Black engraving on white background
Size of label	To suite application / importance
Fixing	With self tapping screws
Use	Main panel, feeders and individual devices

5A456.5.9 Meters

i. All voltmeters and indicating lamps shall be through MCB's.

ii. Meters and indicating instruments shall be digital electronic type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

5A456.5.10 Instrument Transformers

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps unless otherwise specified. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondary for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast/ Flame Retardant resin filled Nylon type robust to withstand thermal anddynamic stresses during short circuits. Metering CTs, shall have inbuilt bus bar mounting arrangement. Secondary terminals of CTs shall be brought out suitable to a terminal block whichshall be easily accessible for testing and terminal connections. The secondary terminal should be covered with insulation cap/cover so that there should not be any possibility of touching thelive terminal. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class 1.

Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. Secondary terminal should be covered with insulation cap / cover so that there should not be any possibility of touching the live terminal.

The secondary windings of instrument transformers shall be earthed at one point through a removable link, with provision for attaching test links.

Current transformers shall be rated to withstand the thermal and magnetic stresses resulting from through fault currents equal to switchgear fault rating.

Voltage transformer primary winding shall be protected by High Rupturing Capacity cartridgefuses and secondary winding shall be protected by MCB. Voltage transformers shall have provisions for safely disconnecting the fuses and transformers from energized busbars.

Instrument transformer nameplate shall be fixed in a position so that details can easily be read when fitted in cubicle. The design and construction shall be dry type, epoxy resin cast / Flame retardant resin filled nylon type robust to withstand thermal and dynamic stresses during short circuits.

5A456.5.11 Selector Switch

Where called for selector switches of rated capacity shall be provided in control panels, to givethe choice of operating equipment in selective mode.

5A456.5.12 Contactor

Contactor shall be built into a high strength thermoplastic body and shall be provided with an are shield for quick are extinguishing. Silver alloy tips shall be provided to ensure a high degreeof reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the fullload current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class “E”.

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 240 / 415 + 10% volts, 50 cycles AC supply.

5A456.5.13 Thermal Overload Relay

Thermal overload relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from –5deg C + 55 deg C.

All overload relays shall be of three element, positive acting ambient temperature compensatedtime logged thermal over load relays with adjustable setting. Relays shall be directly connectedfor motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HPcapacity.

5A456.5.14 Time Delay Relays

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

5A456.5.15 Toggle Switch

Toggle switches, shall be in conformity with relevant IS codes an shall be of 5 amps rating.

5A456.5.16 Push Button Stations

Push button shall be provided for manual starting and stopping of motors / equipment "Green"and "Red" colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start'or 'Stop' indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

5A456.5.17 Indicating Panel

All meters and indicating instruments shall be in accordance with relevant Indian Standards. The meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB.

5A456.5.18 Testing

Testing of panels shall be as per following codes:

IS: 8623 (Part -I) 1993 for factory built assemblies of switch gear for voltages upto andincluding 1000 VAC.

IS: 13947 : 1993 Degree of protection

IS: 5578 & 11353:1985 Arrangement of bus

bars. 5A456.5.18Anti-Condensation Space

Heaters

1 No. 100 W, 240 Volts single phase, 50 Hz AC Anti Condensation space heaters controlled bythermostat and protected by 6 amps MCB's or MPCB's as per fault level at the panel shall be provided in each vertical section of AMP / Synchronizing panel and 1 No. 60 watt Anti Condensation space heater shall be provided in each cable alley of DG Auxiliaries panel and sub distribution boards. Supply and control equipment for the above shall be provided by the vendors.

5A456.5.19 Insulating Mat

Insulating mat shall be provided in front to cover the full length of all panels. Where back spaceis provided for working, operations or maintenance, from the rear of the panel, mat shall also be provided at the back of the panel also to cover the full length of panel on the rear also.

Insulating Mats shall be in compliance with IS-15652-2006.

The insulating mats shall be made of Elastomer (a generic term that includes rubber, latex and elastomer compounds that may be natural or synthetic or a mixture of both) for use as floor covering for the protection of workers on AC and DC installation with the system voltage up to66 KV AC and 240 volts DC.

Mats shall be resistant to acid and oil and low temperatures and shall be identified by therespective class symbol.

Thickness of mats, physical properties, dielectric properties and all other specification shall beas per IS:15652-2006.be free from blisters, pin holes, cracks, embedded foreign matters and other defects.

5A456.5.20 DG

5A456.5.21 Controller Function

General

The auto synchronizing cum LT panel shall have DG controller with following generalrequirements for AMF start, Auto synchronizing and Auto Load sharing functions.

5A456.5.22 AMF function

In the case of failure of normal power supply of individual substations

1. Generator to start after a prefixed time of three second on any of the following conditions:

a. Total absence of voltage.

b. Failure of one or two phases.

c. Under voltage below 375 volts.

d. Overvoltage of more than 6%.

2. After a lapse of 10-12 seconds normal power supply breaker to open and Generatorsupply breaker to close.

3. All auxilliaries (Cooling Tower Fan, Pump etc.) to run automatically. In the case of Resumption of Normal Power supply:

1. Generator breaker to open and normal power supply breaker to close after threeseconds on resumption of normal power on the following conditions.

a. All the three phases available at the normal supply breaker.

b. 380-415 volts available at the normal supply breaker.

2. Generator to over run for the three minutes and stop automatically.

3. All auxiliaries to stop automatically.

4. Generator to be ready for the next operation automatically.

5A456.5.23 Auto Synchronizing &Auto Load sharing function

5A456.5.24 Sequence of Operation in Auto Mode.

In auto mode Master GENERATOR set (Selected by DG controller) shall start through cranking relay & close its ACB / NIC after verifying frequency and voltage. However, the transfer of load shall take place only when the generator output reaches 90% of its rated voltage and frequency.

As load increases beyond 90% (settable from 80 to 100%) of ratings of DG set which is running,other generator will start and synchronize on the same bus. Required no of DG sets as per demand shall run, synchronized automatically and shall feed the loads accordingly

As the load increases or decreases, accordingly switching ON and OFF of the generator on thesynchronizing bus shall continue with the help of DG controller. If any time only one Generator coming and the load is increased suddenly more than the available capacity then non critical load shall drop out from the bus automatically through DG System shall also monitor the slip frequency and the Beat Voltage of the machine or system.

NIC of First generator shall remain in Ckt. In the event of shutting OFF of First Set, NIC of anyother generator shall close first before tripping NIC of first set. It shall be possible to alter sequence of generator starting through, manual selection or through, Man Machine interface.

Active and reactive power shall be made equal on all the machines automatically with the helpof ACTIVE LOAD BALANCING System through Governor Control.

In event of set failing to Synchronize, Alarm from annunciator shall invite attention ofOPERATOR for manual intervention.

LOAD MANAGEMENT SYSTEM shall have 64 output contacts for tripping various loads byfield wiring and also trip the ACB of different generator and give ALARM for shutting OFF generator in accordance with predefined parameters to avoid underloading, overloading, cascading effect of tripping and unnecessary FUEL WASTAGE.

On the removal of load, generator ACB's & Bus Coupler ACB's shall be switched OFF in preset sequence with time delays to cover DIPS. Generator shall continue to run for 3 Minutes at reduced speed after generator ACB has been switched OFF.

DG controller System shall have compatibility for interface with PC (for Graphic Displays / Report Generation).

All auxillaries (Cooling tower fan, pumps supply air fans etc.) to come on Automatically.

Engine start stop control system shall be mounted on the generator panel.

Note :

2.0 KVA on-line single phase input / single phase output (230 V) UPS with 30 minutes battery backup to be provided along with the synchronizing panel.

5A456.5.25 Sequence of Operation in Manual Mode

(Through DG controller)

In the manual mode master generator set shall be started by pressing 'Engine Start' Push Button (PB)

When Engine starting push button is pressed cranking relay shall be energized and give starting signal to the engine.

After full voltage is build up, breaker of the Master generator shall close manually with the help of breaker control switch.

When breaker Control switch is turned to 'CLOSE' position, breaker as per following sequence:

DG controller /Main Selector Switch shall be in Manual Mode.

Solo/Parallel Selector Switch being in 'Solo' mode.

With the conditions mentioned above fulfilled and breaker control switch in 'Close' position, Neutral contactor shall be energized.

Closing command to the generator breaker shall be given.

IN manual mode care shall be taken, to synchronize the follower generator sets with the 'Master' before closing its breaker.

For synchronizing the generator in manual mode, voltage/frequency raise/low commands shall be given to Alternator/Engine with the help of 'Joy sticks' provided in the Relay/Synchronizing Panel.

While synchronizing the generator, manually, all the parameters viz. voltage, frequency and phase rotation shall be monitored with the help of Double voltmeter, Double Frequency Meter and Synchronoscope provided in the Relay/Synchronizing Panel and breaker shall be closed only when all the three parameters are matched properly.

Active/Reactive load sharing between all the running sets in manual mode shall be managed by raising/lowering voltage/frequency with the help of joy sticks.

During the parallel operation of Power Generating sets in 'Manual Mode', Neutral contact of only master generator shall close. This shall be assured by inter locking the neutral contactors of all the generator.

5A456.5.26 Summary of Functions

The following functions shall be performed by the controller for Synchronizing the generatingsets.

Automatic starting of generating sets.

Automatic Synchronization of all available generating sets.

Automatic load sharing between generators, active as well as reactive load

sharingStarting & stopping of generators as per load requirement.

Monitoring of engine & alternator condition and

protections.Complete load management as per

requirement.

The control functions shall be as

follows :Engine Control

Engine pre-glow

controlFuel solenoid

control Engine starter

control

KVA controlled cool-down

timerSpeed monitoring

Over-speed protection

Oil pressure

monitoring

Water temperature

monitoringBattery voltage

monitoring.

Engine Protective Features

High / Low coolant

temperatureHigh / Low oil

pressure

Over-speed

Start Failure

Generator Protective

FeaturesOver / Under

voltage.

Over / Under Frequency

Reverse Power (Inverse time

delay)Loss of Excitation

Over Current (Inverse time

delay)Loss of Utility power

detection Load Surge

Current Unbalance

Voltage Unbalance

Real (KW) Load Control

True RMS power calculations accurate

controlConfigurable loading / unloading

ramp rates. Isochronous load sharing

Soft Utility transfer function

Externally adjustable base load of process reference levels with independent ramp

rates.Dynamic Synchronizing (Mandatory Features)

Digital signal processing to eliminate harmonic

issues Adjustable phase window, voltage window,

dwell times Safe dead bus closing logic internal to

the control Multiple shot re-closing with adjustable

time delays Manual voltage & speed adjusts for

manual synchronizingReactive (KVAR) Control

VAR sharing on isolated buses using %age base reactive load

sharing.Power factor or VAR control when base loaded.

Externally adjustable VAR of PF set point

levels.Control System

All the electrical parameters are monitored centrally through DG controller. All the electrical data is brought to the DG controller & then DG controller controls the complete Synchronizing, Load Control & Management system.

No motorized potentioners are used. AVR & Governor are given direct bias control (Analog / Plum Commands).

There are two options provided for control, monitoring & data logging functions.

Graphic display terminal with printer option

IBM PC based complete SCADA station (PC-PLC connection over Ethernet-100 Mbps).

Min PC requirements :

i. Windows NT or 2000 professional

j. P-IV, 256 MB, 40 GB, FDD, 52 X CD ROM, MM Speakers, LAN (Ethernet Port), 2 x USB ports, 2 x COM ports, 1 x Parallel port.

k. 15" colour monitor

l. 132 Col. Dot matrix printer

5A456.5.27 Synchronizing Logic

The system shall be capable of a dynamic synchronization as described above, where the generator frequency is controlled to be slightly higher than the bus bar frequency, when the breaker closes. This shall ensure that the generator will start to take load the moment the generator breaker is closed. The frequency difference between generator & bus bar at the moment of synchronization shall be programmed. Breaker time shall be adjusted to ensure breaker closure at the exact point of synchronization. System shall control the voltage under synchronization if necessary.

During synchronization system shall supervising the frequency of the generator voltage to makesure that the genset is not unstable due to a cold fuel / genset or an uneven fuel supply. The twofrequencies must be within the accepted slip-frequency in 200 mili sec before synchronization.

The system shall synchronize the generator to the bus, when all below conditions are fulfilled :

- A control order is given by setting the input "start synchronizing / regulating"
- Feedback signal from breaker "GCB open" is present.
- Bus bar voltage is present
- Generator voltage is present

The voltage regulator in the system shall start when the frequency is within 90% of nominal frequency.

System shall close the breaker without synchronization, when all the following conditions are fulfilled :

- Display setting "Black busbar operation is ON.
- A control order is given by setting the input "start synchronizing / regulating"
- Feedback signal from breaker "GCB open" is present.
- Bus bar voltage is not present (Black bus bar)
- Generator voltage is present.

5A456.5.28 Monitoring

Following electrical parameters shall be monitored by DG controller based system, which shall beconnected through set of CT / PT's & shall indicate the following:

i. Voltage – all phases (Line & Phase both)

ii. Current – all phases.

iii. Frequency

iv. Power factor

v. KVAR

vi. KVARH

vii. KW

viii. KWH

All these parameters shall be displayed & shall be used for Load Management & Safety functions. Limitscan be assigned to each parameter in the PLC for alarm & recording / logging purposes.

System shall include the following features:

The system shall work on Isochronous principle thus avoiding the problem of Droop adjustment. Thefrequency shall remain constant at all loads.

Automatic dead bus closing

Active & reactive load

sharing.

Modular system & each module shall be independent of the other. The breakdown of one section shallnot effect the other.

The synchronizing module shall directly communicates with the electronic governors and shall connectto the load control lines of governor directly.

Solid State Annunciator For Auto Synchronizing Panel (Typical For Two DG With Bus

Coupler)Channel No.	Inscription
01	G-1 Fails to Synchronize
02	G-1 Fails to Start
03	G-1 Neutral Discrepancy
04	G-1 ACB Fails to Close
05	G-2 Fails to Synchronize
06	G-2 Fails to Start
07	G-2 Neutral Discrepancy
08	G-2 ACB Fails to Close
09	Bus Coupler ACB-1 Fails to close

Indication : 1 No. Spring charged Indicating Light.

: 1 No. Neutral ON Indicating Light.

: 1 No. Neutral OFF Indicating Light

: 1 No. Trip Indicating Light

: 3 Nos. Ph. Indicating Light

: 1 No. ACB ON Indicating Light

: 1 No. ACB OFF Indicating Light

: 1 Set Control MCB.

:1 set push buttons for generator start / stop, master changing, speed decrease

/ speed increase, voltage decrease / voltage increase.

Protection through Relays

(Applicable for both synchronizing and AMF panel)

1 Following protection shall be provided through relay both for the stator side and the rotor side:

i) Differential Protection (87 G)

Relay shall be percentage biased, low impedance differential relay with following features :Relay shall provide percentage biased differential protection with dual slope characteristics.

ii) Restricted Earth fault Relay : Relay shall have REF protection element (64R), which shall monitor the generator for internal earth faults. It has a built-in O/C protection, as a back up.

iii) Over voltage and under voltage protection.

2 In addition to above, following relays to be providedMaster Trip Relay

Trip Circuit Supervision RelayEngine Cranking Relay

Annunciation

Annunciation with Hooter, Test, Accept and Reset P.B. and Annunciator.16 Window Solid State Annunciator for each DG sets.

Channel No.	Inscription
01	Set fails to start (only alarm)
02	Over current (breaker trip)
03	Earth Fault (Breaker trip)
04	Excitation Failure (Engine should be stop with breaker trip)
05	Reverse Power (Breaker trip)
06	Emergency Shutdown (Breaker will trip with engine stop command)
07	Over speed (Breaker will trip with engine stop command)
08	Low Lube Oil pressure (Breaker will trip with engine stop command)
09	High Water Temperature (Breaker will trip with engine stop comman

10 Under Voltage (Breaker trip)

11. Over Voltage (Breaker trip)

12 Bearing Temperature high (breaker will trip with engine stop command)

13. Under Frequency (Breaker trip)

14 Over Frequency (Breaker trip)

Winding Temperature High Breaker with trip with engine stop command)

15. Low fuel oil level (only alarm at preset level.

5A456.5.29 Battery Charger

5A456.5.30 General

The battery charger shall be Float cum Boost type Thyristor controlled. The charger shall haveselector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

5A456.5.31Construction Feature

The battery charger shall be housed in sheet steel cubicle of Angle Iron frame work with sheet steel panels of 1.6 mm thickness. Louvers shall be provided in the cabinet for the ventilation. The cubicle shall be painted in Siemens Grey shade RAL7032 of IS-5. Four wheels shall be provided at the base.

5A456.5.31 Performance

The D.C output voltage of Float / Boost charger shall be stabilized within + 2% for AC input variation of 230 V + 10%, frequency variation of 50 Hz + 5% and DC load variation of 0-100%.The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content will be within 3% of DC output nominal voltage.

There shall be provision to select Auto Float / Manual Float / Manual Boost modes. During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to FloatMode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the outputvolts by separate potentiometers.

The battery charger shall have automatic output current limiting

feature.

5A456.5.32 Components

The battery charger shall essentially comprise of the following

- 1 No. double pole ON/OFF MCB at AC input
- 1 No. pilot lamp to indicate charger ON.
- 1 No. Main Transformer : Double wound, naturally air cooled, having copper winding.
- 1 set single phase full wave bridge rectifier consisting of 2 Nos. diodes and 2 Nos. SCRs, liberally rated, mounted on heat sinks and complete with resistor / condenser network for surge suppression.
- 1 No. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.

- 1 set solid state constant potential controller to stabilize the DC output voltage of the floatcum boost charger at + 2% of time set value for AC input voltage variation of 230 V + 10%,frequency variation of + 5% from 50 Hz and simultaneous load variation of 0-100% and also complete with Current Limiting Circuit to drop the Float Charger output voltage uponoverloads to enable the battery to take over.
- 1 No. electronic controller to automatically changeover battery charging from boost to floatand vice versa..
- 1 No. DC ammeter and toggle switch to read charger output current and battery charge / discharge current.
- 1 No. moving coil DC voltmeter to read the DC output voltage.
- 2 set potentiometer to adjust the output voltage during manual /auto float and boost modes.
- 2 No. double pole ON/OFF MCB at DC output, 1 No. at charger output and the other at load.
- 2 set DC output terminals. 1 set for the load and the other set for the battery.
- Alarm Annunciation : Visual and audible alarm with manual accept reset facility shall be provided for the following :

    a. AC mains fail

    b. Charger Fail

    c. Load/Output vervolt.

5A456.5.33 Rating

AC Input	:	230 V + 10% AC 50 Hz single phase.
DC Output	:	To float / boost charge 180 AH batteries also supply a continuous load.
Current Rating	:	30.0 Amps
Float Mode	:	27.0 V nominal (Adjustable) between 24-28.0 V.
Boost Mode	:	29.0 V nominal (Adjustable) between 24-32.0 V.
Voltage Regulation	:	+ 2% for AC input variation of 230 V + 10%. Frequency Variation of 50 Hz + 5% and DC load variation 0-100%

5A456.5.34 Performance Tests

The schedule of tests to be performed in the Factory Acceptance Test shall include the following:

On each of three separate days and before any other operation of the diesel-alternator on that day three successful manual start-up operations to be accomplished.

Three separate manual start-up operations each within one minute of the diesel-alternator beingshut down after running continuously for not less than one hour and attaining normal engine running temperatures.

Three separate automatic start-up operations with simulation of “mains failure”. In all

or any ofthese tests the diesel-alternator may be out on load by the automatic closing of the emergency power supply circuit breaker.

Three separate automatic shutdown operations, each initiated by mechanical simulation of a “low pressure” condition.

Three separate automatic shutdown operations, each initiated by manual instigation of an “over-speed” condition.

Three separate abortive start-up operations, each inducing “failure to start” shut-down. The load tests shall be carried out at manufacturer’s works as follows before dispatch: Idle Run - 05 mins

25% Load - 15 mins

50% Load - 30 mins

75% Load - 30 mins

100% Load - 60 mins

110% Load - 60 mins

At the completion of the test, readings shall be taken of Voltage, Frequency, Current, Temperature, Vibration, Fuel ratio to Unit produced, Flue analysis and the following:

Insulation resistance – rotor, stator, exciter – to earth;Insulation resistance – between stator windings; Alternator rotor and exciter armature temperature

Noise level measurement of DG set in acoustic enclosure as per specification

5A456.5.35 Site Test

Upon the delivery to the site and if the generator set is required to re-assemble on site, similartests shall be carried out by the Contractor to ensure that the performance is not degraded.

The tests, but not limited to are:

Diesel engine-Generator coupling and shafts alignment.On load ‘mains failure’ simulation test

Safety devices test

Remote monitoring

Auxiliary contacts

etc.Load tests.

BMS interface test

Load tests shall be carried out through building load (minimum 50%).

Additional Load test at any load other than building load or 100% load at site shall be optionalwhich shall be quoted separately and will be decided by the Client. Cost to arrange the load bank for purpose of testing at site shall be included in the this separately quoted rate.

5A456.5.36 PAINTING OF PIPE WORK

All pipe work, other than buried pipes, shall be painted immediately after installation with at least one coat of red primer and two (2) finishing coats of best quality aluminum

paint. The colour will be determined by the Project Manager on site.

5A443 HSD STORAGE AND SUPPLY SYSTEM

5A443.1 Pumps

5A443.1.1 Scope

The scope of this section comprises the supply, erection, testing and commissioning of pumps suitable for handling HSD as described in specifications and as per requirement. The capacity of pumps shall be accordance with the requirement of as per requirement. All pumps shall havemechanical seal.

5A443.1.2 Rotary Screw Gear Pump

a. Case & Cover

Shall be made of closed grained cast iron accurately machined, bolted and bowled together.

b. Rotor

Shall consist of pair of gears made from special steel. Pump shall have spur gears or double helical gears as required. All gears shall be precision cut and accurately fitted. Flame proof motor for fire protection pumping unit shall be provided with Flame proof ON/ OFF push button station.

c. Bearing

Shall be made of phospher bronze and shall be fitted with grease lubricators to minimize wear & tear.

d. Stuffing Box & Glands

Stuffing box shall be extra deep & shall be fitted with Teflon packings. Gland shall be bolted type.

e. Relief Valve

'ADD ON' type pressure relief valve shall be provided to relieve 100% of capacity with in 25%to 10% of the set pressure. Relieving shall be fast at higher setting and will be slow at lower setting.

f. Speed

Pumps shall run at rated speed upto 500 CST viscosities. For viscosity between 500 to 1250 CST, pump speed shall be reduced utp 60% of rated speed. For viscosity between 1250 to 2500CST, speed shall be reduced upto 30% of rated speed.

g. Pipe Connections

Suction & Discharge ends shall be provided with flanges.

h. Drive

Pumps shall be directly coupled to electric motor through flexible coupling.

i. Efficiency

Pumps shall be selected for higher volumetric efficiency. Mechanical efficiency shall be in therange of 40 – 75%, pump shall be selected to operate at low noise.

5A443.2 Hsd Storage Tank

5A443.2.1 Scope

The contractor shall design supply, install, test and commission of the HSD tank, fittings andaccessories as per requirements of the following BIS codes:

- IS : 10987 / IS : 823 / IS : 1239
- Rules and regulations of the Chief Inspector of Explosives India.
- Petroleum Rules 1936 with latest amendments
- All site welding shall be carried out by fusion welding as per

IS:823.For all butt welds, the roof run and final run shall be carried

out.

The tank design shall be as per the above codes and contractor shall submit criteria of designadopted by them along with the tender.

5A443.3 Bulk Oil Storage Tank

5A443.3.1 Tank

The HSD tank shall be MS construction, horizontal cylindrical in shape with dished ends. The tank shall be all welded construction and shall be suitable for storage of HSD upto a maximumtemperature 40 deg.C at atmospheric pressure, end plate with stiffener shall be 10 mm and shellplate thickness shall be 6 mm thick Painting

Tanks shall be painted externally and internally to prevent corrosion. The internal surface of thestorage tanks shall be thoroughly cleaned and treated with one coat of suitable oil resistant paint.The external surface of the tanks shall be thoroughly cleaned with wires brush / emry paper to remove rust, scale, etc. and apply one coat of zinc chromate primer followed by two coats of finishing paint (Bitumen based). The tank shall be provided with Anticorrosive paint protection as per manufacturer's specification / detail. Anti-corrosive Pypcoat (AW4) treatment shall be provided.

5A443.3.2 Piping

All the oil supply pipe shall be seamless as per relevant code & standards. All fittings shall beof heavy duty. Flanges shall conform to ASA-Class 150 weld neck and material to IS:226. Seamless double walled pipe & fittings like tees, elbows, junctions, unions, bends, plugs etc.

RCC pipe sleeves of larger diameter to the provided wherever the pipes are crossing the road and sleeves as per requirement, including clamps hangers, nuts, bolts etc for pipe supports andwrapping of under Ground pipe with wrapping coating material including cutting and making hole in wall / slab and making good the same. Include a coat of fire retardant paint over two coats of primer complete as required.

5A443.3.3 Valves

All valves MoC shall be provided as per requirement

5A443.3.4 Strainers

5A443.3.5 The strainers MoC shall be provided as per

requirementPipe Supports / Bridges

The HSD supply pipes from HSD yard to respective day oil storage tank shall be laid underground. These pipes shall be provided with weather proof treatment. Cleanliness

The area around the vessels shall be kept free from readily ignitable materials, such as weedsand long dry grass by providing stone pitching.

5A443.3.6 Earthing

HSD tank and pipe lines shall be provided with copper earthing and earthed in an

efficientmanner.

5A443.3.7 No smoking

A permanent notice with letters minimum 500 mm high prohibiting smoking and naked lightsshall be fixed to the fence surrounding the area.

5A443.3.8 Fire Protection

The area where tanks, pumping equipment, loading and unloading facilities are provided shall be well protected from fire by providing fire hydrants and fire extinguishers (to be provided byother agencies).

5A443.4 General Requirements

a. Inlet and outlet connections.

b. Vent pipe with flame arrestor.

c. Dip pipe assembly with calibration chart.

d. 550 mm dia manhole with cover.

e. Lifting lugs.

f. MS ladder

g. Providing Anti corrosive Pypcoat (AW4) treatment.

h. Provision for level sensor (BMS)

i. Common base plate of required strength manufactured out of MS channels.

j. Suitable RCC foundation and anti vibration damping arrangement with cushy foot orsimilar mounting arrangement.

k. Coupling and coupling guard for direct coupling of pump and motor.

l. Pressure gauge with valve on the delivery side.

m. Strainer at inlet.

n. flame proof level controller for day oil storage tanks, including wiring, cabling, probes withall other accessories ready for automatic operation of fuel oil pump.

o. level indicator in plant room for UG oil storage tanks, including wiring, cabling, probes with all other accessories ready for working complete as required. Level indication shall be compatible with BAS system

p. Oil flow meter with flanged end for bulk oil storage tank.

q. Pressure switch online to start / stop the pump at set pressure.

5A443.5 Inspections, Approval & License

The contractor shall arrange the inspection, approval and license for the proposed HSD oil installation by the Chief Inspector of Explosives as given below:

Pre-installation Approval

The contractor shall upon the award of the work, prepare working drawings for the

HSD installation and submit the drawings to the consultants for their provisional approval. The drawings so approved by the consultants shall be submitted to the Chief Inspector of Explosivesfor his scrutiny and approval. Test & Safety Certificates

It shall be the responsibility of the contractor to arrange test and safety certificates under rules 126 after the installation is commissioned.

Inspection / Storage License

It shall be the responsibility of the contractor to arrange for inspection of the installation by theChief Inspector of Explosives and carry out any modifications / additions if required by the Chief Inspector of Explosives and obtain storage license and submit the same to the Owners.

5A443.6 Fuel Oil Piping

5A443.6.1 Scope

The scope of this section comprises the supply and laying of double walled pipes, pipe fittingsand valves testing and balancing of all HSD piping required for the complete installation as shown on the drawings. All piping inclusive of fittings and valves shall follow the applicable BIS Codes.

a. Pipes shall be seamless & fittings shall be welded type fittings conforming to relevant BIScodes. All jointing in the pipe system shall generally be by welding / flanges, unless otherwise mentioned or directed at site. All welding shall be done by qualified welders andshall strictly conform to BIS code of procedure for manual metal arc welding of mild steel.

b. All pipes and their steel supports shall be thoroughly cleaned and given on primary coat ofred oxide paint before being installed. All welded piping shall be subject to the approval at site.

c. Thread joint fittings shall be malleable casting of pressure rating suitable for the piping system. Fittings used on welded piping shall be of the weldable type.

d. Tee-off connections shall be through equal or reducing tees other-wise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not beresorted to.

e. Valves, conforming to the following specifications, shall be provided as shown on drawings.

Size	Construction	Ends
15 to 65 mm	as per requirement	Flanged
75 mm over	as per requirement	Flanged

All valves shall be heavy duty.

f. Flanges shall be approved make. The supply of flanges shall also include supply of bolts and nuts and suitable asbestos fiber / rubber insertion gaskets (minimum 3 mm thick).

g. Non-return (check) valves shall be provided as shown on the drawings, conforming to relevant BIS codes and in accordance with the following specifications:

Size	Construction	Ends

15 to 65 mm	Gun Metal	Flanged
75 mm over	Gun Metal	Flanged

Swing check valves shall normally be used in all services. Lifts type valves may be used inhorizontal runs.

h. The strainers MoC shall be provided as per requirement.

i. All piping and fitting shall be pressure tested, then painted and shall be provided with additional weather proof treatment for buried pipes.

j. All piping shall be painted as specified herein. After piping has been installed, tested and run for atleast three days of eight hours each, all exposed piping and pipe supports shall begiven two finish coats, 3 mils each, of approved paint, conforming to relevant BIS codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows.

5A443.7 TESTING, COMMISSIONING & HAND-OVER

5A443.7.1 General

The entire works included in this Contract shall be fully tested in stages as the work proceedsand on completion of work as applicable.

The Contractor shall provide during normal working hours, all necessary labours, instruments,equipment, materials, fuel, power and manufacturer's representatives, to carry out such tests asmay be necessary to satisfy the Construction Manager / Architect that the installation meets therequirement and intent of the Specification as well as such tests required by Local Authorities.

All tests shall be made in the presence of the Construction Manager / Consultant/ Client’s representative or any inspecting authority. At least seven working days’ notice in writing shall be given to the inspecting parties before performing any test.

Three copies of all test results shall be submitted to the Construction Manager in A4 size sheetpaper within two weeks after completion of the tests.

Tests described hereinafter and including all tests prescribed by the Authority having jurisdiction shall be carried out. Any tests proved unsatisfactory shall be repeated to the satisfaction of the inspecting parties.

The Contractor shall provide skilled technicians/engineer to commission the plant and associated controls to the satisfaction of the Construction Manager / Consultant/ Client’s representative . The technicians/ engineers will be required to demonstrate the correct procedures in starting and stopping the plant, running the various items of equipment under automatic and manual control and the correct maintenance of the plant.

5A443.7.2 On-Site Testing and Commissioning

Two months prior to completion of the Contract Works, the Contractor shall liaise with the Main Contractor and the Electrical Contractors and submit for the Construction Manager / Consultant/ Client’s representative approval a detailed program for conducting on-site acceptance tests and commissioning.

The Contractor shall start up, operate, test and adjust the systems in accordance with the

agreedprogram. The setting shall be supervised by the manufacturer's representative, who shall remain on site until the equipment is operating satisfactorily and accepted by the Construction Manager / Architect. The Contractor shall advise and co-ordinate with the manufacturer's representatives so that all testing is carried out according to the agreed program.

The whole installation shall be given the following tests to bring the systems into running order.The Construction Manager / Consultant/ Client's representative shall be given reasonable noticetogether with a copy of recorded test results, generally not less than seven (7) days, regarding the nature of tests, the time and location. Acceptance tests will only be witnessed by the Construction Manager / Consultant/ Client's representative when the submitted tests results are found satisfactorily.

All instruments, tools, material and labour required to perform these tests shall be provided bythis Contractor.

Before the tests are carried out, the Contractor shall remove connected equipment and components which are liable to damage under test, and shall provide and fix all the necessary gauges, blanking flanges, etc.

Prior to the system start-up, the following inspection, tests and pre commissioning treatment shall be carried out by the Contractor:

b Tanks and Level Switches

Check sides and edges of sectional tanks for distortion. The tanks shall be thoroughly cleanedwith water and drained before effluent supply will feed in.

Also before effluent supply will feed in, the level switch shall be simulated for the various cut-in and cut-out settings.

c Pressure Switches

The testing equipment arrangement for pressure switches and pressure gauges shall be as shownon the drawings or of an approved equivalent.

The pressure gauges to be tested shall be connected as shown on the drawing in lieu of the pressure switch. The gauges to be tested shall be regarded acceptable when the pressure readings of all three gauges are the same throughout the jacking pressure range varied by applying the hand pump.

d Hydrostatic Tests

All parts of the water circuit shall be filled with water before hydrostatic pressure testing, and pump running tests for verification of pressure and flow rate, are conducted.

The hand jacking pump shall be applied to increase the system pressure to 2 times the workingpressure or 1.5 times the working pressure plus 3.5 bar whichever is the lower but in any case not less than 7 bar. The pressure shall be maintained for a period not less than 24 hours.

Where any section of pipework or equipment is found to be unable to withstand the maximumpipework test pressure, it shall be isolated during the pipework test then that section of pipeworkor equipment shall be made good and re-tested at the appropriate test pressure.

The working pressure for various systems shall be as shown on the drawings.

e House drains shall be hydrostatically tested to a water head of 1.2 m at the high end and not more than 2.4 at the low end and shall show no appreciable loss of water after elapse of two hours.

In every test, water used shall be left in the pipes until they are covered with earth or other trenchfilling material to a depth of at least 1 m over the top of pipes and until permission is given by the Construction Manager / Consultant/ Client's representative for the water to be released. If after the Construction Manager / Consultant/ Client's representative has approved the sewer orpipeline and has given permission for the trenches to be refilled the pipes become damaged andloses water from any cause and/or admit subsoil water, the Contractor shall uncover the pipes and make good the defect made good and the pipes retested as before and all at the Contractor'sexpense.

f Cleaning, Flushing and Pre-Treatment

Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation includingall fitments and pipework and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminatingmaterials. All pipes shall be roded to ensure clearance of debris, cleaning and flushing shall becarried out in sections as the installation becomes completed.

All strainers shall be inspected and cleaned out or replaced.

When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced andcirculated for at least 8 hours. Warning signs shall be provided at all outlets during pre- treatment.

The pre-treatment chemical shall:

Remove oil, grease and foreign residue from the pipework and

fittings;Pre-condition the metal surfaces to resist reaction with

water or air; Establish an initial protective film;

After pre-treatment, the system shall be drained and refilled with fresh water and left until thesystem is put into operation.

Details and procedures of the pre-treatment shall be submitted to the Construction Manager /Consultant/ Client's representative for approval.

g Electrical Tests

Electrical tests shall comply with the current edition of IEEE regulations and requirements enforced by Local Authorities.

Electrical insulation tests shall apply to busbars, isolators and other equipment and wiring whereapplicable.

A 500V DC instrument shall be used to check the insulation resistance. The reading shall not be less than 50 mega-ohm in all instances.

Function simulation tests shall be performed to ensure that the systems have been installed to the control requirements as described in the Specification therein.

h Pump Drives

The direct coupling of the pump drives shall be dismantled before the pump motor control panelis energized.

The Contractor shall demonstrate to the Construction Manager/ Consultant/ Client's representative of acceptable clearances of the coupling alignment for ensuring satisfactory power transmission.

The coupling shall not be re-mated again till the correct motor rotation has been demonstrated with power drawn from the energized pump motor control panel.

i Pump Operating Test

The Contractor shall ensure to the satisfaction of the Construction Manager / Consultant/ Client's representative that the installation or portion thereof which has been set to work complies with all requirements including the following:

That the plant and apparatus shall be of robust construction and of capacity for the duty specified.

That all valves, switches, controls and the like are properly regulated and capable of proper operation and in the case of valves are capable of being shut-off.

That all apparatus shall be silent.

That all instruments are correctly calibrated and read accurately.

That all services are tested in accordance with the details of the relevant clauses of this Specification.

5A443.7.3 Statutory Authorities' Tests and Inspections

As and when notified in writing or instructed by the Construction Manager / Consultant/ clientrepresentative, the Contractor shall submit shop drawing and attend all tests and inspections carried out by Statutory Authorities, and shall forthwith execute free of charge any rectificationwork ordered by the Construction Manager / Consultant/ client representative as a result of suchtests and inspections where these indicate non-compliance with Statutory Regulations. Some ofthese tests may take place after the issue of Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by these Authorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Construction Manager / Consultant/ Client's representative for checking beforesubmission. The Contractor shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within four months after the award of the Contract but not less than six weeks before the inspection. The Construction Manager / Consultant/ clientrepresentative may at his discretion instruct the Contractor for additional submissions to the Local Authorities whenever necessary.

The Contractor shall notify the Construction Manager / Consultant/ client representative at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the Construction Manager
/ Consultant/ client representative without

delay.

5A443.7.4 Preliminary Commissioning Checks

Ensure that all equipment is thoroughly cleaned, lubricated and checked for serviceability before setting to work. Particular attention is drawn to the removal of building debris from thepipework systems.

Special attention is drawn to the need for thoroughly flushing out all pipework systems to ensurethat all foreign matter is removed.

All automatic controls and safety devices shall be inspected and checked for service ability before the working fluid or electricity is applied to the system.

5A443.7.5 Commissioning

When the various installations have been completed and the preliminary commissioning checkscarried out, the Contractor shall set to work, regulate and calibrate all system in the entire installation. Special attention shall be paid to the following items:

That all valves, switches, controls, etc. are regulated and capable of proper operation and in thecase of isolation valves that they are capable of tight shut off.

That all apparatus is silent in accordance with the requirements of this

Specification.That all instruments are correctly calibrated and read

accurately.

That all services are tested in accordance with the details in the relevant clauses of thisSpecification.

Operate pumps, pressure reducing sets, etc. to ensure that all control systems are functioningcorrectly and are properly set, sequenced or interlocked.

5A443.7.6 Final Acceptance Tests

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance witha program to be agreed with the Construction Manager / Consultant/ client representative.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further paymentin order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these testsshall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

5A443.7.7 Safety Regulations

The Contractors shall follow the following safety regulations in addition to detailed safetyrequirements specified in the contract.

The contractor will arrange for safety provisions as per safety codes of Indian StandardsInstitution, Indian Electricity Act and such other Rules, Regulations and Laws as may be applicable, as indicated below, in respect of all labour, directly or indirectly employed in the work for performance of the Contractors' part of this agreement.

No inflammable materials shall be stored in places other than the rooms specially constructed for this purposes in accordance with the provisions of Indian Explosives Act. If such storage isunavoidable, it should be allowed only for a short period and in addition, special precautions, such as cutting off the supply to such places at normal items, storing materials away from wringand switch boards, giving electric supply for a temporary period with due permission of Engineer-in-charge shall be taken.

Protective and safety equipment such as rubber gauntlets or gloves, earthing rods, line men's belt, portable artificial respiration apparatus etc. should be provided in easily identifiable locations. Where electric welding or such other nature of work is undertaken, goggles shall alsobe provided.

Necessary number of caution board such as "Man on Line, Don't switch on" should be readilyavailable in easily identifiable locations.

Standard first aid boxes containing materials as prescribed by the St. John Ambulance Brigadeor Indian Red Cross should be provided in easily identifiable locations and should be readily available. Periodical examination of the first aid facilities and protective and safety equipment provided shall be undertaken and proper records shall

be maintained for their adequacy and effectiveness.

Charts (one in English and one in regional language) displaying methods of living artificial respiration to a recipient of electrical shock shall be prominently displayed at appropriate places.

A chart containing the names, addresses and telephone numbers of nearest authorized medical practitioners, hospitals, Fire Brigade and also of the officers in charge shall be displayed prominently along with the First Aid Box.

Steps to train supervisory and authorized persons of the Engineering staff in the First Aid Practices, including various methods of artificial respiration with the help of local authorities such as Fire Brigade, St. John's Ambulance Brigade, Indian Red Cross or other recognized institutions equipped to impart such training shall be taken, as prompt rendering of artificial respiration can save life at time of electric shock.

No work shall be undertaken on live installations, or on installations which could be energizedunless one another person is present to immediately isolate the electric supply in case of any accident and to render first aid, if necessary.

Before starting any work on the existing installation, it should be ensured that the electric supplyto that portion in which the work is undertaken is preferably cut off. Precautions like displaying"Men at Work" cautions boards on the controlling switches, removing fuse carrier from thesesswitches and these fuse carriers being kept with the person working on the installation, etc. should be taken against accidental energization. "Permit to Work" should, be obtained form theEngineer-in-charge.

Before energizing on an installation after the work is completed, it should be ensured that all tools have been removed and accounted, not person is present inside any enclosure of the switchboard etc. any earthing connection made for doing the work has been removed, "Permit to Work" is received back duly signed by the person to whom it was issued in token of having completed the work and the installation being ready for re-energizing and "Men at Work" caution boards removed.

In case of electrical accidents and shock, the electrical installation on which the accident occurred should be switched off immediately and the affected person should be immediately removed from the live installation by pulling him with the help of him coat, shirt, wooden rode,broom handle or with any other dry cloth or paper. He should be removed from the place of accident to a nearby safe place and artificial respiration continuously given as contained in BIS. Code and Standard prescribed by St. John Ambulance Brigade or Fire Brigade.

5A443.7.8 Electrical Inspection (Holiday Test)

All coated and wrapped pipes shall be tested with an approved high voltage holiday detector equipped with a positive signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

The applied output voltage of the holiday detector shall have a spark discharge at least twice thethickness of the coating to assure adequate inspection voltage and compensate for any variationin coating thickness.

The applied output voltage of the holiday detector shall have a spark discharge at least twice thethickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. When selecting test voltages, consideration should be given to thetolerance of coating thickness and the voltage should be selected on the basis of maximum coating thickness likely to be encountered.

The test shall be carried out in co-ordination with the coating / wrapping manufacturers.

5A456.6 Automatic Transfer Switches

5A456.6.1 Scope

a. Supply and installation of automatic transfer switches (ATS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation.

b. All transfer switches and controllers shall be the products of the same manufacturer.

5A456.6.2 Codes and Standards

- The automatic transfer switches and controls shall conform to the requirements of:
- UL 1008 - Standard for Transfer Switch Equipment
- or
- IEC 947-6-1 Low-voltage Switchgear and Control gear;
- Multifunction equipment; Automatic Transfer Switching

Equipment

5A456.6.3 Mechanically Held Transfer Switch

a. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid or linear motor mechanism (upto 1000A). Main operators which include over current disconnect devices shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possiblepositions under normal operation and only one position at a time, normal or emergency.

b. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

c. All main contacts shall be silver composition. Switches rated 600 amperes and above shallhave segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

d. Inspection of all contacts shall be possible from the front of the switch without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

e. Designs utilizing components of moulded-case circuit breakers, contactors, or parts thereof,which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

f. Where neutral conductors must be switched as shown on the plans, the ATS shall be provided with fully rated simultaneous switching or overlapping neutral transfer contacts. In case of overlapping neutral, the neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer isbeing made. The overlapping neutral contacts when provided shall not overlap for a periodgreater than 100 milliseconds.

g. Where neutral conductors are to be solidly connected as approved by Engineer, a neutral conductor plate with fully rated Copper pressure connectors shall be provided.

5A456.6.4 Microprocessor Controller

a. The controller's sensing and logic shall be provided by a single built-in

microprocessor formaximum reliability, minimum maintenance. (The ability to communicate serially throughan optional serial communication module shall be added while specifying ATS for criticalapplications).

b. A single controller shall provide different selectable nominal voltages as per local requirements for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to □ 1% of nominal voltage frequency sensing each.

c. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrialgrade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance.The protective cover shall include a built-in pocket for storage of the operator's manuals.

d. All customer connections shall be wired to a common terminal block to simplify field- wiring connections. All the programming shall be done through keypad.

e. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

- EN 55011:1991 Emission standard - Group 1, Class A
- EN 50082-2:1995 Generic immunity standard, from which:
- EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
- ENV 50140:1993 Radiated Electro-Magnetic field immunity
- EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
- EN 61000-4-5:1995 Surge transient immunity
- EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
- IEEE472 (ANSI C37.90A) Ring Wave Test.

5A456.6.5 Controller Display

a. A 20 character VFD/LCD display and keypad shall be an integral part of the controller forviewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

- Nominal line voltage and frequency
- Single or three phase sensing
- Operating parameter protection
- Transfer operating mode configuration (Open transition, Closed transition, or Delayed transition)

b. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

5A456.6.6 Withstand and Closing Ratings

The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of over current protection shown on the plans. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

5A456.6.7 Tests and Certification

a. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

b. Upon request, the manufacturer shall provide a notarized letter certifying compliance withall of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

c. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

5A456.6.8 Service Representation

a. The service center's personnel must be factory trained and must be on call 24 hours a day,365 days a year.

b. The manufacturer shall maintain records of each switch, by serial number, for a minimumof 20 years. Meters

- All voltmeters and indicating lamps shall be through MCB's.
- Multifunction meters and other indicating instruments shall be flush type.
- All CT's connection for meters shall be through Test Terminal Block (TTB).
- CT ratio and burdens shall be as per design requirement.

5A456.6.9 Instrument Transformers

a. Current transformers shall be provided in all distribution panels. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondary's for operation of associated metering.

b. The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block whichshall be easily accessible for testing and terminal connections. The protection CTs shall beof accuracy class 5P10 and measurement CTs shall be of accuracy class I.

5A456.6.10 Indicating Panel

All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of clustered LED type of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level.

5A456.6.11 Testing

- Testing of the panels shall be as per relevant BIS Codes.
  BIS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages up toand including 1000 VAC.
  BIS/IEC 60947 Degree of protection
  BIS: 5578 and BIS: 11353, 1985 Arrangement of bus bars.

- The Contractor shall provide test certificates with his quotation for each design and rating of switchgear for Type and Routine tests carried out on the switchgear. Tests shall be those listed in the relevant standards. The tests shall be for the precise cubicleconfiguration proposed, including any adapter units between switchgear and control gear.
- The Contractor shall provide type test certificates for all ratings of current transformers, Voltage transformers, relays, meters and other auxiliary equipment used in the switchgear.
- The Engineer reserves the right to witness the following tests:-
- Routine tests on all switchgear / components as specified in the relevant standards

a. Operational (electrical and mechanical) tests on all components.

b. Protection operation by secondary injection of current and voltage as required.

c. Protection operation by Primary injection of current as applicable.

d. Inter changeability test

e. Type tests were carried out for this application.

f. (Certificate for witnessed tests shall be available for signature on the day of the test)

g. The Contractor shall give two weeks' notice of tests prior to commencement.

The Engineer reserves the right to inspect switchgear at the Manufacturer's works at any time prior to dispatch to prove compliance with this specification. The Employer shall also have the right to carry out intermediate inspection at manufacturer's works during manufacturing stage. The costs associated with these on-site inspections by Engineer and/or Employer shall be borne by the Contractor.

5A456.6.12 Wiring

In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per approved shop drawing.

5A456.6.13 Anti-Condensation Space Heaters

1 No. 100 W, 240 volts, single phase, 50 Hz AC Anti Condensation space heaters controlled bythermostat and protected by 6 amps MCB's or MPCB's as per fault level at the panel shall be provided in each vertical section of main distribution panel and 1 No. 60 watt Anti Condensation space heater with thermostat shall be provided in each cable alley of main distribution boards and sub distribution boards.

5A456.6.14 Insulating Mat

- Insulating mat shall be provided in front to cover the full length of all panels and shallbe not less than 1100 voltage level. Where back space is provided for working, operations or maintenance, from the rear of the panel, mat shall also be provided at theback of the panel also to cover the full length of panel on the rear also.
- Insulating Mats shall be in compliance with BIS-15652-2006.
- The insulating mats shall be made of Elastomer (a generic term that includes rubber, latex and elastomer compounds that may be natural or synthetic or a mixture of both) for use as floor covering for the protection of workers on AC and DC installation
- Mats shall be resistant to acid and oil and low temperatures and shall be identified by the respective class symbol.
- Thickness of mats, physical properties, dielectric properties and all other specificationshall be as per BIS: 15652-2006 and shall be free from blisters, pin holes, cracks, embedded foreign matters and other

defects.

5A456.7 Final Distribution Boards (FDB's)

Final Distribution Boards (FDBs) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum di-electricstrength of 2.5 KV / Sec. All Final Distribution Boards shall be installed recessed/ flushing to wall surface. All Distribution Boards shall manufactured by a manufacturer listed in Appendix-

I. FDB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per BIS/IEC - 60947.

5A456.7.1 Construction Features

- FDB's shall be made out of 1.2 mm thick high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of FDB shall be folded and braced as necessary to provide a rigid support for all component. FDB shallbe suitable for indoor / outdoor installation, wall mounting free standing type, in doubledoor construction. The Final Distribution Boards shall be totally enclosed, completelydust and vermin proof and shall be with hinged doors, Neoprene EPDM, gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 2.5 Sq.m tinned stranded copper connectors. Final Distribution Boards shall be suitable for the climatic conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to BIS-8623-1977 (Part-1) for factory built assembled switchgear and control gear for voltage upto and including 1100 V AC.
- All DB's and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self-threading screws shall not be used in the construction of FDBs.
- Knockout holes of appropriate size and number shall be provided in the FDB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.
- Final Distribution Boards shall comprise of the following:
- A panel for mounting where appropriate incoming supply circuit breaker and other auxiliaries for Control and distribution as required.
- Installation accessories shall be part of the DB for fixing conductor and rails for mounting MCB's and RCCB's etc. neutral bus bars and earthing bus bars required in the circuit. All busbars in the FDB shall be insulated type.
- Service cable /interconnection shall be part of the Distribution Boards.
- The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.
- Degree of protection shall be IP-52 for indoor application, IP-55 for kitchen and laundry and IP-65 for outdoor application.
- All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.
- Phase segregation to be maintained in all three phase distribution boards.
- Earthing shall be provided in each FDB's.

5A456.7.2 MANUFACTURING FACILITIES

Sheet steel manufacturing shall be done according to the drawings on in house CNC cutting and bending machines.

In house facility to be available for seven tank pre-treatment process and powder coating facilities. The Pretreatment and painting process shall be regularly checked for the stability of the process the final paint thickness should be 60 to 80microns.

The manufacturer must have established stores with proper procedures for checking incoming material, stocking, rejection etc so that non-Quality material does not enter the shop.

In house facility for routine testing of the switchboards

The Manufacturing facility should have ISO 9001

certification.

5A456.7.3 DOCUMENTATION

Following documents shall be submitted for approval of Engineer-in-Charge after award of work:

a. General arrangement details for each panel.

b. Bus bar sizing calculation for various bus bars rating for incomer/outgoings.

c. Quality assurance plan for the switchboard.

Post Award (for site preparation and before commencement of panel manufacturing)

Following diagrams/data/documents shall be prepared / submitted and got approved by the Engineer-in-charge before commencement of panel manufacture and final two sets on approval.

- Detailed drawings showing General Arrangement, plans, sections, elevations,foundation details, base plate details with dimensions and critical information.
- Single Line Diagram
- Control & Schematic Diagram
- Bill of Materials/quantities indicating makes, technical specs, quantity etc.
- Data sheets (where applicable)
- Control logic and write up (where applicable)
- Technical leaflets / specifications.
- Characteristic curves of equipments (where applicable)
- Tests offered at factory and testing procedure
- Others documents / drawings as required by client
-

5A456.7.4 COMPLETION PLANS

On completion of work, the contractor shall submit 4 sets of following documents along withsoft copy of as built drawings. The drawings shall be Computer aided design drawings (CADD).

- General Arrangement Layout drawings with dimensions, plans, sections, etc.
- Single Line Diagram
- Control & Schematic Diagram
- Bill of Materials/quantities indicating makes, technical specs, quantity etc.
- Data sheets
- Control logic (where applicable)
- Details of Inventory
- Equipment name plate details
- Installation & Maintenance Manuals
- Test certificates (Factory tests, Site tests)
- Guarantee/Warranty certificates (where applicable)

5A457 Earthing (Electrical Grounding)

5A457.1 General

5A457.7.1.1 The system shall be TNS with four wire supply system (R, Y, B, N and 2 Nos. E) brought from the main panel. All the non-current carrying metal parts of electrical installation and allmetal conduits trunking, cable sheaths, switchgear, distribution panels, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All metal work such as pipe lines, ducts, cable trays, stair case railing etc. shall be bonded to earth.

5A457.7.1.2 All earthing shall be in conformity with BIS: 3043 2018, and the basic system of earthingshall be Indian TNS.

5A457.7.1.3 Earthing work shall also conform to CPWD General Specifications for Earthing work

and Indian Electricity Rules 1956 amended up to date and in the regulations of the local ElectricitySupply Authority.

5A457.2 Earthing Conductors

Earthing conductors shall be of copper / GI as per the design intent/calculations and shall be protected against mechanical injury and corrosion.

5A457.3 Sizing of Earthing Conductors

5A457.7.3.1 Sizing of earth conductor for distribution panels etc. shall be based on actual fault current calculated.

5A457.7.3.2 Earthing of electronic \ IT equipment shall also be provided.

5A457.7.3.2 For lighting and power circuits cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 mm2. If the area of the largest current carrying conductor or bus bar exceeds 160 mm2 then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits up to 15 amps shall be earthed with PVC insulated copper wire.

5A457.4 Connection of Earthing Conductors

5A457.7.4.1 Main earthing conductors shall be taken from the earth connections at the main panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub-mains earthing conductors shall run from the main distribution panel/meter board panel to the final distribution boards.

5A457.7.4.2 Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord.

Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

5A457.5 Earth Electrodes

5A457.7.5.1 Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for electrode does not affect the foundation of the building.

Description	Type of electrode	Material of earth continuityconductor
Transformers Body	GI Plate	GI Strip
Transformers Neutral	Copper plate	Copper Strip

Equipment body (HT, LTPanel etc.)	GI Plate	GI Strip
Lifts	GI Plate	GI Strip
LV equipment	Copper plate	Copper Strip

5A457.6 Prohibited Connections

5A457.6.1 Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed 1 ohm. All switches carrying medium voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. The overlapping in strips at joints where required shall be minimum 75 mm.

5A457.6.2 The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

5A457.7 Earthing (Electrical Grounding)

The following must always be ensured in earthing system.

a. All earths must be interconnected.

b. Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure.

c. The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

5A457.8 Resistance to Earth

The resistance of earthing system shall not exceed 1 ohm.

5A458 <u>Lightning Protection System</u>

Installation of Lightning Protection System shall be strictly in accordance with BIS: /IEC 62305. The lightning protection installation can consist of Mesh, down conductors, earthing and bonding.

5A458.1 Protection

The Contractor shall submit the Risk Evaluation and the achieved Lightning Protection Level (LPL) calculation based on IS/IEC 62305 – Part 2. The Contractor shall then submit the shop drawings based on the achieved LPL and shall employ the air termination network as per the protection level.

5A458.2 Material

The materials of lightning conductor, down conductors, earth termination etc. shall be aluminum and conform to BIS/IEC 62305.

5A458.3 Joints and Bonds

The lightning protective system shall have as few joints as far as possible. Wherever joints in the conductor are necessary they shall be mechanically and electrically effective, and shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner.

5A458.4 Earth Terminations

Each down conductor shall have an independent earth termination. All the earth termination shall be inter connected and shall be capable of isolation for testing using test links.

5A458.5 Earth Electrode

5A458.5.1 Earth pits shall be installed in accordance with

BIS: 3043The resistance of earthing system shall not exceed 1

ohm.

5A458.6 Air Terminations Mesh (On the Terrace)

As an alternative to vertical air termination, grid of horizontal air termination may also be provided as perBIS/IEC62305.

5A458.6.1

Level of Protection	Rolling Spher eRadius(r) in meter	Mesh Size Wm in meter	Protection angle
I	20	5X5	As per IEC 62305
II	30	10X10	
III	45	15X15	
IV	60	20X20	

Air Termination Mesh Details

5A458.7 Down Conductor

In order to reduce probability of damage it is often necessary to have several parallel current paths. As recommended by BIS/ IEC 62305 equal spacing of aluminium down conductors around the building perimeter depending on the level of protection. Down conductor should nottouch the building / wall surface.

Level of Protection	Typical distance in meter
I	5
II	10
III	15
IV	20

Down Conductors Distance

5A458.8 Fasteners

Conductors shall be securely fixed to the building to be protected by fasteners (insulating material) which shall be not more than 1.20 meter apart for horizontal run and 1.0 meters for vertical run.

5A459 External Lighting Poles in Building Periphery

5A459.1 External Lighting

Poles shall be FRP straight pole with arrangement for mounting light fixtures. Pole shall be provided with 300 mm x 300 mm x 6 mm thick GI base plate. Foundation for the pole shall beof cement concrete in 1:2:4 rates (1 part cement, 2 parts coarse sand and 4 parts stone aggregate)IP-55 weather proof junction box shall also be provided to accommodate 1 No. 3 phase and neutral terminal block and 1 No. 6 amps SP MCB including 2.5 sq.mm PVC insulated copper conductor wires from the terminal block to the fixture and 2 Nos. 32 mm dia. GI sleeves of suitable length shall be provided to the junction box. The poles shall be compliant to relevant BIS codes. All external lights along the buildings periphery shall have power supply from the building premises. The ON/OFF switching of these lights shall be controlled by Photo sensors for energy conservation. Please refer infrastructure electrical for technical specifications of Conical poles.

1) Marine Grade Coating

The material shall be treated with:

Primer coating of 60–80 microns thickness

Finished with environmentally stable pure polyester powder coating of selected colour with 30–40 microns thickness

Total coating thickness (Marine Grade): 90–120 microns

Salt Spray Resistance

The coating system must comply with a minimum 500 hours salt spray test as per relevant standards.

2)Base Material Requirement

All decorative poles must be provided with a cast iron base for enhanced strength, durability, and aesthetic appeal.

3)Wind Load Design

The pole structure shall be designed to withstand wind speeds up to 200 km/hr.

4)Manufacturer Capability

The manufacturer should have in-house manufacturing and refining capabilities, including coating, fabrication, and quality control processes

5A460 SAFETY REQUIREMENTS

5A460.1 SCOPE

This section covers the requirements of items to be provided in the sub-station for compliance with statutory regulations, safety and operational needs.

5A460.2 REQUIREMENTS

Safety provisions shall be generally in conformity with appendices (A) and (C) of CPWD General Specifications of Electrical Works (Part I-Internal), 2013. In particular, following itemsshall be provided:

5A460.3 Insulation Mats

Insulation mats conforming to IS 15652: 2006 shall be provided in front of main switch boardsas well as other control equipments as specified.

5A460.4 First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in Regional language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate place. Standard first aid boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in each sub-station.

5A460.5 Danger Plate

Danger Plates shall be provided on HV and MV equipments. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enameled white on both sidesand with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

5A460.6 Fire Extinguishers

Portable CO2 conforming to IS 2878: 1976/ chemical conforming to IS 2171: 1976 extinguishers, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

5A460.7 Fire Buckets

Fire buckets conforming to IS 2546: 1974 shall be installed with the suitable stand for storage of water and sand.

5A460.8 Tool Box

A Standard tool box containing necessary tools required for operation and maintenance shall beprovided in the sub-station.

5A460.9 Caution Board

Necessary number of caution boards such as “Man on Line” ‘Don’t Switch on’ etc. shall beavailable in the sub-station.

5A460.10 Key Board

A keyboard of required size shall be provided at a proper place containing castle keys, and allother keys of sub-station and allied area.

5A460 Testing

5A461.1 General

At the completion of the work, the entire installation shall be subject to the following tests inthe presence of the Engineer.

a. Wiring continuity test.

b. Insulation resistance test.

c. Earth continuity test.

d. Earth resistivity test.

5A461.6.2 Test as per Appendix `E' of BIS: 732 -1989

5A461.6.3 Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the Contractor at his own cost.

5A461.2 Testing of Wiring

All wiring systems shall be tested for continuity of circuits, and earthing after wiring iscompleted and before installation is energized.

5A461.3 Insulation Resistance Test

5A461.3.1 The insulation resistance shall be measured between earth and the whole system of conductors, or any section thereof, with all switches closed and except in concentric wiring alllamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from AC three phase systems, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 divided by the number of points provided on the circuit, the whole installation shall have an insulation resistance greater than one megaohms.

5A461.3.2 The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant standard specification or where there is no such specification, shall not be less than one a mega ohms. All equipment, cables shall be inspected at works by the Architect as per relevant IS and testing commissioning of installation as per Appendix `E' of BIS: 732-1989 shall be done andall record to be maintained.

5A461.4 Testing of Earth Continuity Path

The earth continuity conductor metallic envelopes of cables shall be tested for electric continuityand the electrical resistance of the same, along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation, shall not exceed one ohm.

5A461.5 Testing of Polarity of Non-Linked Single Pole Switch

In a two wire installation a test shall be made to verify that all non-lined single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation, a test shall be made to verify that every non-linkedsingle pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Engineer as well as the localauthorities.

5A462 <u>Annexure –XIII</u>

5A462.1 Abbreviations

The following abbreviations have been used in the accompanying specifications.ACB Air Circuit

Breaker	
AMP	Amperes
BIS	Bureau of Indian Standards
CU	Copper.
DP	Double Pole
FDB	Final Distribution Board
GI	Galvanised Iron (Mild Steel)
HV	High Voltage (3.3 KV and above)
HT	High Tension
IEE	Institution of Electrical Engineers - London
KWH	Kilowatt Hours
KW	Kilo Watts
KV	Kilo Volts
LV	Low Voltage (32 V and Below)
LT	Low Tension
MV	Medium Voltage (110 V, 230 V, 415 V, 600 V)
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MDB	Main Distribution Board
MTBF	Mean Time between Failure
MCC	Motor Control Centre
NEC	National Electrical Code
PVC	Polyvinyl Chloride
PPCP	Poly propylene Co-polymer
PMMA	Poly methyl methacrylate
RCCB	Residual current Circuit Breaker
SP	Single Pole
SDB	Sub Distribution Board
TPN	Triple Pole and Neutral
TP	Triple Pole
V	Volts
VCB	Vacuum Circuit Breaker

5A463 ANNEXURE –XIV

5A463.1 List of Standards

BIS-325	Three phase induction motors
BIS - 374	Ceiling fans and regulators (3rd revision)
BIS-398 (part-1)	Aluminum stranded conductors

BIS-398 (part-2)	Aluminum conductors, galvanized
steel reinforced BIS-694	PVC insulated cables for working
voltage up to 1100V	
BIS-732	Code of practice for electrical wiring installation
BIS-900	Code of practice for installation and maintenance of inductionmotors
BIS-1248	Electrical measuring meters : Part 1,2,3,4,5,6,7,8,9
BIS-1255	Code of practice for installation and maintenance of powercables including and up to 33 kV rating
BIS-1293	Three pin plugs and socket outlets
BIS-1554 (Part-1) cables	Specification for PVC insulated (heavy duty) electric for working voltage up to and including 1100V
BIS-1554 (Part-2) cables	Specification for PVC insulated (heavy duty) electric for working voltage from 3.3 to 11 KV
BIS-1646	Electrical installation fire safety of buildings (general) Codeof practice
BIS-1885	Glossary of items for electrical cables and conductors
BIS-1944	Part 1 and2 – Code of practice for lighting of public throughfares
BIS-2071	Method of high voltage testing(Part1 to 3
BIS-2147	Degree of protection provided by enclosures for low voltageswitchgears and control gears
BIS-2148	Specification for double compression cable glands
BIS-2268	Electric call bells and buzzers
BIS/IEC-62305	Protection of building and allied
structure against lightning.	BIS-16102 Part 1, 2 LED lamps for
general lighting services	
BIS-2440	Guide for day lighting of building

BIS-2551	Danger notice board
BIS-2667	Fittings rigid steel conduits for electrical wiring
BIS-2705	Specification for Current transformer (Parts 1 to 4)
BIS-3043	Code of practice for earthing
BIS-3419	Fittings for rigid non-metallic conduits
BIS-5133(part 1) Steel and	Boxes for enclosure of electrical accessories Part-1 : cast iron boxes
BIS – 5077	Decorative lighting outfits
BIS-5216	Recommendation on safety procedures and practices inelectrical works(Part 1and2)
BIS : 5578	Marking and arrangement of bus bars
BIS-5819 cables	Recommended short circuit rating of high voltage PVC
BIS-5987	Code of practice for selection of switches
BIS-7098 (Part2) sheathed	Cross-linked Polyethylene (XLPE) insulated PVC cables For working voltages from 3.3 KV up to and including33 KV
BIS-8623	Specification for Low voltage switchgear and control gear assemblies(Part1,2and3)
BIS-8828	Circuit breakers for household applications – MCB
BIS-9537	Rigid steel conduits(Part 1 and2)
BIS-9537(Part 3)	PVC rigid conduits
BIS-10118	Code of practice for selection, installation and maintenance of switchgear(Part 1,2,3and4)and control gear
BIS 3646	Interior Illumination Pt – I and II
BIS – 10322	Luminaries – General requirement(Part-1,2,3)
BIS- 10810	Methods of test for cables

BIS-12360	Voltage bands for electrical installation including preferredvoltages and frequency
BIS-12640/IEC 61008	Specification for RCCB
BIS-12729	Switchgear and control gear for voltage exceeding 1000V
BIS-12943	Specification single compression cable gland
BIS-13703	Specification for low voltage fuses upto 1000V
BIS/IEC 60947	Specification for low voltage switchgear and control gear (Part 1,23)
BIS-15652-2006	Specification for rubber mats

for electrical purposesBIS: 1651 and 1652 Stationary

cells and batteries lead acid type.

IEEE 519-1992	IEEE recommended practices and Requirements for harmonic control in Electrical Power Systems
IEEE 1100	IEEE Recommended Practice for Powering and GroundingElectronic Equipment
IEEE 241	Recommended Practice for Electric Power Systems inCommercial Buildings
NEC	National Electric Code
NBC	National Building Code 2026 with latest amendments

5A465 Aviation Lighting

5A465.1 Aircraft warning lights which are lighting devices used to make tall structures more visibleto aircrafts, during both daytime and night time should have specific features, in terms of light intensity, beam pattern and light colour defined by international regulations and national standards

5A465.2 Lighting systems, often called obstruction lights, are designed with different shapes, coloursand light intensity to produce an acceptable level of safety: the final purpose is to prevent arisk of collision for aircraft flying near the structures

5A465.3 Location of lights to be placed on the object, the regulation suggests that one or more low-,medium- or high-intensity obstacle lights shall be located as close as possible to the top of the object. Top light shall be so arranged as to at least indicate the points or edges of the highestobject in relation to the obstacle limitation surface

5A465.4 All buildings / towers height S+10 floor & above and HTR shall be provided with aviationlight.

5A465.5 The Contractor shall be responsible for the necessary wiring, installation, testing and commissioning.

LIFT SPECIFICATION

PATIENT BED, PASSENGER, DUMBWAITER AND GOODS LIFTS

All works shall be carried out as per CPWD specification, NBC and governing standards latest amended till date.

1.1 SCOPE

This specification calls for Planning, designing, Supply, Installation, Testing and Commissioning of the Lifts at site. all Statutory clearance from the inspecting authorities for the safe operation of the lifts shall form a part of the scope of work of the bidder & shall be obtained prior to putting the lifts in service. Lift capacity, size, speed and dimensions etc shall be as per NBC 2026 guidelines. All design calculations regarding lift capacity and speed etc. shall be furnished for verifications and client approval.

1.2 STANDARDS

- The passenger lifts shall conform to the following I S standards as applicable:
  - IS: 4666-1980 : Specification for electric Bed, Passenger & Goods Lifts.
  - IS: 2332-1963 : Nomenclature of Floors & Stories.
  - IS: 14665, pt-1, 2000 / goods, IS: 3534 : Guide lines for out-line dimensions for passenger, service Lifts.
  - IS: 14665, pt-2, 2000 : Recommended elevator speed for passenger, goods services & Lifts.
  - IS: 14665, pt-3, 2000 : Safety rules for passenger, goods, service Lifts.
  - IS: 14665, pt-4, 2000 : Components for passenger, goods, service Lifts
    - Section-1/ IS: 9803 : Lift Buffers.
    - Section-2/ IS: 11615 : Lift Guide Rails and guide shoes.
    - Section-3/ IS: 10191/ IS: 11706 : Lift Car frame, car, counter weight & suspension.
    - Section-4/ IS: 9878 : Lift Safety gears and governors.
    - Section-5/ IS: 10448 : Lift Retiring Cams.
    - Section-6/ IS: 7759 : Lift doors, locking devices and contacts.
    - Section-7/ IS: 7759/ IS: 10913 : Lift Machines and brakes.
    - Section-8/ IS: 8216 : Lift Wire ropes.
    - Section-9 : Lift Controller operating devices.
  - IS: 14665, pt-5, 1999 / service & IS: 14671 : Inspection manual for passenger, goods, lifts.
  - IS: 8151 : Induction motors for electric Passenger & Goods Lifts.
  - IS: 4289-1967 : Specification for lift Cables.
- The Installation of Lifts shall conform to:
  - IS: 1860-1980 / IS: 6620 : Code of Practice for Installation, Operation & maintenance of electric & Passenger & Goods lifts.
  - IS: 3043-1966 : Code of Practice for earthing.
  - National Building Code-Chapter VIII-2016.
  - Lifts Acts and Rules,
  - Indian Electricity Rules and Acts.
  - Local authorities' requirements, if any.

1.3 TECHNICAL SPECIFICATION

1.3.1 SITE PREPARATION

The site where the Lift has to be installed, shall have following basic requirements:

MACHINE ROOM:

Lifts with Geared mechanism and machine room shall be preferred. MRL may be used for shuttle lifts between parking and podium levels. Number of lifts and their orientation with respect to each other shall determine the size of the Lift machine room. All the overhead machines and control panels for each lift shall be located in the common Machine room. if machine room less (MRLS) lifts are required, it has to be planned and provided based on clients requirement & approval.

LIFT SHAFT:

Each lift shall have its own shaft having a size determined by the no. of passengers to be carried in the Lift carriage. The shaft shall be in plumb as per I S: 14665 pt. 2, 2000.The shaft shall serve each floor in which suitable opening shall be available. An opening shall be available in the wall at each landing for fixing the landing door. Size of the opening shall be commensurate with the lift Carriage door size.

LIFT PIT:

A suitably sized 'Pit' shall be made available below the first landing floor, free of moisture/water etc. The depth of the pit shall be suitable to accommodate the passenger carriage and the 'Shock absorbing springs 'required to be installed in the base of the shaft.

1.3.2 LIFT FEATURES

PASSENGER CARRIAGE:

Size of the Passenger Carriage shall be extra tall and determined by the number of passengers to be transported at a time.

- The door of the carriage shall be 2.4m tall and 'Centrally opening type in two halves' or telescopic type, opening in one side.
- Door may be manually / automatically operated – electrically.
- The internal finish of the Passenger Car and the Door shall be as per the standard practice of the lift manufacturer and as agreed with the Client/Consultant.
- The lift finish shall be Moonrock or Linen Finish scratch resistant.
- TFT of lift should have provision for OB&CC Logo.
- The lift shall be operable with/without an attendant. The controls shall be operation friendly, matching with the ambience.
- The floor of the car shall be durable, abrasion resistant.

FLOOR LANDING DOOR:

It shall have a fire rating as per I S Standards. It shall be made of M. S. painted. / Stainless Steel as agreed with the Client/Consultant. All Lifts shall serve all the floors including basements.

SPEED OFTRAVEL:

As per I S standards and as agreed with the Client/Consultant.

TYPE OFDRIVE:

The type of 'Drive' may be Single speed / Two Speed / A C Variable Voltage, Variable frequency (VVVF) drive. The type of drive shall be selected depending on the use; the lift shall be put to.

TYPE OFCONTROL:

The type of 'Control' shall be selected best suited for the use of the lift in consultation with the Client, Consultant and the manufacturer of the Lift. The control shall be one of Automatic Push Button / Dual Push Button / Duplex Down-Collective Control / Duplex Collective- Selective Control
/ Triplex Down-Collective Control / Triplex Collective-Selective Control.

FIREMAN'S CONTROL:

Required for one lift as per IS & local Fire Department's standards.

OPERATIONAL FEATURES:

Operational features shall be as per the specific requirements of the lift and as agreed with the Lift manufacturer.

1.3.3 ADDITIONAL FEATURES REQUIRED

a. FIREMAN'S SWITCH

A fireman's toggle switch shall be provided in a break glass for the specified elevator at ground floor to enable firemen to bring the elevator non-stop to ground floor from any location and to cancel hall calls until the car is operated on attendant control.

b. ANTI - NUISANCE

If number of calls registered is in excess of corresponding car load, all car calls shall be cancelled.

c. HOME LANDING FACILITY

A car shall return to a pre-determined landing after the last call is answered.

d. LOAD NON-STOP

When the car load exceeds a predetermined limit the elevator shall not respond to hall calls.

e. SEPARATE DOOR TIMES

When a car responds only to hall calls or only to car calls, the door shall open for a shorter time than when responding to both car and hall calls.

f. DOOR FAILURE OPERATION

When an obstruction prevents a door from opening, the controller shall attempt its removal by repeated opening and closing, failing which the car shall travel to the next floor.

g. NUDGING DOOR OPERATION

When the doors remain open for more than a predetermined period a buzzer shall sound and the door shall close automatically. The door sensing device shall be rendered

inoperative but the Door Open button and the safety shoe shall remain operative

h. SELF - DIAGNOSTIC FACILITY

The Controller shall perform self - diagnostic tests and report the health of the system. The system shall take care of minor faults like door operation and motor overheating.

i. CAR FAILURE OPERATION

In case of car mal-function, the system shall make a self - diagnostic check and then allow the car to travel to the nearest floor at slow speed, if safe.

j. SELECTIVE FLOOR SERVICE

Programming for selective floors services shall be software driven.

k. AUTO FAN OFF

In case no call is registered for pre-set time, the cabin fan shall be automatically switched off.

l. AUTOMATIC RESCUE DEVICE (ARD)

- In case of mains power failure and elevator control system failure, the elevator's own rechargeable and maintenance free battery power shall move the car to the nearest floor or GF and the door shall open automatically for automatic rescue of passengers. A battery run-down indicator / alarm shall also be provided.
- Compulsory Automatic Rescue Device shall be provided for all the Elevators.

1.4 SPECIFIC TECHNICAL REQUIREMENTS SITE REQUIREMENTS:

The lift shall meet the following site requirements:

- Lift machine type & control: Gearless machine in machine room directly above lift well or MRLS as required.
- No. of lifts : As per traffic analysis and drawing
- Type of Lift : Passenger/goods lift.
- Lift Capacity : ---- Passengers / ---- Kg (Ref Dwg/NIT/ as per std.).
- No. of operating floors : High rise / low rise (Ref Dwg). Patient Bed/ Stretcher/ Freight / Fire tower from basement to terrace.

- Distance between floors : ----- mm (Ref dwg).

- Lift Well dimension : ---------mm, plaster finished (Ref Dwg).
- Speed of Travel : 1.5~4.5 M/second or as directed by Engg.in charge.
- Type of drive : AC variable voltage, variable frequency (VVVF) drive.
- Type of Control : Duplex collective-selective control .
- Fireman's Control : Required for one lift.
- Lift operation : Destination Control System
- Machine Room : Refer enclosed Drawing
- Type of Lift Door : Center opening (Horizontal), automatic door with ACVF drive, made of stainless steel. Optimized timing for opening
- Floor Landing Door : It shall have a fire rating of 2Hrs. It shall be made of MS Stainless Steel Velvet / Moon Rock finish. o

  Type of Car Interior : Stainless steel interior
  - Car suspended ceiling : Stainless steel Velvet/ Moon rock finish with glare free LED fixtures for car lighting.
- Car flooring : As per finishes schedule- shall be as per approval.
- Natural mirror in car : Provided
- Handrail : Stainless steel Round handrail on 3 walls of car.
- Car operating panel : NA
- Landing operating panel : 2 touch pads for DCS at each landing and 3 at GF lobby level
- CCTV : Provisions for 4MP or better, IR, Mini dome camera, PA, Tel. shall be considered inside.
- Inside the lift shaft there shall be arrangement of one light point at each floor level and one light point at overhead top, & one light point in lift pit. All light points shall be in group controlled and wired with 2.5 sq mm FRLS copper wires. 15-amp power plug and 5- amp power plug shall be provided at each floor level. Wiring of these power plugs shall be done with 4.0 sq mm FRLS copper wires. LED Bulk head fittings of suitable rating to provide inside shaft. Average 100 lux shall be planned with each light point of lift shaft.

OPERATIONAL FEATURES:

- Over-load control (non-start with audio-visual warning indication).
- Landing Calls automatic By-pass on lift-car loading > 80% rated load.
- Emergency power control (with DG set) (on Mains failure; lift to come on nearest landing when DG Power available; lift door opens. Same operation repeats with next lift and so on).
- Emergency Rescue Device (with Battery power for each lift – same as above).
- Up / Down direction indication on all floors.
- Emergency Alarm & Light inside the lift-cabin with chargeable battery.
- Auto-shut-off of car fan when lift car is empty.
- Two way Intercom device in Car (One set in the Car-cabin & the other in Warden's office within 10Meters).
- Infra-red full door safety Screen in addition to the mechanical Al. nose safety shoes.
- Audio-visual announcement of lift on approaching the landing with single stroke of gong.
- Voice announcement in the lift car on approaching the landing.
- Music in the Lift-Car.
- Door closing over-ride through push button in lift car.
- Anti-Nuisance of empty car operation & car-call cancellation on reverse direction.
- Braille signage shall be provided in Lifts.
- Potential free contacts for BMS use.
- Flame retardant travelling cable, O/L & phase reversal protection.

1.5 FACILITIES TO BE PROVIDED BY THE CONTRACTOR/ VENDOR

The lift well of the specified dimension shall be made available in finished condition.

- Entrance door opening of 1000-1200 (W) x 2400 (H) mm on each floor without door / door-

frame. (or as per NBC 2026)

- Machine room for the lifts shall be made available along with the approach ladder, natural and forced ventilation as per the lift vendor's requirement.
- The owner shall make available the three phase, 415V, 4 Wire, 50Hz. power supply at one point in the Lift Machine room through a 63Amps TPN MCB.
- Two nos. building Earth connection shall be extended up to the Lift machine room.
- The power distribution and control of the lifts shall be the responsibility of the Lift supplier.
- All inserts, grouting, minor civil work etc. including the Scaffolding required shall be carried out by the lift vendor.
- Illumination and 15amps power points at each landing shall be arranged by the vendor.

1.6 VENDOR'S RESPONSIBILITY

- All arrangements other than specifically mentioned as Owner's responsibility, as required for installation, testing & commissioning of the lifts to make them functional in a safe manner shall be made by the Lift vendor.
- The vendor shall also be responsible to obtain the Certificate from the 'Inspector of the Lifts' as well as the 'local fire department' as applicable for safe operation of the lift.

1.7 SITE TESTS

Following tests shall be carried out on the lift on completion of erection in addition to any other tests that may be required to determine the safe operational requirement:

- Insulation of Electrical system (should be > 0.5MΩ.)
- Earth continuity tests.
- Function of Motor, Brake control equipment and Door locking devices.
- Rated Load-Test of the lift.
- Rated speed test at full load & No load.
- Safety gear stopping the Lift on Landings at rated Load.
- Any other test required by local authorities.

1.8 PERFORMANCE & TYPE TEST

Consignee will inspect the lift at manufacturing stage at firm premises to carry out all the routine tests. The performance test at site shall be carried out in the presence of inspector of local authorities and certificate thereof shall be supplied to the consignee. The testing shall be in accordance with I S: 4666/68. The contractor has to arrange the Inspection by Lift Inspector Local Govt.

1.9 GUARANTEE

The standard guarantee for a period of 12 months after final commissioning for trouble free performance against defective workmanship or manufacture, wear and tear in parts not attributable to the negligence, shall be given along with tender.

1.10. FREE POST COMMISSIONING MAINTENANCE SERVICE

The supplier must give minimum one year free post commissioning service which shall be all inclusive.

1.11 DRAWINGS & LITERATURE

- The supplier shall provide general arrangement layout drawing of the elevator on award of the contract. Necessary number of final approval layout drawings is to be provided for purchasers records.
- In addition to the elevator drawing wiring diagram, maintenance and lubricating check charts are also to be supplied on completion of installation.
- One schematic wiring diagram is to be displayed in the machine room as per applicable lift code.
- Screen printing data of major equipment with date of commissioning is also to be displayed in the machine room..

Operation & Comprehensive Annual Maintenance

The Contractor shall quote for Operation & Comprehensive Annual Maintenance service contract for the system offered by him for a period of 5 years for all items. Any parts / components whatsoever need replacement during the above period shall be supplied and installed by the vendor free of cost.

Periodical checking for all parameters for machines operation and diagnosis, routine checking and cleaning operations, annual preventive maintenance / overhauling as required for smooth and trouble-free operation of the package shall be carried out by the contractor. A Routine Preventive Maintenance (PM) and Operation Plan schedule shall be submitted in accordance with the general specifications.

The PM and Operation plan shall cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract). The Contractor shall submit a full operation and maintenance document and manual for Plant and machinery history card giving full details of all installed equipment and frequency of checks and routine maintenance and overhaul in order to result in fully functioning and operational equipment at all times during defect liability period. The Contractor shall comply to the general specifications.

Testing of the Lifts

The Contractor shall carry out inspection and testing at manufacturer's works for item elevators for this contract. No equipment shall be delivered without prior written confirmation from Engineer.

Guide Rails
Steel guide rails shall be installed to guide the car and counterweight, erected plumb and securely fastened to the building structure, fitted to ensure smooth joints. The guide rail shall be minimum 16 mm, tongued and grooved type. All insert plates and their positions and fixing to be provided by the Contractor.

Next Car Up
"Next Car Up" shall be indicated by flashing of lantern for the car so designated at the lobby. Other cars shall remain parked with doors closed until each car, in turn, is assigned as "Next Car Up".

Despatch System
The dispatch system shall be microprocessor based. The system's main computer shall communicate with each car's computer. Microprocessor shall be intelligent in that it learns traffic patterns and applies best solution to each traffic condition, as determined by shortest predictable response. The CPU shall monitor demand on the system and shall execute the most economical assignment of cars.

Earthing (Electrical Grounding)
All conducting parts of the elevators / panels etc., power and lighting in the shaft shall be earthed properly as per codes to ensure safe operation.

The Elevator Panel shall be able to accept signal from the Fire Alarm Panel in case of fire and automatically ground the elevator to the designated floors (Default or alternate) on receipt of this signal. Minimum two number of copper plate earthing shall be provided for each elevator.

Safety Aspects and Procedures
Since lift installation consists of a number of electrical and mechanical components having linear / rotary motions, utmost caution should be exercised while working and all safety precautions shall be rigorously followed.

Only authorized persons shall be allowed to work on lift installations and officer (s) empowered for such authorization shall keep proper record thereof during the tests, inspection and maintenance except where necessary.

Other Specifications

- Door Operation : Automate with Door Monitor
- Noise Level in cabin (Running Car) : 55 db.
- Door : SS hairline
- Lift Flooring : Granite (Golden Galaxy) Premium with 16mm Recess for Flooring.
- Cooling in Lifts : Axial Blower
- Illuminated Buttons & Digital Car Position Indicator : YES

DUMBWAIETRS GENERAL SPECIFICATION

LOCAL CONDITIONS

Tenderers must acquaint themselves fully with the situations, the local conditions and the requirements of this specification. Later claims by the successful tenderer for extra payment arising out of under-estimating any of the requirements will not be considered by the Department.

WORK SURROUNDING THE DUMBWAITER INSTALLATION

The work surrounding the Dumbwaiter installation will consist of the following:

a) The Contractor will provide the machine rooms complete with floors, access doors and openings as per drawings approved by Principal Consultant/ Engineering-In-Charge.

b) The Contractor will provide the shafts, shaft pits and shaft openings as detailed on the drawings. The Lift Sub-Contractor shall supply and install all necessary, fixing brackets required for the installation of equipment in the shaft.

c) The Contractor will do the screeding of the floors, plastering and painting of walls.

d) The provision of permanent lighting to the machine room as required by the Inspector of the Department of Labour will be the responsibility of the Contractor.

e) The Electrical Sub-Contractor shall provide a 3-phase, 4-wire, 50 Hz *400/230V* permanent power supply to a surface-mounted distribution board in each machine room in the position shown on the drawings. The Lift Sub-Contractor shall supply and install the necessary wiring in conduit from the controlling circuit breakerto the power section of the hoist controller.

f) The Electrical Sub-Contractor shall provide separate circuit breakers in the distribution board in each hoist machine room to feed the machine room lights, socket outlets and ventilation fan as well as the car lighting and car socket outlets. The conduit and wiring for the car lighting and socket outlets shall be supplied and installed by the Lift Sub-Contractor and terminated and connected-up at the distribution board.

HANDLING OF MATERIAL

The Sub-Contractor shall be responsible for providing all the required equipment for the off-loading and proper handling of the material on site. He/She shall also be responsible for the installation in the correct position.

APPROVAL OF DRAWINGS

All drawings, circuit or schematic diagrams prepared by or on behalf of the Sub-Contractor for submission to the Engineer in terms of the requirements of this specification shall have been thoroughly checked, corrected where necessary and signed as approved by the Sub-Contractor, prior to such submission.

The Principal Consultant's/ Engineering-In-Charge's approval of any drawings will cover the arrangement, type and operational suitability of the equipment in general only. Such approval will not release the Sub-Contractor from his responsibility for the proper operation of the installation or for its full compliance with the specification, drawings, local authority and statutory requirements, or for ensuring that the equipment can be physically accommodated within the space and via the access provided.

INSPECTION AND TESTING

PHYSICAL INSPECTION PROCEDURE

On completion of the Installation or before any inspection or testing is required, the Contractor shall carry out his own inspections to ensure that the installation and equipment comply with the Specifications and that the quality of workmanship and materials are to specified standards. The Principal Consultant/ Engineering-In- Charge will not act as the Contractor's inspector or quality control official.

Once the Contractor has completed the installation, written notice shall be given to the Principal Consultant/ Engineering-In-Charge in order that a mutually acceptable date can be arranged for a formal inspection.
During the course of the inspection, the representative of the Principal Consultant/ Engineering-In-Charge will compile a list of items (if any) requiring further attention. A copy of this list will be provided to the Contractor who will have seven days in which to rectify the offending items of the installation.

The Contractor shall then provide written notice that he is ready for an inspection of the remedial work to the offending items.

This procedure will continue until the entire installation has been correctly completed in accordance with the specifications.

After the first inspection, all time and traveling costs incurred by the engineer for further inspections or re-inspections will be payable by the Contractor.

Factory Inspections and Tests

The Contractor shall advise the Engineer in writing of any routine, type or specific tests to be carried out on equipment during the course of manufacture in the manufacturer's factory or works or any stage of completion in the manufacturing

process which requires inspections in terms of the Contract and Specifications. Such notice shall be given at least seven days prior to the testing or inspection being required.

The Contractor shall dispatch equipment from the factory at his own risk if tests have not been witnessed and inspections not been carried out by the Engineer or his authorized representative and approval given by the Engineer for dispatch.

The Contractor's Project Engineer shall in all instances do his own inspections and ascertain that the equipment will be ready for inspection and testing before the Engineer's attendance requested. The Principal Consultant/ Engineering-In-Charge also reserves the right to inspect any equipment at the manufacturer's works at any stage during the manufacture.

Testing

The Contractor shall arrange for the complete installation to be tested by the local authorities where applicable.

The Tenderer must submit with his tender one copy of each of all type of test certificates called for in the Specifications.

All tests shall be carried out in accordance with the requirements of the specified and recognized standards. Where tests have not been detailed in the documents, the contractor shall provide comprehensive documentation of the standards and procedures he intends using in testing.

Such additional tests in the manufacturer's works, on site or elsewhere as in the opinion of the Principal Consultant/ Engineering-In-Charge are necessary to determine that the contract works comply with the specifications may be called for if deemed necessary nothing extra will be paid for. A retest will under no circumstances be paid for.

The Contractor will be required to submit certified copies of all type, routine and rating test certificates which forms part of this contract.

CONTROL REQUIREMENTS

The Dumbwaiter shall be of the single-speed AC electric drum or traction driven type and shall be manufactured to comply with the basic requirements listed in the schedule of requirements and designed to meet the detailed requirements specified in the subsequent clauses of this part.

The equipment offered shall be suitable for continuous operation, with electricity supply being, 3-phase, 4-wire, 50Hz AC with nominal voltage of 415/230V varying between 95% and 105% of the nominal voltage.

SCHEDULE OF REQUIREMENTS

Description	**Design Requirements**
Lift No.	As per Tender
Type of service	Dumbwaiter
Shaft size	As per detail design & drawing
Headroom	As per site

Internal size of	As per OEM for required capacity
Approximate net	As per OEM for required capacity
Duty mass load	As per Tender
Total travel	As per detail design & drawing
Number of stops	As per tender
Type of doors	Vertical sliding, folding shutter
Clear opening of doors	minimum 850 x 850 mm
Position of entrances	750mm above floor level or as per site
Type of landing door frames	Stainless steel 316 L
Position of machine room	At top of shaft
Type of drive	Drum Traction / as per OEM
Contract speed	max *0.5m/s*
Power control system	Single-speed, AC resistance
Operation	Single automatic pushbutton
Type of car and landing buttons	Self illuminated Vandal-proof, mechanical micro push
Pit depth	As per detail design & drawing
Type of shaft	Concrete/ Galvanised steel as per site requirement

EQUIPMENT IN MACHINE COMPARTMENT

Structure

The structure shall be free standing and manufactured from cold rolled and galvanised profiles, pre-mounted in 2m sections.

The structure once assembled shall be enclosed in brickwork/ RCC (by the Contractor)
through which openings will be provided for sills, door frames etc.

Machine

The machine shall consist of a flange-mounted motor driving a continuous groove drum through a gearbox, and a solenoid brake. The machine and control equipment shall be mounted on a platform installed in the top of the shaft. Access to

the machine compartment shall be provided by means of a hinged access panel at the front of the shaft at a suitable height above the top landing served.

2.3.3 Motor

The motor shall be a single-speed, 3-phase, squirrel cage induction motor with a high torque and low slip characteristic to reduce the variation in speed with load to a minimum.

The motor shall be started direct-on-line and shall be retarded and stopped by cutting- off the power supply and applying the solenoid brake.

Gear Box

The gearbox shall consist of a cast iron housing accommodating the worm wheel and worm shaft, which shall be partly immersed in a specially selected lubricating oil. Removable covers shall be provided in the housing to facilitate easy inspection of the gears. The worm shaft shall be carried in sleeve bearings at the driven end and double thrust ball bearings at the other end.

The worm wheels shall be cut from a centrifugal cast phosphor bronze rim and shall be shrunk on and fixed to a cast iron spider by means of keying screws. The drum shall be mounted to the worm wheel shaft, which shall run in sleeve bearings or roller bearings provided silent operation can be guaranteed. Thrust bearings shall be removable without having to dismantle the complete machine.

The drum shall be provided with an accurately machined continuous rope groove, the profile of which is to be selected with due regard to the specified duty, to ensure sufficient and even traction and long rope and groove life. The drum shall have sufficient metal thickness to allow for future re-grooving and shall be easily removable.

Brake

The brake shall be of the drum of disc type mounted on the motor drive shaft between the motor and the gear box and shall be operated by a DC solenoid acting on two self- aligning rake shoes lined with friction material. The shoes shall be independently mounted and shall be spring applied and electrically released. One half of each brake must be capable of holding the car in the event of failure of the other half. The rake shall operate in the event of a power failure or the operation of any other safety device designed to stop the hoist.

Hand turning Gear

The lift machine shall be provided with a hand winding wheel and manual

brake release lever to facilitate the safe turning of the machine by hand.

Mounting of Lift Machine in Machine Compartment

The lift Sub-contractor shall supply and install suitable structural steel beams with bearing plates for the mounting of the lift machine in the machine compartment.

Anti-vibration mountings shall be provided to minimise the transmission of vibrations to the structure and to ensure the silent and smooth operation of all the equipment. Tenderers shall describe the methods to be used to achieve the desired result.

Controller

The control gear shall be assembled on a separate frame, mounted on the main machinery or machine compartment walls.

Contact surfaces of contactors and relays shall be of the silver-to-silver type. Copper- to-copper contacts will not be accepted.

All wearing parts must be easily renewable, and flexible connections must be used for all moving contacts. Spring or moveable joints shall not be current carrying.

The controllers must incorporate all switch-gear, relays and other equipment necessary for the operation and protection of the hoist, and must be so designed that the car will automatically be brought to a stop in the event of: -

Interruption of the main power supply, or the interruption of anyone phase of the main supply, or if a phase reversal of the main supply has occurred;
The operation of the top limit switch;
Operation of the slack rope sensing switches;

All terminals of the machinery and control gear shall be marked with distinctive letters or numbers, and corresponding markings shall appear on the contract drawings.

Access Panels

The Sub-contractor shall allow for the supply and installation of the hinged access panel required for closing off the machine compartment. The panel shall be manufactured from 1.6mm folded stainless steel suitably reinforced to provide rigidity. The panel shall be secured to a hollow section, SS frame, fixed to the side, top and bottom of the opening, by means of two sturdy hinges at the

top of the frame. Two foldaway knee braces shall be provided to keep the panel in its position. A lockable lever catch shall be fitted at the bottom and the panel shall be finished to match the landing doors of the hoist.

EQUIPMENT INSTALLED IN THE HOIST-WAY

Guide Rails and Guide Shoes

The guides for the car and counterweight shall consist of suitable rolled steel channel or T - sections designed to be fixed directly to the shaft walls or constructed top form a self-supporting structure for the hoist. Metal splice plates shall be a suitable length and fixing brackets for guide rails shall be located in such positions that when the car is at any landing the guide shoes on the car will be at a fixing bracket.

All brackets shall be secured by means of approved expandable concrete anchor bolts of adequate size and length.

The hoist shall be fitted with spring-loaded sliding-type guide shoes provided with automatic oil feed lubricators. The shoes shall have ample bearing surfaces and shall be easily adjustable and removable for renewal.

Ropes

Ropes shall be of the best quality and of suitable number, size and manufacture to ensure proper operation of the lift, and to give satisfactory wearing qualities. All ropes shall consist of at least six strands wound round a hemp core centre.

Over-Travel Protection

Normal and final terminal stopping switches shall respectively be arranged to stop the car and prevent its normal operation should it travel beyond the zone of the normal stopping device at the upper and lower terminal floors or travel within the top and bottom clearances.

Stop Switch In Pit

A watertight stop switch shall be provided in the lift shaft in a position that can be reached from the lowest floor served.

Accessibility for Maintenance

The equipment in the machine compartment shall be so arranged and positioned that all adjustments and maintenance work can be carried out through an access panel situated above the landing door of the uppermost floor served by the hoist.

HOIST CAR

Construction
The hoist car shall be manufactured of folded, Stainless steel 316L sheets and shall be fitted with one removable shelf.

LANDING EQUIPMENT

Landing Doors

The landing doors for the hoist shall be of the manually operated, vertical bi- parting type. The doors shall be of brushed satin finished stainless steel construction, designed so that the clear door opening shall be equal to the full height of the car and 100mm less than the width of the car to give unobstructed access when open. The doors shall be of rigid and robust construction, suitable to withstand the impact of goods being handled and the general abuse usually occurring in service areas.

The doors shall be supported on both sides by bearing tyred runners in smooth polished steel track and guided at the bottom by non-metallic shoes sliding in smooth machined grooves. The doors shall completely close off the door opening, lock positively and be equipped with the necessary safety devices to prevent the lift from starting unless all the doors are fully closed.

Landing Sills and door Frames

Landing sills shall consist of a substantial angle or channel section stainless steel and shall be firmly fixed to the building work surrounding the structure and at 700mm above floor level.

The doors and frames shall be manufactured from brushed satin finished stainless steel angle or channel sections and shall be built into the door openings.

Landing Operating Panel

A landing operating panel shall be provided adjacent to the landing doorframe on each level. The following facilities shall be provided in the panel:

a) Indication that the hoist is in use;

b) Indication that the hoist has arrived at a floor by means of a gong andilluminated call button;

c) Pushbutton to call the hoist;

d) Pushbutton for each floor served to send the hoist to a particular floor.

Operation of the Hoist

The operation of the hoist shall be fully automatic, i.e. it shall carry out one instruction at a time and when in use shall ignore any other calls and will only become available to a second user upon completion of the trip initiated by the first user.

COST OF MAINTENANCE

Tenderers shall quote in the Price Schedule individual monthly rates for each Dumbwaiter for the Comprehensive Maintenance in accordance with the Department's Comprehensive Maintenance Contract which is included as Part
5 for reference purposes. The tender price for each escalator shall include the cost of free maintenance for a period of 60 calendar months after installation and testing at site has taken place.

SCHEDULES OF TECHNICAL INFORMATION

GENERAL

Tenderers are required to complete the following Schedule of Technical Information and shall in addition, under separate cover, give full particulars of the equipment and installations offered as well as detailed descriptions of the variousmethods of control and operation.

Sr. No.	Item Description	Details
1	**Manufacturer's Name**	
2	**Country of Origin**	
3	**Manufacture**	
4	**Performance**	
	a) Car speed in *m/s*	
	b) Average round trip time	
	c) Maximum carrying capacity of each lift car	
5	**Main Hoist Motor**	
	a) Maker's name	
	b) Type	
	c) Rated output (kW)	
	d) Time rating (starts/hr)	
	e) Manufacturing standard	
	f) Maximum speed (RPM)	
	g) Rated voltage (Volts)	
	h) Full load current (Amps)	
	i) Starting current (Amps)	
	j) Type of bearings	
	k) Maximum line current with lift starting with full contract load (Amps)	
6	**Brakes**	
	a) Type	
	b) Position on machine c) Method of control	

	Item Description	Details
7	**Gearing**	
	a) Material of worm	
	b) Material of wormwheel	
	c) Type of thrust bearings	
	d) Ratio of gearing	
	e) Type of wormshaft bearings	
	f) Worm above or below wheel	
8	**Drive**	

a) Diameter of traction sheave (rope centres)

b) Type of grooving used on traction sheave

c) Type of bearing for sheave shaft

d) Number of turns of rope around traction sheave

9 Switch-gear and Control System

a) Make of main circuit breaker

b) Rupturing capacity of main circuit breaker (kA)

c) Type of control system d) Control voltage

e) Make of contactors

f) Make of control relays

g) Contact material used for auxiliary and main contacts of controller switch-gear

10 Car and Doors

a) Mass of complete car with doors and operating gear (kg)

b) Net inside dimensions: width x depth x height (mm)

c) Thickness of material of landing doors d) Finish of landing doors

e) Clear width and height of landing doors

f) Type of suspension used for landing doors

g) Thickness and type of car floor

h) Type of materials used for inside finishes of car

i) Stopping tolerance

11 Ropes

a) Maker's name

b) Diameter of ropes (mm)

c) Number of ropes

d) Breaking load of each rope

e) Maximum working load of each rope

f) Factor of safety

g) Tensile strength of steel used (MPa)

h) Number of strands in rope

i) Number of wires per strand

j) Construction and lay of rope

k) Type of rope fastenings used

l) System of roping (i.e. 2:1 or 1:1, single or double wrap)

12	**Guide Rails**
	a) Type and section
	b) Mass per meter-length (kg) for:
	1) Car
13	**Guide Shoes**
	a) Type
	b) Are sliding type shoes fitted with renewable linings?
14	Deviations from Specification:
	Does the equipment offered comply strictly with the specification (Yes/No)

ESCALATOR		
	PARAMETERS	**SPECIFICATION**
PRODUCT OVERVIEW	**CODES/STANDARD**	**EN115 /IS: 4591 – 1968 (**Latest Amended till date) / ANSI part VIII or to more stringent local requirements in construction, operational safety and installation. Escalator and their installation shall conform to governing codes for fire safety, as per N.F.P.A. 101. Escalators shall have 30 deg inclination. inclination unless otherwise indicated on technical data sheet. Contractor shall coordinate with other agencies also to establish structural requirements and dimensions. Provision of integration with fire alarm panel and BMS required.
	STEP Width	As per site requirement, minimum 1000 mm
	HORIZONTAL/FLAT STEPS	As per site requirement, minimum 250 mm
	INCLINATION	As per actual site condition
	VERTICAL RISES [mm)	As per actual site condition
	UNITS [Nos)	As per site requirement
	SPEED	0.5m/s
	TRASPORTATION CAPACITY	Capacity-9000 Person/hours Four flat steps at upper and lower landings
	MAIN POWER SUPPLY	3 x 415 V (-10% to +6%) at50 Hz (±2 Hz), 240 V lighting supply
	INSTALLATION ENVIRONMENT	Outdoor
	LOAD CONDITION	Commercial - Medium duty
	BALUSTRADE TYPE	Brushed stainless steel solid inclined and solid vertical balustrade panels
	BALUSTRADE HEIGHT	1000/ 1100 mm
BALUSTRADE AND HANDRAIL	HANDRAIL MATERIAL	Synthetic rubber with nylon lining
	HANDRAIL COLOR	Black
	DECKING [INNER & OUTER)	Stainless steel Hairline
	SKIRTING	Stainless steel with clear antifriction coating
DECK, SKIRT, ACCESS COVER, STEP,COMB, AND FRONT PLATE	SKIRT BRUSH DEFLECTOR	Skirt brush with holder
	ACCESS/LANDING COVER	Ribbed aluminum with natural color
	STEP TYPE	One piece die cast Aluminum
	STEP COLOR	Silver
	STEP DEMARCATION	Yellow painted lines at three sides
	COMB SEGMENT	Aluminum with yellow color
	FRONT PLATE	Black plastic
	LOAD DEFLECTION	Max 1:750

TRUSS	TRUSS STRUCTURE	Hollow profiles, L-profiles and U-profiles
	TRUSS FINISH	Hot dip galvanized
	MOTOR	3-phase, 6-pole induction motor and F insulation with IPSS protection
	GEARBOX	Worm gear
DRIVE UNIT	HANDRAIL DRIVE	Friction *drive* wheel via pressure rollers
	BRAKE	Operational brake
	DRIVE CHAIN STEP	Duplex drive chain
	CHAIN CONTROLLER	Precision roller type, with heat-treated links
	TYPE CONTROLLER	Microprocessor based PCB
ELECTRICAL SYSTEM	CABINET OPERATION	Steel Cabinet with IP 54 protection
	MODE CABLE TYPE	Automatic start / stop
		PVC Insulation
		Comb plate impact devices
		Handrail inlet switches
		Step sag switches
		Broken step chain switches (chain tension control switches, lower)
		Motor speed monitor (overspeed, under-speed, unintentional reverse, and braking deceleration)
		PVC Insulation
		Comb plate impact devices
		Handrail inlet switches
		Step sag switches

SAFETY AND ADDITIONAL FEATURES

1. Motor thermal protection
2. Mains supply isolator
3. Emergency stop buttons for passengers in the top left and bottom right handrail inlet front plates
4. Handrail speed and breakage monitor
5. Auxiliary brakes
6. Broken drive/ step chain (chain tension) switches in the return station which stop the escalator in case of failure of the drive/ step chain
7. Missing step detector
8. Mechanical step band lock
9. Brake lift monitoring switch
10. Step reverse fences
11. Phase failure
12. Handrail anti-static roller
13. Handrail inlet switches with contacts at the handrail inlets into the balustrade heads
14. Monitoring contacts, Buzzer alarm, Fire alarm relay, Wrong direction warning
15. Comb plate impact device switches which stop the escalator in case objects become trapped between the comb teeth and the moving step band
16. Step sag switches, which stop the escalator if a step sags by more than 5 mm before it enters the comb
17. Step guards at the top and bottom
18. Step band locking device
19. Speed sensor system, which electronically monitors the motor for over/under speeds and step band reversal
20. Motor thermal protection for temperature monitoring
21. Main switch with thermal and magnetic release
22. Stop switches for engineers' use within upper and lower end pits
23. Sockets for inspection use installed in the upper and lower machine compartments
24. Skirt deflector brushes
25. Access cover contacts
26. Handrail speed monitor
27. Missing step monitor
28. Diagnostic display
29. Automatic Lubrication; Water Drainage & Oil Separator
30. Remote Monitoring and E-link

Lighting

The Contractor shall provide the following:
Light outlet fittings, switches and wiring together with general purpose power point outlets as considered necessary by the Engineer to facilitate maintenance at machine compartment, pit and in the escalator trusses.

Comb illuminators complete with skirt panels on each inner side of the balustrades at both top and bottom landings. The comb illuminators shall be connected to the control panel and wired so that the strobing illuminators shall operate only when the escalators are in motion. LED lights shall be full tread width. Continuous LED Skirting lighting, Comb lighting and PIT lighting shall be provided.

Control Board

The control boards shall have all necessary microprocessor/ PLC, contactors, push buttons, overload devices, safety switches and circuit breakers for the safe operation of the system.
Overload protection for the motor shall be by thermal overload backed up by circuit breakers of sufficient capacity and the fault level. Reduced voltage starting is preferred to limit starting current. Contactors for

reversing the motor rotation shall be electrically and mechanically interlocked. In DC operation, governor shall stop escalator operation if speed exceeds rated speed. Micro switches used for the monitoring of safety devices shall be of a quick Snap-On type with non-sticking contacts. Relays used shall be of continuous duty. Sufficient auxiliary contacts or relays shall be provided for stoppage of escalator. Sensing cables and visual monitoring panel shall be provided.

Construction
Each escalator shall be self-contained unit consisting of Truss, step device units, step chains, comb plates, handrails, driving machine controller, safety devices, balustrades and all other parts required to provide a complete escalator.

Machine shall have worm gear and shall produce lower noise level and shall have higher efficiency than the conventional geared machine.

Motor insulation shall be Class F and protection shall be Class IP-55.

Operational brake shall be located between motor and the gear box shall have DC commercial magnet to avoid use of asbestos lining. The double acting shoe brake shall be failed safe and shall operate automatically via spring in the event of power failure or one of the safety switches tripping.

Controller
Machine switches shall be provided in metal cabinet housing. Controller shall be equipped with modular electronic boards. Mother board shall cover all basic functions. Interface capability for remote monitoring shall be by potential free contact. Interface for interfiling operation shall be by contact mats.

Controller shall have the following functions Directional settings Supervision of power supply voltage Motor protection against overheating. Fault indicator by means of display Control of safety contacts Asymmetric relay.

Truss
The welded truss shall be made of warm rolled steel/ angle/ tabular profiles. The sides of the truss shall be of framework design. All cords, truss posts and diagonals shall be hollow profiles/ angle and channels. The support angles which shall be welded to the truss at the ends of both landings shall carry the weight of the escalator. The truss design shall ensure that the maximum deflection shall not be more than the permissible limit with a calculated passenger load. An oil tight welded 5 mm sheet steel bottom plate shall be welded over the full length and width of the bottom of the truss.

Track System
Escalator shall have closed track system and track holders shall be fastened to the framework of the truss. Track holders shall be welded to the truss after very precise alignment.

Main Drive
The main drive shall be located in the upper landing and shall consist of a rigid solid shaft, which shall eliminate torsion and allow replacement of main shaft bearing easily without dismantling the balustrade.

Tension Carriage
The tension carriage for tensioning of the step chain shall be located at the lower landing of the escalator. It shall be laterally guided by sliding block, which shall guide and constantly tensioned by two compression springs. Correct chain tension shall be monitored by safety switches at each side of the tension carriage.

Step Chain
The step chain shall be made of links and shall be provided with wheels. The links shall be interconnected by pins made of hardened and ground steel. Links shall be made of flat steel. Both sides of the step chain shall be linked by solid axles to optimize its performance.

Steps

Steps shall be one piece die-cast aluminium design with created treads and risers, so that each step meshes with the adjacent step.
Steps shall be fastened to the step fixed by means of retainer's ring with alien cap screw.

Handrail Drive System
The handrail system shall be driven by friction wheel. The handrail drive units shall be located on both sides of the escalator in the incline section close to the upper landing.
Handrails shall be provided as endless vulcanized loops and shall have endless inner steel cord member and shall avoid frequent re-tensioning materials.

Interior Panels
Interior panels shall be as per Architects requirement tentatively self-supporting safety glass panels.

Skirting Panel
Skirting panels shall be made of stainless steel with a grain finish or as per Architect's requirement.

Combs, Comb Plates and Floor Plates

Combs
Comb shall be made of die-cast aluminium and shall be served to the comb plate in case of replacement if necessary. The comb teeth shall have intentional rupture points, allowing them to break in the event of an object getting trapped between the step and the comb thereby preventing serious damage.

Comb Plates
The comb plates shall be made from steel comb plate cladded with stainless steel sheet with antiskid properties.

Floor Plates
There shall be a fixed floor plate and a removable floor plate allowing access to both machine area and maintenance area.

The fixed floor plates shall be made from extruded aluminium profiles with laterally extending groove to match the comb plate.

The removable floor plate shall be constructed from low weight extended aluminium profile section allowing ease of removable by one service mechanic by key.

Exterior Cladding
The exterior cladding shall be made of stainless-steel panels to cover the side and the bottom side of the escalator.

Operation Panel and Escalator Management

Two different operations panels shall be installed at upper and lower landing. They shall be located in the panels next to handrail entry guard. This shall give useful information on operation and the status of the escalator.
After release via key switch the owner can use the keyboard.
After setting of the password via key board the display shall show following information for service engineer:
Memory of fault e.g. amount of faults within a definite period of time.
Operating hour counter (total and per week).
Start counter (total and per week)
Stopping distance and declaration indicator.
Electrical Safety Devices
Emergency stop button and starting key switches shall be integrated in the operation panels

which shall be installed at upper and the lower landings.

Operational Brake
Operational brake shall be an AC operated DC commercial magnet and shall be located between motor and gear box.

Non Reversal Device
In case of an unintentional change of the travel direction the safety circuit shall be interrupted and the operational brake shall be applied.

Hand Rail Entry Device
The handrail entry device shall be located in each hand rail entry box on both side at the upper and lower landings. Should an object be drawn between the hand rail and rubber guard it shall push the guard and activate the contact to stop the escalator.

Broken Step Chain Devices
Contacts shall be located at the lower landing at both sides of the tension carriage. If the step chain should break or stretch, the tension carriage recoils by spring tension shall release the contacts. The contacts shall be locked after being released and shall be reset manually.

Comb Plate Safety Device (at Both Landings)
Safety switches shall be located at both sides of each comb plate. If an object is drawn between the step and the combs, it shall lift the comb plate and activate the contact. Comb plates shall be held down by adjustable springs.

Main Circuit Breaker
Main circuit breaker shall be located inside the upper landing and can be locked in the OFF position, sub circuit breaker shall be located inside the lower landing.

Motor Thermic Device
If the motor winding temperature reaches more than 155 deg.c, the escalator shall have switched off by this protection against overheating. The motor thermic device shall be located inside the winding of the motor.

Over Speed Governor
Over speed monitoring sensor mounted below the motor fly wheel which will compute the speed in case of over speed a signal will be given to the controller to activate the auxiliary brake.

Auxiliary Brake
Auxiliary brake shall be provided to guarantee the safety of the passengers by interrupting the safety circuit and stopping the escalator.

If the main drive chain breaks
If the over speed governor trips, or
If the direction of movement of the steps shall involuntarily reversed.

Traffic Flow Lights
In order for passenger to know the set direction (UP or DOWN), moving traffic flow lights shall be provided at the convenient location at the upper and lower landings.

Labelling on Escalator Landing Plates.

All escalators shall be labelled on both top and bottom landing plates in alphabet or numeral as required. Labelling shall be done by casting, welding or other approved means on the landing plates. At least at one

landing, the name of manufacturer and the manufacturer serial number shall be indicated, visible from the outside. The design of marking or labelling shall be such that it shall not give to risk of causing tripping of the passenger and secure foothold provided by the landing plates shall be maintained.

ELV SYSTEM

GENERAL NOTES:-

- The components, equipment, accessories, and materials mentioned in the technical specification for all ELV systems shall not be construed as limiting the scope of work of the Contractor/Bidder. The Contractor/Bidder shall be responsible for providing, supplying, installing, testing, commissioning, integrating, and handing over all additional components, accessories, hardware, software, interfaces, licenses, cabling, connectors, mounting arrangements, and any other essential items, whether specifically mentioned in the technical specification or not, as required for the complete, satisfactory, and end-to-end functionality, interoperability, reliability, and performance of the respective ELV systems in accordance with the project requirements, applicable standards, statutory regulations, and the intended operational objectives.

SECTION 0: GENERAL REQUIREMENTS COMMON TO ALL ELV SYSTEMS [Added]

0.1 Testing, Commissioning and Acceptance

0.1.1 Site Acceptance Test (SAT): On completion of installation, the Contractor shall carry out a documented SAT covering 100% of installed devices, all integrations, all alarm/event scenarios, redundancy and failover, and end-to-end functional testing. Test formats shall be approved by the Employer before commencement.

0.1.2 The Contractor shall submit a detailed Method Statement, Inspection & Test Plan (ITP) and Testing & Commissioning Protocol for each ELV system for approval prior to commencement of installation.

0.1.3 Integration testing between ELV systems (e.g., Fire Alarm to PA/VA, Fire Alarm to Access Control door release, CCTV to Access Control, BMS to all systems) shall be demonstrated and recorded as part of SAT.

0.2 Warranty, Defect Liability and Post-Warranty AMC

0.2.1 All equipment and systems shall carry a comprehensive on-site warranty of five (5) years from the date of successful handover and issue of the Completion Certificate, covering all parts, labour, software updates and firmware upgrades.

0.2.2 The Bidder shall separately quote a Comprehensive Annual Maintenance Contract (CAMC) for five (5) years beyond the warranty period, covering preventive maintenance, breakdown maintenance, spares, software/firmware updates and manpower. CAMC rates shall be considered for evaluation of the overall bid.

0.2.3 The Contractor shall guarantee availability of spares and technical support for a minimum period of ten (10) years from the date of handover. An OEM undertaking to this effect shall be submitted.

0.3 Service Level Agreement (SLA)

0.3.1 For all life-safety and critical systems (Fire Alarm & Detection, PA/Voice Evacuation, Nurse Call, Access Control, CCTV): response time shall not exceed four (4) hours and resolution time shall not exceed twenty-four (24) hours from the time of logging a complaint, on a 24x7x365 basis.

0.3.2 For all other ELV systems: response time shall not exceed eight (8) hours and resolution time shall not exceed forty-eight (48) hours.

0.3.3 Minimum system uptime of 99.5% shall be maintained on a quarterly basis for each ELV system, computed excluding scheduled preventive maintenance windows agreed with the Employer.

0.3.4 Where resolution exceeds the stipulated time, the Contractor shall provide equivalent standby equipment at no cost until the defect is rectified. Penalties for SLA breach shall be as per the General Conditions of Contract.

0.3.5 The Contractor shall maintain a complaint logging and escalation mechanism (helpdesk/ticketing) accessible to the Employer, with monthly reports on complaints logged, response times, resolution times and uptime achieved.

0.4 Documentation, Training and Handover

0.4.1 The Contractor shall submit, prior to handover: approved shop drawings, as-built drawings (in both editable CAD and PDF formats), single-line and schematic diagrams, cable schedules, device/asset schedules with locations and addresses, and IP address/port allocation schedules.

0.4.2 Operation & Maintenance (O&M) manuals shall be supplied in three (3) hard copies and in soft copy, covering system description, operating procedures, preventive maintenance schedules, troubleshooting, and OEM product literature.

0.4.3 All software licences, configuration backups, source configuration files, passwords and administrative credentials shall be handed over to the Employer in a documented and sealed manner. Licences shall be registered in the name of the Employer, not the Contractor.

0.4.4 The Contractor shall conduct structured training for the Employer's personnel: a minimum of three (3) batches covering operator-level training, and one (1) batch covering administrator/maintenance-level training, for each ELV system. Training material shall be provided and sessions shall be recorded.

0.5 Electrical Protection, Earthing and Power Supply

0.5.1 All ELV panels, racks, equipment enclosures and cable armour/screens shall be earthed in accordance with IS 3043 and the latest National Electrical Code. Earth resistance shall not exceed 1 ohm for electronic/signal earth, and shall be verified and recorded at handover.

0.5.2 A clean, isolated signal earth, separate from the power earth, shall be provided for all ELV head-end equipment where required by the OEM.

0.5.3 Surge Protection Devices (SPDs) conforming to IEC/EN 61643 shall be provided on incoming power supplies to all ELV head-end equipment and panels, and on outdoor-routed signal/data and camera cabling entering the building.

0.5.4 All ELV head-end equipment shall be fed from the UPS/essential supply, with a minimum of thirty (30) minutes of battery autonomy at full load, unless a longer autonomy is specified for a particular system elsewhere in this specification.

0.5.5 All cabling in occupied areas, escape routes and risers shall be LSZH (Low Smoke Zero Halogen) type conforming to IEC 60754 and IEC 61034. Fire-survival cabling for life-safety circuits shall conform to IEC 60331 / BS 6387 as applicable.

0.6 Cybersecurity and Data Protection (applicable to all IP-networked ELV systems)

0.6.1 All ELV systems processing personal or health-related data (including CCTV footage, access control records, nurse call records and patient queue data) shall be configured and operated in compliance with the Digital Personal Data Protection Act, 2023 and any rules issued thereunder.

0.6.2 All ELV systems shall support role-based access control with individually assigned credentials, enforced password complexity, and a tamper-evident audit trail of user actions. Default and shared credentials shall be changed prior to handover and recorded in the handover documentation.

0.6.3 All default services, ports and accounts not required for operation shall be disabled. The Contractor shall submit a hardening checklist for each system, based on OEM hardening guides, duly completed and signed at handover.

0.6.4 The Contractor shall apply all security patches and firmware updates released by OEMs during the warranty and O & M period, following an approved change-control procedure.

0.7 Standards, Compliance and Equivalence

0.7.1 All equipment and installation shall comply with the latest published editions of the standards referenced in this specification, together with the National Building Code of India, the relevant State Fire Service rules, and any statutory requirements applicable to healthcare facilities.

SECTION 1: CCTV Surveillance system

GENERAL

The objective is to provide high degree of surveillance system for building premises and Periphery area of the hospital campus. The purpose is to monitor & servile the entire area for unwanted, untoward incidents, routine operational efficiency monitoring. It is also essential to have recorded images to be stored at least for 90 days of Entire Premises Like, Patient area, Emergency Patient Admit area, critical Periphery areas to facilitate investigations of a reported case. The objective is also to restrict unauthorized intrusion, movement of person through critical areas and facilitate effective people management.

This section of the specification includes the Design, Engineering, Supply, Erection, Installation, Testing, Commissioning & Training of an IP cameras, related software, cabling, server & storage equipment required to form a complete coordinated system ready for operation. All equipment and materials used shall be standard components that are regularly manufactured and used in the system. All systems and components shall have been thoroughly tested and proven in actual use.

The intent of the specification is to achieve enterprise-grade security and video surveillance.

The supplied product OEM/Brand should satisfy the following criteria and declaration of same to be furnished on Letterhead.

- The OEM/Brand or any of its divisions or group companies must never been banned, blacklisted or their procurement discontinued by any government/ PSU organizations in INDIA in last 5 Years.
- The OEM/Brand or any of its divisions or group companies must never been banned by ONVIF in last 5 Years.
- The OEM/Brand must share Test Reports (MTBF Test, Halt Test & Other Environmental Test) Certificates pertaining to Offered Cameras.
- The Camera OEM/Brand must have a website or central portal, and which is publicly available to connect and report cybersecurity information related to their products.
- OEM/Brand of Camera must have below mentioned data security certificates. Valid Copy of the same must be submitted in Technical Bid.
    1) IEC-62443-4-2: Security for industrial automation and control systems or Similar.
    2) UL 2900, IEC 62443, ISO 27001, FIPS, Common Criteria or equivalent recognized cybersecurity certifications shall be acceptable.

Recording Footage Type, Format, and retention Schema

- System should have provision to record and store video data & for a period of 90 Days max FPS, on RAID 5 or better redundant mechanism. In this case a mandatory Head Room of 10% considered on actual current requirement. Net required storage considered accordingly.
- VMS Database should have mandatory N: N (Active, Active) Recording Failover (redundancy) License.
- Storage appliances shall also be deployed In N+1 (Active, Active) Deployment mode.

- Video analytics and Video Management Software should be natively integrated for appropriate representation of DATA and capable of adding sense to the scene.

- Video analytics and Video Management Software should be natively integrated for End to End (E2E) secured encrypted communication (TLS-1.3 Certification activation) to safeguard against man in the middle attack.

- VMS shall be capable to receive Encrypted video streams from the camera. Said encrypted stream shall be recorded directly into the proposed storage or VMS without intermediate decryption.

The supplied solution should meet the mandatory following criteria for Data/Cyber Security

- Camera shall provide hardware-based cybersecurity protection through Secure Element, Trusted Platform Module (TPM), secure credential storage, Common Criteria certification, FIPS-compliant modules, or equivalent security technologies.

- Modern cryptographic algorithms and secure device identity mechanism.
- Camera and Recording Appliance should TLS 1.2 or higher for all encrypted communication sessions.
- The camera shall support cybersecurity hardening features including secure boot, signed firmware, disabling unused services, IP filtering, certificate-based authentication, and access control mechanisms.
- Configurable account lockout and brute-force protection.
- The Camera shall detect unauthorized configuration changes on the camera and immediately generate an alert via SNMP trap or syslog when such events occur.

System architecture proposed for the installation of CCTV Surveillance System to enhance monitoring and management of security incidents.

The IP CCTV System OEM & or Camera OEM must confirm of not using or procuring any such equipment or processors or software patches or firmware from those or any blacklisted companies (or any subsidiary or affiliate of such blacklisted or barred entities) either by ONVIF or by any Global Government or by any recognized global Forum or Institutions in-view or reporting of suspicious activities of hacking/cyber-attacks/malwares/etc. to safeguard the public safety & security of Government facilities, physical security surveillance of critical infrastructure, and other national security purposes, including the scope of video surveillance system & components. A declaration cum undertaking must be submitted in this regard.
The Camera and VMS should have ONVIF Profile S, G, T Compliant with valid ONVIF Certificate.
CCTV OEM shall have ISO Certifications as mandatory - ISO 9001, ISO 14001, Or ISO 27001, Or ISO 22301.
CCTV Cameras shall be STQC (BIS-ER Certified) at the time of supply as per latest MEITY Guidelines.
CCTV OEM shall have service center in India and have 24x7 support mechanism.

TECHNICAL SPECIFICATION

1. CCTV SYSTEM

5MP IR Dome Camera		
S.No	Parameter	Specification
1	Sensor Type	1/2.8" progressive scan CMOS
2	Image Sensor	5MP 2592x1944 @25FPS
3	lens	Lens 3.5 - 10mm with remote zoom and focus
4	Iris	P-iris or DC-Iris Or Auto Iris
5	IR Illumination	minimum 30 meter effective IR Range
6	WDR	minimum 120 dB or More
7	Camera features	BLC, Gain control, True Day/Night, white balance, Backlight Compensation, Privacy Masking Zones, Image Rotation 0°,90°,180°,Mode.
8	Image Compression	H.264, H.265, Motion JPEG, OEM Smart Compression
9	Streaming	3 Individual configurable streams in H.265 Format
10	Analytics Object classification	Dedicated AI processing hardware or equivalent analytics capability. Support simultaneous classification and tracking of multiple objects. Metadata export through ONVIF, APIs, MQTT or equivalent. Support advanced analytics calibration methods.
11	Smart AI based analytics	• Intrusion detection • Line crossing • Loitering detection • Direction detection • Object left behind • Object removal • Object classification • Tamper detection • Object tracking • Person and vehicle classification
12	Security	Password protection, HTTPS encryption, digest authentication, WS authentication, user access log, 802.1x port based authentication. The device shall support hardware-assisted security through FIPS 140-2, FIPS 140-3, Common Criteria, TPM, Secure Element, or equivalent industry-recognized cybersecurity mechanisms. TPM Secure Boot, Signed and encrypted firmware, STQC (BIS-ER Certified)
13	Protocols	IPv6, IPv4, HTTP, HTTPS, NTP, RTSP, RTCP, RTP, TCP, SNMP v2c, SNMP v3,IGMP, ICMP, DHCP
14	Power Source	POE
15	Onboard Storage	SD Card support up to 2TB
18	ONVIF	S,G,T, M and certificate shall be available on website
19	Operating temperature	-10 °C to +55 °C
20	Environmental Protection	Environmental Protection: Minimum IP66, IK10 and suitable for outdoor operation. Type 4X or equivalent corrosion protection shall be acceptable where required.
21	Certifications	UL, CE, EN, FCC, BIS-ER.
22	Warranty	5-year warranty

2.

5MP IR Bullet Camera		
S.No	Parameter	Specification
1	Sensor Type	1/2.8" progressive scan CMOS
2	Image Sensor	5MP 2592x1944 @25FPS
3	lens	Lens 3 - 10mm with remote zoom and focus
4	Iris	P-iris or DC-Iris Or Auto Iris
5	IR Illumination	minimum 60-meter effective IR Range
6	WDR	minimum 120 dB or More
7	Camera features	BLC, Gain control, True Day/Night, white balance, Backlight Compensation, Privacy Masking Zones, Image Rotation 0°,90°,180°,Mode.
8	Image Compression	H.264, H.265, Motion JPEG, OEM Smart Compression
9	Streaming	3 Individual configurable streams in H.265 Format
10	Analytics Object classification	Dedicated AI processing hardware or equivalent analytics capability. Support simultaneous classification and tracking of multiple objects. Metadata export through ONVIF, APIs, MQTT or equivalent. Support advanced analytics calibration methods.
11	Smart AI based analytics	• Intrusion detection • Line crossing • Loitering detection • Direction detection • Object left behind • Object removal • Object classification • Tamper detection • Object tracking • Person and vehicle classification
12	Security	Password protection, HTTPS encryption, digest authentication, WS authentication, user access log, 802.1x port based authentication, The device shall support hardware-assisted security through FIPS 140-2, FIPS 140-3, Common Criteria, TPM, Secure Element, or equivalent industry-recognized cybersecurity mechanisms., Secure Boot, Signed and encrypted firmware, STQC (BIS-ER Certified)
13	Protocols	IPv6, IPv4, HTTP, HTTPS, NTP, RTSP, RTCP, RTP, TCP, SNMP v2c, SNMP v3, IGMP, ICMP, DHCP
14	Power Source	POE
15	Onboard Storage	SD Card support up to 2TB
18	ONVIF	S,G,T, M and certificate shall be available on website
19	Operating temperature	-10 °C to +55 °C
20	Environmental Protection	Environmental Protection: Minimum IP66, IK10 and suitable for outdoor operation. Type 4X or equivalent corrosion protection shall be acceptable where required.
21	Certifications	UL, CE, EN, FCC, BIS-ER.
22	Warranty	5-year warranty

5 MP IR Panoramic Camera for Lobby, OT and Nurse Desk Area (as per requirement)

S.No	Parameter	Specification
1	Sensor Type	2 (Dual) 1/2.8" CMOS image sensor
2	Image Sensor	Dual 5MP (2592 x 1944) @ 30 fps in full feature mode with video analytics enabled.
3	lens	Automatic Varifocal lens with P-iris or Auto Iris, or Fixed Iris or DC Iris control, focal length range 3mm to a minimum of 8 mm (+ - 1 mm)
4	IR Illumination	30 meter illumination distance, adjustable IR intensity and beam angle.
5	WDR	120dB
6	Camera features	BLC, Gain control ,True Day/Night, white balance, Backlight Compensation, AI Blurring & Privacy (Static & Dynamic for Patient), AI Static Masking Zones with Video analytics on
7	Image Compression	H.264, H.265, Motion JPEG, OEM Smart Compression
8	Streaming	3 Individual configurable streams in H.265 Format
9	Analytics Object classification	Dedicated AI processing hardware or equivalent analytics capability. Support simultaneous classification and tracking of multiple objects. Metadata export through ONVIF, APIs, MQTT or equivalent. Support advanced analytics calibration methods.
10	Smart AI based analytics	• Intrusion detection • Line crossing • Loitering detection • Direction detection • Object left behind • Object removal • Object classification • Tamper detection • Object tracking • Person and vehicle classification
13	Security	Password protection, HTTPS encryption, digest authentication, WS authentication, user access log, 802.1x port based authentication, The device shall support hardware-assisted security through FIPS 140-2, FIPS 140-3, Common Criteria, TPM, Secure Element, or equivalent industry-recognized cybersecurity mechanisms., Secure Boot, Signed and encrypted firmware, STQC(BIS-ER Certified)
14	Protocols	IPv6, IPv4, HTTP, HTTPS, NTP,RTSP, RTCP, RTP,TCP,SNMP v2c, SNMP v3,IGMP, ICMP, DHCP
15	Power Source	POE & 12VDC
16	Onboard Storage	SD Card support upto 2TB
17	Audio Input/Output	Line level audio I/O
18	External I/O Terminals	Alarm In, Alarm Out
19	ONVIF	S,G,T, M and certificate shall be available on website
20	Operating temperature	-10 °C to +55 °C
21	Environmental Protection	Environmental Protection: Minimum IP66, IK10 and suitable for outdoor operation. Type 4X or equivalent corrosion protection shall be acceptable where required.
22	Certifications	UL, CE, EN, FCC, BIS-ER.
23	Warranty	5-year warranty

5MP IR Dual Head Camera For Corridors (as per requirement)		
S.No	Parameter	Specification
1	Sensor Type	2 (Dual) 1/2.8" CMOS image sensor
2	Image Sensor	Dual 5MP (2592 x 1944) @ 30 fps in full feature mode with video analytics enabled, pixel pitch not less than 2.0 µm
3	lens	Automatic Varifocal lens with P-iris or Auto Iris, or Fixed Iris or DC Iris control, focal length range 3mm to a minimum of 8 mm (+ - 1 mm)
4	IR Illumination	30 meter illumination distance, adjustable IR intensity and beam angle.
5	WDR	120dB
6	Camera features	BLC, Gain control,True Day/Night, white balance, Backlight Compensation, Privacy Masking Zones, Image Rotation 0°,90°,180°,270°including Corridor Mode.
7	Image Compression	H.264, H.265, Motion JPEG, OEM Smart Compression
8	Streaming	3 Individual configurable streams in H.265 Format
9	Analytics Object classification	Person and vehicle
10	Smart AI based analytics	• Intrusion detection • Line crossing • Loitering detection • Direction detection • Object left behind • Object removal • Object classification • Tamper detection • Object tracking • Person and vehicle classification
13	Security	Password protection, HTTPS encryption, digest authentication, WS authentication, user access log, 802.1x port based authentication, The device shall support hardware-assisted security through FIPS 140-2, FIPS 140-3, Common Criteria, TPM, Secure Element, or equivalent industry-recognized cybersecurity mechanisms, Secure Boot, Signed and encrypted firmware, STQC(BIS-ER Certified)
14	Protocols	IPv6, IPv4, HTTP, HTTPS, NTP,RTSP, RTCP, RTP,TCP,SNMP v2c, SNMP v3,IGMP, ICMP, DHCP
15	Power Source	POE & 12VDC
16	Onboard Storage	SD Card support upto 2TB
17	Audio Input/Output	Line level audio I/O
18	External I/O Terminals	Alarm In, Alarm Out
19	ONVIF	S,G,T, M and certificate shall be available on website
20	Operating temperature	-10 °C to +60 °C
21	Environmental Protection	Environmental Protection: Minimum IP66, IK10 and suitable for outdoor operation. Type 4X or equivalent corrosion protection shall be acceptable where required.
22	Certifications	UL, CE, EN, FCC, BIS-ER.
23	Warranty	5-year warranty

4 MP PTZ Camera		
S.No	Parameter	Specification
1	Sensor Type	1/1.8 ” progressive scan CMOS
2	Maximum Resolution	4 MP @ 50/60 fps
3	Image Resolutions	Effective pixels (H x V) 2560 x 1440
4	Lens control	7mm (+- 1 MM) – 200 (+- 10 mm) Remote Zoom and Focus, Autofocus, IR Cut Filter, Auto Iris
5	Optical Zoom	30x or better
6	Electronic Image Stabilization	Shall be available
7	WDR	120dB or better
8	Digital Defog	Shall be available
9	Presets	250 or Above
10	Tour	The camera shall support multiple patrol tours, preset tours, guard tours or equivalent PTZ automation functions.
11	Tilt range	Tilt 95°,
12	Pan range	Pan Horizontal rotation: 360 °
13	Frame rate	50 fps/60 fps
14	Image Compression	H.264, H.265, Motion JPEG, OEM Smart Compression
15	Streaming	3 Individual configurable streams in H.265 Format
16	Analytics Object classification	Deep learning based Person and Vehicle
17	Smart analytics	• Intrusion detection • Line crossing • Loitering detection • Direction detection • Object left behind • Object removal • Object classification • Tamper detection • Object tracking • Person and vehicle classification
18	Pan and Tilt speed	Pan speed 0.05-200°/sec, Tilt speed 0.05-100°/sec
19	Security	Password protection, HTTPS encryption, digest authentication, WS authentication, user access log, 802.1x port based authentication, The device shall support hardware-assisted security through FIPS 140-2, FIPS 140-3, Common Criteria, TPM, Secure Element, or equivalent industry-recognized cybersecurity mechanisms, STQC (BIS-ER Certified)
20	Protocols	IPv6, IPv4, HTTP, HTTPS, NTP, RTSP, RTCP, RTP, TCP, SNMP v2c, SNMP v3,IGMP, ICMP, DHCP
21	Power Source	Dual Power POE+ & Aux 24 VDC/VAC +/- 10% The camera shall support redundant or dual power inputs, where available, to improve system reliability.
22	Onboard Storage	SD Card support up to 2TB
23	Audio Input/Output	Full Duplex Line level input and output
24	External I/O Terminals	2 Alarm In, 1 Alarm Out
25	ONVIF	S,G,T & M and certificate shall be available on website
26	Operating temperature	-10 °C to +60°C
27	Environmental Protection	Environmental Protection: Minimum IP66, IK10 and suitable for outdoor operation. Type 4X or equivalent corrosion protection shall be acceptable where required.

4 MP PTZ Camera		
28	Certifications	UL, CE, EN, FCC, BIS-ER.
29	Warranty	5-year warranty

B. Joystick for PTZ Camera –
USB keyboard for managing CCTV applications, with joystick and jog shuttle functions determined by the controlled application.
The user can easily personalise and print several pre-cut sheets supplied for this purpose.
The keyboard can be turned round so that both right- and left-handed users can use all the functions with ease.
Backlit rubber keys, Alarm buzzer.

3. Video Management Software Key Features

1	Video Management System (VMS)	
	General Requirements	
1.1	The Platform shall be based on a true open and Cloud ready architecture that shall allow the use of non-proprietary workstation and server hardware, non-proprietary network infrastructure and non-proprietary storage.	
1.2	The Platform shall integrate cameras using dedicated driver or using the industry standards ONVIF Profile S, G, T and Profile M. The same must be listed on the ONVIF website.	
1.3	The Platform shall offer a complete and scalable video surveillance solution which allows cameras to be added on a unit-by-unit basis. The database shall support more than 50,000 cameras/IP endpoints through centralized or distributed architecture.	
1.4	The Platform Shall support native Fail over within application with no dependency on any external application for both hardware and application redundancy. The platform shall support native or industry-standard high availability technologies including active-active, active-passive, clustering, virtualization or equivalent solutions. The native failover architecture must be for both management and recording servers.	
1.5	The Fail over and Fallback management and recording Server shall be on hot standby, ready to take over during the primary management server fails. No manual action from the user shall be required. The failover time should not be beyond 1 Min and there should not be any loss in the Live video and recorded video.	
1.6	The Platform shall support disaster recovery scenarios where a server can be in another geographic area (or building) and only take over if the Primary server becomes offline.	
1.7	The Platform shall support real-time synchronization of the configuration databases for high reliability.	
1.8	The Platform shall offer a plug and play type hardware discovery service for Automatically discover Video surveillance units as they are attached to the network.	
1.9	The Platform shall allow for multiple recording schedules to be assigned to a single camera.	

1.10	The Platform shall support Direct Multicast from Camera to Client. The architecture should not use Multicast streaming via recording servers or any other servers and increase the overall computing capacity of Recording servers.	
1.11	The Platform shall allow important video sequences to be protected against normal disk cleanup routines.	
1.12	The Platform shall have the following options when protecting a video sequence: Until a specified date, for a specified number of days, indefinitely (until the protection is explicitly removed for evidence).	
1.13	The Platform shall support edge recording capabilities with ability to playback the video recorded at different speeds and ability to offload the video recorded on the application server on schedule, on event, or manually to store it on the recording server.	
1.14	The Platform shall be capable to handle both IP v4 and IP v6 Unicast and Multicast traffic	
1.15	The Platform management server should not have any limitation on the no of recording servers added on one single management / fail over server. Any limitations must be clearly specified by the bidder.	
1.16	The platform shall support the parallel recording on primary and secondary control room , The platform shall support recording redundancy, failover recording, replication, or equivalent methods. The Monitoring UI shall support multiple display tile patterns (for example one display tile (1x1 matrix), 16 tiles (8x8 matrix), and multiple additional variations. Support for video playback on each and every display tile. The ability to simultaneously view the same camera in multiple tiles at different time intervals. The ability to control playback with Forward and Reverse Playback at: 1x, 2x, 4x, 6x, 8x, 10x, 20x, 40x, 100x Slow Forward and Reverse Playback at: 1/8x, 1/4x, 1/3x, 1/2x Tools for exporting video sequences in standard video formats, such as ASF or MP4.	
1.17	The platform Shall support the Multiple storage drive mapped redundancy, if one mapped failed then automatically new recording shall be start next mapped storage drive .The VMS application provider must support ONVIF-compliant cameras and industry-leading manufacturers through native drivers, APIs, SDKs or certified integrations. The Monitoring UI shall provide a Track Target functionality that enables the operator to manually follow a moving subject across cameras. The platform shall support assisted or automated target tracking using adjacent cameras, maps, analytics, or equivalent technologies. The system shall allow the operator to switch from one camera view to an adjacent camera within the same display tile, eliminating the need to open multiple views. The Monitoring UI shall support semi-transparent overlays or shapes that represent adjacent camera views. The visual tracking and camera-switching capabilities shall be supported in both live view and recorded playback modes The Video Management System (VMS) must support an intelligent "Quick Search" capability to enable operators to efficiently locate specific moments within recorded video footage without manual scrubbing. The VMS shall support forensic search using motion,	

	metadata, thumbnails, AI analytics, or equivalent technologies. Users shall be able to visually scroll through these thumbnails to quickly identify the exact moment when an item appeared, moved, or was removed.	
1.18	Dashboards: The Platform shall support the ability to create dashboards Dashboard shall consist of a canvas with various widgets displayed on the canvas. All widgets should offer the ability to specify location and size to the widget, a title to the widget, a background color to the widget, and the ability to refresh the content of the widget. Dashboard widget types shall be Image: provides the ability to display an image (JPG, PNG, GIF, BMP) on a dashboard. Text: provides the ability to display a text on a dashboard. The text style shall be configurable, so font, size, color, and alignment can be specified by the user. Tile: provides the ability to display any entity of the USP inside of a tile. Web page: provides the ability to display a URL on a dashboard. Entity Count: provides the ability to display the total number of a specific entity type like cameras, user online, no of alarms, in the VMS. Reports: provides the ability to display the results of any saved reports in the system. The results shall be displayed either by showing the total number of results in the report, a set of top results from the report, or a visual graph from the data returned by the report. The VMS shall provide integrated dashboard functionality, either natively or through supported modules. The VMS, ACS and PIDS shall provide seamless integration through APIs, SDKs, ONVIF, SIP, or certified interoperability mechanisms. Different OEMs shall be acceptable provided complete integration is demonstrated.	
1.19	Cyber Security Requirements:	
1.20	The Platform shall support only secured media stream requests, unless explicitly configured otherwise. Secured media stream requests shall be secured with strong certificate-based authentication. Client authentication for media stream requests is claims-based and may use a limited lifetime security token.	
1.21	The Platform shall offer the ability to encrypt the media stream, including video, Audio, and metadata with authenticated encryption. Media stream encryption shall be done at rest and in transit and be a certificate-based AES 128-bit encryption.	
1.22	The Platform shall allow encryption to be set on a per camera basis for all or some of the cameras.	
1.23	The platform shall possess recognized cybersecurity certifications such as: • UL 2900 • IEC 62443 • ISO 27001 • Common Criteria • FIPS • Equivalent internationally recognized certifications.. The VMS must possess cybersecurity certification from a globally reputed firm like UL, accompanied by a	

	letter certifying that the application has undergone rigorous testing for cybersecurity vulnerabilities through penetration testing, binary code analysis, and other assessment techniques. This certification should confirm the platform's resilience against sophisticated cyberattacks, ensuring its suitability for mission-critical applications. The testing must include evaluations against advanced attack vectors, demonstrating resistance to threats such as denial-of-service (DoS), man-in-the-middle, and data exfiltration.	
1.24	Software Upgrade: The Platform shall support software update service with following features Update products when a new release becomes available. Check for updates at regular intervals. Download update packages in the background. Updates must be manually installed. See when the system was last checked for updates.	
1.25	Password Management: VMS shall support password management tool which randomly generate the password and apply the password on camera based on user trigger.	
Mobile App		
1.26	Functionalities: a. The platform should provide the mobile app being made available from day 1 and must be easily downloadable from iOS and Android stores online. b. Ability to display a geographic map with the platform entities geo-located on the map. c. Ability to view any camera and doors configured on the map. d. Ability to search for cameras, doors or location on the map. e. Ability to view live and recorded video from the cameras of the central recording server. f. Ability to lock / unlock and monitor doors from the mobile application. g. Ability to perform digital zoom on cameras. h. Ability to perform actions on cameras such as add a bookmark, control a PTZ, start/stop recording. i. Ability to use the camera of the smartphone and stream a live video feed to a video recorder in the system. j. Ability to locate the mobile app user on map and provision to in app message and collaborate in real time with the central command center or field staff.	
2	Access management System	
	General Requirement	
2.1	The ACS shall be an enterprise class IP access control software solution. The ACS shall seamlessly integrate with the Video Management System through native integration, APIs, SDKs, ONVIF, or other open integration mechanisms.	
2.2	The ACS shall be highly scalable to support configurations consisting of thousands of doors with facilities spanning multiple geographic areas	
2.3	The ACS shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.	

2.4	The ACS shall support a variety of access control functionalities, including but not limited to: Controller (Unit) management, door management and area management. Cardholder and cardholder group management, credential management, and access rule management. Badge printing and template creation. People counting, area presence tracking Offering a framework for third party hardware integration	
2.5	The ACS shall possess recognized certifications such as UL294, CSPN, CE, EN, or equivalent.	
2.6	The ACS shall support OSDP and Wiegand protocols.	
	Access Management	
2.7	The ACS shall be based on an open architecture able to support multiple access control hardware manufacturers (minimum 5).	
2.8	The ACS shall be able to integrate with multiple non-proprietary interface modules and controllers, access readers, and other third-party applications.	
2.9	The ACS shall be an IP enabled solution. All communication between the ACS and hardware controllers shall be based on standard TCP/IP protocol.	
2.10	The ACS shall able to synchronize all access control hardware units under its control, such as door controllers and I/O modules. It shall also be able to validate and log all access activities and events when the door controllers and I/O modules are online	
2.11	The ACS shall maintain the communication link with the hardware controllers under its control. It shall also continuously monitor whether the controllers are online or offline	
2.12	Synchronization of hardware units shall be automated and transparent to users and shall occur in the background. It shall also be possible to manually synchronize units or to synchronize units on a schedule.	
2.13	The ACS shall support doors and controllers located within one or more facilities. The Access Server shall support a minimum of 200 readers and up to 2000 readers per computer.	
2.14	The Access Server shall store all access events associated with the doors, areas, hardware zones (hardware input points), and controllers under its direct control.	
2.15	The ACS shall support 802.1x authentication.	
	Access Control Hardware Controllers	
2.16	An 2/4 Door IP Controller having multiple reader options (OSDP/Wiegand) ensures interoperability with various existing card reader technologies. The large storage buffer supports offline operation, which is critical during connectivity outages.	
2.17	The controller shall support sufficient cardholder capacity and offline event storage suitable for the project requirements.	
2.18	The controllers should be cyber secured having built-in protection like 802.1x and secure boot mitigates risks of unauthorized access, device spoofing, or firmware manipulation.	
2.19	The controllers should have certifications for compliance with safety and	

	interoperability standards, such as UL 294, FCC, CE, EN etc. making it suitable for regulated environments.	
	Seamless Integration with VMS	
2.20	The ACS shall seamlessly integrate with the Video Management System through native integration, APIs, SDKs, ONVIF, or other open integration mechanisms.. Integration with an IP video surveillance system shall permit the user to view live and recorded video	
2.21	Users shall be able to associate one or more video cameras with the following entity types: doors, elevator and hardware zones (input points), and more.	
2.22	The monitoring interface shall provide integrated access control and video management functionality. Advanced live video viewing and playback of archived video shall be available through Monitoring UI.	
2.32	It shall be possible to view video associated with access control events when viewing a report.	
2.24	The ACS shall support the configuration and management of cardholders and cardholder groups. A user shall be able to add, delete, or modify a cardholder or cardholder group if they have the appropriate privileges.	
2.25	Custom fields shall be supported for both cardholders and cardholder groups.	
2.26	The ACS shall permit the following activation/expiration options for a cardholder's profile: delayed activation of a cardholder's profile, expiration based on the date of first use of credentials, or expiration on a user-defined date	
2.27	It shall be possible to set a start date and expiration date for the association of a cardholder and an access rule for temporary access.	
2.28	It shall be possible to associate a picture to a cardholder's profile. The picture shall be imported from a file, captured with a digital camera, or captured from a video surveillance camera. When a cardholder event occurs, the picture of the cardholder shall be displayed in the Monitoring UI. The ACS shall support multiple standard picture formats.	
2.29	The Platform shall support SDK (Software Development Kit) integration for integrating third party systems.	
	Threat Level:	
2.30	The Platform should be able to create Threat Level setting. The platform shall be able to change the threat level, so all the screen in client shall have specified with change in color GUI changes and sensitize the user that Threat level. It shall be possible to block or unblock some video feed for specified time, add bookmark, change the PTZ view, start recording on specified camera, trigger alarm, elevate the door access priority level, lock / unlock doors, override unlock schedule, etc. once threat level is activated.	
3	Integration with Perimeter Intrusion Detection System (PIDS)	
3.1	The PIDS system shall be an enterprise class IP perimeter Intrusion Detection and tracking software solution. The platform shall allow the seamless unification of the PIDS system with Video Management System (VMS).	
3.2	The PIDS shall be highly scalable to support configurations consisting of thousands of detection sensors with facilities spanning multiple geographic areas.	

3.3	The PIDS shall support a variety of perimeter intrusion and tracking functionalities, including but not limited to: Sensors management and multi-tech support. Zone management, target management, and alarm rule management. Reporting and investigation. Threat management. Target tracking on map	
3.4	PIDS shall allow an unlimited amount of detection zones to be created. The zones are not linked to sensor coverage and can spread across multiple sensors representing a fraction of a sensor.	
3.5	The zone will create an event when an intrusion occurs. The behavior of the zone can be configured to filter relevant targets	
3.6	The PIDS shall allow the display of the target location at the intrusion point (fence system) or in real time (tracking systems) on a map	
3.7	Upon target selection the PIDS shall display the live path of the target when using tracking systems	
3.8	The PIDS shall allow automated target classification from sensors and subsystems	
3.9	The PIDS shall allow manual classification of target upon operator verification	
3.10	The PIDS shall support native and off-the-shelf sensors technologies. Such as a not limited to: Perimeter Intrusion Detection Systems (PIDS) such as fiber systems Radars. Lasers. Lidars. Video Analytic.	
3.11	The PIDS allows the selection of a default camera per zone.	
3.12	The PIDS offer visual tracking of the target leveraging all cameras from the system. Using PTZ cameras the PIDS will control the PTZ to track the moving target and The system shall support assisted or automated visual tracking using available cameras and PTZ devices	
3.13	The PIDS offer threat management of the targets. PIDS shall enable operators to qualify the threat posed by the target. The choice of threat levels, qualifications and associated colors shall be freely configurable	
3.14	The PIDS offer a dedicated user interface for the operator in charge of investigation and reporting.	
3.15	The PIDS shall be able to search and display full list of the intrusions over the retention time, filtered by time, intrusion zones, classification, speed, threat qualification and system events.	
4	Session Initiation Protocol (SIP) based Communication Management and PA	
4.1	System shall support SIP-based communications within your security system, letting you make, receive, and manage SIP-based voice and video calls over a network.	
4.2	An operator of the Unified Security Platform shall be able to, within the platform Monitoring UI, initiate calls to and answer calls from other operator and edge voice devices such as intercoms, emergency call stations, information desks, softphones, or phone devices	

4.3	SIP endpoints shall be able to register to the Unified Security Platform using a standard SIP protocol	
4.4	The Unified Security Platform shall support the configuration of paging zones for pre-recorded and live message announcements.	
4.5	Access a history log of calls that the operator both initiated and received. This log shall show the time of the call, duration, direction and the reason for its ending. The platform shall allow bidirectional audio and video recording of call sessions.	
4.6	The platform shall provide the capability to create Ring Groups. A Ring Group is a group of call numbers grouped under a single call number. It shall be possible to set a Ring Group to simultaneously or sequentially call the members of the group. Dwell time for sequence mode shall be configurable.	
5	Server Specs	
5.1	Management Server: • Intel Xeon Silver 4210 or equivalent enterprise server processor. • 32 GB of RAM or better • 64-bit operating system or latest • 200 GB SSD hard drive or better for OS and applications, • GbE network interface card • Standard SVGA video card	
5.2	Recording Server: • Intel Xeon Silver 4210 or equivalent enterprise server processor. • 32 GB of RAM or better • 64-bit operating system or latest • 200 GB SSD hard drive or better for OS and applications or better • Dedicated video disks of at least 12 drives in RAID 5 or 6 • GbE network interface card • Standard SVGA video card	

SECTION 2: TECHNICAL SPECIFICATIONS: - NETWORKING SYSTEM

CAT6A U/UTP, U/FTP or F/UTP LSZH INDOOR CABLE

Details	Specification
Type	23 AWG Solid Bare Copper, Unshielded (U/UTP, U/FTP or F/UTP) Twisted 4 Pair, Category 6A, confirming to TIA 568.2.D/E, Class EA - ISO/IEC 11801:2002.
Conductors	Solid Bare Copper 23 AWG
Insulation	Polyolefin/Polyethylene
Jacket	Flame Retardant LSZH jacket complying with: Acid Gas Emission pH per IEC 60754-1 Acid Gas Conductivity per IEC 60754-2 Smoke density IEC 61034-2 Flame Test: IEC 60332-1 or Better EN 50575 Class: Dca s2 d2 a1 Test Report of above parameters needs to be enclosed with bid.
Pair Separator	+ Shape Spline with Barrier Tape Technology or foil based on the selection.
Suitable Applications	Premise Horizontal Cable, 10 Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Audio, AES51, RS-422, Noisy Environments, PoE
Tested Bandwidth	500 MHz for 100 MT 4 Connector Channel (Intertek/ETL Report to be enclosed with bid)
Packing	Box of 305 meters
Cable Nominal Outer Diameter	7.2 +/- 0.3 mm
Cable Weight	52 Kg/km
Max. Delay Skew	45 ns @ 100M
Bend Radius (Installation)	50 mm
Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/100 m) < 8.0
Cold Bend Test	-20°C x 4 Hrs., No Crack

Third Party Verification for Cable	Cable ETL/Intertek Test Report for compliance to ANSI/TIA-568.2-D/E as referenced in ISO/IEC 11801-1 for 500Mhz Cable ETL/Intertek Test Report for Alien crosstalk for ANEXT, AFEXT, PS ANEXT. Above test reports to be submitted along with bid
Nom. Mutual Capacitance	Capacitance (nF) < .56 / 100m
Nom. Velocity of Propagation	67 % or better
Temperature Range Operation	-20 Deg C to +75 Deg C
IEEE Requirement	IEEE 802.3bt Type 1, Type 2, Type 3, Type 4
RoHS	Yes
ETL/Intertek Tested (Enclose Report with bid)	The Channel Test Report for a 4-Connector Channel (as per TIA-568.2-D/E Category 6A) shall meet the 3dB headroom criteria at 500Mhz.
	The OEM shall maintain an established technical support organization in India, including pre-sales and post-sales support.

CAT6A U/UTP or F/UTP OUTDOOR CABLE

Details	Specification
Type	23 AWG Solid Bare Copper, UTP or F/UTP Twisted 4 Pair, Category 6A, confirming to TIA 568.2.D, Class EA - ISO/IEC 11801:2002, Outdoor Cable
Conductors	Solid Bare Copper 23 AWG
Insulation	Polyolefin/Poylethylene
Jacket	Jacket – PE with Sunlight/UV Resistant
Pair Separator	+ Shape Spline
Suitable Applications:	Premise Horizontal Cable, 10 Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Audio, AES51, RS-422, Noisy Environments, PoE
Guaranteed Bandwidth	Min. 500 MHz for 100 MT Channel
Packing	Box of 305 meters

Cable Nominal Outer Diameter	8.5 +/- 0.5mm
Max. Delay Skew	45 ns @ 100M
Bend Radius (Installation) Max	66 mm
Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/100 m) < 9.5
Max. Mutual Capacitance	Capacitance (pF/m) < 56
Nom. Velocity of Propagation	64 % or better
Temperature Range Operation	-40 Deg C to +60 Deg C, ROHS
IEEE Requirement	IEEE 802.3bt Type 1, Type 2, Type 3, Type 4
	The OEM shall maintain an established technical support organization in India, including pre-sales and post-sales support.

Cat6A Unshielded / Shielded Modular Jack

Parameters	Specifications
Type	Modular Jacks shall meet or exceed channel specification of ANSI/TIA/EIA-568-C.2 Category 6a and ISO/IEC 11801:2002/Amd 1:2002 Ed2 when used as a component in a properly installed UTP/Shielded channel.
Front Connection	RJ 45 - 50uin Gold plated contacts over Nickel or equivalent at contact interface
Rear Connection	Copper alloy, Gold plated contacts over Nickel or equivalent at contact interface (IDC)
Connector Body	PBT glass reinforced UL94V-0 or Plastic
Accessories	Jack should support uniform hassle-free termination technology and be able to ensure performance in each termination without dependency on expertise of technician.
Termination Interface	Front Mated Connection: 750 Cycles Min.
	Rear Mated Connection: 5 Cycles Min.
IEEE Specification (PoE)	IEEE 802.3bt type 3 and 4 (up to 100W)

	Ultra PoE technology (up to 60W) and Power over HDBaseT (up to 100W)
Performance tests	Modular Jacks shall be tested for performance to ANSI/TIA/EIA-568-C.2 or latest
Guaranteed Bandwidth	Min. 500 MHz or higher Guaranteed Bandwidth for 100 MT Channel Link
Approvals	UL Listed, ETL, 3P, Delta or equivalent international certifications shall be acceptable. Where plenum applications are required, UL2043 compliance may be provided.
Other Specifications	UL 1863, IEC 60603-7, FCC part 68-F, UL 94V-0
PoE Test Report	It shall meet IEC 60512-99-002 for support of IEEE 802.3 Type 4 Remote Powering. (Enclose test report with bid)
RoHS	EU Directive 2002/95/EC Compliant
Feature	The jack design shall ensure reliable long-term operation under hospital environmental conditions.
Operating Temperature	-10° to 60°C
Dielectric Strength	1,000 V RMS 60 Hz
Termination Process	The termination method shall ensure consistent Category 6A performance. Pairs should not be separated in termination process to avoid any crosstalk issue at Jack. The jack shall utilize a controlled termination methodology capable of delivering consistent Category 6A performance. Tool-based or tool-less termination methods shall be acceptable provided the channel performance requirements are achieved.
Cat6A Jack	It should be covered under 25 year warranted solution from OEM.
Third Party Test Report	Enclose 4 Connector ETL/UL/3P Test Report ANSI/TIA – 568 Cat6 / 6A, ISO/IEC 11801 (Class Ea), EN 50173 (Class Ea) and IEEE 802.3-2012.

Cat 6A Unshielded / Shielded Patch Cords, LSZH

Cat6A Unshielded Patch Cords

Parameters	Specifications
Type	Modular Cord shall meet and exceed channel specification of ANSI/TIA/EIA-568-C.2 Category 6a and ISO/IEC 11801-1 up to 500 MHz when used as a component in a properly installed channel.
Conductor	Stranded Bare Copper (for more flexibility) with 24-28 AWG Gauge. Solid conductor shall not be proposed as it creates flexibility issues.
Insulation	Foam Polyethylene/PE/PO
Plug Boot	Plug Body Flame Rating UL94 V-0, Boot Flame Rating UL94 HB Minimum
Plug Housing	Polycarbonate (PC)
Plug contact blade	Phosphor bronze plated with 1.27um gold over 2.54um nickel undercoat or equivalent
Insertion Life	Minimum 750 Cycles
Insulation Resistance	>= 500 Mega Ohms
Current Rating	>= 1.5A
Dielectric Strength	1000 V AC
Max. Contact Resistance	20milli Ohm
Operating/Storage Temperature Range	-20 to +60 Deg C
Guaranteed Bandwidth	500 MHz or Better Guaranteed Bandwidth
Sheath Material	LSZH (Flame Retardant)
Flame Rating	LSOH: IEC 60332-3-22, IEC 60332-1, 60754, 61034
OD	6.1 ± 0.3 mm
PoE Test Report	It shall meet IEC 60512-99-002 for support of IEEE 802.3 Type 4 Remote Powering. (Enclose test report with bid)

Horizontal Cable Manager, 1RU

Details	Specification
Type	Horizontal Cable Manager

	1RU with Fingers and Cover
Dimension	19” Rack Mount, 1U, Height 1.5”, Depth 2.0”
Material	Steel with Black Powder Coated

24 Port, 1U Angled Unloaded Unshielded / Shielded Jack Panel

24 PORT ANGLED JACK PANEL, 1U	
Parameters	**Specifications**
Type	-24 Port 1U Straight Patch Panel or Angled Modules -Patch panels IDC (IDC of Information Outlet) Connectivity should be at rear end & RJ-45 jack on front panel, 19" rack mountable. -Patch panels Ports should be individually replaceable & Consistent port-to-port performance.
Availability	Patch Panel should be available with 24 Ports in 1U
Cable management	The patch panel design shall facilitate effective cable management
Height	1U (1.75”)
Feature	The jack design shall ensure reliable operation and maintain long-term performance under hospital operating conditions. Patch Panel shall be able to mount with Cat5e/Cat6/6A Modular Jacks.
Operating Temperature range	-10 Deg C to +60 Deg C
Color and Material	Steel, Powder paint finish, black, Plastic inserts, UL94V-0 plastic, Black. Cable support bar should be provided with panel.
RoHS	EU Directive 2011/65/EU (ROHS II)
Third Party Verification	ETL/UL/3P Test Report of Loaded Modular Jacks for ISO/IEC 11801-1 and ANSI/TIA-568-C.2 standard needs to be submitted along with bid.

Face Plate, UK Style, 6C Type, Square

Details	Specification
Type	**Simplex/Duplex with Shutters**
Material & Color for face plate and backbox	Plastic, ABS, UK Style face plate, White Color Face Plate & Backbox
Acceptability	Should be able to accept Cat6A, Cat6 and Cat5e information outlets
Mounting screws	2 pcs - M3.5 x 25mm, Station ID label- 2pcs
Compliant	RoHS
Dimensions for face plate	(H x W x D) 86mm x 86 mm x (10 mm or less)
Dimensions for backbox	(H x W x D) 86mm x 86 mm x (40 mm or more)

Cat 6A Field Mount Modular RJ45 Plug for MPTL Design

Cat 6A Unshielded Field Mount Plug for Wi-Fi & CCTV direct connect Application	
Parameters	**Specifications**
Type	Cat 6A UTP, U/FTP or F/UTP Field Mount Plug, TIA Category 6A, ISO Class E
Front Connection	RJ 45: Gold plated contacts over Palladium/Nickel or equivalent
Connector Body	Polycarbonate - UL94V-0 or Plastic
Accessories	Jack should support uniform hassle-free termination technology and be able to ensure performance in each termination without dependency on expertise of technician.
Termination Interface	Front Mated Connection: 750 Cycles or Better
	Rear Mated Connection: 3 Cycles or Better
IEEE Specification (PoE)	Power Over Ethernet (PoE) IEEE 802.3at type 1 and 2 (up to 30W), IEEE802.3bt/D1.7 type 3 and 4 (up to 100W), Ultra PoE technology (up to 60W), Power over HDBaseT (up to 100W)
Termination Pattern	Category 6A - TIA 568.C.2, Category 6A - ISO/IEC 11801:2002 Ed.2
Guaranteed Bandwidth	500 MHz or Better Guaranteed Bandwidth for 100 MT Channel Link

UL Rating	UL, ETL, 3P, Delta or equivalent international certifications.
Other Specifications	UL 1863, IEC 60603-7, FCC part 68-F
RoHS	EU Directive 2002/95/EC Compliant
Operating Temperature	-10°C to +60°C
Dielectric Strength	1,000 V RMS 60 Hz
Termination Process	The termination method shall ensure consistent Category 6A performance. Pairs should not be separated in termination process to avoid any crosstalk issue at Jack.
Cat6/6A Plug	Cat6/6A Plug Solution for Wi-Fi/CCTV should be covered under 25 year warranted solution from OEM.
Third Party Test Report	Enclose 4 Connector Direct Attach ETL/UL/3P Test Report ANSI/TIA – 568 6A, ISO/IEC 11801 (Class Ea) and EN 50173 (Class Ea)

Cat 6A Industrial IP20 Field Mount Modular RJ45 Plug for MPTL Design

Cat 6A Shielded Field Mount Plug for Wi-Fi & CCTV direct connect Application	
Operating Temperature	-40°C to +70°C
Dielectric Strength	1,000 V RMS @ 60 Hz
Termination Process	The termination methodology shall ensure Category 6A/Class EA performance and compliance with applicable standards.

6 / 12 Core Single mode Outdoor Armored Fiber Cable

Details	Specification
Cable	6 or 12 Core single mode 9/125, Central Loose Tube Cables, High mechanical and rodent protection provided for Outdoor – Corrugated Steel Tape Armor (CST), complying to 9/125 ITU G.652D
Application	Cable should be suitable for Structured (premises) wiring systems: For outdoor use in structured (data) wiring systems such as industrial backbone, campus backbone, building backbone (riser). Suitable for direct burial. Easy to install in ducts, tunnels and trenches.
Jacket	Black UV resistant HDPE / MDPE outer jacket. Glass yarns and two steel wires embedded in jacket as strength members.
Loose Tube Construction	Central tube, jelly filled (non-dripping and silicon-free) / Gel free with up to 6 & 12 fibers. Individually colour coded optical fibres. 1 – 6: Blue, Orange, Green, Brown, Slate, White 7-12: Red, Black, Yellow, Violet, Pink, Aqua
Optical Properties	Core: 9.2 +/- 0.4 um Cladding: 125 +/- 0.7 um Loose Tube fibres: Ø 250 ± 15 µm 1310 Wavelength (nm): 0.36 Attenuation max. (dB/km) 1550 Wavelength (nm): 0.22 Attenuation max. (dB/km) Zero Dispersion Wavelength: 1302 – 1322 nm Core-Clad Concentricity Error: ≤ 0.5 µm Clad non-circularity: ≤ 0.7 % Cutoff Wavelength: ≤ 1260 nm PMD (ps/km): ≤ 0.1 Point Loss @ 1310nm & 1550nm: 0.05 dB Refractive Index @1310nm: 1.467 Refractive Index @1550nm: 1.468 **Attenuation Change in Bends**: - ● 100 turns on 60mm diameter mandrel: ≤0.05 dB at 1550 nm & 1625 nm ● 100 turns on 50 mm diameter mandrel: ≤0.05 dB at 1310 nm & 1310 nm ● 1 turn on 32 mm diameter mandrel: ≤0.05 dB at 1550 nm
Warranty & Putup	Std. delivery length: 2000 ± 105m Minimum Warranty: 25 years.
Temperature Range	-40 to +70 °C

Physical Properties	Bending radii tube (Installation & Operation): 20 x OD mm Cable Max. Tensile Strength Installation (Short Term): 2700 N Cable Max. Crush Resistance Installation (Short Term): 22 N/mm Nominal Cable OD: 12.5mm Max. RoHS for Outer Jacket Buffer Tube Material: PBT – Polybutylene Terephthalate

12/24/48 or more Fiber Port 1U Rack Mount Fiber Enclosure (LIU) including Splice Trays, Pigtails and Couplers

Details	Specification
Fiber Interface Unit	Fiber Patch Panel Typically used in Server rooms, Network rooms, Data Centres and Small offices Can be mounted directly on any 19" rack or cabinet. It should be able to accommodate a variety of Fiber connectors and terminated to fiber cables using Splicing or other methods.
Type	Fiber LIU should be 1U (1.75”), 19 Inch Rack Mount.
	12/24/48 Fiber Port should be available in 1U.
	LC Type Connectors will be required.
Features & Compatibility	Each 1U LIU should be able to accommodate at least 96 fibers in LC type connectors.
	12/24/48 or more Fiber Splice trays should load in LIU with Pigtails, Splice Tubes, Min. 2 x PG13.5 Gland, Cable Ties and Velcro Straps
	Panel Material – Powdered Coated Steel
	Couplers in adapter strips should be colored to specify OS2 and shall meet Pigtail and Patch Cord Color
	Operating Temp Range: -10ºC to +60ºC
	EU Directive 2011/65/EU (ROHS II)
Pigtails Parameters	LC - Simplex, Singlemode OS2, Min. 1 Mtr, 0.9mm Tight Buffer
Standard	Optical Fiber Pigtail should comply with TIA 568.3-D
Optical Performance	Insertion Loss of <=0.30dB

Optical Performance	Return Loss of ≥ 55dB
Connector Standard	IEC 61754, TIA 604
RoHS	EU Directive 2011/65/EU (ROHS II)

Fiber Patch Cords, LC-LC Duplex, Singlemode OS2 Bend Insensitive, 3MT

Details	Specification
Type	2mm Duplex Zip cord or better
	OS2 ITU-T G.657A2 or Better with Uniboot Technology, Push-Pull Boot Design, Polarity Reversible Fiber Patch Cord
Outside Diameter	(Duplex): 2.0mm or better
Jacket Material	LSZH
Length	3 MT
Cable Crush Resistance	500 N/100mm
Insertion Loss	≤ 0.20 dB
Return Loss	≥ 55dB
RoHS Certified	Yes
Cable/Connector Standard	TIA 568.3-E, ISO/IEC 11801-1, TIA-492CAAC, IEC 61754-20, IEC 61753 Category C, TIA-598-D, ITU-T G.657.A2, TIA-604-10 (FOCIS-10), Telcordia GR-326-CORE issue 4
Flame Standard for LSZH	LSOH (IEC 60332-3C)
ANSI/TIA	ANSI/TIA-568.3-D (shall be mentioned in datasheet)

FIREWALL:

Feature	Technical Specification

Interface and Connectivity Requirement	8x 1000BASE-T Gigabit Ethernet 4x SFP+ 1/10Gbps Ethernet Day 1
Hardware Architecture	The appliance based security platform should provide Next-Gen Firewall functionality like IPS, Application Control, URL filtering and Anti-malware functionality in a single appliance from day one.
	The appliance hardware should be a multicore CPU architecture and should not be proprietary ASIC based in nature & should be open architecture based on multi-core cpu's to protect & scale against dynamic latest security threats.The appliance hardware should have a hardened operating system from the OEM and should support support minimum of 16 GB of RAM to make sure all the security capabilities are provided without degradation form day one
	Minimum storage should be 480GB with an option to field-replace it to 900GB
	Proposed firewall should not consume more than 1RU of rack space to make sure sustainability goals of the organization.
Performance & Scalability	The NGFW throughput of the firewall should be a minimum 9 Gbps with application identification and firewalling enabled with real world/enterpirse/ production traffic.The IPS throughput should be 10 Gbps
	The firewall should provide 12 Gbps of IPSEC VPN throughput
	NGFW Firewall should support at least 400,000 Layer 7/app-id Concurrent sessions
	NGFW Firewall should support at least 350,000 new connections per second L3/L4 and 50K Layer 7/app-id connections per second.
	High Availability Configurations shall support Active/ Passive
Next Gen Firewall Features	Firewall should support creating security policies with soruce/destinatoin zones , network subents/ranges, geolocation objects, ports/protocols, applications, user/group attributes, URL/URL categories and action on traffic . The actions on the traffic should be to allow, alert, block, block and continue , reset. The firewall should provide time based polices with optoins for reccurrecing schedule or one time schedule.
	The firewall should supports NAT's like source NAT , destination NAT , U-Turn NAT. Firewall should support Nat66, Nat 64 & Nat46 functionality.
	Solution should provides capabilities like dynamic real-time metrics based , policy-based, application path selection across multiple WAN connections and supports service chaining for additional services such as WAN optimization

	and firewalls.
	The solution should provide the following routing capabilities: OSPF, BGP, RIP, Multicast, Static,Route Tracking(SLA) PBR, ISIS, BFD, ECMP, VRF, Application based Routing
	The solution should be able to provide contextual information about the hosts and the network subnets present such that the admins are able to capture all the required information and build the security profiles based on the details shown on the solution . The details captured should consist of the following: IOC's , MAC addresses, IP address , Applications , Ports and protocols, vunerabilites etc.
	Should support capability to integrate with other security solutions to receive contextual information like security group tags/names.
	Should support more than 5000+ (excluding custom application signatures) distinct application signature as application detection mechanism to optimize security effectiveness and should be able to create 40 or more application categories for operational efficiency
	Should be capable of dynamically tuning IDS/IPS sensors (e.g., selecting rules, configuring policies, updating policies, etc.) with minimal human intervention.
	Should support more than 25,000 (excluding custom signatures) IPS signatures or more. Solution should be able to passively detect endpoints and infrastructure for threat correlation and Indicators of Compromise (IoC) intelligence. The signatures should also have categorization based on MITRE TTP's.
	The firewall solutoin should have the following capabilites to make sure the current solutoin is future ready for technoliges like WAN routing , SASE etc. The firewall should have application aware routing with HTTP and ICMP ping , ZTNA based clientlesss access to applicatoins.
	The firewall solution should have capabilities like Application Aware Routing, Health Monitoring, DIA,Dual ISP, Data interface Management for simplified branch capabilities
	Should be capable of automatically providing the appropriate inspections and protections for traffic sent over non-standard communications ports.
	The solution should be able to identify, decrypt and evaluate both inbound and outbound SSL traffic on-box. The NGFW shall support the

	ability to have a SSL inspection policy differentiate between personal SSL connections i.e. banking, shopping, health and non-personal traffic.
	The solution should have ML/AI capability to detect client apps and process . Moreover it should be able identify malicious encrypted traffic even when it is destined for a trustworthy service. This is required to help administrators control specific applications and improve network security
	The solution must provide IP reputation feed that comprised of several regularly updated collections of poor repuration of IP addresses determined by the proposed security vendor. Solution must support IP reputation intelligence feeds from third party and custom lists of IP addresses including a global blacklist. The solutoin should have the capability to detect MD5, SHA256 and SHA512 traffic hashs to detect any malicious traffic pattern
	The solution should provide Configuration Deployment History,Pending Changes and Policy Compare capability before the security polices are deployed on the firewall. It should also provide configuration rollback capabity to the last good configuration running on the firewall.
	Should must support DNS threat intelligence feeds to protect against threats
	The Appliance OEM must have its own threat intelligence analysis center and should use the global footprint of security deployments for more comprehensive network protection.
	The detection engine should support capability of detecting and preventing a wide variety of threats (e.g., network probes/reconnaissance, VoIP attacks, buffer overflows, P2P attacks, etc.).
	Should be able to identify attacks based on Geo-location and define policy to block on the basis of Geo-location
	The detection engine must incorporate multiple approaches for detecting threats, including at a minimum exploit-based signatures, vulnerability-based rules, protocol anomaly detection, and behavioral anomaly detection techniques.
	Should support Open based Applicaion ID / Custom Application ID for access to community resources and ability to easily customize security to address new and specific threats and applications quickly
URL Filtering Features	Should must support URL threat inetllifence feeds to protect against threats

	Should support Reputation- and category-based URL filtering offering comprehensive alerting and control over suspect web traffic and enforces policies on more than 250 million of URLs in more than 75+ categories.
Anti-APT / Malware Features	Should support the capability of providing network-based detection of malware by checking the disposition of unknown files using SHA-256 file-hash or signature as they transit the network and capability to do dynamic analysis.
	Solution shall have capability to analyze and block TCP/UDP protocol to identify attacks and malware communications. At minimum, the following protocols are supported for real-time inspection, blocking and control of download files: HTTP, SMTP, POP3, IMAP, NetBIOS-SSN and FTP
	Proposed solution shall have required subscription like Threat Intelligence for proper funtioning
VPN	The solution should support IPSec and SSL VPN
	The Solution shall provide a secure Remote Access VPN capability for users connecting from trusted and untrusted networks, using industry-standard SSL/TLS and/or IPsec protocols.
	The proposed solution must support endpoint posture assessment (HostScan) at the time of VPN connection and during the active VPN session. The HostScan functionality shall be tightly integrated with the VPN gateway and shall not require third-party posture engines for baseline checks.
	HostScan must be capable of checking, at a minimum: Operating system type and version Antivirus / Anti-malware presence, status, and update level Endpoint firewall status Disk encryption status (where supported) Presence of prohibited or mandatory processes/applications
	The solution should provide 100 SSL VPN license from day1
Management	The management platform must be accessible via a web-based interface and ideally with no need for additional client software and must provide centralized logging and reporting functionality
	The management platform must be a dedicated OEM appliance and VM running on server will not be accepted

	The management platform must be capable of integrating third party vulnerability information into threat policy adjustment routines and automated tuning workflows
	The management platform must be capable of role-based administration, enabling different sets of views and configuration capabilities for different administrators subsequent to their authentication.
	Should support troubleshooting techniques like Packet tracer and capture
	The management platform must provide multiple report output types or formats, such as PDF, HTML, and CSV. The management platform support running on-demand and scheduled reports
	The management platform must support multiple mechanisms for issuing alerts (e.g., SNMP, e-mail, SYSLOG).
	The centralized management platform must not have any limit in terms of handling logs per day
	The management platform must provide built-in robust reporting capabilities, including a selection of pre-defined reports and the ability for complete customization and generation of new reports.
	The management platform must risk reports like advanced malware, attacks and network
	The management platform must include an integration mechanism, preferably in the form of open APIs and/or standard interfaces, to enable events and log data to be shared with external network and security management applications, such as Security Information and Event Managers (SIEMs), and log management tools.
	Proposed solution should support 24x7x365 OEM TAC support and advance Next Business Day Hardware replacement

AAA Solution:

SNo	Technical Specifications
1	The proposed solution should provide a highly powerful and flexible attribute-based access control solution that combines authentication, authorization, and accounting (AAA); posture; Guest; profiling; and BYOD services on a single platform.
2	The proposed solution should control access to the network with policies, including pre-admission endpoint security policy checks and post-admission controls over where users and devices.
3	The proposed solution should have the capability of traffic log retention for a period of 365 days.

4	The proposed solution should have a Centralized Management Console with customizable dashboard and role-based admin. Solution should enables administrators to centrally configure and manage profiler, posture, guest, authentication, and authorization services in a single web-based GUI console, greatly simplifying administration by providing consistency in managing all these services.
5	The proposed solution should operate within a heterogeneous network with switches, routers, etc. from multiple vendors. NAC appliance should support vendor agnostic switch infrastructure.
6	The proposed solution should allow to authenticate and authorize users and endpoints via wired, wireless, and VPN with consistent policy throughout the enterprise.
7	The proposed solution should provide comprehensive visibility of the network by automatically discovering, classifying, and enforcing policy for endpoints connected to the network and must have capacity to enable the appropriate services for atleast a total of 1000 endpoint devices.
8	The proposed solution should support on-demand health-check of the hardware nodes.
9	The proposed solution should support the backup and recovery of policies/configuration.
10	The proposed solution should support consistent policy in centralized and distributed deployments that allows services to be delivered where they are needed
11	The proposed solution should support Federal Information Processing Standard (FIPS) 140-2
12	The proposed solution should support remote access capabilities on its management interface via HTTPS or SSH access
13	The proposed hardware should have Dual Power supply for redudancy.
14	The proposed solution must support a managed switch environment having 802.1 x support.
15	Should support multiple Admin Group Roles and responsibilities like HelpDesk Admin, Identity Admin, Monitoring Admin, Network Device Admin, Policy Admin, RBAC Admin, Super Admin, Read-Only Admin and System Admin
16	The proposed solution to be in High availability so that even if one appliance/server fails, the other server takes over.
17	The proposed solution should have capability to send alerts regarding the health of the solution through emails.
18	The proposed solution should support API ERS and Open API
19	The proposed solution should be able to control the user even before IP address is assigned. It should act as a pre-admission solution
20	The proposed solution should supports a wide range of authentication protocols, including PAP, MS-CHAP, Extensible Authentication Protocol (EAP)-MD5, Protected EAP (PEAP), EAP-Flexible Authentication via Secure Tunneling (FAST), TEAP , and EAP-Transport Layer

	Security (TLS).
21	The solution should provide a wide range of access control mechanisms, including downloadable access control lists (dACLs), VLAN assignments and URL redirect etc.
22	The Solution should support Certificate Fingerprinting to evaluate Certificate issuer SHA-256 in policies.
23	The proposed solution should have capability to assign services based on the assigned user role, group, and associated policy (job role, location, device type, and so on).
24	The proposed solution should be capable of being bypassed in the event of any failure of the solution.
25	The proposed solution should be able to control Maximum concurrent sessions per user/group
26	The solution should be able to block unauthenticated/rogue machine without giving any access to the network.
27	The proposed solution should support Real time Policy hit counts
28	The proposed solution should provides complete guest lifecycle management by empowering sponsors to on-board guests.
29	The proposed solution should provides sponsors to extend, terminate & manage password for the registered guest.
30	Advanced Guest Networking Capabilities Solution should provide below mentioned mechanism for notification of user credentials to Guest Users a. SMS integration b. Email (Microsoft Office 365)
31	The portal used for Device registration should be customizable, allowing to customize portal theme by changing text, banners, background color, and images
32	The proposed solution should support multiple guest types to differentiate between external guest based on time period for which the account is created for.
33	The proposed solution should have provision for Sponsor admin to approve the request coming from external guest and after approval the credentials will be shared.
34	The proposed solution should have provision to provide grace period to guest till the time Sponsor admin approves the request.
35	The proposed solution should support testing of the Guest portal before pushing it into production.
36	The solution should support guest users onboarding through social media login to simplify the registration process
37	The solution should support sponsor approval for guest users connecting into the network and the approval request should have control from multiple sponsor to avoid single point of failure
38	The proposed solution should have provision to customise the Guest portal with Logos and text.
39	The proposed solution should automatically enforce security policies by blocking, isolating, and repairing noncompliant machines in a quarantine area with appropriate notifications

	to the administrator
40	The proposed solution should support running custom scripts to remediate non-compliant endpoints.
41	The solution should provide granular compliance checks for Windows, MAC and Linux in terms of: - Check operating system , service packs , hotfixes - Check process, registry, file & application - Check for Antivirus installation , Version , Antivirus Definition Date - Check for Antispyware installation , Version , Antispyware Definition Date - Check for windows update running & configuration - Ability to run custom scripts and policies
42	The proposed solution should permit admin to define thresholds for Anti-Virus Defination checks, if defination is not updated then Endpoint should be blocked.
43	The proposed solution must be able to integrate with Endpoint Patch management such as WSUS for Auto or Manual Remediation
44	The proposed solution should provide automatic remediation.
45	The proposed solution should update the latest defininations and product versions automatically.
46	The proposed solution should permit configuring baseline version of the AV/AM to be checked on the endpoints.
47	The proposed solution should have predefined device templates for a wide range of endpoints, such as IP phones, printers, IP cameras, smartphones, and tablets.
48	The proposed solution should allow Administrators to create their own device templates. These templates can be used to automatically detect, classify, and associate administrative-defined identities when endpoints connect to the network. Administrators can also associate endpoint-specific authorization policies based on device type.
49	The proposed solution should have capability to see endpoints attribute data via passive network telemetry or alternatively from the infrastructure via device sensors on switches at Core, Distribution and Access Layer.
50	The solution should have profiling capabilities integrated into the solution in order to detect headless host. The profiling features leverage the existing infrastructure for device discovery. Should support the use of attributes from the following sources or sensors: - Profiling using MAC OUIs - Profiling using DHCP information - Profiling using RADIUS information - Profiling using HTTP information - Profiling using DNS information - Profiling using NetFlow information - Profiling using SPAN/Mirrored traffic

51	The proposed solution should support importing endpoints from a comma-separated values (CSV) file in which the list of endpoints appears with the MAC address and the endpoint profiling policy details separated by a comma.
52	The soultion should support BYOD workflow for Partner/Contractor or Employees for BYOD scenario by automatically provisioning the supplicant such that Owner & the device are authenticated based on certificate.
53	Solution should support confguring MDM policy based on the attributes lie: DeviceRegisterStatus, DeviceCompliantStatus, DiskEncryptionStatus, PinLockStatus, JailBrokenStatus, SerialNumber, Manufacturer, IMEI, OsVersion & phone number, etc
54	The proposed solution should support configuring multiple MDM
55	Solution should have capability to determine whether users are accessing the network on an authorized, policy-compliant device.
56	Should provide a Registered Endpoints Report which provides information about a list of endpoints that are registered through the device registration portal by a specific user for a selected period of time. The report should provide the following details •Logged in Date and Time •Portal User (who registered the device) •MAC Address •Identity Group •Endpoint Policy •Static Assignment •Static Group Assignment •Endpoint Policy ID •Device Registration Status
57	The solution must have internal CA server functionality with flexibility to create certificate template to be used by other network services
58	The proposed solution should have capability to revoke the issued certificate.
59	The CA server should be able to provision certificate for multiple use cases like BYOD, EAP authentication and Third Party Client and Server side authentication.
60	The proposed solution should have capability to integrate with External CA for issuing the certificates
61	The proposed solution should support Group based policies with Scalable Group Tags (SGT) to prevent malware propagation for East-West traffic segmentation
62	The proposed solution should have capability to grant authenticated users with access to specific segments of the network, or specific applications and services, or both, based on authentication results.

63	The proposed solution should support configuring multiple Identity sources to validate for user credentials. Solution should support the following databases: •Internal Users •Internal Endpoints •Active Directory •Azure Active Directory •LDAP •RSA •RADIUS Token Servers •ODBC •Certificate Authentication Profiles
64	The proposed solution should support configuring Multiple Active Directory Domains for Authentication of User Credentials.
65	The proposed solution should support enabling or disabling authentication towards any child domain that is part of the same forest.
66	The Solution should support MSRPC protocol for pulling Login information from Active Directory to be used for Authentication of Endpoints.
67	The proposed solution should have capability to re-write the incoming Identity to a different format which LDAP/Active directory understands.
68	The proposed solution should integrate with vulnerability scanner like Rapid7, Tenable etc. and allow use of threat intelligence to build authorization permissions based on the vulnerability scores received from these tools to enforce permissions.
69	Solution should support 3rd party integration for sharing Contextual awareness and other endpoint related data such that it can Publish, subscribe and work as broker as well.
70	The proposed solution should be able to integrate with existing Firewall to share User-IP and IP-TAG mapping to create more granualar policies.
71	The proposed solution shall monitor, detect, alert, report and provide remediation for any unauthorized access.
72	The proposed solution should integrate with Enterprise level SIEM solutions to forward all the logs and events.
73	The proposed solution should have capability to establish user identity, location, and access history, which can be used for compliance and reporting.
74	The proposed solution should have extensive troubleshooting capabilities to collect packet captures, debugs particular endpoint , run commands on switch to collect information to provide visibility for an administrator.
75	The proposed solution should have built-in web console for monitoring, reporting, and troubleshooting to assist help-desk and network operators in quickly identifying and resolving issues. Offers comprehensive historical and real-time reporting for all services, logging of all activities, and real-time dashboard metrics of all users and endpoints connecting to the network.

76	The solution should provide full TACACS+ capability including enable password, configuration present for different NAD types, TACACS+ proxy etc.
77	Supports a wide range of authentication protocols, including PAP, MS-CHAP, Extensible Authentication Protocol (EAP)-MD5, Protected EAP (PEAP), EAP-Flexible Authentication via Secure Tunneling (FAST), and EAP-Transport Layer Security (TLS).
78	Solution must allow administrator to add exception for certain device properties in the device templates/ device profiles available in the solution to filter unintentionally picked paramters of endpoints.
79	Solution should allow end users to interact with a self-service portal for device on-boarding, providing a registration vehicle for all types of devices as well as automatic supplicant provisioning and certificate enrollment for standard PC and mobile computing platforms.
80	Solution should support automatic provisioning of NAC agents
81	The NAC solution should support any SAML v2 compliant solution.
82	Should support native supplicant profiles to enable users to bring their own devices into network. When the user logs in, based on the profile that you associate with that user's authorization requirements, solution should provide the necessary supplicant provisioning wizard needed to set up the user's personal device to access the network. This should be supported over Microsoft windows, Apple Mac and iOS and Android devices.
83	The soultion should support BYOD workflow for Partner/Contractor or Employees for BYOD scenario by automatically provisioning the supplicant such that Owner & the device are authenticated based on certificate.
84	The NAC solution should be standard RADIUS server with built-in certificate authority
85	The CA server should be able to provision certificate for multiple use cases like BYOD, EAP authentication and Third Party Client and Server side authentication.
86	Solution should have capability which allows users to add a device on a portal, where the device goes through a registration process for network access. Should allow users to mark as lost any device that you have registered in the network, and blacklist the device on the network, which prevents others from unauthorized network access when using the blacklisted device. Should have capability to reinstate a blacklisted device to its previous status in Device Portal, and regain network access without having to register the device again in the Devices Portal. Should also support removing any device in the enterprise network temporarily, then register the device for network access again later.
87	Open seating environments where the MAC addresse is not peristance, solution should be to authorize managed endpoint

88	The solution should be able to detect the IOT devices using MUD for identifying the device type and its capabilities. Manufacturer Usage Description (MUD) is an embedded software standard defined by the IETF that allows IoT Device makers to advertise device specifications, including the intended communication patterns for their device when it connects to the network.

SECURE ACCESS Solution

S.No	Functional Category	Specification statement
1	Remote Access	All applications used with on-premise VPN must be available in the cloud-based Remote Access.
2	Remote Access	In order to be able to support any applications that may exist, Remote Access must have both the ZTNA function and the VPN function in the cloud.
3	Remote Access	From the perspective of avoiding resource consumption and application conflicts, there should be only one agent used for Remote Access.
4	Remote Access	An IPsec connection should be established between the SSE function and the location where the application resides, and the routing information within the location should be made available via the SSE using one of the following methods. -Static Routing -BGP
5	Remote Access	The ability to provide users with a reason when access is blocked by the terminal integrity check function (posture)
6	VPNaaS	Must have cloud-type VPN functionality.

7	VPNaaS	The following authentication functions must be available for VPN connections. - SAML - SAML + Single Certificate - Single Certificate - Multi Certificate - RADIUS
8	VPNaaS	The ability to create multiple VPN connection profiles.
9	VPNaaS	The VPN connection should include a device health check (posture) function, and connections from vulnerable devices should be restricted using the following criteria - Use of old operating systems and browsers - Use of anti-malware products - Use of client firewalls - Disk encryption status - Presence of specific files - Presence of specific registries (Windows only) - Presence of specific processes - Certificates
10	VPNaaS	The specified destination must be set to communicate directly with the Internet without going through the VPN tunnel.
11	VPNaaS	Even for those that communicate directly to the Internet without going through a VPN tunnel, it should have functions that can protect and control the security of DNS queries and web communications.
12	VPNaaS	The ability to apply IPS functions to VPN communications to prevent attacks from the inside.

13	ZTNA	It must have the ZTNA (Zero Trust Network Access) function, which is more secure than VPNs, with the following functions ・It must be able to create a session for each application access and manage it on a session-by-session basis ・It must be able to restrict application access rights to the minimum for the user
14	ZTNA	To minimize connection and transmission delays when accessing the ZTNA function in the cloud, use MASQUE to access it.
15	ZTNA	When connecting to ZTNA, the terminal health check function (posture) should be performed, and connections from vulnerable terminals should be restricted using the following criteria. - Use of old operating systems - Use of anti-malware products - Use of client firewalls - Disk encryption status - Whether or not system passwords are set
16	ZTNA	By placing SDP connectors inside the data center, it is possible to use Remote Access without having to allow two-way communication with SASE on the data center network.
17	ZTNA	The SDP connector must support the following virtual platforms. ・AWS ・Azure ・VMware ・KVM
18	ZTNA	Even if the application exists in a network environment where the IP address range overlaps, the ZTNA function can be used for each application.

19	ZTNA	The IPS function can be applied to ZTNA communications to prevent attacks from the inside.
20	ZTNA	The ability to access internal applications from Apple iOS devices using MASQUE Proxy technology.
21	ZTNA	The ability to access internal applications using MASQUE Proxy technology from Android devices with a supported hardware-backed mobile security/enterprise management platform (e.g., Samsung Knox or equivalent) installed.
22	Clientless ZTNA	The Clientless ZTNA function allows you to use web applications that use HTTP/HTTPS for access from outside the company without installing an agent on the terminal, thanks to the reverse proxy-type cloud-based remote access function.
23	Clientless ZTNA	With Clientless ZTNA, you can use Remote Access with your usual browser (such as Google Chrome) without using any special apps.
24	Clientless ZTNA	Clientless ZTNA must be able to use SAML for authentication.
25	Clientless ZTNA	Clientless ZTNA should be able to restrict connections from devices running older versions of the OS by using the device health check function (posture) when connecting.
26	Clientless ZTNA	Clientless ZTNA allows you to restrict device connections depending on the type of browser used, thanks to the device health check function (posture) when connecting.
27	S2S Communication	The ability to communicate between multiple IPsec-connected locations via the

		SSE function.
28	S2S Communication	The ability to use the firewall function when communicating between bases.
29	DNS Security	To provide DNS security functions.
30	DNS Security	DNS security is implemented using a database reference method rather than a list download method in order to always refer to the latest DNS records.
31	Proxy	It is possible to use SAML authentication when browsing the web in conjunction with EntraID.
32	Proxy	It should be possible to use SAML authentication in conjunction with other authentication platforms (e.g. Okta).
33	Proxy	HTTPS communication can be decrypted and security inspections can be performed using resources in the cloud without using on-premises resources.
34	Proxy	To provide a full proxy function that checks all destinations in web communication (excluding destinations that have been excluded).
35	Proxy	Support for transparent and explicit proxies.
36	Proxy	Even without making individual settings, it should have a function to bypass security checks for communications to MS365 in bulk.
37	Proxy	The ability to control whether or not files can be downloaded depending on the file type.
38	Proxy	The ability to check files for viruses and file reputations when downloading files. In addition, if a file with the potential to be malicious is detected as described above, it should be possible

		to verify it in a sandbox in the cloud.
39	Proxy	When accessing the Internet via Proxy (SWG), it is possible to provide a unique IP address for the subscriber to use as the source of web browsing on the cloud.
40	CDFW	To have a cloud-based firewall function to manage firewall policies in bulk.
41	CDFW	With cloud-based firewalls, it is possible to set control policies for communications other than web communications (ports 80, 443).
42	CDFW	It must have an L7 firewall function that can control communication by IP address, port number, protocol, and application.
43	CDFW	The L7 Firewall function should be able to control applications that use non-standard port numbers. (e.g. SSH communication using TCP/80)
44	IPS	To provide an IPS function that detects and blocks unauthorized access targeting malware and host vulnerabilities at the Internet boundary.
45	IPS	It is possible to use the pre-prepared preset IPS signature list, and it is also possible to create a unique IPS signature list by selecting the ISP signature to be used by the user.
46	CASB	The ability to visualize the usage of cloud applications (visualization of Shadow IT)
47	CASB	The ability to check the risks of visualized cloud applications.

48	CASB	The ability to perform advanced communication control for some applications (e.g. allow file downloads from Box but prohibit uploads)
49	CASB	When accessing MS365 and Google Workspace, only access to the tenant contracted by this organization should be permitted, and access to the tenant contracted by other organizations should be blocked.
50	DLP	Provide inline and API-based DLP functions. The inline type monitors traffic via a proxy, and the API type monitors data on cloud storage such as MS365 and Google Workspace.
51	DLP	Inline and API-type DLP logs should be able to be checked on the same screen.
52	DLP	As a countermeasure against information leaks, it has a function that monitors communications sent from inside to outside the organization and blocks them when it detects that information important to the organization has been sent outside.
53	DLP	The ability to create your own detection rules using keyword lists and regular expressions to define important information.
54	DLP	In order to prepare for the introduction, the following important information detection templates must be prepared in advance. ・My Number ・Driver's license number ・Health insurance card number ・Bank account number ・Email address

55	DLP	In order to improve the accuracy of important information detection, it should have a real data detection function that uses data managed in a table format, such as in a database or Excel.
56	DLP	The ability to read information contained in documents such as MS Word and PDF files and prevent similar documents from leaking outside.
57	DLP	It is possible to detect the sensitivity labels (Microsoft Sensitivity Labels) assigned to Microsoft Office and use them for blocking control.
58	DLP	The OCR function should be able to read the text strings contained in the image and apply them to the DLP function.
59	RBI	To provide web isolation functionality for any destination and destinations that are at risk based on threat information.
60	RBI	The downloaded file should be displayed in a way that minimizes security risks.
61	RBI	It is possible to download PDF, Word, and other files with a low security risk.
62	Remote User	For terminals with remote user agents installed, the Internet Security function must be available even when used outside the organization's network.
63	Remote User	The remote user agent must have both Internet Security and Remote Access functions, and it must not be installed multiple times.

64	Remote User	Remote terminals with Windows, MacOS, Apple iOS, Android, Chromebook, and Linux agents installed can connect directly to the SASE infrastructure in the cloud and access the Internet using the following security functions. - Cloud Firewall - SWG - CASB - DLP
65	Other	The ability to exclude access control for specific users.
66	DEM	In the event of a problem with the communication path to the cloud application, the system should have a function that suggests where the problem lies from the following perspectives - CPU and memory usage of the device - WiFi connection status of the device - Communication status between the device and SSE - Communication status between SSE and the specific SaaS
67	System Environment	Support for multiple IPsec tunnels.
68	System Environment	By bundling multiple IPsec tunnels, it is possible to secure a bandwidth of 10Gbps or more.
69	Policy Management	The ability to easily create and modify policies with the support of generative AI.
70	User Authentication	The system must have a function to authenticate users when accessing the management portal.
71	User Authentication	The system must have a function that performs multi-factor authentication by linking IdP and SAML for user authentication when accessing the Internet or performing remote

		access.
72	Agent	The agent cannot be easily stopped by the user.
73	Agent	The agent must have the ability to automatically connect to the SSE infrastructure via VPN before logging in to Windows.
74	Support	After receiving an inquiry by email or on the website during standard business hours, a response should be sent within one hour.
75	Support	The ability to provide support in Japanese.
76	Support	A technical account manager will be assigned to provide support.
77	Support	Support options for introducing the service can be contracted.
78	Userbility	To provide a Japanese WebGUI.
79	Operation	The ability to store 30 days of communication logs. The ability to store more than 30 days by linking with an external storage service.。
80	Operation	It should have a report function and analysis function.
81	Operation	In order to easily check the behavior of specific users and terminals in the event of an emergency, it is possible to display logs such as Internet access, Zero Trust access, Firewall, DNS, and IPS on a single screen and narrow down the results using filters, etc.
82	Operation	Logs must have SIEM integration or export functions.
83	Operation	Internal IP information can be checked as a log to identify the terminal.
84	Operation	The SSE function must disclose information on the types of data handled, how they are handled, where

		they are stored, how long they are stored for, and the disposal cycle.
85	Availability	The utilization rate must be 99.999% or more based on actual results.
86	Availability	Service Structure must be available 24 hours a day, 365 days a year, and there must be advance notice of planned outages.
87	Availability	In the event of a service failure or maintenance, it should be possible to continue using the service by automatically switching to another data center (location).
88	Availability	The ability to use anycast routing to use the nearest server from the terminal.
89	Threat Intelligence	The company develops and maintains its own threat intelligence.
90	Regional Restrictions	If there are any restrictions on the provision of services depending on the country, clearly state the details of these restrictions.

Core Switch 48 Port, Layer 3

S. No.	Core Switch Layer 3 (48 ports)
1	**Physical Specification:**
1.1	The Switch shall be rack mountable and 1RU high
1.2	The switch shall be a Layer 3 managed device with minimum 48x 10G/1G SFP+/SFP ports and 6x 100G/40G QSFP28/QSFP+ uplinks, and shall support Energy Efficient Ethernet (EEE). All required transceivers shall be provided. The device shall include dedicated management port and RJ-45 console port, in a 1RU rack-mount form factor.
1.3	Fixed 6 Nos. 40Gbps BaseX optical QSFP+ Ports
1.5	Fixed one RJ45 console port for local management
1.7	Fixed one USB2.0 port
1.8	Must have two modular power slots, Must support 250W AC power module, 1+1 redundant backup. The switch shall have minimum 8GB RAM

1.9	Must have four modular FAN slots, Must support hot-swap intelligent FAN modules.
1.1	Operating Voltage: 110-220 VAC / 50-60 hz
1.11	Operating Temperature: -10 to 55℃ or better
1.12	Humidity: 10% to 90% (non-condensing)
2	**System Specifications: -**
2.1	MAC Capacity ≥ 250K
2.2	ACL Capacity ≥ 10K
2.3	The switch shall have minimum 8GB RAM
2.4	Flash ≥ 8GB
2.5	Packet Buffer (Should be sufficient for wired speed performance)
2.6	VLANs ≥ 4K
2.7	Jumbo Frame ≥12K
3	**Performance**
3.1	The switch shall support minimum 2.1 Tbps switching capacity, 1800 Mpps forwarding rate, and < 1µs latency.
3.2	Packet forwarding rate no less than 1,071Mpps
3.3	Must support 288K MAC table
3.4	Must support 4K active VLAN, The solution shall support minimum 64K MAC table, 16K IPv4 host entries, 8K IPv6 host entries, and 16K IPv4, 8K IPv6, and 16K multicast route entries. The switch shall support management over IPv4/IPv6 via Telnet, SSHv2, HTTP, HTTPS, and SNMP v2c/v3 (v1 disabled by default for security)
3.5	Must support Layer-3 IPv4 forwarding, at least support 175,000 IPv4 routing entries
3.6	Must support Layer-3 IPv6 forwarding, at least support 16,000 IPv6 routing entries
3.7	Must support stacking technology, support at least 4 devices stack into one logic device.
3.8	Stacking bandwidth no less than 320Gbps
3.9	Support stacking by dedicated stacking cables
3.10	Support stacking on 10G SFP+ and 40G QSFP+ ports
3.11	Support Long Distance Stacking Upto 8 Devices
4	**Software Specification:**
4.1	Support VLANs based on MAC and IP subnets

4.2	Support MAC VLAN, Private VLAN, Guest VLAN, Voice VLAN, Super VLAN, Protocol VLAN, GVRP
4.3	Support Basic QinQ, Selective QinQ, VLAN mapping
4.4	Support Local SPAN, RSPAN, VLAN SPAN
4.5	Support Broadcast, Multicast, Unknown Unicast and Unknown Multicast storm suppression
4.6	Support static LACP and dynamic LACP. Each link aggregation group supports at least 8 member ports.
4.7	Support H-VST,M-VST Stacking, MAD LACP, MAD Fast-Hello, M-LAG
4.8	Support STP/RSTP/MSTP, BPDU Guard, Flap Guard, Loop Guard, Root Guard, TC Guard
4.9	Support VIST/VIST+
4.10	Support DHCP/DHCPv6, Static routing/Static routev6, RIP/RIPng, OSPFv2/OSPFv3, BGP/BGP+, ISIS/ISISv6, VRRP/VRRPv3, VBRP, PBR/PBRv6, IP-VRF
4.11	Support IGMPv1/v2/v3, MLD, MSDP, PIM-SM/PIM-DM, PIMv6-SM
4.12	Support IGMP Snooping and MLD Snooping
4.13	Support DHCPv4/DHCPv6 Snooping, IPv4/IPv6 Source Guard, Dynamic ARP inspection, Host Guard, ND Snooping, ARP Guard, PPPoE+. The proposed switches must support centralized management the OEM's native NMS platform, where the switches are managed ensuring uniform configuration, monitoring, and policy enforcement across the network. Centralized management shall be provided as an integral part of the proposed solution.
4.14	Support BFD with Static, RIP, OSPF, BGP, ISIS, VRRP, Track, PIM-SM
4.15	Support VRF and MPLS Network, Support MPLS L3 VPN, MPLS TE.
4.16	Support VxLAN Technology, VxLAN Routing, VxLAN Bridging, EVPN
4.17	Support Radius, TACACS+, 802.1x and L2 Portal authentication
4.18	Support ICMP flood interception, Smurf attack interception, Fraggle attack interception, SYN Flood attack interception
4.19	Support Standard IP ACL, extended IP ACL, standard MAC ACL, extended MAC ACL, Standard Hybrid ACL, extended Hybrid ACL,time-based ACL
4.20	Support SP, RR, WRR, WDRR, SP+WRR, SP+WDRR.
4.21	Support G.8032 protocol and realize ms-class service switching
4.22	Support ZTP provisioning through DHCP server and USB disk. Support SDN controller management
4.23	Support Netconf, Telemetry, IP SLA, BSMv4 and sFlow
4.24	Support Telnet, SSHv2, Web, Console, TR069, SNMPv2/v3, Hot Patch, Cloud management methods

4.25	Support Ethernet OAM, 802.11ag and 802.3ah
4.26	Support Energy Management IEEE Supported / IEEE 802.3az
5	**Certification Requirement**
5.1	The switch shall comply with international certifications such as FCC, CE/EU, UL, RoHS2.
5.2	The quoted model/family shall be TEC/MTCTE Approved and shall be available on MTCTE Govt. website.
5.3	The quoted model/family shall be IEC 62443-4-1 - Cyber Security Compliant
5.4	EN 55032 Class A, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11
5.5	Min. EAL 2+ for Common Criteria
5.6	RoHS 2015
5.7	The quoted model/family shall be IPv6 Logo Certified. Device Must be MTCTE Certified as per TEC. The certificate with model number / family to be shown on MTCTE Portal.

24 Port Gigabit L3/L2 PoE+ Switch

S. No.	Access PoE Switch Layer 2 & L3 lite (24 ports)
1	**Physical Specification:**
1.1	The Switch shall be rack mountable and 1RU high
1.2	Fixed 24 Nos. 10/100/1000Mbps Base-T RJ45 Ports, Support PoE (802.3af/at). The switch shall be a Layer 3 managed device with minimum 24x 1G/10G SFP/SFP+ ports and 2x 40G/100G QSFP+/QSFP28 uplinks, and shall support Energy Efficient Ethernet (EEE). All required transceivers shall be provided.
1.3	Fixed 4 Nos. 1/10Gbps Base-X optical SFP+ Ports
1.4	Fixed one RJ45 console port for local management
1.5	Fixed one USB2.0 port
1.6	Must have no less than 380Watts PoE budget
1.8	Must have inbuilt power supply, two redundant AC 100V~240V power supplies.
1.9	Must have Intelligent FAN
1.1	Operating Voltage: 110-220 VAC / 50-60 hz
1.1	Operating Temperature: -10 to 55°C or better
1.1	Humidity: 10% to 90% (non-condensing)
2	**System Specifications:-**

2.1	MAC Capacity ≥ 16K
2.2	ACL ≥ 1500
2.3	The switch shall have minimum 8GB RAM
2.4	Flash ≥ 256MB
2.5	Packet Buffer (Should be sufficient for wired speed performance)
2.6	VLANs ≥ 4K
2.7	Jumbo Frame ≥12K
3	**Performance**
3.1	Switching capacity of the proposed switch should be minimum 120 Gbps
3.2	Packet per second capacity of the switch should be minimum 180 Mpps and the network latency should be ~1us
3.3	Must support 16K MAC table
3.4	Must support 4K active VLAN
3.5	Must support Layer-3 IPv4 forwarding, at least support 400 IPv4 routing entries
3.6	Must support Layer-3 IPv6 forwarding, at least support 200 IPv6 routing entries
3.7	Must support 12K Jumbo Frame
3.8	Must support stacking technology, support at least 4 devices stack into one logic device.
3.9	Stacking bandwidth no less than 80Gbps
3.10	Support stacking by dedicated stacking cables
3.11	Support stacking on 10G SFP+ ports
3.12	Support Long Distance Stacking Upto 8 Devices
4	**Software Specification:**
4.1	Support VLANs based on MAC and IP subnets
4.2	Support MAC VLAN, Private VLAN, Guest VLAN, Voice VLAN, Super VLAN, Protocol VLAN, GVRP
4.3	Support Basic QinQ, Selective QinQ, VLAN mapping
4.4	Support Local SPAN, RSPAN, VLAN SPAN
4.5	Support Broadcast, Multicast, Unknown Unicast and Unknown Multicast storm suppression
4.6	Support static LACP and dynamic LACP. Each link aggregation group supports at least 8 member ports.
4.7	Support H-VST,M-VST Stacking, MAD LACP, MAD Fast-Hello, M-LAG

4.8	Support STP/RSTP/MSTP, BPDU Guard, Flap Guard, Loop Guard, Root Guard, TC Guard
4.9	Support VIST/VIST+
4.10	Support ERPS(G.8032), EIPS 50ms link protection
4.11	Support PDI(POE Dynamic Inspection)
4.12	Support DHCP/DHCPv6, Static route/Static route v6, RIP/RIPng, OSPFv2/OSPFv3 routing protocols
4.13	Support IGMP Snooping and MLD Snooping
4.14	Support DHCPv4/DHCPv6 Snooping, IPv4/IPv6 Source Guard, Dynamic ARP inspection, Host Guard, ND Snooping, ARP Guard, PPPoE+. The switch shall support management over IPv4/IPv6 via Telnet, SSHv2, HTTP, HTTPS, and SNMP v2c/v3 (v1 disabled by default for security). The proposed switches must support centralized management the OEM's native NMS platform, where the switches are managed ensuring uniform configuration, monitoring, and policy enforcement across the network. Centralized management shall be provided as an integral part of the proposed solution.
4.15	Support Radius, TACACS+, 802.1x and Portal authentication
4.16	Support ICMP flood interception, Smurf attack interception, Fraggle attack interception, SYN Flood attack interception
4.17	Support Standard IP ACL, extended IP ACL, standard MAC ACL, extended MAC ACL, Standard Hybrid ACL, extended Hybrid ACL,time-based ACL
4.18	Support SP, RR, WRR, WDRR, SP+WRR, SP+WDRR.
4.19	Support ZTP provisioning through DHCP server and USB disk. Support SDN controller management.
4.20	Support Netconf/Yang, Telemetry, IP SLA and sFlow
4.21	Support Telnet, SSHv2, Web, Console, TR069, SNMPv2/v3, Hot Patch, Cloud, SDN management methods
4.22	Support 802.11ag and 802.3ah Ethernet OAM
4.23	Support Energy Management IEEE Supported / IEEE 802.3az
5	**Certification Requirement**
5.1	CE/FCC, CCC Compliant
5.2	The quoted model/family shall be TEC/MTCTE Approved and shall be available on MTCTE Govt. website.
5.3	The quoted model/family shall be IEC 62443-4-1 - Cyber Security Compliant
5.4	EN 55032 Class A, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11

5.5	Min. EAL 2+ for Common Criteria
5.6	RoHS 2015
5.7	The quoted model/family shall be IPv6 Logo Certified, The switch shall comply with international certifications such as FCC, CE/EU, UL, RoHS2.

24 Port Gigabit L3/L2 Non PoE Switch

S. No.	**Access Switch Layer 2 & L3 lite (24 ports)**
1	**Physical Specification:**
1.1	The Switch shall be rack mountable and 1RU high
1.2	Fixed 24 Nos. 10/100/1000Mbps Base-T RJ45 Ports
1.3	Fixed 4 Nos. 1/10Gbps Base-X optical SFP+ Ports
1.4	Fixed one RJ45 console port for local management
1.5	Fixed one USB2.0 port
1.6	Must have inbuilt power supply, two redundant AC 100V~240V power supplies.
1.7	Must have Intelligent FAN
1.8	Operating Voltage: 110-220 VAC / 50-60 hz
1.9	Operating Temperature: -10 to 55°C or better
2	Humidity: 10% to 90% (non-condensing)
2	**System Specifications:-**
2.1	MAC Capacity ≥ 16K
2.2	ACL Capacity ≥ 1500
2.3	The switch shall have minimum 8GB RAM
2.4	Flash ≥ 256MB
2.5	Packet Buffer (Should be sufficient for wired speed performance)
2.6	VLANs ≥ 4K
2.7	Jumbo Frame ≥12K
3	**Perfomance**
3.1	Switching capacity of the proposed switch should be minimum 120 Gbps
3.2	Packet per second capacity of the switch should be minimum 180 Mpps and the network latency should be ~1us
3.3	Must support 16K MAC table

3.4	Must support 4K active VLAN
3.5	Must support Layer-3 IPv4 forwarding, at least support 400 IPv4 routing entries
3.6	Must support Layer-3 IPv6 forwarding, at least support 200 IPv6 routing entries
3.7	Must support 12K Jumbo Frame
3.8	Must support stacking technology, support at least 4 devices stack into one logic device.
3.9	Stacking bandwidth no less than 80Gbps
3.10	Support stacking by dedicated stacking cables
3.11	Support stacking on 10G SFP+ ports
3.12	Support Long Distance Stacking Upto 8 Devices
4	**Software Specification:**
4.1	Support VLANs based on MAC and IP subnets. Proposed Switch should support minimum 32k MAC address storage
4.2	Support MAC VLAN, Private VLAN, Guest VLAN, Voice VLAN, Super VLAN, Protocol VLAN, GVRP
3.3	Support Basic QinQ, Selective QinQ, VLAN mapping
4.3	Support Local SPAN, RSPAN, VLAN SPAN
4.4	Support Broadcast, Multicast, Unknown Unicast and Unknown Multicast storm suppression
4.4	Support static LACP and dynamic LACP. Each link aggregation group supports at least 8 member ports.
4.5	Support H-VST,M-VST Stacking, MAD LACP, MAD Fast-Hello, M-LAG
4.6	Support STP/RSTP/MSTP, BPDU Guard, Flap Guard, Loop Guard, Root Guard, TC Guard, Support VIST/VIST+
4.7	Support DHCP/DHCPv6, static routing/Static route v6, RIP/RIPng, OSPFv2/OSPFv3 routing protocols, VRRP/VRRPv3, VBRP
4.8	Suppot IGMP Snooping and MLD Snooping
4.9	Support DHCPv4/DHCPv6 Snooping, IPv4/IPv6 Source Guard, Dynamic ARP inspection, Host Guard, ND Snooping, ARP Guard, PPPoE+. Should support Telnet, SSHv2, HTTP, HTTPS with IPv4 and IPv6 Management. Switch should support SNMP v2c and v3 (v1 disabled by default for security) , Proposed switch should be managed via both, GUI and CLI, Should Support for HTTP REST APIs for Configuration and Monitoring
4.10	Support Radius, TACACS+, 802.1x and L2 Portal authentication
4.11	Support ICMP flood interception, Smurf attack interception, Fraggle attack interception, SYN Flood attack interception

4.12	Support Standard IP ACL, extended IP ACL, standard MAC ACL, extended MAC ACL, Standard Hybrid ACL, extended Hybrid ACL,time-based ACL
4.13	Support SP, RR, WRR, WDRR, SP+WRR, SP+WDRR.
4.14	Support G.8032 protocol and realize ms-class service switching
4.15	Support ZTP provisioning through DHCP server and USB disk. Support SDN controller management
4.16	Support Netconf/Yang, Telemetry, IP SLA and sFlow
4.17	Support Telnet, SSHv2, Web, Console, TR069, SNMPv2/v3, Hot Patch, Cloud management methods
4.18	Support Ethernet OAM, 802.11ag and 802.3ah
4.19	Support Energy Management IEEE Supported / IEEE 802.3az
5	**Certification Requirement**
5.1	FCC, CE/EU, UL, RoHS2
5.2	The quoted model/family shall be TEC/MTCTE Approved and shall be available on MTCTE Govt. website.
5.3	The quoted model/family shall be IEC 62443-4-1 - Cyber Security Compliant
5.4	EN 55032 Class A, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11
5.5	Min. EAL 2+ for Common Criteria
5.6	RoHS 2015
5.7	The quoted model/family shall be IPv6 Logo Certified

48 Port Gigabit L3/L2 Non PoE Switch

S. No.	**Access Switch Layer 2 & L3 lite (48 ports)**
1	**Physical Specification:**
1.1	The Switch shall be rack mountable and 1RU high
1.2	Fixed 48 Nos. 10/100/1000Mbps Base-T RJ45 Ports
1.3	Fixed 6 Nos. 1/10Gbps Base-X optical SFP+ Ports
1.4	Fixed one RJ45 console port for local management
1.5	Fixed one USB2.0 port
1.6	Must have inbuilt two redundant AC 100V~240V power supplies.
1.7	Must have Intelligent FAN
1.8	Operating Voltage: 110-220 VAC / 50-60 hz

1.9	Operating Temperature: -10 to 55°C or better
2	Humidity: 10% to 90% (non-condensing)
2	**System Specifications:-**
2.1	MAC Capacity ≥ 16K
2.2	ACL Capacity ≥ 1500
2.3	The switch shall have minimum 8GB RAM
2.4	Flash ≥ 256MB
2.5	Packet Buffer (Should be sufficient for wired speed performance)
2.6	VLANs ≥ 4K
2.7	Jumbo Frame ≥10K
3	**Performance**
3.1	Switching capacity no less than 216Gbps
3.2	Packet forwarding rate no less than 160Mpps
3.3	Must support 32K MAC table
3.4	Must support 4K active VLAN
3.5	Must support Layer-3 IPv4 forwarding, at least support 12,000 IPv4 routing entries
3.6	Must support Layer-3 IPv6 forwarding, at least support 4,000 IPv6 routing entries
3.7	Must support 12K Jumbo Frame
3.8	Must support stacking technology, support at least 4 devices stack into one logic device.
3.9	Stacking bandwidth no less than 120Gbps
3.10	Support stacking by dedicated stacking cables
3.11	Support stacking on 10G SFP+ ports
3.12	Support Long Distance Stacking Upto 8 Devices
4	**Software Specification:**
4.1	Support VLANs based on MAC and IP subnets
4.2	Support MAC VLAN, Private VLAN, Guest VLAN, Voice VLAN, Super VLAN, Protocol VLAN, GVRP
3.3	Support Basic QinQ, Selective QinQ, VLAN mapping
4.3	Support Local SPAN, RSPAN, VLAN SPAN
4.4	Support Broadcast, Multicast, Unknown Unicast and Unknown Multicast storm suppression

3.4	Support static LACP and dynamic LACP. Each link aggregation group supports at least 8 member ports.
4.5	Support H-VST,M-VST Stacking, MAD LACP, MAD Fast-Hello, M-LAG
4.6	Support STP/RSTP/MSTP, BPDU Guard, Flap Guard, Loop Guard, Root Guard, TC Guard
3.5	Support VIST/VIST+
4.7	Support DHCP/DHCPv6, static routing/Static route v6, RIP/RIPng, OSPFv2/OSPFv3 routing protocols, VRRP/VRRPv3, VBRP
4.8	Support IGMP Snooping and MLD Snooping
3.6	Support DHCPv4/DHCPv6 Snooping, IPv4/IPv6 Source Guard, Dynamic ARP inspection, Host Guard, ND Snooping, ARP Guard, PPPoE+
4.9	Support Radius, TACACS+, 802.1x and L2 Portal authentication
4.10	Support ICMP flood interception, Smurf attack interception, Fraggle attack interception, SYN Flood attack interception
3.7	Support Standard IP ACL, extended IP ACL, standard MAC ACL, extended MAC ACL, Standard Hybrid ACL, extended Hybrid ACL,time-based ACL
4.11	Support SP, RR, WRR, WDRR, SP+WRR, SP+WDRR.
4.12	Support G.8032 protocol and realize ms-class service switching
3.8	Support ZTP provisioning through DHCP server and USB disk. Support SDN controller management
4.13	Support Netconf/Yang, Telemetry, IP SLA and sFlow
4.14	Support Telnet, SSHv2, Web, Console, TR069, SNMPv2/v3, Hot Patch, Cloud management methods
3.9	Support Ethernet OAM, 802.11ag and 802.3ah
4.15	Support Energy Management IEEE Supported / IEEE 802.3az
5	**Certification Requirement**
5.1	CE/FCC, CCC Compliant
5.2	The quoted model/family shall be TEC/MTCTE Approved and shall be available on MTCTE Govt. website.
5.3	The quoted model/family shall be IEC 62443-4-1 - Cyber Security Compliant
5.4	EN 55032 Class A, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11

1G SFP Module (for L3/L2 Switch), Single mode

Specifications

Type of Transceiver	**SFP**
SFP Mode	**Single mode**
Range (Kilo Meter)	0 to 20 Km
Optical Component (nm)	1310nm
Maximum Data Rate (Mbps)	1000
On Site OEM Warranty (Year)	1
Operating Temperature Range(Degree C)	0 to 60 or better

10G SFP Module (for L3/L2 Switch), Single mode

Specifications	
Type of Transceiver	**SFP**
SFP Mode	**Single mode**
Range (Kilo Meter)	0 to 10 Km
Optical Component (nm)	1310nm
Maximum Data Rate (Mbps)	10000
On Site OEM Warranty (Year)	1
Operating Temperature Range(Degree C)	0 to 60 or better

10G SFP Module (for L3/L2 Switch), Multimode

Specifications	
Type of Transceiver	**SFP**
SFP Mode	Multimode Mode
Range (Meter)	0 to 300 m
Optical Component (nm)	850nm
Maximum Data Rate (Mbps)	10000
On Site OEM Warranty (Year)	1
Operating Temperature Range(Degree C)	0 to 60 or better

8 Port Industrial Grade PoE+ Switch

8 Port Industrial Grade Switch	
No. of Ports	Minimum 8 X 1G RJ45 PoE/PoE+ ports and Minimum 3 X 1G SFP ports
PoE / PoE+	Access ports shall deliver PoE/PoE+ with 240W power budget.
Redundancy	Switch should support Min. RSTP, MRP (Client), ERPSv2
Type of VLANs	Switch should support IEEE 802.1Q Port based VLANs.
Switching & QoS	Switch should support Multicast traffic through IGMPv1, v2, v3 snooping, IGMP querier, QoS/Port Prioritization, TOS/DSCP, CoS, Egress Interface Shaping, Ingress Storm Protection, IEEE 802.1p, Flow Control (802.3X),
Security	Switch should support local user management, restricted management access, MAC Limiting per port, Multiple privilege level
Min. MAC Address	4K
Management & Diagnostic	Switch should support LLDP, LLDP-MED, SSHv2, HTTP, HTTPS, SNMPv2/v3 (v1 disabled by default for security), Telnet, TFTP, Dual software image, syslog, RMON (1,2,3,9), Port mirroring 1:1 N:1, Web based Management and CLI, MIB Support
Operating Voltage	48-54 VDC
Operating Temperature:	-30 to 60°C or better
Operating Humidity	5% to 95% (non-condensing)
Mounting	Din Rail
Housing	Fanless Design IP30 rating
Approvals & Certifications	CE, FCC, EN61131, EN 55032 Class A, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, cUL 61010-1

1G SFP Module (for Industrial L2 Switch)

Specifications	
Type of Transceiver	**SFP**
SFP Mode	Multi Mode
Range (Kilo Meter)	0 to 20 Km
Optical Component (nm)	1310nm

Maximum Data Rate (Mbps)	1000
On Site OEM Warranty (Year)	1
Operating Temperature Range (Degree C)	0 to 60 or Better

NMS

Sr No	Specification
1	NMS shall have user friendly GUI using pull down menu options.
2	NMS shall carry out real-time monitoring and measurement of Network Status, Bandwidth Utilization, Alarms, Operational Status and Performance.
3	NMS shall have Auto Topology Feature in which Network Topology is automatically recognized and accurately visualized
4	NMS shall work with all the third-party devices which supports SNMPv2/V3 (v1 disabled by default for security)
5	NMS should have Network dashboard to provides up-to-the-minute visibility of key network performance and security indicators. The Network Dashboard should have option for customized view of various parameters should be possible.
6	NMS should have multi-config feature to configure multiple devices together
7	NMS shall have a linux and windows variant for better compatibility with OS.
8	Should support Radius/LDAP authentication for flexible user authentication
9	Should be able to record link status and throughput utilization on the links
10	Should have Centralized Security, Management of logs, firmware and configuration should be possible through clicks
11	Should be able to generate report periodically and should have Graphical Event Correlation feature.
12	NMS should have feature of Audit Trail to get complete history of user actions.
13	It should have SNMP/OPC Server Feature for integration of SCADA Applications, if any.
14	Should have device auditing feature to have details of device serial number, firmware version etc
15	Should support rogue device detection
16	Event history -play back option tab should be mandatory to verify the network events
17	NMS should have Distributed network management for hierarchical master/ slave stations to supervise large networks with Domain hierarchy for the management of large networks

18	NMS should have client-server model of installation possibility in the network
19	Should have HTTPS based remote monitoring
20	Should have Multiple Login Credential possibility
21	It shall License for 1000 nodes.

Indoor Wireless Access Point

Indoor Access Point	
Port Type and Quantity	1 × 10/100/1000/2500Mbps RJ45 port, 1 × 10/100/1000Mbps RJ45 port, Eth1, PoE PD (IEEE 802.3af/at), 1 × RJ45 Console Port; 1 × USB 3.0 Type-C, 1 × Kensington security slot
Access Point Features	Wi-Fi 6 (802.11ax) Access Point Indoor, dual radio, 5 GHz 802.11ax 4x4:4 and 2.4 GHz 802.11ax 2x2:2, Built-In Antennas, MIMO Support, integrated with BLE/Zigbee, Scanning and Security function, Supply should include Mounting kit, Dedicated Scanning Radio for WIPS,Must have the Tri-radio option to support radio1 as 2.4 GHz and radio 2 as 5 GHz devices and radio 3 as 6 GHz with 4 Wi-Fi Antennas, Should have minimum 1 x 100M/1000M/2.5G/5.0G Multigigabit Ethernet (RJ45), 1x RS-232 RJ45 Serial Port
Functionality	All APs It should be able to work in cluster mode without any dedicated controller also. It should support Distributed Solution. APs should be able to work without any dedicated controller for <= 255 APs. Access point should support SSID's in Tunnel, Bridge, Split-Tunnel and mesh mode. Should support 8 Simultaneous SSIDs per client serving radio
Controller	Controller should be a software-based controller which can keep all the information on the premise (not on cloud)
Management	ZTP, SNMP Trap Notification with Floor Plan and Heat Map with Software, System Log Reports, Internal User Database (IUD)
Radio Protocol	802.11a/g/n/ac, 802.11ax, IEEE 802.11b, up to 2.9 Gbps (2.4Gbps in 5GHz and 500Mbps in 2.4GHz) data rate, Bluetooth BLE5/Zigbee (802.15.4) with additional Scanning and Security Function.
Authentication	WPA2, WPA3 (Personal/Enterprise), IEEE 802.11i, IEEE 802.1x, AES/CCMP (legacy WPA and TKIP shall be disabled), Portal Page Authentication for Users or more
Power/Operating Voltage	Support PoE (PD) and Direct DC Power Source (48V DC Nominal).
Roaming, Channel Selection & Power	L2/L3 Roaming with or without software, Auto Channel Selection and Auto Transmit Power Control,

Protection Class	IP40 Rating
Security	WIPS, Wireless Attack Detection & QoS, Rouge AP Detection and Containment, ACL, Captive Portal, Radius Client, User Behavior Tracking, Client Sticky Avoidance Should Support the IKEv2 protocol in CAPWAP-data tunnel with IPsec-VPN encryption. Should support following EAP types : EAP-TLS, EAP-TTLS/MSCHAPv2, PEAPv0/EAP-MSCHAPv2, PEAPv1/EAP-GTC, EAP-SIM, EAP-AKA, EAP-FAST
Software Features	NTP Server Client, Bandwidth Control w.r.t SSID, Wireless Mesh P2P or P2MP
Operating Temperature:	0°C to 50°C or better
Humidity	5% to 95% (non-condensing)
Mounting	Wall or Ceiling
Approvals & Certifications	Access point should support IEEE standards 802.11a, 802.11e, 802.11g, 802.11h, 802.11i, 802.1X, 802.11j, 802.11k, 802.11n, 802.11r, 802.1u, 802.11v, 802.11w, 802.11ac, 802.11ax, 802.1Q, 802.1X, 802.3ad, 802.3af, 802.3at, 802.3az

Wireless Access Point Controller

S. No.	**Architecture**
1	Wireless Controller should be appliance or server (physical or virtual) with Min. 200 AP's support from day one and scalable upto 1000 AP's or more. The proposed solution should be premise based and not compeletely cloud based. For Small network, with less than 256 APs, the APs should be able to work under "Cluster" mode for self management.
	Access Control and Authentication
2	Support Radius server, MAC auth server, embedded Portal server and Radius client for third-party Radius server, LDAP/AD client for external LDAP/AD infrastructure
3	Support multiple authentication methods, such as MAC, 802.1x, MAC with Portal, and 802.1x with Portal
4	Support standard Personal and Enterprise authentication mode along with Internal Radius Server (support Access Role Profile) and External Radius server
5	Support Authentication via PAP, CHAP, MS-CHAP, MS-CHAPv2, EAP-MD5-Challenge, EAPGTC and EAP-MSCHAPv2
6	The wireless controller portal server shall Support “Guest” and "Employee" authentication modes with capability to provide customized portal page template and it should be able to support and record end devices by MAC Address. The Portal Server should be able to support inter-connection with external portal servers.

7	The authenticated users should be able to get Access Role atleast for below:- 1. Admin. can define Access Control Rules based on Location and Period and also should be able to define detailed policy and policy list for each profile 2. Support QoS on Bandwidth Limitation (Uplink/Downlink) and Policy support ACL 3. VLAN Attribute (assign specific client to a defined VLAN or VLAN Pool) 4. Access Role Profile to be implemented on Access Points
8	The WLAN solution shall support BYOD and be able to provide device onboarding that is as simple as possible and without requiring additional third party components
	Intrusion Detection and Prevention
9	The WLAN solution have wIDS/wIPS capabilities with no additional and dedicated equipment nor additional license.
10	The WLAN solution shall be able to identify Interfering APs.
11	The WLAN solution shall be able to identify Rogue APs via below mentioned Policies:- 1. If Signal Strength Threshold Exceeds the value defined by Admin 2. If APs, SSID name is valid according to system definition 3. Defined Keywords within SSID name of APs 4. Defined Organizational Unique Identifier (OUI) of APs
12	Controller should be able to detect following cyber-attack behaviors from potential rogue APs or clients: 1. APs: AP Spoofing, Broadcast de-authentication, Broadcast disassociation, Ad-hoc network with SSID being used in current infrastructure, invalid long SSID, AP impersonation, Omerta attack, Null probe response, invalid address combination, invalid reason code of de-authentication, invalid reason code of dis-association. 2. Clients: Valid Client mis-association, Omerta Attack, Unencrypted Valid Clients, 802.11 40MHz bandwidth intolerance setting, Active 802.11n Greenfield Mode, DHCP client ID, DHCP conflict, DHCP name change, Frequent authentication, long SSID (client), Malformed Frame-Assoc request, invalid reason code of de-authentication, invalid reason code of dis-association.
13	Implement Security policy to suppress rogue APs by preventing clients from connecting to rogue APs, to suppress rogue clients (active/passive) by means of blacklist mechanism (static or dynamic), to protect legal equipment by providing whitelist mechanisms.
14	Controllers should be able to provide a dashboard to represent Wireless Cyber Security Situations which can show Rouge APs and Channel Interferences, Rouge Clients and related Rouge APs, Blacklist status of clients.
15	Access Control and Security of ACL IPv4 Stateful functionality, L2 Isolation among clients withing one SSID, Packet filtering.
	Software
16	Radius/EAP Server shall support User administration MAC-based, rate limiting, passphrases, VLAN user based, authentication of IEEE 802.1X clients via EAP-TTLS, EAP-MD5, EAP-GTC, PEAP, MSCHAP or MSCHAPv2
17	AP supports following routing functions (DHCP server, NAT, DNS proxy) and works as default gateway for clients

18	Support VLAN or VLAN Pool, Data on L2 to be isolated within one SSID, IGMP, MLD, User Data per SSID or per Access Role Profile for clients.
19	AP Firmware should be centrally deployed (with external webserver or SFTP Server) and automatically download firmware from its server and update APs, Daily checking according to defined policy
20	APs should automatically discover the controller via DHCP, Controller should be able to collect APs notification and log by SYSLOG Protocol, Controller as per APs list should be able to register/authenticate semi-automatically and manually via web configuration.
21	For Redundancy, HA Cluster Mode Min. 2 or more physical machines for one logical Controller entity (for large scale network)
	Services
22	Online Report Generation, Audit and offline Report via Email. Time Interval for report to be defined.
23	Automatic (via DHCP) or Manual AP Registration Process for User for a Single or Batch of devices.
24	For Asset Management via Bluetooth the controller should provide I/O to interconnect with third party asset management platform. The controller shall support minimum 1000 AP from day one.
	Mobility/Radio/RF Management/Roaming
25	The WLAN solution shall support both IEEE 802.11k(Radio Resource Measurement), 802.11v(Wireless Network Management), and 802.11r(Fast Roaming) along with OKC Mechanism when using 802.1x authentication.
26	Background Scanning to enable APs to work intermittently/Continuously and get background information of air interface. Shall support Wireless Intrusion Detection and Prevention (WIDS/WIPS) including rogue AP detection, classification, and mitigation. Shall provide real-time visibility into AP status, utilization, client monitoring and usage statistics. Shall support wireless mesh topology for AP-to-AP connectivity without wired backhaul.
27	Load Balancing - Between different bands of 1 AP and multiple APs under 1 AP Cluster. It should have 5 Ghz Band Steering Function and enable clients to connect with best AP by measuring APs workload.
28	Automatic Wireless Channel List setting (according to country regulations) and automatic bandwidth selection (2Ghz or 5Ghz) as per IEEE 802.11. Shall support latest Wi-Fi standards including Wi-Fi 6 / 6E / 7 IEEE standards.
29	Wireless Transmit Power on each channel to be automatically controlled by system or should be able to specified to a fix value or range of values by Admin.
30	To Optimize RF Technology, Single/Dual Band should be selectable by Admin as per on-site environment, QoS on Voice and data to define priority)802.1p/DSCP to WMM), IEEE 802.11ax work mode on each band, Admin to allow limit access from 802.11b/g old devices to improve bandwidth efficiency on 2.4Ghz.

Speaker Cable 2C x 2.5Sqmm (14AWG)

Details	Specification
Type	2 Core or 1 Pair Unshielded High Conductivity Tinned Copper Speaker Cable
Conductors	Tinned Bare Copper 2.5Sqmm or 14 AWG, Multi Stranded 42x30
Insulation	PVC
Insulation Color	Black & White
Jacket	PVC
Jacket Color	Gray or Chrome
Nominal Jacket Thickness	1.0mm or Better
EU CE Mark	Required
Packing	Box of 305 meters
Cable Nominal Outer Diameter	9 mm
Cable Weight	<= 90 Kg/km
Insulation Resistance	1000 Megohms/1000 ft. @ 500 VDC or Higher
Bend Radius (Minor Axis)	<= 90 mm
Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/100 m) < 0.95
Recommended Current	9.0 Amps or Better / Conductor @ 25Deg C
UL Rating	UL 1685 UL Loading, NEC/UL – CL3 Rated (300V)
UL AWM	UL Style 2587 (90 Deg C, 600V)
Nom. Mutual Capacitance (C-C)	Capacitance (pF/m) < 75
Nom. Velocity of Propagation	67 % or Better

Temperature Range Operation	-20 Deg C to +90 Deg C
Pulling Tension	400N or Better
RoHS	Yes

RG6 Coaxial Cable for CATV

Details	Specification
Type	RG6 BCCS, Gas-injected foam polyethylene insulation, Aluminum Foil tape + aluminum braid shield (60% coverage)
Conductors	18 AWG Solid Bare Copper Covered Steel (1.02mm Nominal)
Insulation	Gas-injected FPE - Foam Polyethylene
Insulation Diameter	4.57mm Nominal
First Layer of Shield	Bonded Aluminum Foil – Polyester Tape –Aluminum Foil with 100% Coverage
Second Layer of Shield	AL – Aluminum Braid Shield with Min. 60% Coverage
Jacket	PVC
Jacket Color	Black
Jacket Thickness	0.7mm or Better
Packing	Box of 305 meters
Cable Nominal Outer Diameter	<= 7.0 mm
Cable Weight	<= 40 Kg/km
Nom. Characteristics Impedance	75 +/- 3 Ohms
Sweep Testing	950 MHz – 3 GHz
Min. Structural Return Loss (5 - 3000 MHz)	20 dB
Max. Attenuation@ 1000Mz	21.50 dB/100m

Max. Attenuation@2150Mhz	31.80 dB/100m
Max. Attenuation@3000Mhz	38.80 dB/100m
Bend Radius (Installation)	<= 53.6 mm
Maximum Conductor DC Resistance	DCR @ 20°C (Ohm/1000 m) < 92
Nom. Outer Shield DC Resistance @ 20°C	<= 30 Ohms/1000m
Nominal Delay	<= 4.5 ns/m
NEC/UL	UL 444, UL13, UL 1685
Nom. Capacitance (Conductor - Shield)	Capacitance (pF/m) <= 54
Nom. Velocity of Propagation	82 % or Higher
Temperature Range Operation	-20 Deg C to +70 Deg C
Pulling Tension	680N or Better
RoHS	Yes

RG11 Coaxial Cable for CATV

Details	Specification
Type	RG11 BCCS, Gas-injected foam polyethylene insulation, Aluminum Foil tape + aluminum braid shield (60% coverage)
Conductors	14 AWG Solid Bare Copper Covered Steel (1.63mm Nominal)
Insulation	Gas-injected FPE - Foam Polyethylene
Insulation Diameter	7.11mm Nominal
First Layer of Shield	Bonded Aluminum Foil – Polyester Tape –Aluminum Foil with 100% Coverage

Second Layer of Shield	AL – Aluminum Braid Shield with Min. 60% Coverage
Jacket	PVC
Jacket Color	Black
Jacket Thickness	1.0mm or Better
Packing	Box of 305 meters
Cable Nominal Outer Diameter	<= 10.0 mm
Cable Weight	<= 60 Kg/km
Nom. Characteristics Impedance	75 +/- 3 Ohms
Sweep Testing	5 MHz – 3 GHz
Min. Structural Return Loss (950 - 3000 MHz)	18 dB
Max. Attenuation@ 1000Mz	14.30 dB/100m
Max. Attenuation@2150Mhz	21.70 dB/100m
Max. Attenuation@3000Mhz	25.90 dB/100m
Bend Radius (Installation)	<= 120 mm
Maximum Conductor DC Resistance	DCR @ 20°C (Ohm/1000 m) < 37
Nom. Outer Shield DC Resistance @ 20°C	<= 26 Ohms/1000m
Nominal Delay	<= 4.5 ns/m
NEC/UL	UL 444, UL13, UL 1685
Nom. Capacitance	Capacitance (pF/m) <= 54

(Conductor - Shield)	
Nom. Velocity of Propagation	82 % or Higher
Temperature Range Operation	-20 Deg C to +70 Deg C
Pulling Tension	1200N or Better
RoHS	Yes

Control Shielded Cable 2C x 20AWG

Details	Specification
Type	1 Pair (2C) Shielded Control Cable, Intercom/PA Systems, Sound/Audio Systems
Conductors	Bare Copper 20 AWG, Multi Stranded 7x28
Insulation	PP - Polypropylene
Insulation Color	Black & Red
Nominal Insulation Diameter	1.3mm
Outer Shield	Bi-Laminate (Alum+Poly) Tape Shield with 100% Coverage
Drain Wire	24 AWG (7x32) Tinned Copper
Jacket	PVC
Rip Cord	Shall be present
Jacket Color	Gray or Chrome
EU CE/UKCA Mark	Required
Packing	Box of 305 meters
Cable Nominal Outer Diameter	3.6 mm
Cable Weight	<= 20 Kg/km
Bend Radius (Installation)	<= 36 mm
Maximum Conductor DC Resistance:	DCR @ 20°C (Ohm/305 m) < 10.3

Recommended Current	8.0 Amps or Better / Conductor @ 25Deg C
UL Rating	UL 1666 Riser (CMR/CMG) – Certificate to be enclosed along with Bid
CPR Euroclass	Eca or Better
Nom. Mutual Capacitance (C-C)	Capacitance (pF/m) <= 130
Temperature Range Operation	-20 Deg C to +75 Deg C
Pulling Tension	130N or Better
RoHS	Yes

SECTION 3: Intelligent Addressable Fire alarm & detection system

1.0 Approvals:

The control panel, detectors and accessories of the system shall be certified & approved by, at least, one of reputed organizations such as:

- VdS- Verband der Sachversicherer, Germany.
- UL 10th Edition/ Latest edition

1.1 Guidelines:

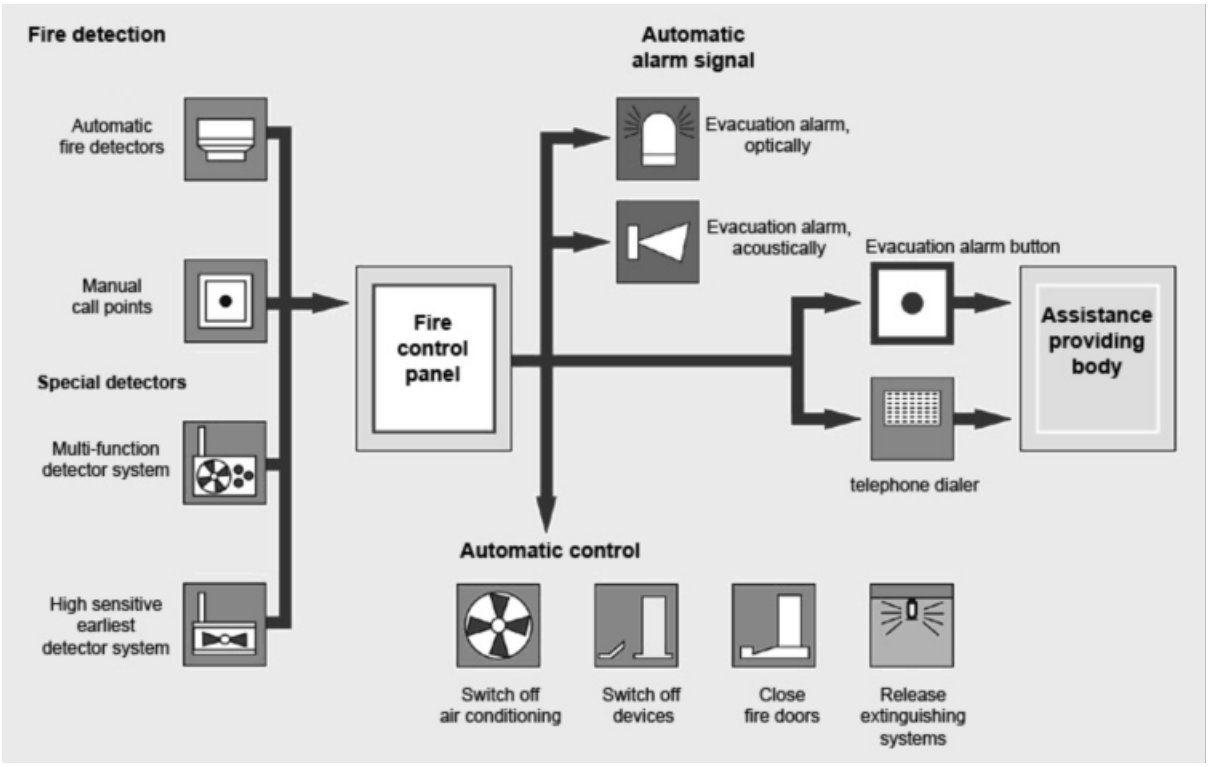
- IS/ ISO 7240: Indian Standard/ International Organization for Standardization
- EN54: European Norms
- NFPA72

2.0 GENERAL DESCRIPTION

2.1 Basic of Fire Alarm System:

If a fire breaks out in a building that is monitored by a fire alarm system, then it will be detected by the detectors in this system. The detection of a fire is forwarded to the fire alarm control panel, which then in turn triggers the relevant alarms and controllers.

Context diagram of FAS is given below.



2.1 Brief Description of Fire Alarm System:

The Fire Alarm System equipment shall consist of the following. :-

- Modular Control Panel
- External Indicating & operating Panel (Repeater Panel)
- Automatic Detectors & Field Modules
- Alarm Notification Devices
- Special Detectors
- Accessories
- Management System

The minimum Design Requirements of Fire Alarm System are:

- The Fire Alarm System should constitute the technological state-of-the-art and the latest scientific findings, whilst observing the currently enforced standards.
- One of the main feature of the Panel should be that it should complete, intelligent redundant in a nature.
- The System should be design such a way that a single fault on a system should not affect the operation of any of other components.

2.2 General Requirement:

1. The automatic fire alarm system must be assembled using a modern, redundant system structure and using microprocessor-controlled intelligent detectors.
2. The System should be design such a way that a single fault on a system should not affect the operation of any of other components. The panel shall be modular with hot redundancy in CPU and other cards such as loop card, networks card, motherboard etc..
3. Every detector and every controller module constantly checks its own status and sends status information to the microprocessor-controlled and monitored fire alarm control panel.
4. False alarms are filtered out by backed-up digital data transmission between detectors and the fire alarm control panel.
5. Each Detector & field Devices should have automatic addressing. The manual addressing (Rotary switch type, DIP switch type) or hand held programmer addressing is strictly not acceptable.
6. It must be ensured that a fault in an operating group or a detector does not influence or falsely manipulate the functionality of other operating groups or detectors.
7. In the event of a failure, a short circuit or a wire break in a detector or in the fire alarm system cable, all other detectors and connected input and output modules must remain fully functional. Since a short circuit isolator has been integrated into every connected input and output module, it is possible to optimise cabling into fire zones.
8. Faulty detectors, modules and controller modules as well as short circuits or wire breaks must be located and the information about their precise position must be indicated in plain text on the display and on the printer.
9. Automatic intelligent detectors and manual call points, as well as input and output elements for fire prevention doors, sirens, flashing lights etc. must all be directly connectible to a loop circuit.
10. The assignment and interconnection of detectors into detector zones must be possible from any position on the loop circuit, regardless of the position. Subsequent extensions of a detector zone must be simple to implement and must not require that the addresses of other detectors be changed or that the other detectors require reprogramming.
11. For optimal maintenance of the system, an early warning system must be integrated. Contaminated detectors, or detectors requiring maintenance, must be indicated in plain text on the control panel.
12. The fire alarm control panel must contain a 840 character LCD must allow a plain text indication to be given of all system states.

13. Programmable buttons and LED-displays at the control panel.
14. There must be an individual user management with password and user level possible, furthermore, each user change must be recorded.
15. A section operation at the control panel and an entire operation must be possible.
16. The failure of the alphanumeric display unit or of individual elements must not precipitate the loss or misinterpretation of individual messages, e.g. the display unit should be supplemented by a plain text printer with a log memory.
17. It must be possible to display all alarm messages, fault messages, disablements and actuations by manually "scrolling".
18. If the capacity of the alphanumeric display unit does not permit all messages, faults, disablements and alarms to be simultaneously displayed, then the total number of fire alarms, faults, disablements and actuations must be individually displayed in a separate display.
19. To permit the quick, clear and focused operation of the fire alarm system, it must be possible to fully-redundantly connect to 8 autonomous remote indicating and operating panels all with alphanumeric plain text displays.
20. For the focused preparation of information, the fire alarm control panel must be equipped with serial data log printers. It must be possible to print out all alterations in the fire detection and fire alarm systems such as alarms, faults, disablements, actuations, processes, operating processes, alarm delays service notes etc. in plain text in English and with the date, time and additional information.
21. It must be possible to save the last 40000 system changes and to print them out repeatedly, to see the saved incidents, printed on data log printer or picked up by means of PC software.
22. The printer must contain a message filter, to concentrate on printing out important messages.
23. The fire alarm system must automatically switch between wintertime and summer time.

24. It must be possible to connect the fire alarm system to superordinate computer systems or fire alarm control systems by means of serial data interfaces. It must also be possible to fully redundantly link several control panels together to one another. The fire alarm control panel can, if need be, consist of up to any no of Fire Alarm Panel, with each sub control unit forming an autarchic unit with its own power supply and battery backup supply, to which external operating panels, fire brigade control panels and printers etc. can also be connected as well as detector zones and controllers.
25. Communications between the sub control units take place via a redundantly (duplicated) constructed loop circuit, so that the connection remains fully functional even in the event of three simultaneous connection faults.
26. Central download during operation of operating systems and project planning data.
27. The control panel must be equipped with interfaces to be integrated into the customer´s network
28. The centralised structure allows the serial data connection of as many fire alarm control panels as required at any time, even subsequently.
29. As a result of the special redundancy concept, detector groups may also be connected to the main control unit, and it is therefore possible to not have to install operating panels in the sub control units
30. Display panels and operating panels, log printers, parallel panels and other system components are connection via digital communication circuits, with the devices being able to be used in any possible combination regardless of the devices' locations.
31. **Networking**:

Module for Networking with Fiber optic with SFP module:

The Network card should be redundant and modular installation in the control panel, for dual ring redundant networking of control panels over Single mode fibre optic cable and for the redundant connection of PC applications.

The module has following features:

- 2 x Ethernet 100 Base TX interface max. 100 m, max. 100 Mbit/s

The Fire Alarm System should be capable up to 16 control panels can be linked up without a superior guidance system into a logical unit which features:

- mesh network with up to 4 connections per partial control penal: in case of a failure of a device or a connection failure, it is possible to redirect (routing) the data to continue communication
- Data transmission speed up to 2500 kbit/s
- flexible topology: stitch connection at loop possible
- Ethernet protocol: use of customers IT infrastructure
- Access to control panels via Intranet & Internet
- use of standard IT components

32. Contractor should provide letter of support from the OEM stating tender no and particulars
33. It must be possible to group several fire alarm control panels in different locations together over Internet Protocol to allow their common operation and indication. If existing IT networks are to be used for this purpose, then no further connections and/or cabling are required. The Fire Alarm Panel must feature onboard TCP/ IP port with Modbus over TCP/IP interface with BMS System. Any other third-party converter is not acceptable.
34. **Modbus TCP-IP**

Each panel must provide Modbus over TCP-IP separately for integration with SCADA/PLC, necessary hardware and software must be considered by the bidder in every panel.

3.0 Modular Control Panel:

3.1 General Requirement:

1. 32-bit microprocessor-controlled and monitored system technology
2. The System should be designing such a way that a single fault on a system should not affect the operation of any of other components. The panel shall be modular with hot redundancy in CPU and other cards such as loop card, networks card etc.
3. Fully redundant modular panel minimum 12 loop and expandable up to 16 loops as per site requirement.
4. Loop Capacity : up to 250 addressable detectors & devices (any combination)
5. Loop Length: Up to 3500 mtrs.
6. Alphanumeric LC display of 840 character, with inbuilt 10 nos. zone LED indication programmable
7. Plain text lettering of display- and operating panels
8. Alphanumeric individual- and group display for all status of alarms
9. Individual programmable alarms, faults, disablements and actuations messages with date and time
10. Up to 15 deposable alphanumerical display- and control panels
11. Automatic restart function of the fire alarm system
12. Permanent automatic cyclic tests of parts of the fire alarm system and programs
13. User-specific software for three programmable receipts and exits
14. Individual addressing and disablement of detectors, I/O modules, as well as operating zones
15. 32 bit dual core processor in the mother board for fast & reliable communication
16. Free allocation of detector groups and single detectors
17. Detector zones can consist of detectors connected to different modules or control panels
18. Integrated short circuit isolator in each detector and module
19. Two detector dependency programmable
20. Two operating groups programmable
21. 2-wire technology
22. To verify deceptive alarms, the system must be able to be equipped with an intervention function, if necessary.
23. Freely selectable time for intervention and delay function
24. Combinations of functions and dependencies of fire controls units must be freely programmable by software
25. The offered fire alarm system must fulfil the demanded performance features without restrictions.
26. Panel shall have battery backup to 48 hours in normal condition and 30 mins incase of alarm condition.

4.0 Repeater Panel:

External operating panel should be like main panel with menu-based operation, including case, membrane keypad, 840-character LCD display for indicating all system states in plain text and a controller module. The panel should be VDS approved. The external operating panel should have following features:

- Indication of all conditions of the fire alarm system in plain text (alarm, fault, disablement, actuation of the transmission equipment to the fire brigade, etc.)
- menu controlled user guidance
- Log- and recall function for 65.000 messages
- Indication of freely definable additional text, e.g. information in case of an alarm, depending on programming
- keypad and display indication
- Alarm counter
- Access control by means of entering a code
- Users Switching are logged in the event recorder

5.0 Digital Voice Command Center

- The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone, and main telephone handset.
- Function: The Voice Command Center equipment shall perform the following functions:

  a. Operate as a supervised multi-channel emergency voice communication system. Operate as a two-way emergency telephone system control center.
  b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
  c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
  d. Provide all-call Emergency Paging activities through activation of a single control switch.
  e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
  f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
  g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
  h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.
  i. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
  j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.
  j. Fire, Voice & Telephone data shall flow through single network cable.

k. The Voice Evacuation System shall be capable of establishing communication between the master voice controller and amplifier over fiber optic cable network without using any third party media converter.
l. Failure of Fire Panel CPU shall not affect the operation of DVC. Incase DVC / Amplifiers are controlled by Fire Panel CPU, a separate panel with dedicated CPU shall be considered for each DVC & Amplifier.
m. The Fire Fighters Telephone System shall be capable of having minimum 30 Telephones in conference in multiple FFT Risers

5.1 Audio Amplifiers

1. The Audio Amplifiers shall provide Audio Power @25 Volts RMS@70 Volts RMSfor distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:

a. Earth Fault Detection & Annunciation for Communication bus
b. Audio Amplifier Failure Trouble Annunciation
c. External trigger input indication in case of Amplifier failure
d. Audio Detected on Firefighter's Telephone Riser
e. Receiving Audio from digital audio riser
i. Short circuit on detection & annunciation on each speaker circuit
j. Communication Status
n. Board failure
r. Active fiber optic media connection
t. Power supply monitoring of below conditions – Earth fault, Low Battery, Charger Trouble

4. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
5. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
6. System shall be capable of backing up digital amplifiers.
7. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
8. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.
9. System shall support distributed architecture of voice evacuation system to enable remote installation of amplifiers. Remote Amplifier’s shall communicate with the centrally located Digital Voice Command

6.0 Automatic Detectors & Field Devices:

6.1 Multi Sensor Detector:

- Interactive multiple Criteria detectors should be intelligent addressable detector.

- The detector can be configured as a smoke detector, heat detector or combination fire detector pursuant to EN 54 standard for the early detection of smoldering and open fires with or without smoke formation.
- Multi sensor Detector shall be UL approved with latest edition or VdS approved as per EN54-5, EN54-7 and EN54-29. Detector without UL latest edition/ EN54-29 is not acceptable.
- Principle of function shall be “Scattered light”
- The Detector should have its own inbuilt 8 bit microprocessor.
- Sensitivity: The detectors shall constantly monitor their surrounding conditions regarding absolute highest temperature and relative temperature increase and shall calculate the optimum smoke and heat sensitivity for the area it is deployed in based on these factors. The sensitivity of the smoke detection part shall permanently and automatically adapt to the surrounding conditions i.e. if the temperature increases above the absolute or relative values, the sensitivity of the smoke detection chamber shall automatically increase and if the temperature falls again, the smoke chamber shall become less sensitive again. The sensitivity shall always remain within the range set out in standards.
- Various detection methods, linked sensors, smoke detection always with temperature support should be possible.
- It should be possible to set temperature detection parts, can be configured for the classes A1; A2; B as well as indices R (Rate of Rise) and S (Static)
- The Detector should have capability of permanent self-monitoring and it should also have inbuilt memory which will keep a log of Smoke density & relevant temperature for self-adjustment to the surrounding condition.
- The Each detector should have intelligent decision-making logical processor which will use the Dynamic signal evaluation method for detecting the alarm condition (Distributed Intelligence).
- The Detector should have inbuilt fault isolator as per NFPA Style X.
- The Detector should have automatic addressing. The Rotary switch type, DIP switch type or hand held programmer addressing is strictly not acceptable.
- The Detector should have working temperature range up to -25 °C to + 60 °C
- Detector shall have inbuilt LED indicator having 360 deg view angle
- The inbuilt LED indication shall flash in normal condition & steady Red colour in alarm condition
- **Standard Detector Base** for fitting automatic fire detectors. Plastic case equipped for surface mounting in dry rooms, with in-built 6 pole terminal block. It should give IP 44 rating protection against dust & moistures when it is fitted with the Detector.

6.1.1 Multisensor Detector with addressable inbuilt sounder / Speech

- The Detector must have all the features mentioned above in “Multisensor Detector” with additionally inbuilt addressable sounder and Speech messages with up to 89 Db output as per EN 54-3/ UL . Detector shall be installed in closed cabin/ office/ meeting rooms and occupants may not hear corridor alarms.

6.2 Manual call point

The Manual Call Point should be in a red plastic case, conforming to UL/ EN 54-11 for manually triggering a fire alarm, suitable for use indoors. The alarm is triggered by smashing the glass panel, with the alarm remaining in alarm state until a new glass panel is inserted. The built-in LED indicates its triggered state. The detector can be installed on the same loop circuit as automatic detectors thanks to the short circuit isolator that is integrated as standard.

- LED alarm indication
- Fault message in the event of a component failure

- Individual detector disablement
- integrated short circuit isolator

IP Rating for Indoor type: IP24, IP Rating for Outdoor type: IP67,

6.3 Addressable Input/Output Module

Analogue Addressable Input / Output module with IP66 casing shall have require no. Of input & output as per site requirements with in-built short circuit isolator (in case short circuit isolator is not inbuilt, the price of this item shall be inclusive of an independent short-circuit isolator along with each monitor module), it must be UL/ VdS approved and as per EN-54 standard. The ambient temperature range shall be -20ºC to +60ºC.The quoted item shall completely comply to the technical specification. There may be different combination of input output module as per site requirement like:

1 input module, 1 output module, 2 input & 1 output module (for solenoid valve), 4 input module, 4 output module etc.

Approval: VdS/ UL

6.4 ADDRESSABLE LOOP POWERED SOUNDER

Addressable signal emitter for acoustic signaling of a fire alarm in indoor areas, suitable for direct connection to the loop. The siren shall be red in colour, with four different types of tone and the volume being set using DIP switches.

Parameters:
- Signal volume: 89 to 99 dB / 1 m (dependent on sound)
- Short Circuit Isolator: Integrated
- Ambient temperature: -10° to +55°C
Approval: VdS/ UL

6.5 ADDRESSABLE LOOP POWERED FLASHLIGHT:

Addressable flashing light for optical signaling of a fire alarm in indoor areas, suitable for direct connection to the loop. The flashlight shall be in red colour, with the flash rate being set by means of software and using DIP switches. The flashlight shall have the integrated Short Circuit Isolator and shall be capable to handle the Ambient temperature of -10° to +50°C.

Approval: VdS/ UL

6.6 Hooter cum Strobe:

A combined hooter cum strobe for audio & visual indication as per site requirement. It shall be either loop powered or separate power cable from the fire alarm panel should be provided. For conventional hooter cum strobe, it shall be interface through addressable relay module.

Approval: VdS/EN/UL

6.7 Ventilation duct smoke detector

for smoking monitoring in ventilation circuits in buildings. For use in ventilation ducts with dimensions from 15 cm to 1 m, in round channels from Ø 20 cm to Ø 1 m and with airspeeds from 1 to 20 m/s, consisting of:
- A case with a built-in smoke detector

- ventilation pipe:
- Flow adapter
- Stoppers and seals

The Detector should be able to work up to 20m/s Air flow. The detector Should have inbuilt fault isolator, and it should be VdS/ UL.

6.8 Linear Smoke Detector (Beam Detector):

Linear smoke detector shall comprise of a transmitter and receiver unit, which shall be fitted opposite one another between 5 and 100 m away from each other. In the event of a fire, the rising smoke reduces the intensity of the infrared ray between the transmitter and receiver and an alarm is sent to the fire alarm control panel.

Parameters:
- Operating Voltage: 15 to 33 VDC
- Monitoring length: 5 to 100 m
- Sensitivity: 3 levels i.e. 25%, 50%, 60%
- Protection Class: IP42
- Ambient Temperature: -10° to +50°C
- Max. Air Humidity: 95% non-condensing
- UL/ VdS

6.9 **Response Indicator** – A compatible external response indicator shall be used for above false ceiling area detectors where detectors inbuilt LED is not visible.

7.0 Management System with Graphic user Interface (GUI):

7.1 General Requirement:

- The management system with GUI software must be suitable and approved for monitoring and operating a connected fire alarm system in accordance with EN54

Cybersecurity Requirements for Networked Fire Alarm Management System [Added]:

• Communication between the fire alarm control panel(s), network interface, and the GUI/graphical management workstation shall be encrypted (TLS 1.2 or higher) where carried over the IP network.

• Access to the graphical management software shall require individually assigned, role-based user credentials with an audit trail of configuration and acknowledgement actions.

• The system shall support secure (signed) firmware/software updates for network-connected panels and servers.

• Any IP connectivity of the fire alarm system shall be isolated on a dedicated VLAN, with the life-safety control and monitoring functions remaining fully operational (stand-alone) in the event of a network or IT-side failure.

- Alarms, messages and conditions of the connected fire alarm system are collected and indicated clearly on one or several PC workstations
- The management system with GUI operates on a latest Windows 11/10 basis.
- Operation is carried out by means of mouse and keyboard, the user interface is clearly structured and similar to Windows.
- The management system with GUI consists, apart from the required system software, of a high-performance PC. Connection to the fire alarm system is carried out via the LAN Cable using IP based technology.
- The system is suitable for operation on two (flatscreen) monitors, but can be also operated on a single monitor if necessary.
- In standard operation mode, the left monitor displays building graphics (floor plans, operating plans etc.), whilst the right monitor lists all occurring events (alarm messages, faults, detectors that have been disabled, etc.) in lists.
- In the event of one monitor failing, the interface is automatically refreshed, and displayed in its entirety on the remaining monitor.
- The system must function and be operable in alarm and control modes.
- Up to 8 workstations can be connected to the system, being connected as a PC network connected to the fire alarm control panel(s). The system can also be subsequently extended to include additional workstations.
- The individually configurable floor plans and reaction texts are printed out automatically on the printer and within 60 seconds in the event of an alarm.
- For each detection point / element three independent graphic representations can be printed out (location plan/access plan/detailed plan).
- When using several workstations, each one must have equal rights with regard to functions and also have the full range of functions at their disposal.
- All events in the entire system are continuously and automatically logged, and can be printed out at any time, if necessary, using message filters. The system status (status report) can be ascertained at any time using this log function.
- Reaction texts can be made customer-specific and can be added or modified during operation.
- Graphical representations can be loaded and modified during operation.
- The failure of a fire alarm control panel is signalled visually and acoustically by the fire detector control system.
- The failure of the control system is signalled visually and acoustically at the fire alarm control panel. Faults during data transmission are signalled visually and acoustically at the fire alarm control panel and at the fire detector control system.
- Faults or the failure of the control system do not influence the functions of the connected fire alarm control panel(s).
- After the operating system has been restarted, the fire detector control system automatically starts up with the lowest authorisation level.

- The status of the connected fire detector system (alarms, faults, disablements and actuations) is automatically reloaded after the restart.
- During the restart process of start-up and entry into operating status, as well as reloading processes of the fire alarm control panel, the processing times for messages on the fire alarm control panel continue to remain within the intervals permits pursuant to Standards.
- The time span for the generation of alarm messages (from detector to the fire detector control system's display) is allowed to be a maximum of 10 seconds.
- The time span for the generation of other messages (from their source to the fire detector control system's display) is allowed to be a maximum of 100 seconds.

7.2 PC Workstation Requirements:

- PC with Minimum Intel I3 8th generation processor (min. 2300 MHz) and 8 GB RAM
- hard drives, min. 100 GB each
- Windows 10 operating system or latest
- network adapter with 10/100 Mbit
- Dual head graphics card with 256 MB RAM
- 2 serial COM ports, 2 USB ports
- CD-ROM drive
- 2 colours Active TFT matrix monitor (resolution at least 1280 x 1024 pixels), suitable for use in two monitor operating mode.

8.0 CONDUIT AND WIRE:

8.1 Conduit:

Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signalling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer. Conduit shall be minimum 25 mm.

8.2 Wire:

All fire alarm system wiring shall be 2C x 1.5 Sq.mm. mineral insulated annealed Copper clad cable fire survival 950-degree centigrade 3 hours C/W/Z category as minimum to maintain circuit integrity, LPCB/ UL approved, shall be used.

Wiring used for the loop circuit shall be twisted and shielded and support wiring distance up to 3.5 KM. All field wiring shall be electrically supervised for open circuit and ground fault.

Technical Specifications:- Public Address, Voice Alarm System & BGM System

1. System Description:

The objective is to have an effective public address and evacuation system for the entire area. The system will combine all the essential EVAC functionality- such as zone wise paging & voice evacuation, event logging, digital mixing & feedback cancellation, digital message management and a relay-based fire alarm panel interfacing as per EN 54-16/UL. The system shall monitor all the peripherals such as speakers & speaker circuits, amplifiers, battery, voice messages, microphones etc as per EN 54-16 and EN 54-24/ UL. **The system should be design and installed such a way so that the 0.5 STI (Speech Transmission Index) should be achieved.** The system shall fully comply with EN 50849:2017 (successor to the withdrawn IEC/EN 60849) and BS 5839 part 8 standards . The same also should be comply Indian Standard IS 2189.

2. APPLICABLE STANDARDS:

- EN 54-16: Components for fire alarm voice alarm systems. Voice alarm control and indicating equipment
- EN 54-24: Voice alarms - Loudspeakers
- BS 5839 part 8: Code of Practice for the design, installation and servicing of voice alarm systems
- EN60849: International Standards Sound Systems for Emergency Purposes
- NEN 2575: System and quality requirements and guidelines for locating of alarm devices
- DIN 0833-4: Planning, design, installation, commissioning, use and maintenance of voice alarm system.
- UL

The system should comprise of digital signal processor, Monitoring Module as per EN 54-16/ UL, Digital Amplifier with Option of Battery power, High Quality monitored Speaker as per EN 54-24/ UL, Power supplies, Music Aux input, Paging announcement Microphone, Audio Rack and integrated with Fire alarm system.

The system shall provide Paging announcement from Microphone station, emergency message and /or background music simultaneously on different zone. The system should accommodate up to 64 nos programmable microphone console with (Monitored as per EN 54-16) working on RS 485. The microphone console should have inbuilt preamplifier.

The contractor shall make sure that all power tapping of the speakers must be carried out as specified, even if the acoustic calculations indicates less power tapings. The back-ground noise of the project shall be considered 65dBA as minimum and 120dBA as maximum. The contactor must endure minimum of 0.5 STI is achieved.

The system shall be fully programmed to accommodate fire alarm and voice communication zones as indicated on the drawings and schematics. The system shall be configured to allow.

The system must have emergency battery backup in case of failure of Main 230 VAC power supply.

on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to the buildings.

The System shall be capable of identifying the Evacuation Zones via Software, and shall be able to Page, Evacuate, Alert zones as required by the Cause and Effect of the Fire Alarm without any limitation to the number of zones.

The System shall be capable of integrating with SIP based PBX system with zone selection via IVR menu.

3. System Description:

The public address system shall contain all equipment required for automatic voice evacuation, Public Address system, Audio Control, Audio Message configuration, Recorded Message storage, Back up for Audio files, Time bound Cause-n-Effect configuration, Audio Zone Selection & Annunciation and all other necessary accessories to complete the system requirements.

4.1 Master Control Unit

The Controller unit is programmable with the software on each specific system configuration, with automatic and permanent monitoring of the system controller and the system components according to EN 50849, BS5839, NEN2575 and EN54-16/ UL. Programmable over network interface with code protected access to the processing unit and other components in the system. (modules, amplifiers and paging stations).

Features
- Monitored system processors for control of the voice alarm system
- Emergency operation for general call via analog microphone
- 24-bit digital signal processing
- Convenient programming by PC configuration software, individually programmable with 99 different priorities and layers
- Control of all processes in the system
- Possibility of simultaneous announcement and play background music in several lines, groups or zones
- Networking opportunity over LAN (optional) with several conditioning systems and connections, control and individual selection of loudspeaker lines by module extension.
- Management of digital and analog control inputs and outputs
- Interfaces for LAN (optional), RS-485
- Remote control via microphone units, web server for touch panels (in preparation) and external control units
- Redundant audio network via LAN module with option
- Management for connection and control of one or more digital voice memory modules for playback of digital audio files
- Storage of programming and corresponding controlling of the system
- Monitoring of components according to EN 50849, EN 54-16, NEN 2575, BS 5839 standards/ UL
- 2 Input for microphone consoles
- 4 Input for analogue audio signals
- 2 Output for analogue audio signals
- 8 Input for monitored contacts
- 4 Output for floating contacts
- 1 Output for fault indication
- 8 free programmable LED's and buttons
- RC-16 connectivity for remote controls
- APS bus for extending with existing modules and amplifiers
- Service access per ethernet
- 10'000 log file entries
- Switch for network connections and SFP port
- Playback of MP3 files
- Audio and control data transfer between systems via local network

- Processing of audio signals with digital signal processor

4.2 Digital , continuous line and line monitoring according to EN 54-16/ UL

Processor-controlled line and line monitoring with DSP technology for uninterrupted , permanent (even with music mode) automatic monitoring of up to 16 speaker lines (expandable) for short circuit , open circuit , short to ground and impedance change .

High-precision error detection with DSP technology by load measurement, measurement of the phase shift between current and voltage. Determination of the average value from 64 measurements/sec. Displaying errors by front-side LEDs per speaker line. Setting and service operation using the rotary encoder on the front panel. Integrated display for menu-guided operation for :

- Individual deactivation of unused zones or for a service case .
- Lists detailed error analysis .
- Automatic calibration of each individual zone.
- Individual adjustment of the measuring tolerance for each individual zone .
- Maintenance and service
- Call the serial numbers, nominal and actual states

Further features

- Fault signal by collecting floating contact or / and internal fault propagation in the system to the higher-level monitoring module
- Fault memory in an error list in accordance with EN 54-16
- Automatic isolation of the defective speaker line in short-circuit
- Recognition of the re- functioning speaker line without a device reset
- Integrated system clock for watchdog circuit for accurate logging
- Programming and analysis by software.
- Permanent monitoring of each line without additional modules (eg end-of -line)
- No interruption of the line for voice announcements or background music with high-quality DSP technology
- with zone selection function

Technical characteristics

Control: DSP processor + co-processor
Power supply: 17 VDC / system
Display: 18 LEDs, LCD display
Inputs: 16-pin terminal connector
Outputs: 16 screw-terminal connector
System: 2 x D-sub 25-pin
CE Conformity: EN 54-16
Electromagnetic. Immunity: to EN 55024 / EN 301 489
Emission standard: according to EN 55022 / EN 300220-1
Operating temperature: -5 ° C - 50 ° C

4.3 Digital Class-D power amplifier (400W*4 or 250W*4 or 250W*2 or 250W Power Amplifier)

Digital, fully monitored, convection cooled power amplifier, with a continuous output of **400W*4 or 250W*4 or 250W*2 or 250W Power Amplifier** watts as per site requirements especially for applications in emergency evacuation warning systems and voice alarm systems according to EN 54-16. The amplifier has a micro-controller including digital fault management and emergency charging electronics for standards-compliant, redundant supply of emergency power unit . The programmable 6 x 4 matrix, the 4 internal digital and 2 external analog LF buses can be set system-specific in the software on each amplifier channel . The power amplifier features a high efficiency, low waste heat from the components, and low power consumption by the digital circuitry.

Other performance

- Digital switching power supplies
- High-quality output transformer
- Electronically balanced audio input via XLR jacks
- High-impedance outputs via screw-clamp connectors
- **Built in Noise Cancellation**

- Speaker output: 100 V
- Emergency power input and output for 48 volt emergency power
- Integrated Digital Charging electronics in support of the emergency device according to EN 54-4/ UL
- Complete internal monitoring according to UL/ EN 54-16 and BS 5839 (audio signal, output impedance , ground fault, etc.)
- Serial data bus according to UL/ EN 54-16 and BS 5839 for information to the monitoring module - Digital Bus 2 x DB bus
- 2 x analog audio input per amplifier 0 dB XLR 3-pin , symmetric miscible with system bus.
- 4 x digital audio input per amplifier system bus
- 6 x 4 matrix programmable via software
- Separate volume control for each amplifier stage separately for announcement, alarm and music transmission (knobs removable to prevent incorrect handling)
- A housing address (device ID) per amplifier
- Protection circuits against overload, short circuit, open circuit, overvoltage, power failure, battery failure, data communications failure , thermal overload
- Integrated amplifier monitoring in combination with processor module with front LED per amplifier for the display of defect or failure
- Integrated digital disaster selector for automatic locking on the backup amplifier
- Integrated temperature sensor and connector for an external temperature sensor
- Level meter per channel via LED chain (5 LEDs) for visual level monitoring
- Activatable standby mode

Technical characteristics
Controlling: Microrocessor
Power supply: 230 VAC + / - 10 %
Rated frequency: 50 - 60 Hz
Emergency power supply: 48 VDC
Signal to noise ratio : 84 dB
Signal to noise ratio : > 94 dB
Input Sensitivity: 10 kilohms , balanced
Frequency range: 30 Hz - 20,000 Hz , -3dB
Output Power: **400W*4 or 250W*4 or 250W*2 or 250W Power Amplifier** (IEC268-3/19.4)
Output voltage: 100 volts
CE Conformity: EN 54 -16: 2008
Electromagnetic. Immunity: to EN 55024 / EN 301 489
Emission standard: according to EN 55022 / EN 300220-1
Operating temperature: -5° C - 50° C

4.4 Digital , programmable microphone console, monitored
Microprocessor -controlled digital microphone console for operating the entire voice alarm system in case of fire and normal operation, the transmission of fire announcements, but also of information and call announcements. A manual triggering of alarm signals and the stored emergency announcements, as well as for the selection of speaker lines and groups. Suitable for connection of up to 30 other digital microphone consoles to one input module of the system on a bi -directional communication channel, with permanent monitoring of the microphone capsule and the processor including serial data exchange with the processor-controlled monitoring CPU to EN 54-16/ UL . Dynamic gooseneck microphone with acoustic monitoring of the microphone capsule by test frequency. 16 freely programmable keys with LED indicator lights in 2 levels, for 16 additional freely programmable additional functions. 3 lighted, monitored push-buttons protected with plastic cover (such as home alarm, amok, gong tripping). A built-in buzzer provides for signalling of fault message conditions..

Other line features

- Stable-designed plastic housing, desk form
- LED status indicators for power, alarm, fault and occupied
- Gooseneck microphone
- Microphone preamp with limiter
- 16 programmable keys, each for two levels
- 3 buttons with cap
- Each button has a 3 colour LED with blue, red, yellow for visualization
- Programmable timer function for each key
- Sound and volume control on the console
- Additional unit with built-in speakers (optional) for control or intercom purposes
- Volume control for intercom between the microphone consoles and between headquarters and delegate units

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- Starting with 0 dBm, symm, for serial data transfer.
- Built-in generator for periodic monitoring of NF- line and the microphone capsule

Keys can be programmed
- Fire announcement in all loudspeaker lines and groups
- Fire announcement in single loudspeaker lines
- Evacuation signal in all loudspeaker lines and groups
- Evacuation signal single loudspeaker lines
- Announcement in all loudspeaker lines and groups
- Traffic into individual speaker lines and groups
- Background music in all loudspeaker lines and groups
- Background music in single loudspeaker lines
- Selection of individual loudspeaker lines

Clear selection -
- Volume control background music
- Volume control announcement
- Display the automatic mode
- Evacuation signal
- Display general announcement
- Show background music
- Delete

Technical characteristics
Control: Microprocessor
Power supply: 17 VDC / system
Display: 8 + 3 LEDs
Levels: 2 (freely programmable)
Port (external) : XLR, 6-pole
Frequency response: 200 Hz - 12,500 Hz
Microphone Gooseneck (235mm), dynamic
Nominal impedance: 200 ohms
Audio output: transformer balanced, 600 ohms (0.775 V)
Execution as a LAN station
CE Conformity: EN 54 -16
Electromagnetic immunity: to EN 55024 / EN 301 489
Emission standard: according to EN 55022 / EN 300220-1

Product safety: according to EN 60950 / EN 60065
Operating temperature: -5 ° C - 50 ° C
relative humidity : 25% to 90 %

4.5 Digital, programmable fireman's microphone monitored.
Microprocessor controlled digital push to talk Microphone unit in red colour wall housing in case of fire operation. It is capable of transmission of fire announcements of firefighters and other emergency personnel. It should have 3 covered alarm keys. It should be possible to connection of up to 30 additional firefighter intercoms to one input module of the system on a bi-directional communication channel, with permanent monitoring of the microphone capsule and the processor according to EN 54-16/ UL. Handheld dynamic microphone with all-metal housing with acoustic monitoring of the microphone head by means of test frequency. 3 + 2 (optional) freely programmable keys with hinged lid and LED indicator lights (e.g.: alarm, amok, gong activating). A built-in buzzer provides for signalling fault state.

4.6 EN 54-24/ UL Ceiling speaker with Firedome
EN 54-24 certified 6W Ceiling speaker with maximum SPL of 99.1 db @6W/1m. It must have sensitivity of Sensitivity (1 W/ 1 m) 91.3 dB. The speaker should have 1.5W/3W/6W tapping. It should be of EV-Version with ceramic terminal and thermal fuse and with IP 44 protection.

Specification:
Loudspeaker system 1-way
Nominal noise power 100 V 1.5 / 3 / 6 W
Nominal noise power 8 Ω 6 W
Nominal impedance 100 V 6667 / 3333 / 1667 Ω
Sensitivity (1 W / 1 m) 91.3 dB
Sensitivity (1 W / 4 m) 77.9 dB
Maximum SPL (6 W / 1 m) 99.1 dB
Maximum SPL (6 W / 4 m) 85.7 dB
Frequency range (-10 dB) 140–16'000 Hz
Coverage angle (-6 dB) H 180º / 180º / 180º / 68º
(0.5 / 1 / 2 / 4 kHz) V 180º / 180º / 180º / 68º

4.7 EN 54-24/ UL Wall Mounted speaker
EN 54-24/ UL certified 6W wall mounted speaker with maximum SPL of 99.1 db @6W/1m. It must have sensitivity of Sensitivity (1 W/ 1 m) 91.3 dB. The speaker should have 1.5W/3W/6W tapping. It should be of EV-Version with ceramic terminal and thermal fuse and with IP 44 protection.

Specification:
Loudspeaker system 1-way
Nominal noise power 100 V 1.5 / 3 / 6 W
Nominal noise power 8 Ω 6 W
Nominal impedance 100 V 6667 / 3333 / 1667 Ω
Sensitivity (1 W / 1 m) 91.3 dB
Sensitivity (1 W / 4 m) 77.9 dB
Maximum SPL (6 W / 1 m) 99.1 dB
Maximum SPL (6 W / 4 m) 85.7 dB
Frequency range (-10 dB) 140–16'000 Hz
Coverage angle (-6 dB) H 180º / 180º / 180º / 68º
(0.5 / 1 / 2 / 4 kHz) V 180º / 180º / 180º / 68º

4.8 EN 54-24/ UL Wall Mounted Cylindrical speaker.

EN 54-24/ UL certified 20W cylindrical 360 deg wall mounted speaker with maximum SPL of 100 db @20W/1m. It must have sensitivity of Sensitivity (1 W/ 1 m) 87.2 dB. The speaker should have 5W/ 10W/ 20W tapping. It should be of EV-Version with ceramic terminal and thermal fuse and with IP 44 protection.

Specification:
Loudspeaker system 1-way, tweeter dome.
Nominal noise power 100 V 5 / 10 / 20 W
Nominal noise power 8 Ω 20 W
Nominal impedance 100 V 2000 / 1000 / 500 Ω
Sensitivity (1 W / 1 m) 87.2 dB
Sensitivity (1 W / 4 m) 77.1 dB
Maximum SPL (20 W / 1 m) 100.2 dB
Maximum SPL (20 W / 4 m) 90.2 dB
Frequency range (-10 dB) 120–15'600 Hz
Coverage angle (-6 dB) H 360º / 220º / 110º / 60º
(0.5 / 1 / 2 / 4 kHz) V 360º / 220º / 110º / 60º

4.9 EN 54-24/ UL Wall Mounted Horn speaker.

EN 54-24/ UL certified 20W Horn 360 deg speaker with maximum SPL of 118.8 db @20W/1m. It must have sensitivity of Sensitivity (1 W/ 1 m) 105.8 dB. The speaker should have 2.5W / 5W / 10W / 20W tapping. It should be of EV-Version with ceramic terminal and thermal fuse and with IP 66 protection.

Specification:
Loudspeaker system 1-way
Nominal noise power 100 V 5 / 10 / 20 W
Nominal noise power 8 Ω 15 W
Nominal impedance 100 V 4000 / 2000 / 1000/ 500 Ω
Sensitivity (1 W / 1 m) 105.8 dB
Sensitivity (1 W / 4 m) 90.4 dB
Maximum SPL (20 W / 1 m) 118.8 dB
Maximum SPL (20 W / 4 m) 103.4 dB
Frequency range (-10 dB) 699–5'531 Hz
Coverage angle (-6 dB) H 360º / 135º / 75º / 40º
(0.5 / 1 / 2 / 4 kHz) V 360º / 135º / 75º / 40º

4.10 EN 54-24 Ceiling speaker with Fire dome

EN 54-24 certified 15W Ceiling speaker with maximum SPL of 106 db @15W/1m. It must have sensitivity of Sensitivity (1 W/ 1 m) 94.5 dB. It should be of EV-Version with ceramic terminal and thermal fuse and with IP 44 protection.

Specification:
Loudspeaker system 2-way
Nominal noise power 100 V 15 W
Nominal impedance 100 V 667 Ω
Sensitivity (1 W / 1 m) 94.5 dB
Sensitivity (1 W / 4 m) 76.8 dB
Maximum SPL (15 W / 1 m) 106 dB
Maximum SPL (15 W / 4 m) 88 dB
Frequency range (-10 dB) 140–16'000 Hz
Coverage angle (-6 dB) H 180º / 180º / 180º / 68º
(0.5 / 1 / 2 / 4 kHz) V 180º / 180º / 180º / 68º

4.11 EN 54-24/ UL Wall Mounted speaker

EN 54-24/ UL certified 10W wall mounted speaker with maximum SPL of 110.6 db @10W/1m. It must have sensitivity of Sensitivity (1 W/ 1 m) 100.6 dB. The speaker should have 1.5W/3W/6W/10W tapping. It should be of EV-Version with ceramic terminal and thermal fuse and with IP 44 protection.

Specification:
Loudspeaker system 1-way
Nominal noise power 100 V 1.5 / 3 / 6 / 10 W
Nominal noise power 8 Ω 6 W
Nominal impedance 100 V 6667 / 3333 / 1667/ 1000 Ω
Sensitivity (1 W / 1 m) 100.6 dB
Sensitivity (1 W / 4 m) 80.1 dB
Maximum SPL (10 W / 1 m) 110.6 dB
Maximum SPL (10 W / 4 m) 89.2 dB
Frequency range (-10 dB) 225 –22'200 Hz
Coverage angle (-6 dB) H 180º / 180º / 102.5º / 65º
(0.5 / 1 / 2 / 4 kHz) V 180º / 180º / 102.5º / 65º

SECTION 5: Technical Specifications: - CLEAN AGENT BASED PANEL SUPPRESSION SYSTEM

1. **General**

The scope covers Supply, Installation, Testing and Commissioning of Automatic clean agent based FK-5-1-12 local flooding system complete for electrical panels with flexible pneumatic linear heat-detection tubing (of any UL-listed manufacturer), cylinder, valves, integration with Main Fire Alarm Control Panel for status monitoring etc. The scope of work includes, but not limited to the following.

- Providing a clean agent FK-5-1-12 flooding system with flexible fire detection/ discharge tubes inside panels.
- Clean agent storage cylinder valve assembly
- Audio-visual annunciation devices for indicating incidence of fire.
- Any other item required to the successful commissioning of the system.
- The complete system should be UL certified.
- Bidder has to submit a project specific authorization letter issued by the OEM at time of bidding.
- The Cylinder must be filled in a PESO approved plant.

The electrical panel fire suppression system shall be complete with Direct Clean Gas storage cylinders for required capacities, extinguishing agent as specified, fire detection tubing, filling and end-of-line adaptors, pressure switches, pressure valves control equipment, pressure gauge, Clean Agent, System fittings such as Tee, Union, Elbow. Cylinder Mounting Bracket and all necessary accessories to protect the Electrical panel in case of fire.

1. **System Equipment**

    1. The tube should be UL Listed (UL- 521)and shall be installed throughout the Electrical Panel with one end connected to the top of the Clean Agent container valve. The tubing shall be pressurized with Dry Nitrogen. The tube shall burst at temp of 100-120 degree C. Tube shall perform below three functions:

1. Heat Detection,
2. System Activation and
3. Clean Agent discharge.

1. **Clean agent Container**

1. All cylinders shall be approved to CE requirements. Containers shall be standard model and size of ease of replacement and addition.
2. The cylinders shall be of stainless-steel material.

1. **Technical and Installation Requirements**
    1. Provide sufficient amount of Extinguishing Agent to Inert the Microenvironment being protected considering the following when computing volume to verify suitability and to establish design limitations:

- Volume of hazard area.
- Specific volume of Clean Agent.
- Detector/discharge tubing placement.

1. The unit shall be a self-contained and shall be equipped with its own non-electric automatic detection system to detect the fire and agent release system into the Electric panel to suppress the fire.
2. Provide wall-mounted bracket to mount the container/valve assembly in a vertical (upright) position. Each bracket should be equipped with at least two integral quick-clamp straps as per manufacturer standard practice.
3. The installation and commissioning of the system should be by Manufacturer or their authorised channel partner. The final connections between equipment and system detection tubing should be under direct supervision of factory trained and certified representative of manufacturer.
4. It shall be so designed that it does not affect the IP ratings of electrical panels. The Sub- Contractor has to coordinate with manufacturer of electrical panels for provision of holes to run the tube and brackets for mounting the tube. The entry of tube inside the panel shall be through suitable size of connector.
5. The tubing shall be manufactured from specially processed polymer material to achieve the desired heat detection and delivery characteristics. Provide minimum two runs of fire tube along with any two sides of every compartment of the panel.
6. The tubing shall be capable of working even when contaminated with oil, dust and debris as long as the contamination will allow the heat to pass through the tube.
7. Distribution of Detection Tubing shall be ensured in each compartment of the Panel viz. Busbar Section, Switchgear Section and Cable Alleys etc. with routing on any two sides. Mounting/ installation
8. of the detection tube to be as per manufacturer design.

SECTION 6: Technical Specifications:- BUILDING MANAGEMENT SYSTEM

1. SYSTEM DESCRIPTION & INPUT OUTPUT SUMMARY

BTL Certified, 64-bit Microprocessor based Direct Digital Controllers (DDC) with real time clock shall interface with sensors, actuators and environmental control systems (i.e. HVAC units, chillers, pumps, electrical & plumbing system etc.) and carry out followings functions:

- Individual input/output point scanning, processing and control.
- Centralized operation of the plant (remote control).
- Dynamic graphic details of plant and building.
- Energy Management through optimization of all connected electrical and mechanical plants.
- Alarm Detection and early recognition of faults.
- Time, event and holiday scheduling as well as temporary scheduling.
- Prevention of unauthorized or unwanted access.
- Communication interface and control.

The control system shall be designed such that mechanical equipment will be able to operate under de-centralized control. In general, the operation of any controllers on the network shall not rely on any other controller for its functional operation. System controllers that require a master computer will not be considered. Function specific modules may be used to supplement the functionality resident in each controller. As such, in the event of a network communication failure or the loss of any other controller, the control system shall continue to independently operate under local control of the resident program stored in nonvolatile memory as detailed herein. In such a case, each individual controller shall continue to perform basic functions until a network connection can be restored.

Native multiple protocols

The Building Management System (BMS) shall be comprised of Controllers & Third-Party Integration Units. The Controllers (DDC) shall connect to the local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each Controller shall communicate to BACnet IP.

NETWORKS

The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3

2. Cable; 100 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 100 Mbps.

Web access

Each Controller (DDC) must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish this shall not require any additional engineering labor over that required to show them at the WorkStation itself. No additional software, other than a Java supported network browser, shall be required.

Graphics

The system shall use FBD/Scalable Vector Graphics (SVG) technology. Change in monitor or screen resolution should not affect the graphics quality and ratio.

The number of controllers for central plant room equipment shall be decided by the contractor with a maximum capacity limited to 160 points per controller. Overall, the system shall be provided with 15% spare capacity for each point in each Controller.
There shall be one control station located in BMS Room. The computer shall be sized to cover the graphic display memory and planning information. The display shall be in the form of dynamic color graphics and text format with menu driven pop-up windows and help facility.

Customized Reports

The system should be capable of providing user defined custom dashboard-based reports. Reports shall be pulled or mailed automatically to the designated mail id's and also be stored on the local server simultaneously.

Reporting should have User-friendly functionality, including drag-and-drop trending, one-click reporting, interactive graphics, calendar-like scheduling, and easy-to-use alarms, lets you focus on optimizing your buildings, rather than just running them.
Software shall be able to generate customized reports as per client requirement.
System shall be capable to generate reports in Excel, PDF & Graphical formats.

Alarming, Trending & Scheduling

System shall generate & store the alarms & there shall be pop up for critical/as defined by Customer/Consultants.
System shall be capable to generate the trends for energy data for analysis purpose.
Scheduling shall also be possible through system as required at site. Schedules will be created in Controller & can be change through Graphical software as well.
Energy Management & Reports shall be part of BMS software.
Software shall be capable of generating customized reports.

Graphical Representation

Each System like chillers, AHUs, FCUs, FANs, etc. shall have ICONs page as well as dynamic graphics representation. The parameters as mentioned in IO Summary shall be mapped in graphics also. Example for AHU graphics is as follows:

Similarly, the vendor has to create graphics for Chillers, Chiller Pumps, and Ventilation fans etc.
The system shall be capable of generating reports in PDF, Excel & graphical representation.

Energy management software shall be capable of generating reports in graphical representation.

2.0 CENTRAL STATIONS HARDWARE

The Control stations shall comprise of Personal computers (PC) providing high-level operator interface with the system. The terminals shall be capable of providing the operator with the facility for remote system interrogation, control, and retrieval / storage of logged data, annunciation of alarms and reports, analysis of recorded data and the formatting of management reports.

The control station shall consist of the following hardware with all of them suitable for the power supply voltage of 230 V AC ± 10%, 50 HZ + 3%.

a.) Minimum Specifications for Workstations:

FEATURES	**DESCRIPTION**
Processor	i7 Processor or better
RAM	16 GB RAM
Graphic Accelerator	NVIDIA minimum 4GB or better
Storage	Minimum 2 TB Enterprise-grade HDD or SSD in RAID-1 mirrored configuration, Gigabit (10/100/1000 Mbps) Ethernet card, SATA 6Gb/s or better interface
Operating System	Windows 11 pro or better

b.) Minimum Specifications for Server:

FEATURES	**DESCRIPTION**
Processor	Dual Intel Xeon processor 10core or better
RAM	32 GB RAM or better
Graphic Accelerator	NVIDIA minimum 4GB or better
Storage	Minimum 2 TB Enterprise-grade HDD or SSD in RAID-1 mirrored configuration, Gigabit (10/100/1000 Mbps) Ethernet card, SATA 6Gb/s or better interface
Operating System	Windows 11 pro or better

c.) Key board: The central station shall be complete with detached 101-keys keyboard which includes full upper/lower case ASCII keyset, a numeric pad, dedicated cursor control pad, and a minimum of 10 programmable functional keys.

d.) Color Monitor: The color monitors shall be with a minimum 19” diagonal nonglare LED screen and minimum Super resolution of minimum 1024 pixels horizontal, 768 lines vertical and minimum 16 base colors. The monitor shall be with tilt and swivel facilities.

e.) Mouse: For keyboard less operation, in addition to the enhanced keyboard, a mouse shall also be provided as an alternative user interface for day-to-day system operation. 2 Nos. mouse pads shall be provided for each mouse.

f) Printers: The contractor shall provide printers as specified in the schematic diagram for printing alarms, operator transactions and reports.

3.0 CENTRAL STATION SOFTWARE

A. Command & Operating Software

1. The integrated building management software provides a user interface to manage and operate a building management system. BMS Software should be highly flexible and scalable solution which accompanies you from installation and configuration of field IP devices, all the way to daily operation oaf the facilities.

Thus, a common user interface for the building automation system is available at all phases of the project. **BMS Software should use client–server model consisting of the Server and one or multiple Clients**. Server manages and stores system and operating parameters, historic data, access rights, and device configurations in an SQLite/MySQL/SQL data base. **It exchanges real time data with distributed autonomous IP devices via web services independently of the underlying field bus technology (CEA709, BACnet, DALI, MBus, Modbus, KNX, etc.).** Client is the user interface of the building management system. The client can be installed on the same PC as the server or on a remote PC. **Min. 5 Client License should be available along with Software & operate all 5 clients simultaneously**. The use of web services to communicate between clients and server ensures that remote access is easily possible across firewalls and NAT routers. As a minimum, the menu driven command and operating software shall permit the operator to perform the following tasks with a minimum knowledge of the HVAC Control System provided and basic computing skills.

i. Configure the network.

ii. Create control sequences.

iii. Graphical interface to systems.

iv. EMS

1. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

Network & Communication Security [Added]:

• All communication between BMS field controllers, servers, and client/web workstations shall support encryption (TLS 1.2 or higher); legacy unencrypted protocols shall be disabled by default.

• The BMS server and controllers shall support secure (signed) firmware/software updates and shall log unauthorized configuration change attempts.

• The BMS network shall be capable of segmentation (VLAN) from the general hospital IT network, with remote/vendor access routed through a secure, logged gateway.

2. System Diagnostics. The system shall automatically monitor the operation of all HVAC control workstations, printers, modems, network connections, and nodes. The failure of these devices shall be annunciated to the operator.

3. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. Data shall be able to transferable to other software packages so as to create custom reports.

4. Web Browser Access: The DDC system shall provide total integration of the facility infrastructure systems with user access to all system data, either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.

IBMS Software shall be a fully integrated Human Machine Interface (HMI) solution that enables customers to increase return on assets by delivering a highly scalable, reliable control and monitoring system. The Software architecture shall provide the advanced clustering technology available and help safeguard plant reliability. It shall also extend the benefits to rapid-change deployment and a number of other enhancements that help increase security and maximize engineering productivity.

Also, the following parameters shall be ensured through the Central Management System Software but not limited to the same:

- Provide view across existing control systems
- Provide a combination of control (including alarms, reports and trends), local to the process, paired with a central standby server
- Support additional processing for expansion requirements by simply adding a new I/O Modules and/or servers to the control system
- Segment your control system to ensure changes in one business unit do not affect the others
- Connect to multiple control systems to analyze the alarms and trend data directly from the similar systems
- Support for Virtual Machine environments
- Dynamic-point licensing whereby customers only pay for the points they use
- Software should be flexible to store the Controller program. If controller replaced in the field, Logic can be downloaded directly from the Graphical software.

Web Client of the software shall be of zero-maintenance, fully functional client that can be viewed using any current HTML5-compliant web browser (e.g., Chrome, Edge, or Firefox). This web client shall allow all users throughout an enterprise to take advantage of real-time information by providing easy access to the BMS system. Software shall allow operators and process engineers to analyze the cause of process disturbances by bringing together trend and alarm data, which traditionally has been stored separately.

The central software shall provide an operating environment, which enables the following functions. The user must able to query or change any point in the system (save or reload a controller database or generate a system report) from a single command line.

Control Schedules: time of day scheduling shall be arranged in a weekly format. Multiple days, weeks or months shall be programmable from a single schedule. Scheduling shall be capable of one year in advance configuration. Multiple week and month selection shall allow the user to define a schedule over the elected. Range. The user shall also be allowed to select individual days over a selected range during configuration (example Mondays, Wednesday and Fridays for the months of February and March). This selection shall be capable of overriding the existing schedules for those days or apprehending to them. The range selectable shall cover a minimum of twelve months.

This system must possess the ability to copy a schedule for any day, range of days, months, range of months or entire year within its own schedule calendar or between calendars. It must also allow the user to view an entire week at one time.

The system must allow for a logical arrangement between equipment and schedules so that devices and schedules being configured for interaction may form an English language component relationship.

The ability to configure a holiday schedule for any or all days of a selected range shall be via a one-year calendar format. Holiday schedules shall be stored vial user defined names for repetitive use and later data selectivity via menu options. Holidays shall be superimposed (or overlapped) in a yearly format onto a base schedule therefore taking priority for each day which has been defined within the holiday schedule. Holidays shall be differentiated on the calendar vial color-coded dating for quick and visual acknowledgment. Any changes made to a holiday schedule shall automatically be made to any base schedule without the need to select the Holiday schedule.

The ability to configure a special day schedule shall be via a one-year format. Special day schedules shall be stored via user defined names for repetitive use and later data select ability via menu options. Special days shall be superimposed (or overlapped) in a yearly format onto a base schedule hence taking top priority for each day which has been defined within the special day schedule. Special day shall be differentiated on the calendar vial color-coded dating for quick and visual acknowledgment. Any changes made to a special day schedule shall automatically be made to any base schedule to which it has been superimposed. Special days must represent on the base schedule without the need to select the special day's schedule.

The system shall allow for the user to define a single schedule for any or all devices configured in the system. Any change made to this single schedule will automatically be down loaded to all controllers.

Report Generation -

The system shall contain a full text editor for the creation of custom reports.

All reports created shall have full access to the systems database for the purpose of embedding any selected point into a report location for ease of display and view.

The system shall permit full programmability for report generation. The following logical and mathematical operators must provide. Greater than, equal to, not equal to, add, subtract, multiply, divide, square root, and/or comparators, absolute value and modules. All of the above operators shall be capable of being used in an easy-to-follow English language-based program to trigger generation and/or change formats of specific reports.

The system shall allow for report grouping so that pre-defined or selected reports may be generated by a single request.

The report generator shall have the ability to conduct mathematical calculations at report time so as not to burden the CPU with processing which will not be required until generation time.

A report shall be configurable to ask for user input, which can be used in the calculation and generation of a report.
The system must include a programmable looping function to allow for the repeated generation of one report containing different data.
A report must be capable of being configured to invoke other executable software programs at generation time.
All report programs shall be capable of time of day, day of week, or day of year scheduling.
Standard report generation to be provided by the manufacturer with the system shall include:

a. Alarm Summary - Print out in text format descriptor, value, status and engineering unit of each point in alarm.

a. Historical Trend - System shall have software capable of sampling points at periodic intervals and logging values for future reporting.

a. Dynamic Trending - System shall have software capable of plotting dynamic line graphs, bar charts curve plots and pie charts for up to six values.

All points in the system shall be accessible via an on-line directory for immediate use to avoid the need for point's reference notebooks or any other written material.
Point grouping shall be allowed so that operator defined groups allows the recall by name to view the status of a pre-selected group of points.
Automatic and manual storage and reload ability of full programming database and point's configuration for stand-alone controllers.
The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification

4.0 BACnet IP DIRECT DIGITAL CONTROLLER (DDC) & IO-Module

a. All DDC Controller shall be BTL & CE/UL Certified, with 64-bit microprocessor & real time operation.

a. DDCs shall be standalone in nature – All the DDCs shall be on BACnet IP & BACnet Secure Connect.

a. Power failure safety – DDC shall have built in battery to secure controller memory data for minimum 7-Days. DDC shall have built-in Real-time clock.

a. DDC controller and Modules both shall have built in LCD display & buttons/Jog Dial to enable monitoring / Controlling / Testing at controller level.

a. DDC CPU shall be of minimum 1.1 GHz.

a. Each controller shall have built in 8 GB Flash Memory to save Graphics, Trend log, Alarms & logics in controllers.

a. DDC Controller should be programmed with IEC-61499 standard with response time down to 10ms.

a. Each controller shall have built in two Ethernet ports to form RSTP loop. If requires 2nd Ethernet port can be configured with Separate IP Address.

a. DDC controller shall have built in OPC & Web server. In case of communication failure with Software, controller can operate through Web Browser.

a. DDC Controller should have at least one On-board Modbus RS-485 / BACnet MS/TP port to integrate 3rd Party equipment.

a. Multiplexer (MUX) shall not be allowed for increasing IO points in DDCs.

A. Remote Communication

1. Provide all functions that will allow remote communications via modern to off-site locations. Include modem along with all cabling necessary for installation.

1. Provide latest Windows or more software for off-site computer, which allows operator to view, and change all information associated with system on color graphic displays if desired. Operator shall be able to change all parameters in this section form off-site location including all programming of global controllers and programmable terminal unit controllers.

A. Schedules

1. Each schedule object (Weekly or Exception) shall be capable of performing an optimum start. Optimum start calculation shall be based on outside air temperature, zone air temperature deviation from zones daytime cooling set points, and individual zone adaptive cooling coefficients that are adjusted each day based on performance parameters of the individual zone.

A. Alarm Generation

1. Object type change of values and change of states may be identified as alarm conditions. This summary of active alarms (Event State property value not equal to NORMAL) is presented to and displayed at the operator's terminal for system user action.

    a. Alarm may be generated within the system for any object type change of value or state either real or calculated. This includes things such as analog object type value changes, binary object type state changes, and various controller communication failures.

1. Alarm log shall be provided for viewing of alarms. Log may be viewed in-site at the operator's terminal/ controller or off-site remote communications.

The DDC's shall have10% spare capacity (digital/analog input/output) to give flexibility for future expansion.

All DDC controllers shall be capable of handling Voltage, mA, Resistance or open/closed contacts inputs in any mix, if required.

Analog Inputs/outputs of the following minimum types shall be supported:

i) 4-20 mA.
ii) 0-10 volts.
iii) 2-10 volts.
vi) Resistance Signals (either PTC or NTC)
(PT 100, PT 1000, NI 1000)

Digital input/output types to be supported shall be, but not limited to the following:

i) Normally-open contacts.
ii) Normally-closed contacts.

Modulating outputs shall be true proportional outputs and not floating control type.
Controller's packaging shall be such that complete installation and check out of field wiring can be done prior to the installation of electronic boards.
All board terminations shall be made via plug-in connectors to facilitate trouble-shooting, repair and replacement. Soldering of connections shall not be permitted.
Controllers shall preferably be equipped with diagnostic LED indicators with at least indication for controller health indication.
It shall be possible for the controllers to accept regulated uninterrupted power supply to maintain full operation of the controller functions (control, logging, monitoring and communications) in the event of a localized mains failure.
There shall be the facility for programming / accessing the controllers (DDC) locally, via either an integrated GUI display, access to the system thus provided shall be restricted by passwords in the same way as at the main operator terminal.
The controllers shall be housed in vandal proof enclosures to protect them from tampering by any unauthorized personnel. All DDC controllers used in plant room spaces and external applications shall be housed in IP66/IP54 rating enclosures.

It shall be possible to add new controllers to the system without taking any part of the system off-line.
Detailed description of software features and operating sequence of all available energy management software shall be submitted with the tender for evaluation by the Consultant/client.

Alarm Lockout shall be provided to prevent nuisance alarms. On the initial start up of air handler and other mechanical equipment a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating an alarm comparison logic.
Tenderers shall indicate their proposed system alarm handling capability & features.

Run time shall be accumulated based on the status of a digital input point. It shall be possible to total either ON time or OFF time.
It shall be possible to accommodate Holiday and other planned exceptions to the normal time programs. Exception schedules shall be operator programmable up to one year in advance.

5.0 DATA COMMUNICATION

The communication between controllers shall be via a dedicated communication network as per recommended standards. Controllers' microprocessor failures shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.
Every DDC must be capable of communicating with other DDC's either peer to peer or through an IP network.

6.0 A. Third Party Integrations (BTL Certified):

a. The software shall be open architecture & support based for industry standard integrations with third party mechanical & electrical sub-systems. The integration unit shall be capable of integrating BACnet IP / BACnet MSTP / Lon / Modbus RS-485/ Modbus TCP/IP as required at site.

b. The software shall mainly cover the equipment as mentioned above in the IO summary & scope section.

c. The system shall have energy management applications, providing features like learning adaptive optimal start, trim and respond, and demand-based set point adjustment which automatically fine tune the system to run at peak efficiency.

d. Third party Integrator should be of same make as the DDC Controller, or a BTL-certified BACnet integration demonstrated compatible with the proposed DDC Controller.

e. Integrator shall have built in LCD display & buttons/Jog Dial.

B. Communication Protocol(s)

a. The native protocol for the BMS server software shall be BACnet over Ethernet Datalink as defined by ASHRAE standard. The BMS Server shall support BACnet/IP Annex to enable communication through common routers. Proprietary protocols over TCP/IP are NOT acceptable. In addition, the software shall be able to support concurrent operation of multiple standard and non-standard protocols such as:

   i. BACnet over IP

   ii. Modbus RTU / RS485

   iii. OPC

7.0 FIELD DEVICES

6.0 FIELD INSTRUMENTATION / SENSORS [Added heading – items below were previously unnumbered 7.A-7.K with no parent heading]

6.1 Immersion Temperature Sensor with Thermowell:

- Media: water
- Sensing element: PT or NTC
- Output: PT100, PT1000, NTC10K, NTC20K, Ni1000
- Accuracy: ±0.2°C~0.5°C
- Probe length & diameter: 150mm & 6mm
- Protection class: IP65
- Storage Temperature: -30 to 85°C
- Housing material: ABS
- Probe & Thermowell material: Stainless steel 304/316
- Standards: EMC directive EN61326-1
- Approval: CE/UL

6.2 Flow Switch:

- Media: water
- Type: Paddle type
- Pipe diameter: 25mm-150mm
- Output: 1SPDT, 10A 250VAC
- Protection class: IP65
- Liquid pressure: 1Mpa
- Max. working pressure: 13.5bar
- Max. medium temp.: 120°C
- Approval: CE/UL

6.3 Differential Pressure Switch (Water)

- Media: water
- Type: Bellows type
- Switch type: micro switch
- DP range: 0.3-4bar
- Output: 1SPDT, 15A/250VAC
- Repeatability: ±2% of F.S.
- Process connection: 1/4” BSP(M)
- Protection class: IP33 for indoor & IP65 for outdoor application
- Housing material: ABS
- Operating temp. range: -20 to 120°C
    - Maximum working pressure: 17bar
    - Approval: CE/UL

6.4 Differential Pressure Sensor (Water)

- Media: water
- Sensing element: Piezo resistive
- Anti vibration and shock resistance
- Diaphragm & body MOC: SS316L & SS304
- Pressure range: 0-10bar or as per site requirement
- Output: 0-10V or 4-20mA

- Accuracy: ±0.5% of F.S.
- Process connection: 1/4” BSP(M)
- Electrical connection: DIN43650 Hirschman
- Protection class: IP65
- Medium temp. range: -30 to 105°C
- Storage temp. range: -40 to 125°C
- Power supply: 24VDC
- Approval: CE/UL

6.5 Ambient Temperature & Humidity Sensor

- Media: air or non-aggressive gases
- Sensing element: PT or NTC
- Output: PT100, PT1000, NTC10K, NTC20K, Ni1000
- Accuracy: ±0.2°C~0.5°C
- Protection class: IP65
- Storage Temperature: -30 to 85°C
- Housing material: ABS
- Standards: EMC directive EN61326-1
- Approval: CE/UL

6.6 Differential Pressure Switch (Duct Type)

- Media: air or non-aggressive gases
- Type: Diaphragm type
- DP range: 20-200Pa, 50-500Pa, 200-1000Pa
- Output: 1SPDT, 250VAC
- Tolerance: ±15%
- Protection class: IP65
- Max. working pressure: 5kPa
- Housing material: ABS
- Operating temp. range: -40 to 85°C
- Set of accessories should be given along with switch
- Approval: CE/UL

6.7 Temperature & Humidity Sensor (Duct Type)

- T&RH Sensor Type: Digital Temperaturen & Digital polymer
- Media: air or non-aggressive gases
- Temperature range: 0-50°C
- RH range: 0-100%RH
- T&RH output: 0-10V or 4-20mA
- T&RH accuracy: ±0.5°C & ±2%RH of f.s.
- Probe length: 200mm
- Protection class: IP65
- Housing & probe material: Fire retardant ABS+PC (UL94V0)
- Power supply: 24VAC/24VDC
- Approval: CE/UL

6.8 CO2 Sensor (Duct Type)

- Media: air or non-aggressive gases
- Sensor type: NDIR
- Range: 400-2000, 0-2000, 5000, 10000PPM (dip switch settable)
- Output: 4-20mA and 0-10V simultaneous both output
- Response time: 20sec., 60sec (dip switch settable)
- Accuracy: 70PPM +3% of reading
- With automatic background calibration
- Housing material: ABS
- Protection: IP41 for room mount/IP65 for duct mount
- Operating temp.& RH range: 0~50°C & 0~85%RH non cond.
- Standards: EMC directive EN61326-1
- Power supply: 24VAC/24VDC
- Approval: CE/UL

6.9 Differential Pressure Sensor (Duct Type)

- Media: air or non-aggressive gases
- Sensing element: Piezo resistive

- DP range: ±250Pa, ±500Pa, ±750Pa, ±1000Pa, 0-250Pa, 0-500Pa, 0-750Pa, 0-1000Pa (dip switch settable)
- Output: 0-10V and 4-20mA simultaneous both output
- Accuracy: ±1% of F.S.
- Protection class: IP65
- Response time: 1sec., 4sec. (dip switch settable)
- Housing material: ABS
- Operating temp. range: -25 to 70°C
- Standards: EMC directive EN61326-1
- Power supply: 24VAC/24VDC
- With Auto zero setting
- Approval: CE/UL

6.10 Flame proof Level Transmitter

- Media: Diesel
- Mounting: Top mount
- Type: Submersible type
- Tank height: 0-1meter or as per tank height/site requirement
- Output: 4-20mA or 0-10V
- Accuracy: ±0.5% of F.S.
- Diaphragm & housing material: SS316L
- Cable material: SS316L
- Protection: IP66, Flameproof enclosure
- Over pressure & burst pressure: 150% of F.S. & 300% of F.S.
- Operating temp. range: -40~85°C
- Powers supply: 24VDC
- Approval: CE/UL

6.11 Pressure Sensor

- Type: Piezo-electric type, Piezo-resistive type or Diaphragm type
- Output: 4-20mA or 0-10V
- Powers supply: 24VDC / AC
- Measuring Range: 0-10Bar

- Housing: Weather-proof with minimum IP 65 protection
- Sensor connection: screwed ¼ : or ½" NPT or BSP (F)
- Approval: CE

7.0 ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof enclosures which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 14 SWG CRCA sheet steel cubicles with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self-threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the color decided in consultation with the Architect/Consultant.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection) and UL listed.

8.0 CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Architect/Engineers Any modifications suggested by the Contractor shall be got approved by the Architect /Engineers before the actual laying of conduits is commenced.

8.1 CONDUITS / TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required Dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

8.2 CONNECTIONS

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

8.3 BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

SECTION 7: Technical Specifications:- IP EPABX

SL	Minimum Technical Specifications
1.0	**Specification System Architecture**
1.1	The Architecture of the exchange must be a completely IP based Server & Gateway type communications system with ability to run both IP and TDM (Analog & Digital) end points, legacy PCM/TDM based systems are not acceptable.
1.2	Call control server / appliance should be Intel based hardware with necessary configuration to support the desired expandability, No proprietary hardware is acceptable. Support for virtualization should be available from Day-1.
1.3	The system should consist of HA servers be based on server gateway architecture with external server running on Unix / Linux or similar / equivalent OS. No card based processor systems should be quoted. All the users to be managed in a single database, centrally. Multiple databases are not acceptable.
1.4	The IP EPABX system shall support hardware, software and licensing for minimum 1000 end-points which must comprise of collaborative business application features instant messaging, real time telephony presence, click to call (dial by name, answer, release), call log, P2P audio/video, OnDemand voice recording & screen sharing feature should be available for all users in the IP EPABX.
1.5	IP EPABX should Support built-in ACD to achieve future requirement
1.6	The communication server, gateway & endpoints should support IPv6 from day 1 so as to be future proof.
1.7	The system should be fully compliant to VOIP standards like H.323 and SIP (session initiation protocol). the system should be able to operate with any H.323/SIP compliant, The SIP proxy, sip registrar should be inbuilt in the system and should support any open sip stack compliant hard phones or soft phones, if required, it should be able to inter operate with H.323 standard based external gatekeepers.
1.8	The offered system should have Voice compression and decompression in accordance with G.711, G.722, G.729AB, H.264 ITC recommendations and optional echo-cancellation in accordance. The G.711, G.722, G.729A & H.264 codecs
1.9	The System must support Network Time Protocol V4.1.2 (RFC 1305) to synchronize the system data/time of network devices.
1.10	system should support the QOS features for the VOIP implementation. it should be compliant with both QOS standards (layer 2 – 802.1 p/q) and layer 3- diffserv/tos).
1.11	System Diagnostics should be done in server The offered solution should have the provision to analysis detailed system performance, Alarms, network topology,

1.12	IP EPABX should be suitable for up to 8-digit extension numbering scheme. this numbering scheme should be flexible & system should also allow mixed numbering scheme.
2.0	**Scalability**
2.1	The IP PBX system shall support up to 4000 users scalability & at least 15000 devices to achieve future growth requirements without any additional server or cluster server
2.2	It should be possible to add more sites and users without the need to change the software and existing configuration.
2.3	The system should be capable of supporting a high traffic and should support minimum Busy Hour Call Completion (BHCC) 2,50,000 & above
3.0	**System Survivability**
3.1	The call control system should be fully redundant solution with no single point of failure and should provide 1:1 redundancy by separating the servers over LAN / WAN. Call servers should have High-availability seamless redundancy & provide stateful switchover between redundant call server.
3.2	In progress PSTN Calls at each of the locations should not be interrupted in the event of Call Server failure/switchover or WAN link failure.
3.3	The system gateway must be able to restart automatically without human intervention when the external AC power supply is resumed after complete power failure (even after the batteries are discharged).
3.4	The telephony system must be capable of providing 99.999% availability.
3.5	Call processing function shall take place in the core server. Intra IP- EPABX calls between IP extensions and calls from IP extension to public IP network via Ethernet interface shall not be affected in case the media gateway is powered off/faulty.
4.0	**Security**
4.1	The system shall include but not limited to following security features
4.2	System should have commercial grade encryption security with minimum 128-bit key security for both signalling and voice with in a node for all IP subscriber’s.
4.3	Strong password policy for accesses
4.4	must have Local authentification database with password policy enforcement
4.5	External authentication protocols (Radius , LDAP/LDAPs)
4.6	Telephony device shall support IEEE 802.1x (EAP-TLS)
4.7	The telephony server shall allow traffic filtering
4.8	Telephony devices shall be protected against ARP spoofing
4.9	Telephony devices shall be protected against DHCP Server intrusion
4.10	Telephony server shall support SSH and TLS for secure connection
4.11	Telephony server shall support SSH and TLS for secure connection

4.12	Telephony software shall provide protection to ensure software integrity of telephony server, media gateway and telephony devices
4.13	Telephony shall provide protections against toll fraud including transfer/forward cases
4.14	Telephony system shall supporte secure SIP/SRTP
5.0	**Media Gateways Specification**
5.1	Media Gateway must be standard rack-mountable solution having universal-slots architecture for flexibility in putting in any type of interface cards/modules for Analog & Digital Subscriber & Trunks including Analog CO lines and ISDN PRI/BRI. FXO/FXS based gateway solutions will not be considered.
5.2	The gateway card should have dual Ethernet. 10/100/1000 Base -T connection with TCP/IP connectivity to end equipment's , Trunks or remote gateways. It should provide services as per H.323/SIP Protocol Stack.
5.3	The Media Gateway of EPABX system should boot from Flash RAM/Flash Disk/Hard disk
5.4	Media Gateway shall be of the call control architecture in normal operations Core servers process all call control intelligence, however it would undertake local call processing while working in self-survivable mode & allow it to maintain 100% of the telephony services for its subscribers
5.5	Media Gateway should have modular architecture with the ability to stack multiple gateways in a single location. One or more such stacks should be placed in each location under the same Core Server control, offer system should support minimum 240 media gateway scalability.
5.6	Media Gateway should be able to restart automatically & shall support providing 100% of telephony service without human intervention at Media Gateway as well as at Core Server level when the input power supply to the Media Gateway is resumed after complete power failure, even under the failure of IP connectivity with Core Servers of IP based EPABX system.
6.0	**IP PBX Features**
	The PABX system shall offer the following functions :
	Abbreviated Dialling
	Automatic call back on busy set
	Barge-in (intrusion) : It permits a user to break into a call between two sets without having been invited.
	Broker call
	Call Back
	Call Forward and overflow
	Call Log
	Camp-On
	Consultation Call
	Direct Inward Dialling

	Group Call
	Hotline features allowing a set to automatically dial a predefined number on off-hook. On off hook the dialing can be immediate or delayed.
	Last Caller Callback
	Last Number redial
	Loudspeaker barge-in allowing to speak on the loudspeaker of the set called wether the set is busy or not
	Lock/Unlock
	Mastered conference allowing a group of up to 29 users to be connected with each other, or to perform announcement on loud speaker of prerecord or live message.
	Multiple redial list allowing to view, call back or delete any of the last eight called parties.
	Music on Hold
	Priority (Higher priority call should override lower priority call even if the extension is busy)
	15 party ad-hoc conference
	Call Transfer
7.0	**Unified Communication (Must be from Same OEM, or a SIP-certified interoperable equivalent demonstrated by the Bidder)**
	General Specification of UC Client
	- The solution must be enterprise grade
	- Solution must work on all platforms like Desktop, Laptop, Windows and MAC OS, iOS and Android mobiles. It should also support browser based access without the need for client installation.
	- The registration must be based on email address and not mobile numbers. It should support mix and match of email domains and should not restrict from one domain only.
	- The solution should be UCaas ready and should be ready to use without any customization.
	- The solution should be integrated with end customer Mobile and web application and provide cPaas thru API/SDK
	- The application should work on any WiFi or 3G/4G
	- The solution should be integrated with IP Telephony from similar or different vendors to provide call notification, on screen call control and click to call feature.
	- It should have a channel through which the administrator of the end customer will make general announcements and instructions. Department specific channels should be available for users to subscribe. These channels should be available for all users when they log-in to the application

	UC Specification for Senior Officials and Administration Staff
	- Instant Messaging
	- Presence Status
	- Point-to-Point Audio on 3G/4G
	- Point-to-Point Video on 3G/4G
	- Remote Screen Share
	- File Share upto 20GB storage space
	- Web Conference minimum 100 Participants and minimum 6 Video streams
	- Integration with IP Telephony
	UC Specification for Managerial Staff
	- Instant Messaging
	- Presence Status
	- Point-to-Point Audio on 3G/4G
	- Point-to-Point Video on 3G/4G
	- Remote Screen Share
	- File Share upto 1GB storage space
	- Group formation for message with minimum 300 members
	UC Specification for Other Staff
	- Instant Messaging
	- Point-to-Point Video on 3G/4G
	- Remote Screen Share
	- File Share upto 1GB storage space
	Safety and Security features
	- Should be governed under GDPR regulation
	- Data collected should not be used for advertisement or commercialization
	- Should be compliant with ISO 27001
	- Solution should be present in Gartner Magic Quadrant (Optional)

IP PHONE

Sr. No	Features	Specifications
1	Display	Should have min 2.6-inch or more with the 256 x 132 resolution grayscale display and at least 2 or more programmable line keys.
2	Audio	Should support Frequency response 100 Hz – 20 kHz for handsfree speaker, Forward Error Correction(FEC), Automatic Gain Control (AGC), Comfort Noise Generation (CNG), Silence Suppression/Voice Activity Detection (VAD), Acoustic Echo Cancellation (AEC) & Hearing Aid Compatible (HAC) handset.
3	Audio codec	Should support following audio codec - G.711a, G.711u, G.729a/b, iSAC, Internet Low Bitrate Codec (iLBC), OPUS
4	Keys	Should have keys for specific functionalities such as – Configurable Emergency Button, Hold/Resume, transfer, Standard Keypad (dial pad should be ADA-compliant), Volume Control, Speakerphone, mute on/off, headset, 2-way navigation and select key, etc
5	Backlit Indicator	The phone should support Front Arc LED that indicates device status, such as incoming calls, message waiting, missed calls.
6	Speaker Phone	Hands-free operation with full-duplex speaker-phone
7	Port	One RJ-9 port for headset connection
8	Ethernet Switch	The phone should have 2 x 10/100 ports, one for the LAN connection and the other for connecting to PC/laptop.
9	Power	The phone should support Power over Ethernet IEEE 802.3af class 1/2/3/4 and should also have AC power adapter option. AC power adapter should be supplied day one from the same IP Phone OEM.
10	Network	The phone should support IPv4 and IPv6 from day1.
11		The phone should be a SIP based Phone i.e session Initiation protocol (SIP) supported
12		IP address Assignment by DHCP or statically configured
13	Dual-position foot stand	The Phone should have two-position foot stand supports.
14	Wall-mountable	The phone should support mounting against a wall
15	Security	Media Encryption (SRTP) using AES
16		Signalling Encryption (TLS) using AES
17		802.1x support
18		Encryption of Configuration Files
19		The Phone should have additional security, the audible Dual Tone Multifrequency (DTMF) tones are masked when the speakerphone mode is used.
26	Call Features	Should support busy lamp indicator (BLF) to indicate the presence
27		Should support boss-secretary feature, so that secretary can answer calls on behalf of Manager
28		The handset should be hearing aid-compatible

29		The phone should support the following features at a minimum: a. Call forward b. Call pickup c. Call waiting d. Call back e. Call park f. Conference g. Auto-detection of headset h. Immediate Divert i. Music on hold (MoH) j. Message waiting indicator (MWI) k. Personal directory l. Call history lists

IP VIDEO PHONE

Sr. No	Features	Specifications
1	Display	The display should be 7-inch touch screen or higher with minimum resolution of 1024 × 600.
		The virtual keyboard support on the touch screen facilitates easy search and input.
		It expands the number of lines without limitation of hardware keys. It should support minimum contrast ratio: 1200:1 (typical) with viewing angle of +/- 85° (typical) and Brightness: 350 cd/m2
2	Camera	The camera should be minimum 1/3 -inch CMOS with 4MP image sensor.
		The camera should support the resolution of full HD 1080p upto 30fps and 72° HFoV, 45° VFoV.
		The camera should support Automatic white balance and focus distance about 7 inch or above.
		The camera should have privacy shutter and LED light in front (indicating camera status).
3	Audio features and codec support	The Video Phone should support the minimum audio requency response from 150 Hz – 20 kHz full band. It should have following features: AEC (Acoustic Echo Cancellation), BGN (Background Noise Reduction), AGC (Automatic Gain Control), CNG (Comfort Noise Generation), VAD (Voice Activity Detection), Silence Suppression, Acoustic Shock Protection (Handset / headset), Packet Loss Concealment, Adaptive Jitter Buffer & Dual Tone Multi-Frequency (DTMF) tone generation (RFC 2833 and in-band).
		G.711 a-law, G.711 mu-law, G.722, G.729a, iLBC, OPUS and iSAC
4	Hard Keys	Should have keys for specific functionalities such as – Hold/Resume, Transfer, and Conference keys, messaging, Application, Directory keys, Volume-control toggle key, Speakerphone, Headset, and Mute keys, Home button, Power button, etc
5	Backlit indicator	The phone supports backlit indicators for the audio path keys (Handset, Headset, and Speakerphone), Home button, and message waiting.
6	Speakerphone	The Phone should have full-duplex speakerphone gives you flexibility in placing and receiving calls with hands free.
7	Headset	The phone should provide user the flexibility while using the headset i.e. RJ-9/ USB-C/ USB-A/ AUX
8	USB	The phone should have atleast 2 multi-purpose USB ports that could be used for charging mobile phones, connecting USB headsets.

9	Network	The phone should have 2 x 10/100/1000BASE-T Ethernet network, one for the LAN connection and the other for connecting to PC/laptop.
		The phone should support Wi-Fi 802.11a/b/g/n/ac, 2.4 GHz/5 GHz dual bands.
		IP address Assignment by DHCP or statically configured
		The phone should be a SIP based Phone i.e session Initiation protocol (SIP) supported
		The phone should support IPv4 and IPv6 from day1.
		The phone should support QoS mechanism through 802.1p/q.
10	Power	The phone should support Power over Ethernet IEEE 802.3af class 1/2/3/4 and should also have AC power adapter option
11	Security	Media Encryption (SRTP)
		Signalling Encryption (TLS)
		802.1x support
		Encryption of Configuration Files
		The phone should have the ability to register to call control server over an internet link with or without VPN.
12	Call History	Ready access to missed, received or placed calls (plus intercom history and directories).
13	Video	Should support self-view video, picture in picture (pip) with adjustable positions of pip.
14	Bluetooth	Should support Bluetooth (v4.2 LE) for handsfree earphones
15	Handset	The handset should be hearing aid-compatible
16	Standard Features	The phone should support the following features at a minimum: a. Call forward b. Call pickup c. Call waiting d. Call hold/resume e. Call park f. Conference g. Privacy h. Barge i. Speed Dial j. Do not Disturb k. Music on hold (MoH) l. SIP URI dialing m. URL Dialing n. Message waiting indicator o. Personal directory p. Favourates q. Call history lists

5A480 EMERGENCY LIGHTING SYSTEM

Every building shall be so designed, constructed, equipped, maintained and operated as to provide adequate means of egress to avoid undue danger to the life and safety of the occupants from fire, smoke, fumes or panic during the time period necessary for escape.

For high occupancy areas, Emergency Lighting & exit signage shall be provided to avoid situation of panic during distress. Every main occupancy may have certain occupancies which may be incidental to the main occupancy. The exit requirements pertaining to such incidental occupancies from the floor

of the occupancy to the level of exit discharge shall be calculated to meet the requirement of the actual occupancy of such type, tonsure adequate means of egress of the occupants.

Emergency Lighting shall be provided for use when the supply to the normal lighting fails. Emergency Lighting System is a complete but discrete emergency lighting installation also fed from the standby power source to the emergency lighting lamp(s), for example, self-contained emergency luminaire or a circuit from central battery (with or without monitoring system) connected through wiring to several escape lighting luminaries.

Escape Lighting is a part of the emergency lighting which shall be provided to ensure that the escape route is illuminated at all material times, for example, at all times when persons are on the premises, or at times the main lighting is not available, either for the whole building or for the means of egress. The distance to be travelled from any point in a building to a protected exit or external escape route or final exit measured along the line of travel shall be shortest path.

Exit access, exits and exit discharge shall be properly identified, with adequate lightening maintained in the elements of the egress systems so that all occupants shall be able to leave the facility safely. Open structures that are designed for occupancy by not more than three persons shall be permitted to be served by fire escape ladders & shall be exempt from emergency lighting requirements.

STANDARDS: -

The Emergency Lighting & exit signage system for escape route during fire shall be designed, installed and commissioned in accordance with

1. NBC-Part 4 2026 Fire & Life safety
2. NFPA 101 Life safety code
3. NFPA 72 - National Fire Alarm and Signalling Code
4. NFPA 110 - Emergency and Standby Power System
5. NFPA 70 - National Electrical Code

Master System Integrations (MSI)

On-Premises Software

Any software provided by the MSI should be perpetual.

1. **Building Digital Twin (3D – BIM based application)**

A digital twin should formally represent the buildings fixed Assets, process, and system that captures attributes, and behaviors of all the Systems employed in the hospital building. The Digital Twin should be in compliance with the required BIM level of detail (LOD). The attributes and behaviors should be suitable for communication, storage, and interpretation within a specified context. The digital twin information includes but is not limited to, combinations of the following categories:

- Equivalent Visual Model of Building's Physical Model.
- Mapping of each component of the hospital building with associated Data and information.
- Data Modeling including information and trends.
- Time-series Data and Historians.

Overall Equipment Efficiency: The System Should be able to measure, monitor, and dashboard the overall equipment Efficiency, especially for HVAC, PHE, and Electrical System equipment (excluding Switchboards). The Baseline of Equipment Efficiency will be as per the OEM.

Key Performance Indicators (KPI): The platform should automatically capture and analyze key performance indicators (KPIs) related to the buildings fixed Asset's efficiency. The Key Performance Indicators should be managed in such a way that with this real-time monitoring, the Facility Management Team proactively addresses issues, reduces quality appraisal costs, and improves overall performance.

Maintenance Management: The System should be built with Predictive and Preventive maintenance modules. The maintenance of each piece of equipment should be based on OEM recommendations and the same recommendations will be mapped with each piece of equipment with the maintenance schedule. The Maintenance module should be mapped with the required process of communication between the Facility management team and the end users.

Communication: The communication module should be able to communicate with all related stakeholders (including patients) in the event of Maintenance downtime, social gathering, Mock-Drill, sustainability initiative, etc.

Monitoring of Building performance as per Sustainability standards: Parameters of LEED, WELL, and ECBC+ Standards should be monitored on the dashboard and the preventive measures should be displayed if further improvement is needed to be in line with sustainability targets.

Waste Management: The module should also have waste management monitoring features.

2. **Building Management System (BMS)** including all related systems integration such as HVAC, HEPA Filters, IAQ, DG, Lift, UPS, Energy Meters, Chillers, MGPS, etc. as per final I/O summary.

Integration with the building management system (BMS) over APIs or BACnet IP shall enable the hospital building users (facility managers) to visualize the detailed equipment performance in form of custom dashboards and reports. The following KPIs shall be of the core interest for the hospital management:

- Energy management dashboards
- HVAC applications that enable user control over the system.
- Air Quality Monitoring Sensor for Indoor and Outdoor Air. Indoor Air Quality
- Monitoring should include Formaldehyde, VOC, NO2, O3, CO, PM10, PM2.5).
- Monitoring of the chemical dosing systems and dashboard for water quality parameters
- for chilled water & condenser water
- The Dashboard should have the below listed but not trends,
    - Utilization Trend of AHUs.
    - Utilization Trend of Exhaust, Pressurization, and Fresh Air Fans.
    - Utilization Trend of Ventilation Fans.
    - Area-wise utilization trend, for example, cafeteria.
    - Efficiency trend of the AHU

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

3. **PHE and Water Management System**

The Water management and control should be aligned with the P&ID diagram and the requirement of controlling, monitoring, and monitoring the water flow within the various types of Water Sources and end uses.

- Water utilization trends for each kind of water with respect to occupant load.
- Water quality trend (Conductivity, pH value, etc.).
- Measurement and comparison of water utilized from different sources.
- Measurement of wastewater.
- RO plant monitoring.
- WTP plant monitoring.
- STP plant monitoring and trend for specific energy consumption for process
- Replication of critical signals from BMS for PHE system.
- Monitoring and Control as per the enclosed IO list.
- Water Balance chart
- The Trend for HNS system pressure
- Cooling tower makeup water trend with chiller plant load and ambient condition

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

4. Fire Detection and Alarm System (FDAS)

Integration with the Fire Detection and Alarm system over BACnet IP or Modbus IP for centralized monitoring and annunciation of fire related alarms and events such as troubles, etc. for immediate action on the alarms notified. The following shall be the key KPIs but shall not be limited to the below:

- Centralized monitoring, annunciation, and notification of fire alarms.
- Centralized monitoring of troubles and other non-critical events arising from the FDAS.
- Historical comparison of alarms and events.
- Alarm history and log.
- Audit log.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

5. Public Address System (PAS)

Integration with the Public Address System over SPI or any other industry standard protocol shall be performed by the MIS for centralized announcements in case of emergencies and other critical announcements. The following shall be the key KPIs but shall not be limited to the below:

- Integration with IPBX with protocol of choice (SIP preferred) for announcements via the IP telephones.
- Centralized announcement and notification of alerts and fire alarms.
- Centralized request for staff for emergencies and other related actions.
- PC based announcements (optional).

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

6. Security Systems (CCTV & ACS)

The MSI shall integrate the security systems over API / SDK / other industry standard protocol into the platform to achieve centralized monitoring of all CCTV and ACS for centralized monitoring the systems and achieving the following KPIs but shall not be limited to the below:

- Integrate with other subsystems for opening of doors in case of emergencies such as fire alarm, etc.
- Integrate with other systems for automatic opening of required doors in case of Code Blue or a Code Red scenario.
- Record events such as fire, calamities, etc. upon receipt of respective triggers.
- AI based Analytics for CCTV cameras to continuously monitor patient / public behavior and aggression towards the hospital staff and vice-versa.
- Analytics to provide queue management dashboards and notifications.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

7. Lighting Management and Control System (LMS)

Integration over API or BACnet IP with the Lighting Management System should be able to (but not limited to) deliver the below-listed functions, lighting Control based on the lux level.

- Indoor / outdoor Lighting monitoring(wherever controlled lighting is provided) and (optional) control.
- 100% illumination in case of critical alarms such as fire alarm.
- Illumination Measurement.
- Maintenance alerts.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

8. Computerized maintenance management systems

Integration over APIs with the computerized maintenance management shall enable the users to view and update workorders and other maintenance related alerts. The platform shall provide, with help of the data from CMMS, detailed insights on the below as a minimum:

- Workorder analytics to provide detailed insights on created / allotted / attended workorders.
- Facility engineers performance dashboards.
- Facility performance dashboards.
- Asset and equipment performance and utilization.
- Preventive maintenance schedules for centralized notifications.
- Asset documentation and updates.
- Purchase orders and techno commercial documentation updates.
- Maintenance goals and central KPI index.
- Staff performance index.
- Alerts and notifications.
- Records and repository.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

9. Nurse call system (NCS)

Integration over APIs with the nurse call system shall enable the other maintenance related alerts. The platform shall provide, with help of the data from CMMS, detailed insights on the below as a minimum:

- Centralized announcements in case of code blue / code pink to respective nurse call stations.
- Centralized nurse call annunciation during patient discharge / transfers / etc.
- Centralized monitoring of performance of staff in case of calls and response times.
- Monitoring of scheduled nursing rounds for administering medications.
- Other parameters for centralized performance overview in terms of patient safety, patient improvements, and patient satisfaction.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

10. **Medical Gas Pipeline System (MGPS)**

MGPS data shall be made available via the BMS integration and provision of the real time updates for the below:

- Centralized monitoring of gas levels.
- Raise / create workorders based on gas levels for refill / maintenance.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

11. **IP based telephony (IPBX)**

Centralized telephone connectivity via SIP protocol-based integration with the IPBX etc. direct PC based announcements to nurse stations and other key resources.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

12. **Solar Power Systems**

Centralized monitoring of the solar power system (renewable energy source) for measuring the generated vs. consumed vs. grid export analytics. Also, the platform shall provide detailed dashboards for performance of the renewable sources of energy.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

13. **EV Charging System**

The EV charging system will be a Third-Party Cloud-based system. The Platform should be able to integrate with the EV Charging system with the help of API. The EV Charging System should have but not be limited to the below-listed functions.

- Real Time Status Availability of Battery and Charging Spots.
- Fault Log, and summary.
- Live data Visualization of total and station-wise energy delivery.
- Statistics on the number of EVs served.
- Battery Swapping Transactions.
- User Grouping and setting the Group-wise permissions.
- Revenue and Billing System

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

14. **Parking Management System**

Integration with parking management system is to maximize the efficiency of parking and develop a user-friendly mechanism that helps users find available parking at the time of parking. The platform shall provide

detailed dashboards on a high level to monitor daily efficiency of the parking management system with the below outcome as a minimum:

- Daily parking availability
- Parking score
- Safeguard reserved parking slots for staff and doctors.

The platform shall also enable creation of workorders automatically for any anomalies detected. It shall also give alerts when there is fluctuation in key parameters which shall be decided at the time of implementation by the Engineer-in-charge.

TESTING & COMMISSIONING

Evaluation of the performance of Software and Applications by conducting usability tests, which are examinations designed to measure whether or not users can successfully use a given software solution. The primary purpose of performance testing is to ensure that software solutions can meet the customer's objectives and achieve their full potential. The below listed (but not limited to) tests should be carried out before the delivery of the Software and Applications.

- User Acceptance Testing (UAT).
- Installation Testing.
- Requirement Verifications.
- Security and Privacy Testing.

TRAINING

Provide a training course schedule, syllabus, and training materials 15 days prior to the start of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the Safety system. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid in subcontractor-provided personnel training. Base training on the Operations and Maintenance manuals. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the subcontractor should assume the attendees are familiar with Safety systems.

AUDIO VIDIO SPECIFICATION

DENTAL COLLEGE TECHNICAL SPECIFICATIONS		
S. No	**ITEM**	**DESCRIPTION**
	30-PAX MEETING ROOM	

1	**110" or better Interactive flat panel 4K UHD Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
2	**Chairman/ Delegate Unit**	Supply, Installation, Testing and Commissioning of Wired Table Embedded gooseneck Microphone which shall have Frequency Response: 90-20000Hz or better. It shall have impedance: 120Ω or better. It shall have sensitivity of -32dBV (25mA) @1Pa or better. It shall have Signal to noise ratio of 90dB or better. It shall have Gooseneck microphone length of 415 mm or more. It shall have max SPL of 120 dB (@1% THD, 1Khz). It shall have 3 PIN XLR interface. It shall have all metal shell with anti RF interference. It shall have either inbuilt pattern options of Omnidirectional, Cardioid and uni-directional or three separate microphones shall be supplied to use in multiple scenarios. It shall have THD of <0.1% or better. It shall support 24V to 48V Phantom power. It shall have condensor type microphone capsule. It shall have power consumption of 2 Watts or less.
3	**Microphone integration Unit**	Supply, Installation, Testing and Commissioning of Microphone integration unit which shall have 120Ω output impedance. It shall have anti-vibration insulating rubber, effectively reducing vibration and mechanical noise on the mounting surface. It shall have 3 Pin XLR Input interface. It shall have 7 Pin Cannon/XLR output interface. It shall have feather touch Mic Mute/Unmute Button. It shall have ring and button indicators. It shall have 24dBA noise floor.
4	**Dual Microphone Control System**	Supply, Installation, Testing and Commissioning of Dual Microphone Control system which shall have frequency response of 40 Hz – 20000 Hz or better. It shall have less then .1 % distortion. It shall have 2 or more microphone interface. It shall have 2 or more RJ-45 Link interface. It shall be able to control and designate Microphone types as host or participant with indication. It shall have power consumption of 2 Watts or less. It shall be able to supply 24V phantom power to connected microphones. It shall be supplied with 2x RJ-45 cables which shall be 6' in length with protection caps. The OEM Shall have CE, RoHs, FCC, ISO 9001:2015, ISO 14001:2015, ISO 27001:2022, ISO 50001:2018 Certificates.
5	**Advanced Audio Feedback Suppressor**	Supply, Installation, Testing and Commissioning of Advanced Audio Feedback Suppression processor with XLR -3 & TRS 1/4” TRS, single channel Input and output interface. AFC & ANC Bypass switch, 20Hz-20kHz,± 0.3dB Frequency response, 0.005%, 1kHz; 20Hz-10kH, <0.01%, 10kHz-20kHz, <0.025% Total harmonic distortion.

6	**Audio Controller**	SITC of Central Audio control Unit which shall have fully digital conference technology with built-in high-performance processor. It shall have frequency response of 20 Hz – 20000 Hz or better. It shall support up to 40 Units via main controller and upto 128 units with optional Extension unit. It shall support PoE with category5 UTP distance upto 100 meters. It shall support IEEE 802.3af, IEEE 802.3at POE standards or better. It shall support 60 Watts non isolated POE Power or better. It shall support two channel Audio over IP or better. It shall have 1x RJ-45 AOIP interface. It shall have sampling rate of 48 KHz or better. It shall have ring type architecture. It shall have SNR of 85dB or more. It shall have 4x RJ-45 interface for connecting Microphone units or equivalent. It shall have 1x Balanced Audio Output interface. It shall have 2x RJ-45/RS-232 Control interface. It shall have 1x RJ-45 network Interface. It shall be supplied with 4" Control interface which shall be deployable upto 90 meters away from the main unit. It shall be rack mountable with 1U or less height. It shall be supplied with Power Cable, RJ-45 cable and operating manual.
7	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.
8	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
9	**Column Speakers**	SITC of Wall Mountable with 12 mid/high drivers in an articulated array for wide dispersion. The loudspeaker shall meet the following performance criteria: Usable Frequency Range (-10 dB) of 100Hz - 16 kHz. Long-Term Power Handling 300 W (1200 W peak). The Loudspeaker shall have a Max. SPL (Peak) of 119 dB or more with a nominal dispersion of 145° H x 20° V. The loudspeaker system shall be comprised of a Powder-coated steel grille; Twelve 2.25-inch mid/high frequency drivers and and a nominal impedance of 8 ohms. Optional 70/100V OEM transformer module with tap settings of 150/75 W shall be available.

10	**Amplifier**	SITC of class D amplifier with 4 x 300 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 4 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no. of digital Audio channels. The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz).
11	**20X Zoom Camera**	SITC of PTZ camera with minimum 1/2.8" HD CMOS sensor, supporting auto/manual white balance, S/N ratio ≥55 dB, and minimum 20x optical zoom with digital zoom capability. shall support Full HD video (up to 1080p60) over USB 3.0, HDMI, and IP streaming, with dual H.264/H.265 encoding and configurable streaming protocols (TCP/IP, RTSP, HTTP), shall provide wide field of view (≥68°) with pan/tilt range of approximately ±170° and -30° to +90°, support multiple presets (minimum 200), and include RS232/RS422/485 and IP control interfaces. The system shall be supplied complete with mounting accessories, remote control, and required cables.
12	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
13	**AVoIP Encoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec, Dual-Stream Encoder, Shall have Video Preview viewable from the built-in web interface or from a touch panel, USB 2.0 Transport, Shall have Switchable Dual HDMI Inputs, High security network support and features, including multicast, VLAN tagging and QoS, + powered with low-power mode for energy savings. Open Direct-Control API ,Digital Video Input HDMI 2.0 ,Digital Video Output Network video over Ethernet via RJ45 port or HDMI, Color Space 4:4:4, YUV ,Streaming Protocols RTP, RTSP, RTMP, RTMP/S, MPEG2-TS, HTTP Live ,Input Signal Types Embedded audio on HDMI or Analog Stereo (Balanced or Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.

14	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.1, Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM, shall have on board IR In and out, RS232 ,2x HDMI Input and 1x HDMI monitor output.
15	**Controller**	SITC of a hardware or software-based controller with on board 2 x RS232/422/485 ports and 6 x RS232 ports. The unit must support on board 8 x IR, 8 x IO and 8x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN, UL and RoHS certifications. The controller must have a secure platform. External Power Adaptor of above Integrated Controller Unit. It should be from same OEM of integrated controller Unit as requested above.
16	**Touch Panel**	SITC of 10" or better Professional-Grade, Persona-Defined Touch Panel, Pre-loaded Web Kiosk, UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), stand-alone room scheduling touch panel. customizable panel to serve the unique needs of any user, Mounting Flexibility, Advanced Security – Supports HTTPS, 802.1X, TLS 1.3, Modern Authentication or OAuth 2.0, and FIPS 140-3, Over 1 million programmatically selectable colors, Communication-enabling Technologies- Speakers, microphone, and Front-facing HD camera, Intelligence-enhancing Technologies – NFC Read/Write, Proximity Sensor, Ambient Light Sensor, Display Type TFT-LCD, IPS, Resolution 1920x1200, Aspect Ratio 16:10 Landscape, Brightness 350 nits (cd/m2), Contrast Ratio >800:1, Viewing Angle >80°/80°/80°/80°, RAM 4GB, LPDDR4, Storage 16 GB eMMC, Ethernet RJ-45, USB Type C OTG, USB Type 2.0, Speakers 2 x 2W, Microphone Dual, Power POE RJ-45, POE 802.3af, 15.4W, Compliance UL, CE, CB, FCC Class B. along with POE enabled network switch.
17	**Cable Cubby**	SITC of flush-mount tabletop cable cubby with manual flip-top / pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications. The cable cubby shall be suitable for flush installation in conference tables and supplied complete with all required connectors, wiring, and mounting accessories.
18	**Wireless Presentation Device**	SITC of Wireless presentation devices supports video resolution up to 4K, with HDMI output, inbuilt Wi-Fi 2.4GHz/5GHz and MIMO antennas, Networking: 1 x Gigabit LAN Wi–Fi 802.11 ac/b/g/n dual band & Bluetooth, 1 Ethernet port, 3 USB port for connecting keyboard, mouse, etc, Supports iOS, Windows and Android operating systems, display minimum 4 users screen at a time, Supports DHCP, connect 100 participants simultaneously,

		wireless streaming of 4K video at 30 frame per second (FPS), 1024−bit encryption for secure use on the network, participants can share content using Airplay, Miracast & join through any web browser (Chrome, Edge, Firefox) without using device app, Main memory 16GB, Storage 128GB, Calendar widget displays information about meetings scheduled in the room, Certification: CE, FCC, UL, BIS, etc
19	**USB Capture Card**	SITC of 4K HDMI to USB Capture Device, HDMI video input supports resolutions up to 4096×2160p@60 4:4:4, HDR, and 10-bit per channel Deep Color, USB 3.0 Capture - video output supports resolutions up to 3840×2160p@30fps, or 1920×1080p@60fps, Audio Input Embedded, Support for Popular OS Platforms - Windows 10 (64-bit), macOS (10.12 or newer), Software Compatible - Supports Zoom, Teams, WebEx, Skype, Slack, Discord, BlueJeans, GoToMeeting, VLC, and more, Video Inputs: 1 x HDMI 2.1, Video Outputs: 1 x USB 3.0; supports UVC 1.1, Audio Inputs: HDMI Embedded Audio / 3.5mm Analog Stereo Audio, Ports: HDMI Input: (1) HDMI Type A Socket; Analog Stereo Input: (1) 3.5 mm TRS audio jack; USB 3.0: (1) USB Type C Socket, Regulatory Compliance: FCC Part 15 Class B EN 55032, EN 55035, RoHS.
20	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Should also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
21	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
22	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
23	**Network Cables**	SITC of Category 6A Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
24	**Network Switch**	SITC of 24-Port Network Switch.
25	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
26	**Connectors**	SITC of Connectors like LAN, CAT 6A Shielded, RCA, XLR etc.
SEMINAR HALL - 48PAX		

1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL): 150 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
3	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL): 130 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
4	**DSP**	SITC of Integrated Digital Sound Processor with following functionalities and specifications; Signal Processor shall be CPU-32-bit fixed/floating-point DSP + ARM, 456 MHz. The DSP shall have 8 Mic/Line inputs & 8 analogue outputs, 8 Additional digital Outputs; Audio Latency 860 µs (analogue in to analogue out) or less, 24 Bit A-D and D-A Convertors; Sampling Rate : 48 kHz; THD : < 0.002 % ; Channel Separation (Crosstalk) : < -105 dB ; Frequency Response 20 Hz - 20 kHz ; Dynamic Range : > 115 dB; Phantom Power +48 VDC, selectable per input, 5 Control Inputs and Outputs; RS-232 and Ethernet Port for third party Control and Monitoring; inbuilt DSP features like automatic mic mixing, multiband graphic and parametric EQs, signal generators, routers, mixers, AGCs, duckers, gates, compressors, source selectors, and delays. etc. Shall Support at least 15 remote Zone controllers.

5	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
6	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 70/100V ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ pre-sets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
7	**Wall-mounted AV control keypad**	SITC of 6 - 8 or more Button Keypad with volume knob; it should supplied with 3-Input Switching Wallplate Transmitter (2 HDMI, 1 USB-C) includes auto and manual switching modes, and support for transmission of uncompressed video and audio up to 40m/131ft at 4K or 70m/230ft at 1080P over shielded Cat 6/6A/7 cable; It should support supllied Multi-Function Receiver with Built-In 2x25W 4/8-ohm Amplifier, USB signal pass-through, RS232 control, Relay, IR, mic/line input, line out, remote mute, audio de-embedding, USB-AUDIO, ARC function, and CEC control (Embedded HDBaseT™ technology allows for full usage of HDMI and controls over Cat 6/6A/7 cable.); Web Configuration for simplified installation; should support OEM Specific Management PC tool included for campus wide room and device management; etc.
8	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.

9	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8- bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
10	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
11	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
12	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
13	**Network Switch**	SITC of 24-Port Network Switch.
14	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
15	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc
CLASSROOM - 75PAX		
1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL): 150 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.

3	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL): 130 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
4	**Antenna Splitter**	SITC of Active Antenna Splitter with 2 x 1:4 or 1 x 1:8 active connections, which work on 56 MHz Bandwidth and allow for up to 90 channels, Supports Mobile App streamlines setup and operation and eliminates complicated menus, Frequency range: 470 – 694 MHz, along with Automated setup creates reliable connections with minimal time and effort.
5	**Directional Antennas**	SITC of Active directional antenna, Built-in ⅝" and ⅜" threads allow for easy mic stand mounting, Frequency range 470 – 866 MHz, Apex angle (-3 dB) approx. 100°, Front-to-back ratio > 14 dB, Gain typ. 5 dBi and Impedance 50 Ω.
6	**Gooseneck Microphone**	SITC of 450mm Gooseneck microphone with a programmable microphone button (Toggle on/ off, PTM, PTT, and permanent on) and a bi-color LED ring for status indication. 450mm length, condenser capsule with cardioid pickup pattern, Frequency response: 50 Hz - 20 kHz, Maximum sound pressure level: 130 dB SPL, Connectivity: XLR 3M. It should have TTL-logic output for camera control feature.
7	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.
8	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel

		grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
9	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 70/100V ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ presets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz).
10	**20x Optical Zoom (Teacher Camera)**	Supply, Installation, Testing & Commissioning of AI based Full HD 1080p @ 60fps Presenter PTZ Tracking Camera with Dual Camera- one PTZ Camera for Presenter Tracking and second fixed lens Panoramic Camera. PTZ Presenter Camera should support min 20X Optical Zoom and 12x Digital Zoom with Panning range of +170 deg to - 170 deg and Tilt Range of -30 to +90 Degrees, Field of View for PTZ Camera should be min 58 Degree and for Panoramic Camera min. 100 Degree, camera should support simultaneous outputs through HDMI, 3G-SDI, USB 3.0 and IP with 1x Audio In and can be controlled via RS232 and IP. Should support multiple video streams. Tracking Camera should support Everywhere Tracking, Partition Tracking, Auto Framing & Gesture Control. Should support PoE and Virtual USB Driver. Quoted model should be BIS, CE, FCC , Clickshare & RoHS Certified with Test Lab Reports.
11	**Recording and Streaming Hardware**	SITC of Recording, Streaming & Webcasting Hardware simultaneously, Built-in 4x HDMI & IP Inputs with 4x Line Inputs, 2x HDMI Outputs. The system should be capable to record upto any four inputs simultaneously in a single frame and as well as individual sources simultaneously. Should have minimum 1TB inbuilt storage and can be connected to local NAS storage. The system should be able to support minimum 3 unicast streams. The recorded files should have the option of time and date stamp. The device can be controlled and managed through centralised software on network. Quoted model should be CE, FCC & RoHS Certified with Test Lab Reports.
12	**IP+RS 232/VISCA based Joystick Controller**	SITC of Joystick with 3" LCD for Preview Monitoring, PAN/Tilt/Zoom Control, Communication via IP & RS232C/RS455 Interfaces, Auto Backlit Keys, should be able to control minimum 200 Cameras on IP & 10 Cameras through RS232/422, Should support VISCA, VISCA Over IP protocols & PoE. Quoted model should be BIS, CE, FCC & RoHS Certified with Test Lab Reports.

13	**Camera Mount Kit**	Supply of Camera wall mount metal stand. It should be constructed with durable material and can be attached right side up or upside down, depending on camera configuration and requirement. OEM accessory will give a perfect fit and features pre-drilled installation hardware and cable holes.
14	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.1, Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM, Shall have on board IR In and out, RS232 ,2x HDMI Input and 1x HDMI monitor output.
15	**AVoIP Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
16	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 2.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.0, HDCP 2.2, Video Input HDMI 2.0, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
17	**Controller**	SITC of a hardware or software-based controller with on board 1 x RS232/422/485 ports and 3 x RS232 ports, 2 XUSB-A Host Ports, The unit must support on board 4 x IR, 4 x IO and 4 x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN, UL and RoHS certifications. The controller must have a secure platform.

18	**Touch Panel**	SITC of SITC of 8" or above Touch Panel; fully configurable; IPS LCD based Capacitive Multi-Touch with LED backlighting; Should support Any-Color Side LEDs; Ambient Light Sensor; Built-in UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), Book Scheduling, Web Kiosk; Adjustable Security Modes, Resolution (WH) Landscape: 1280x1200, Aspect Ratio (WH) Landscape: 16:10, Brightness 350 cd/m2, Contrast Ratio 800:1, RAM4 GB, storage 16 GB, Ethernet RJ-45, POE 802.3af, 15.4W, Speakers 2 x 2 Watt, Compliance: UL, CE, CB, FCC Class B (-5dB); etc. along with PoE Injector of above Tabletop GUI. It should be supplied by same OEM.
19	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
20	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8- bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
21	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
22	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
23	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
24	**Network Switch**	SITC of 24-Port Network Switch.
25	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
26	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc
EXAMINATION HALL - 125PAX		

1	**115" or better display**	SITC of a minimum 115-inch 4K UHD professional commercial display with a resolution of 3840 × 2160, suitable for continuous 24x7 operation in conference and boardroom environments. The display shall have a minimum brightness of 750 nits, contrast ratio of 18000:1 or better, and 10-bit color depth for superior image quality and wide viewing angles of 178° (H/V). The unit shall be powered by an inbuilt Android 14 or latest operating system with minimum 4 GB RAM and 16 GB internal storage, supporting integrated Wi-Fi, Bluetooth, LAN connectivity, and digital signage capability. The display shall support IP and RS232 control, Wake-on-LAN/WiFi features, and be compatible with standard AV control systems. The display shall have built-in speakers with minimum 100W–120W output, and a panel life of at least 50,000 hours. The system shall be complete with all necessary mounting accessories, cabling, and integration with existing AV/VC systems, and must be supplied with a minimum 3-year onsite warranty.
2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL): 150 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
3	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL): 130 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
4	**Antenna Splitter**	SITC of Active Antenna Splitter with 2 x 1:4 or 1 x 1:8 active connections, which work on 56 MHz Bandwidth and allow for up to 90 channels, Supports Mobile App streamlines setup and operation and eliminates complicated menus, Frequency range: 470 – 694 MHz, along with Automated setup creates reliable connections with minimal time and effort.
5	**Directional Antennas**	SITC of Active directional antenna, Built-in ⅝" and ⅜" threads allow for easy mic stand mounting, Frequency range 470 – 866 MHz, Apex angle (-3 dB) approx. 100°, Front-to-back ratio > 14 dB, Gain typ. 5 dBi and Impedance 50 Ω.
6	**Gooseneck Microphone**	SITC of 450mm Gooseneck microphone with a programmable microphone button (Toggle on/ off, PTM, PTT, and permanent on) and a bi-color LED ring for status indication. 450mm length, condenser capsule with cardioid pickup pattern, Frequency response: 50 Hz - 20 kHz, Maximum sound pressure level: 130 dB SPL, Connectivity: XLR 3M. It should have TTL-logic output for camera control feature.

7	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.
8	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
9	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 4Ω ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ presets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz).
10	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.1, Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM, shall have on board IR In and out, RS232 ,2x HDMI Input and 1x HDMI monitor output.
11	**AVoIP Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 2.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.0, HDCP 2.2,

		Video Input HDMI 2.0, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
12	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
13	**Controller**	SITC of a hardware or software-based controller with on board 1 x RS232/422/485 ports and 3 x RS232 ports, 2 XUSB-A Host Ports, the unit must support on board 4 x IR, 4 x IO and 4 x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN, UL and RoHS certifications. The controller must have a secure platform.
14	**Touch Panel**	SITC of SITC of 8" or above Touch Panel; fully configurable; IPS LCD based Capacitive Multi-Touch with LED backlighting; Should support Any-Color Side LEDs; Ambient Light Sensor; Built-in UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), Book Scheduling, Web Kiosk; Adjustable Security Modes, Resolution (WH) Landscape: 1280x1200, Aspect Ratio (WH) Landscape: 16:10, Brightness 350 cd/m2, Contrast Ratio 800:1, RAM4 GB, storage 16 GB, Ethernet RJ-45, POE 802.3af, 15.4W, Speakers 2 x 2 Watt, Compliance: UL, CE, CB, FCC Class B (-5dB); etc. along with PoE Injector of above Tabletop GUI. It should be supplied by same OEM.
15	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.

16	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8- bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.0 specification and Audio De-embedder for internal connectivity and as per technical specification.
17	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
18	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
19	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
20	**Network Switch**	SITC of 24-Port Network Switch.
21	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
22	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc

PHARMACY COLLEGE TECHNICAL SPECIFICATIONS		
30-PAX MEETING ROOM		
S. No	**ITEM**	**DESCRIPTION**
A.1	**DISPLAY**	
1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.

2	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.1, Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM, shall have on board IR In and out, RS232 ,2x HDMI Input and 1x HDMI monitor output.
3	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.2	**MICROPHONE SYSTEM**	
4	**Chairman/Delegate Unit**	Supply, Installation, Testing and Commissioning of Wired Table Embedded Gooseneck Microphone which shall have Frequency Response: 90-20000Hz or better. It shall have impedance: 120Ω or better. It shall have sensitivity of -32dBV (25mA) @1Pa or better. It shall have Signal to noise ratio of 90dB or better. It shall have Gooseneck microphone length of 415 mm or more. It shall have max SPL of 120 dB (@1% THD, 1Khz). It shall have 3 PIN XLR interface. It shall have all metal shell with anti RF interference. It shall have either inbuilt pattern options of Omnidirectional, Cardioid and uni-directional or three separate microphones shall be supplied to use in multiple scenarios. It shall have THD of <0.1% or better. It shall support 24V to 48V Phantom power. It shall have condenser type microphone capsule. It shall have power consumption of 2 Watts or less.
5	**Microphone intergration Unit**	Supply, Installation, Testing and Commissioning of Microphone integration unit which shall have 120Ω output impedance. It shall have anti-vibration insulating rubber, effectively reducing vibration and mechanical noise on the mounting surface. It shall have 3 Pin XLR Input interface. It shall have 7 Pin Cannon/XLR output interface. It shall have feather touch Mic Mute/Unmute Button. It shall have ring and button indicators. It shall have 24dBA noise floor.
6	**Dual Microphone Control System**	Supply, Installation, Testing and Commissioning of Dual Microphone Control system which shall have frequency response of 40 Hz – 20000 Hz or better. It shall have less then.1 % distortion. It shall have 2 or more microphone interface. It shall have 2 or more RJ-45 Link interface. It shall be able to control and designate Microphone types as host or participant with indication. It shall have power consumption of 2 Watts or less. It shall be able to supply 24V phantom power to connected microphones. It shall be supplied with 2x RJ-45 cables which shall be 6' in length with protection caps. The OEM Shall have CE, RoHs, FCC, ISO 9001:2015, ISO 14001:2015 , ISO 27001:2022 , ISO 50001:2018 Certificates.

7	**Advanced Audio Feedback Suppressor**	Supply, Installation, Testing and Commissioning of Advanced Audio Feedback Suppression processor with XLR -3 & TRS 1/4 ” TRS, single channel Input and output interface. AFC & ANC Bypass switch, 20Hz-20kHz,± 0.3dB Frequency response, 0.005%, 1kHz; 20Hz-10kH, <0.01%, 10kHz-20kHz, <0.025% Total harmonic distortion.
8	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100-meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL): 150 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
9	**Audio Controller**	SITC of Central Audio control Unit which shall have fully digital conference technology with built-in high-performance processor. It shall have frequency response of 20 Hz – 20000 Hz or better. It shall support up to 40 Units via main controller and upto 128 units with optional Extension unit. It shall support PoE with category5 UTP distance upto 100 meters. It shall support IEEE 802.3af, IEEE 802.3at POE standards or better. It shall support 60 Watts non isolated POE Power or better. It shall support two channel Audio over IP or better. It shall have 1x RJ-45 AOIP interface. It shall have sampling rate of 48 KHz or better. It shall have ring type architecture. It shall have SNR of 85dB or more. It shall have 4x RJ-45 interface for connecting Microphone units or equivalent. It shall have 1x Balanced Audio Output interface. It shall have 2x RJ-45/RS-232 Control interface. It shall have 1x RJ-45 network Interface. It shall be supplied with 4" Control interface which shall be deployable upto 90 meters away from the main unit. It shall be rack mountable with 1U or less height. It shall be supplied with Power Cable, RJ-45 cable and operating manual.
A.3	**DIGITAL SIGNAL PROCESSOR**	
A.4	**LOUDSPEAKER SYSTEM**	
11	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.

12	**Column Speakers**	SITC of Wall Mountable with 12 mid/high drivers in an articulated array for wide dispersion. The loudspeaker shall meet the following performance criteria: Usable Frequency Range (-10 dB) of 100Hz - 16 kHz. Long-Term Power Handling 300 W (1200 W peak). The Loudspeaker shall have a Max. SPL (Peak) of 119 dB or more with a nominal dispersion of 145° H x 20° V. The loudspeaker system shall be comprised of a Powder-coated steel grille; Twelve 2.25-inch mid/high frequency drivers and and a nominal impedance of 8 ohms. Optional 70/100V OEM transformer module with tap settings of 150/75 W shall be available.
13	**Amplifier**	SITC of class D amplifier with 4 x 300 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 4 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no. of digital Audio channels. The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
A.5	**VIDEO CONFERENCING SYSTEM**	
14	**20X Zoom Camera**	SITC of PTZ camera with minimum 1/2.8" HD CMOS sensor, supporting auto/manual white balance, S/N ratio ≥55 dB, and minimum 20x optical zoom with digital zoom capability. shall support Full HD video (up to 1080p60) over USB 3.0, HDMI, and IP streaming, with dual H.264/H.265 encoding and configurable streaming protocols (TCP/IP, RTSP, HTTP), shall provide wide field of view (≥68°) with pan/tilt range of approximately ±170° and -30° to +90°, support multiple presets (minimum 200), and include RS232/RS422/485 and IP control interfaces. The system shall be supplied complete with mounting accessories, remote control, and required cables.
15	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.

16	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.6	**VIDEO SWITCHING & CONTROL SYSTEM**	
16	**AVoIP Encoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec, Dual-Stream Encoder, Shall have Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, Shall have Switchable Dual HDMI Inputs, High security network support and features, including multicast, VLAN tagging and QoS, PoE+ powered with low-power mode for energy savings. Open Direct-Control API ,Digital Video Input HDMI 2.1 ,Digital Video Output Network video over Ethernet via RJ45 port or HDMI, Color Space 4:4:4, YUV ,Streaming Protocols RTP, RTSP, RTMP, RTMP/S, MPEG2-TS, HTTP Live ,Input Signal Types Embedded audio on HDMI or Analog Stereo (Balanced or Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
17	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.1, Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM, Shall have on board IR In and out, RS232 ,2x HDMI Input and 1x HDMI monitor output.
18	**Controller**	SITC of a hardware or software-based controller with on board 2 x RS232/422/485 ports and 6 x RS232 ports. The unit must support on board 8 x IR, 8 x IO and 8x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN, UL and RoHS certifications. The controller must have a secure platform. External Power Adaptor of above Integrated Controller Unit. It should be from same OEM of integrated controller Unit as requested above.

19	**Touch Panel**	SITC of 10" or better Professional-Grade, Persona-Defined Touch Panel, Pre-loaded Web Kiosk, UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), stand-alone room scheduling touch panel. customizable panel to serve the unique needs of any user, Mounting Flexibility, Advanced Security – Supports HTTPS, 802.1X, TLS 1.3, Modern Authentication or OAuth 2.0, and FIPS 140-3, Over 1 million programmatically selectable colors, Communication-enabling Technologies- Speakers, microphone, and Front-facing HD camera, Intelligence-enhancing Technologies – NFC Read/Write, Proximity Sensor, Ambient Light Sensor, Display Type TFT-LCD, IPS, Resolution 1920x1200, Aspect Ratio 16:10 Landscape, Brightness 350 nits (cd/m2), Contrast Ratio >800:1, Viewing Angle >80°/80°/80°/80°, RAM 4GB, LPDDR4, Storage 16 GB eMMC, Ethernet RJ-45, USB Type C OTG, USB Type 2.0, Speakers 2 x 2W, Microphone Dual, Power POE RJ-45, POE 802.3af, 15.4W, Compliance UL, CE, CB, FCC Class B. along with POE enabled network switch.
20	**Cable Cubby**	SITC of flush-mount tabletop cable cubby with manual flip-top / pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications.The cable cubby shall be suitable for flush installation in conference tables and supplied complete with all required connectors, wiring, and mounting accessories.
21	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
22	**Wireless Presentation Device**	SITC of Wireless presentation devices supports video resolution up to 4K, with HDMI output, inbuilt Wi-Fi 2.4GHz/5GHz and MIMO antennas, Networking: 1 x Gigabit LAN Wi–Fi 802.11 ac/b/g/n dual band & Bluetooth, 1 Ethernet port, 3 USB port for connecting keyboard, mouse, etc, Supports iOS, Windows and Android operating systems, display minimum 4 users screen at a time, Supports DHCP, connect 100 participants simultaneously, wireless streaming of 4K video at 30 frame per second (FPS), 1024−bit encryption for secure use on the network, participants can share content using Airplay, Miracast & join through any web browser (Chrome, Edge, Firefox) without using device app, Main memory 16GB, Storage 128GB, Calendar widget displays information about meetings scheduled in the room, Certification: CE, FCC, UL, BIS, etc.

23	**AVoIP Encoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec, Dual-Stream Encoder, Shall have Video Preview viewable from the built-in web interface or from a touch panel , USB 3.0 Transport , Shall have Switchable Dual HDMI Inputs, High security network support and features, including multicast, VLAN tagging and QoS,PoE+ powered with low-power mode for energy savings. Open Direct-Control API ,Digital Video Input HDMI 2.1 ,Digital Video Output Network video over Ethernet via RJ45 port or HDMI, Color Space 4:4:4, YUV ,Streaming Protocols RTP, RTSP, RTMP, RTMP/S, MPEG2-TS, HTTP Live ,Input Signal Types Embedded audio on HDMI or Analog Stereo (Balanced or Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
24	**USB Capture Card**	SITC of 4K HDMI to USB Capture Device, HDMI video input supports resolutions up to 4096×2160p@60 4:4:4, HDR, and 10-bit per channel Deep Color, USB 3.0 Capture - video output supports resolutions up to 3840×2160p@30fps, or 1920×1080p@60fps, Audio Input Embedded, Support for Popular OS Platforms - Windows 10 (64-bit), macOS (10.12 or newer), Software Compatible - Supports Zoom, Teams, WebEx, Skype, Slack, Discord, BlueJeans, GoToMeeting, VLC, and more, Video Inputs: 1 x HDMI 2.1, Video Outputs: 1 x USB 3.0; supports UVC 1.1, Audio Inputs: HDMI Embedded Audio / 3.5mm Analog Stereo Audio, Ports: HDMI Input: (1) HDMI Type A Socket; Analog Stereo Input: (1) 3.5 mm TRS audio jack; USB 3.0: (1) USB Type C Socket, Regulatory Compliance: FCC Part 15 Class B EN 55032, EN 55035, RoHS.
A.7	**CABLES & CONNECTORS**	
25	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
26	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation
27	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
28	**Network Switch**	SITC of 24-Port Network Switch.
29	**Equipment Rack**	SITC of 22U Rack with necessary accessories
30	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc

30-PAX SEMINAR HALL		
S. No	**ITEM**	**DESCRIPTION**
A.1	**DISPLAY**	
1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110" size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
A.2	**MICROPHONE SYSTEM**	
2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL) : 150 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
3	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
A.3	**DIGITAL SIGNAL PROCESSOR**	
		SITC of Integrated Digital Sound Processor with following functionalities and specifications; Signal Processor shall be CPU-32-bit fixed/floating-point DSP + ARM, 456 MHz. The DSP shall have 8 Mic/Line inputs & 8 analog outputs, 8 Additional digital Outputs; Audio Latency 860 µs (analog in to analog out) or less, 24 Bit A-D and D-A Convertors; Sampling Rate : 48 kHz; THD : < 0.002 % ; Channel Separation (Crosstalk) : < -105 dB ; Frequency Response 20 Hz - 20 kHz ; Dynamic Range : > 115 dB; Phantom Power +48 VDC, selectable per input, 5 Control Inputs and Outputs; RS-232 and Ethernet Port for third party Control and Monitoring; inbuilt DSP features like automatic mic mixing, multiband graphic and parametric EQs, signal generators, routers, mixers, AGCs, duckers, gates, compressors, source selectors, and delays. etc.

		Shall Support at least 15 remote Zone controllers
A.4	**LOUDSPEAKER SYSTEM**	
5	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
6	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 70/100V ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ presets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
A.6	**VIDEO SWITCHING & CONTROL SYSTEM**	
7	**Wall-mounted AV control keypad**	SITC of 6 - 8 or more Button Keypad with volume knob; it should supplied with 3-Input Switching Wallplate Transmitter (2 HDMI, 1 USB-C) includes auto and manual switching modes, and support for transmission of uncompressed video and audio up to 40m/131ft at 4K or 70m/230ft at 1080P over shielded Cat 6/6A/7 cable; It should support supllied Multi-Function Receiver with Built-In 2x25W 4/8-ohm Amplifier, USB signal pass-through, RS232 control, Relay, IR, mic/line input, line out, remote mute, audio de-embedding, USB-AUDIO, ARC function, and CEC control (Embedded HDBaseT™ technology allows for full usage of HDMI and controls over Cat 6/6A/7 cable.); Web Configuration for simplified installation; should support OEM Specific Management PC tool included for campus wide room and device management; etc.

8	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.7	**CABLES, CONNECTORS & OTHER ACCESSORIES**	
9	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8- bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
10	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
11	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation
12	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
13	**Network Switch**	SITC of 24-Port Network Switch.
14	**Equipment Rack**	SITC of 22U Rack with necessary accessories
15	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc

S. No	ITEM	DESCRIPTION
A.1	**DISPLAY**	
1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
A.2	**MICROPHONE SYSTEM**	
2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL) : 150 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
3	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
A.3	**DIGITAL SIGNAL PROCESSOR**	
4	**DSP**	SITC of Integrated Digital Sound Processor with following functionalities and specifications; Signal Processor shall be CPU-32-bit fixed/floating-point DSP + ARM, 456 MHz. The DSP shall have 8 Mic/Line inputs & 8 analog outputs, 8 Additional digital Outputs; Audio Latency 860 µs (analog in to analog out) or less, 24 Bit A-D and D-A Convertors; Sampling Rate : 48 kHz; THD : < 0.002 % ; Channel Separation (Crosstalk) : < -105 dB ; Frequency Response 20 Hz - 20 kHz ; Dynamic Range : > 115 dB; Phantom Power +48 VDC, selectable per input, 5 Control Inputs and Outputs; RS-232 and Ethernet Port for third party Control and Monitoring; inbuilt DSP features like automatic mic mixing, multiband graphic and parametric EQs, signal generators, routers, mixers, AGCs, duckers, gates, compressors, source selectors, and delays. etc. Shall Support at least 15 remote Zone controllers

A.4	**LOUDSPEAKER SYSTEM**	
5	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
6	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 70/100V ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ presets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
A.6	**VIDEO SWITCHING & CONTROL SYSTEM**	
7	**Wall-mounted AV control keypad**	SITC of 6 - 8 or more Button Keypad with volume knob; it should supplied with 3-Input Switching Wallplate Transmitter (2 HDMI, 1 USB-C) includes auto and manual switching modes, and support for transmission of uncompressed video and audio up to 40m/131ft at 4K or 70m/230ft at 1080P over shielded Cat 6/6A/7 cable; It should support supllied Multi-Function Receiver with Built-In 2x25W 4/8-ohm Amplifier, USB signal pass-through, RS232 control, Relay, IR, mic/line input, line out, remote mute, audio de-embedding, USB-AUDIO, ARC function, and CEC control (Embedded HDBaseT™ technology allows for full usage of HDMI and controls over Cat 6/6A/7 cable.); Web Configuration for simplified installation; should support OEM Specific Management PC tool included for campus wide room and device management; etc.

8	**Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.7	**CABLES, CONNECTORS & OTHER ACCESSORIES**	
9	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8-bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
10	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
11	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation
12	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
13	**Network Switch**	SITC of 24-Port Network Switch.
14	**Equipment Rack**	SITC of 22U Rack with necessary accessories
15	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc

60PAX Lecture Hall		
S. No	**ITEM**	**DESCRIPTION**
A.1	**DISPLAY**	
1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
2	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.1, Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
3	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v.Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.2	**MICROPHONE SYSTEM**	

4	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL) : 150 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
5	**Wireless Lavalier Microphone**	SITC of of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
6	**Antenna Splitter**	SITC of Active Antenna Splitter with 2 x 1:4 or 1 x 1:8 active connections, which work on 56 MHz Bandwidth and allow for up to 90 channels, Supports Mobile App streamlines setup and operation and eliminates complicated menus, Frequency range: 470 – 694 MHz, along with Automated setup creates reliable connections with minimal time and effort.
7	**Directional Antennas**	SITC of Active directional antenna, Built-in ⅝" and ⅜" threads allow for easy mic stand mounting, Frequency range 470 – 866 MHz, Apex angle (-3 dB) approx. 100°, Front-to-back ratio > 14 dB, Gain typ. 5 dBi and Impedance 50 Ω.
8	**Gooseneck Microphone**	SITC of 450mm Gooseneck microphone with a programmable microphone button (Toggle on/ off, PTM, PTT, and permanent on) and a bi-color LED ring for status indication. 450mm length, condenser capsule with cardioid pickup pattern, Frequency response: 50 Hz - 20 kHz, Maximum sound pressure level: 130 dB SPL, Connectivity: XLR 3M. It should have TTL-logic output for camera control feature.
A.3	**DIGITAL SIGNAL PROCESSOR**	
9	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.

A.4	LOUDSPEAKER SYSTEM	
10	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
11	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 70/100V ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ presets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
A.5	**VIDEO CONFERENCING SYSTEM**	
12	**20x Optical Zoom (Teacher& Student Camera)**	Supply, Installation, Testing & Commissioning of AI based Full HD 1080p @ 60fps Presenter PTZ Tracking Camera with Dual Camera- one PTZ Camera for Presenter Tracking and second fixed lens Panoramic Camera. PTZ Presenter Camera should support min 20X Optical Zoom and 12x Digital Zoom with Panning range of +170 deg to - 170 deg and Tilt Range of -30 to +90 Degrees, Field of View for PTZ Camera should be min 58 Degree and for Panoramic Camera min. 100 Degree, camera should support simultaneous outputs through HDMI, 3G-SDI, USB 3.0 and IP with 1x Audio In and can be controlled via RS232 and IP. Should support multiple video streams. Tracking Camera should support Everywhere Tracking, Partition Tracking, Auto Framing & Gesture Control. Should support PoE and Virtual USB Driver. Quoted model should be BIS, CE, FCC , Clickshare & RoHS Certified with Test Lab Reports.
13	**Recording and Streaming Hardware**	SITC of Recording, Streaming & Webcasting Hardware simultaneously, Built-in 4x HDMI & IP Inputs with 4x Line Inputs, 2x HDMI Outputs. The system should be capable to record upto any four inputs simultaneously in a single frame and as well as individual sources simultaneously. Should have minimum 1TB inbuilt storage and can be connected to local NAS storage. The system should be able to support minimum 3 unicast streams. The recorded files should have the option of time and date stamp.The device can be controlled and managed through centralised software on network .Quoted model should be CE, FCC & RoHS Certified with Test Lab Reports.

14	**IP+RS 232/VISCA based Joystick Controller**	SITC of Joystick with 3" LCD for Preview Monitoring, PAN/Tilt/Zoom Control, Communication via IP & RS232C/RS455 Interfaces, Auto Backlit Keys, Should be able to control minimum 200 Cameras on IP & 10 Cameras through RS232/422, Should support VISCA, VISCA Over IP protocols & PoE. Quoted model should be BIS, CE, FCC & RoHS Certified with Test Lab Reports.
15	**Camera Mount Kit**	Supply of Camera wall mount metal stand. It should be constructed with durable material and can be attached right side up or upside down, depending on camera configuration and requirement. OEM accessory will give a perfect fit and features pre-drilled installation hardware and cable holes.
16	**AVoIP Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
17	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.6	**VIDEO SWITCHING & CONTROL SYSTEM**	
18	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.

21	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder ,High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding ,Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport ,High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API .Digital Video Input Network video over Ethernet via RJ45 port ,Digital Video Output HDMI 2.1 ,Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
22	**Controller**	SITC of a hardware or software-based controller with on board 1 x RS232/422/485 ports and 3 x RS232 ports, 2 XUSB-A Host Ports, The unit must support on board 4 x IR, 4 x IO and 4 x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN , UL and RoHS certifications. The controller must have a secure platform.
23	**Touch Panel**	SITC of SITC of 8" or above Touch Panel; fully configurable; IPS LCD based Capacitive Multi-Touch with LED backlighting; Should support Any-Color Side LEDs; Ambient Light Sensor; Built-in UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), Book Scheduling, Web Kiosk; Adjustable Security Modes, Resolution (WH) Landscape: 1280x1200, Aspect Ratio (WH) Landscape: 16:10, Brightness 350 cd/m2, Contrast Ratio 800:1, RAM4 GB, storage 16 GB, Ethernet RJ-45, POE 802.3af, 15.4W, Speakers 2 x 2 Watt, Compliance: UL, CE, CB, FCC Class B (-5dB); etc. along with PoE Injector of above Tabletop GUI. It should be supplied by same OEM.
24	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.7	**CABLES & CONNECTORS**	

25	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8- bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
26	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
27	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation
28	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
29	**Network Switch**	SITC of 24-Port Network Switch.
30	**Equipment Rack**	SITC of 22U Rack with necessary accessories
31	**Connectors**	SITC of Connectors like LAN, CAT 6 Sheilded, RCA, XLR etc

MULTIPURPOSE HALL - 250PAX		
S. No	**ITEM**	**DESCRIPTION**
A.1	**DISPLAY**	
1	**163" or better flat panel Display**	SITC of indoor LED video wall display with Flip-Chip Micro LED COB technology, having pixel pitch of approximately 1.8 mm (±0.1 mm) and configured to form a display of minimum 163" diagonal size (approx. 4.1 m) with 16:9 aspect ratio, and active display area of approximately 3.6 m (W) × 2.0 m (H) or better. shall provide minimum 600 nits brightness, contrast ratio of ≥20,000:1, wide viewing angles of ≥170° (H/V), and high refresh rate of ≥3840 Hz for flicker-free and high-quality image performance. System shall support 16-bit color processing, wide color gamut, brightness and color calibration (≥97% uniformity), and adjustable color temperature (3000K–10000K). display shall have seamless modular construction, surface flatness ≤0.1 mm, and robust protective COB layer suitable for indoor applications. shall be energy efficient with maximum power consumption ≤300 W/m², operate on AC 100–240V, 50/60Hz, and be designed for continuous 24×7 operation with lifetime ≥100,000 hours. The system shall support front access installation and maintenance, with IP rating suitable for indoor use, and shall be supplied complete with mounting structure, control system, required accessories, certifications, and minimum 3 years warranty.
2	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder ,High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding ,Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport ,High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API .Digital Video Input Network video over Ethernet via RJ45 port ,Digital Video Output HDMI 2.1 ,Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
3	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.2	**MICROPHONE SYSTEM**	

4	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL) : 150 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
5	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
6	**Antenna Splitter**	SITC of Active Antenna Splitter with 2 x 1:4 or 1 x 1:8 active connections, which work on 56 MHz Bandwidth and allow for up to 90 channels, Supports Mobile App streamlines setup and operation and eliminates complicated menus, Frequency range: 470 – 694 MHz, along with Automated setup creates reliable connections with minimal time and effort.
7	**Directional Antennas**	SITC of Active directional antenna, Built-in ⅝" and ⅜" threads allow for easy mic stand mounting, Frequency range 470 – 866 MHz, Apex angle (-3 dB) approx. 100°, Front-to-back ratio > 14 dB, Gain typ. 5 dBi and Impedance 50 Ω.
8	**Gooseneck Microphone**	SITC of 450mm Gooseneck microphone with a programmable microphone button (Toggle on/ off, PTM, PTT, and permanent on) and a bi-color LED ring for status indication. 450mm length, condenser capsule with cardioid pickup pattern, Frequency response: 50 Hz - 20 kHz, Maximum sound pressure level: 130 dB SPL, Connectivity: XLR 3M. It should have TTL-logic output for camera control feature.
A.3	**DIGITAL SIGNAL PROCESSOR**	

9	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.
A.4	**LOUDSPEAKER SYSTEM**	
10	**FOH Loudspeaker**	SITC of Two-way Small Format high SPL IP55 rated (as per IEC 60529) all weather surface mount loudspeaker. The loudspeaker shall meet the following performance criteria: Frequency Range (-10 dB) of 70 Hz - 18 kHz or better; Nominal Dispersion : 120°H x 60°V (rotatable Horn); Power handling of 1600W peak or more; Sensitivity : 96 dB; Max SPL : 127dB Peak; Nominal impedance of 8 ohms and Integral multi-tap Transformer with selectable tap settings of 10/20/40/80W@70V & 100V. The loudspeaker system shall be comprised of a Powder-coated finish stainless steel grille with Two-part spray polyurea coating Enclosure; Enclosure Material Exterior-grade plywood, Dual 8-inch woofer; Single 2-inch voice coil high-frequency compression driver; U bracket shall be included.
11	**Subwoofer**	SITC of multipurpose subwoofer with a single 15" neodymium LF driver. Frequency Range (-10dB) of 35Hz - 130Hz or better. Power Handling, Peak: 2800 W or better. It should have an axial Sensitivity of > = 90dB (1W/1m)(free-field) or more delivering a free field Max. Calculated SPL(peak) of >=124db(free-field) or better. The loudspeaker should have a nominal impedance of 8 ohm or more. The loudspeaker shall be enclosed in a Baltic birch plywood enclosure with perforated steel grille. Connectors: 2 × Neutrik® NL4 inputs with wired-parallel through, Suspension/Mounting/Transport: 1 × M20 threaded pole mount, 12 × M10 threaded inserts (for accessory attachment or mounting), 16 × M8 caster attachment points, Complete with installation as per the site requirement.
12	**Front Fill Loudspeaker**	SITC of Two-way Small Format high SPL IP55 rated (as per IEC 60529) all weather surface mount loudspeaker. The loudspeaker shall meet the following performance criteria: Frequency Range (-10 dB) of 80 Hz - 18 kHz or better; Nominal Dispersion : 90°H x 60°V (rotatable Horn); Power handling of 1000W peak or more; Sensitivity : 93 dB; Max SPL : 122dB Peak; Nominal impedance of 8 ohms and Integral multi-tap Transformer with selectable tap settings of 10/20/40/80W@70V & 100V. The loudspeaker system shall be comprised of a Powder-coated finish stainless steel grille with Two-part spray polyurea coating Enclosure; Enclosure Material Exterior-grade plywood, Single 8-inch woofer; Single 2-inch voice coil high-frequency compression driver; U bracket shall be included.

13	**Delay Loudspeaker**	SITC of Two-way Small Format high SPL IP55 rated (as per IEC 60529) all weather surface mount loudspeaker. The loudspeaker shall meet the following performance criteria: Frequency Range (-10 dB) of 80 Hz - 18 kHz or better; Nominal Dispersion : 120°H x 60°V (rotatable Horn); Power handling of 1000W peak or more; Sensitivity : 92 dB; Max SPL : 121dB Peak; Nominal impedance of 8 ohms and Integral multi-tap Transformer with selectable tap settings of 10/20/40/80W@70V & 100V. The loudspeaker system shall be comprised of a Powder-coated finish stainless steel grille with Two-part spray polyurea coating Enclosure; Enclosure Material Exterior-grade plywood, Single 8-inch woofer; Single 2-inch voice coil high-frequency compression driver; U bracket shall be included.
14	**Power Amplifier**	SITC of class D amplifier with 2 x 600 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 2 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no .of digital Audio channels . The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
15	**Power Amplifier**	SITC of Class D amplifier with 2 x 1000 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 2 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no .of digital Audio channels . The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)

16	**Power Amplifier**	SITC of Class D amplifier with 4 x 300 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 4 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no .of digital Audio channels . The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz).
A.5	**VIDEO CONFERENCING SYSTEM**	
17	**30x Optical Zoom (Teacher & Student Camera Camera)**	SITC of AI based Full 4K @ 60fps Presenter PTZ Tracking Camera with Dual Camera- one PTZ Camera for Presenter Tracking and second fixed lens Panoramic Camera. PTZ Presenter Camera should support min 30X Zoom and 8x Digital Zoom with Panning range of +170 deg to - 170 deg and Tilt Range of -30 to +90 Degrees, Field of View for PTZ Camera should be min 58 Degree and for Panoramic Camera min. 85 Degree, camera should support simultaneous outputs through HDMI, 3G-SDI, USB 3.0 and IP with 1x Audio In and can be controlled via RS232 and IP. Should support multiple video streams with PIP. Tracking Camera should support Everywhere Tracking, Partition Tracking, Auto Framing & Gesture Control. Should support PoE+ and Virtual USB Driver. Quoted model should be BIS, CE, FCC , Clickshare & RoHS Certified with Test Lab Reports.
18	**Recording and Streaming Hardware**	SITC of Recording, Streaming & Webcasting Hardware simultaneously, Built-in 4x HDMI & IP Inputs with 4x Line Inputs, 2x HDMI Outputs. The system should be capable to record upto any four inputs simultaneously in a single frame and as well as individual sources simultaneously. Should have minimum 1TB inbuilt storage and can be connected to local NAS storage. The system should be able to support minimum 3 unicast streams. The recorded files should have the option of time and date stamp. The device can be controlled and managed through centralised software on network .Quoted model should be CE, FCC & RoHS Certified with Test Lab Reports.
19	**IP+RS 232/VISCA based Joystick Controller**	SITC of Joystick with 3" LCD for Preview Monitoring, PAN/Tilt/Zoom Control, Communication via IP & RS232C/RS455 Interfaces, Auto Backlit Keys, Should be able to control minimum 200 Cameras on IP & 10 Cameras through RS232/422, Should support VISCA, VISCA Over IP protocols & PoE. Quoted model should be BIS, CE, FCC & RoHS Certified with Test Lab Reports.

20	**Camera Mount Kit**	Supply of Camera wall mount metal stand. It should be constructed with durable material and can be attached right side up or upside down, depending on camera configuration and requirement. OEM accessory will give a perfect fit and features pre-drilled installation hardware and cable holes.
21	**AVoIP Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
22	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.6	**VIDEO SWITCHING & CONTROL SYSTEM**	
23	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.

24	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding ,Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport ,High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API .Digital Video Input Network video over Ethernet via RJ45 port ,Digital Video Output HDMI 2.1 ,Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
25	**Controller**	SITC of a hardware or software-based controller with on board 2 x RS232/422/485 ports and 6 x RS232 ports.. The unit must support on board 8 x IR, 8 x IO and 8x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN , UL and RoHS certifications. The controller must have a secure platform. External Power Adaptor of above Integrated Controller Unit. It should be from same OEM of integrated controller Unit as requested above.
26	**Touch Panel**	SITC of 10" or better Professional-Grade, Persona-Defined Touch Panel, Pre-loaded Web Kiosk, UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), stand-alone room scheduling touch panel. customizable panel to serve the unique needs of any user, Mounting Flexibility, Advanced Security – Supports HTTPS, 802.1X, TLS 1.3, Modern Authentication or OAuth 2.0, and FIPS 140-3, Over 1 million programmatically selectable colors, Communication-enabling Technologies-Speakers, microphone, and Front-facing HD camera, Intelligence-enhancing Technologies – NFC Read/Write, Proximity Sensor, Ambient Light Sensor, Display Type TFT-LCD, IPS, Resolution 1920x1200, Aspect Ratio 16:10 Landscape, Brightness 350 nits (cd/m2), Contrast Ratio >800:1, Viewing Angle >80°/80°/80°/80°, RAM 4GB, LPDDR4, Storage 16 GB eMMC, Ethernet RJ-45, USB Type C OTG, USB Type 2.0, Speakers 2 x 2W, Microphone Dual, Power POE RJ-45, POE 802.3af, 15.4W, Compliance UL, CE, CB, FCC Class B. along with POE enabled network switch.
27	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
A.7	**CABLES & CONNECTORS**	
28	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray

		and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8-bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.0 specification and Audio De-embedder for internal connectivity and as per technical specification.
29	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
30	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation
31	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
32	**Network Switch**	SITC of 24-Port Network Switch.
33	**Equipment Rack**	SITC of 22U Rack with necessary accessories
34	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc

HOSPITAL TECHNICAL SPECIFICATIONS		
S. No	**ITEM**	**DESCRIPTION**
CONFERENCE ROOM - 30 PAX		
1	**115" or better Display Panel**	SITC of a minimum 115-inch 4K UHD professional commercial display with a resolution of 3840 × 2160, suitable for continuous 24x7 operation in conference and boardroom environments. The display shall have a minimum brightness of 750 nits, contrast ratio of 18000:1 or better, and 10-bit color depth for superior image quality and wide viewing angles of 178° (H/V). The unit shall be powered by an inbuilt Android 14 or latest operating system with minimum 4 GB RAM and 16 GB internal storage, supporting integrated Wi-Fi, Bluetooth, LAN connectivity, and digital signage capability. The display shall support IP and RS232 control, Wake-on-LAN/WiFi features, and be compatible with standard AV control systems. The display shall have built-in speakers with minimum 100W–120W output, and a panel life of at least 50,000 hours. The system shall be complete with all necessary mounting accessories, cabling, and integration with existing AV/VC systems, and must be supplied with a minimum 3-year onsite warranty.

2	**Chairman/ Delegate Unit**	Supply, Installation, Testing and Commissioning of Wired Table Embedded gooseneck Microphone which shall have Frequency Response: 90-20000Hz or better. It shall have impedance: 120Ω or better. It shall have sensitivity of -32dBV (25mA) @1Pa or better. It shall have Signal to noise ratio of 90dB or better. It shall have Gooseneck microphone length of 415 mm or more. It shall have max SPL of 120 dB (@1% THD, 1Khz). It shall have 3 PIN XLR interface. It shall have all metal shell with anti RF interference. It shall have either inbuilt pattern options of Omnidirectional, Cardioid and uni-directional or three separate microphones shall be supplied to use in multiple scenarios. It shall have THD of <0.1% or better. It shall support 24V to 48V Phantom power. It shall have condensor type microphone capsule. It shall have power consumption of 2 Watts or less.
3	**Microphone intergration Unit**	Supply, Installation, Testing and Commissioning of Microphone integration unit which shall have 120Ω output impedance. It shall have anti-vibration insulating rubber, effectively reducing vibration and mechanical noise on the mounting surface. It shall have 3 Pin XLR Input interface. It shall have 7 Pin Cannon/XLR output interface. It shall have feather touch Mic Mute/Unmute Button. It shall have ring and button indicators. It shall have 24dBA noise floor.
4	**Dual Microphone Control System**	Supply, Installation, Testing and Commissioning of Dual Microphone Control system which shall have frequency response of 40 Hz – 20000 Hz or better. It shall have less then .1 % distortion. It shall have 2 or more microphone interface. It shall have 2 or more RJ-45 Link interface. It shall be able to control and designate Microphone types as host or participant with indication. It shall have power consumption of 2 Watts or less. It shall be able to supply 24V phantom power to connected microphones. It shall be supplied with 2x RJ-45 cables which shall be 6' in length with protection caps. The OEM Shall have CE, RoHs, FCC, ISO 9001:2015, ISO 14001:2015, ISO 27001:2022, ISO 50001:2018 Certificates.
5	**Advanced Audio Feedback Suppressor**	Supply, Installation, Testing and Commissioning of Advanced Audio Feedback Suppression processor with XLR -3 & TRS 1/4 ” TRS , single channel Input and output interface. AFC & ANC Bypass switch, 20Hz-20kHz ,± 0.3dB Frequency response, 0.005% , 1kHz ; 20Hz-10kH , <0.01% , 10kHz-20kHz , <0.025% Total harmonic distortion.

6	**Audio Controller**	SITC of Central Audio control Unit which shall have fully digital conference technology with built in high performance processor. It shall have frequency response of 20 Hz – 20000 Hz or better. It shall support up to 40 Units via main controller and upto 128 units with optional Extension unit. It shall support PoE with category5 UTP distance upto 100 meters. It shall support IEEE 802.3af, IEEE 802.3at POE standards or better. It shall support 60 Watts non isolated POE Power or better. It shall support two channel Audio over IP or better. It shall have 1x RJ-45 AOIP interface. It shall have sampling rate of 48 KHz or better. It shall have ring type architecture. It shall have SNR of 85dB or more. It shall have 4x RJ-45 interface for connecting Microphone units or equivalent. It shall have 1x Balanced Audio Output interface. It shall have 2x RJ-45/RS-232 Control interface. It shall have 1x RJ-45 network Interface. It shall be supplied with 4" Control interface which shall be deployable upto 90 meters away from the main unit. It shall be rack mountable with 1U or less height. It shall be supplied with Power Cable, RJ-45 cable and operating manual.
7	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.
8	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
9	**Column Speakers**	SITC of Wall Mountable with 12 mid/high drivers in an articulated array for wide dispersion. The loudspeaker shall meet the following performance criteria: Usable Frequency Range (-10 dB) of 100Hz - 16 kHz. Long-Term Power Handling 300 W (1200 W peak). The Loudspeaker shall have a Max. SPL (Peak) of 119 dB or more with a nominal dispersion of 145° H x 20° V. The loudspeaker system shall be comprised of a Powder-coated steel grille; Twelve 2.25-inch mid/high frequency drivers and and a nominal impedance of 8 ohms. Optional 70/100V OEM transformer module with tap settings of 150/75 W shall be available.

10	**Amplifier**	SITC of class D amplifier with 4 x 300 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 4 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no .of digital Audio channels . The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz).
11	**20X Zoom Camera**	SITC of PTZ camera with minimum 1/2.8" HD CMOS sensor, supporting auto/manual white balance, S/N ratio ≥55 dB, and minimum 20x optical zoom with digital zoom capability. shall support Full HD video (up to 1080p60) over USB 3.0, HDMI, and IP streaming, with dual H.264/H.265 encoding and configurable streaming protocols (TCP/IP, RTSP, HTTP), shall provide wide field of view (≥68°) with pan/tilt range of approximately ±170° and -30° to +90°, support multiple presets (minimum 200), and include RS232/RS422/485 and IP control interfaces. The system shall be supplied complete with mounting accessories, remote control, and required cables.
12	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wall plate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
13	**AVoIP Encoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec, Dual-Stream Encoder, Shall have Video Preview viewable from the built-in web interface or from a touch panel , USB 3.0 Transport, Shall have Switchable Dual HDMI Inputs , High security network support and features, including multicast, VLAN tagging and QoS,PoE+ powered with low-power mode for energy savings. Open Direct-Control API ,Digital Video Input HDMI 2.1 ,Digital Video Output Network video over Ethernet via RJ45 port or HDMI, Color Space 4:4:4, YUV ,Streaming Protocols RTP, RTSP, RTMP, RTMP/S, MPEG2-TS, HTTP Live ,Input Signal Types Embedded audio on HDMI or Analog Stereo (Balanced or Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.

14	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport ,High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API .Digital Video Input Network video over Ethernet via RJ45 port ,Digital Video Output HDMI 2.1 ,Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
15	**Controller**	SITC of a hardware or software-based controller with on board 2 x RS232/422/485 ports and 6 x RS232 ports. The unit must support on board 8 x IR, 8 x IO and 8x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN, UL and RoHS certifications. The controller must have a secure platform. External Power Adaptor of above Integrated Controller Unit. It should be from same OEM of integrated controller Unit as requested above.
16	**Touch Panel**	SITC of 10" or better Professional-Grade, Persona-Defined Touch Panel, Pre-loaded Web Kiosk, UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), stand-alone room scheduling touch panel. customizable panel to serve the unique needs of any user, Mounting Flexibility, Advanced Security – Supports HTTPS, 802.1X, TLS 1.3, Modern Authentication or OAuth 2.0, and FIPS 140-3, Over 1 million programmatically selectable colors, Communication-enabling Technologies-Speakers, microphone, and Front-facing HD camera, Intelligence-enhancing Technologies – NFC Read/Write, Proximity Sensor, Ambient Light Sensor, Display Type TFT-LCD, IPS, Resolution 1920x1200, Aspect Ratio 16:10 Landscape, Brightness 350 nits (cd/m2), Contrast Ratio >800:1, Viewing Angle >80°/80°/80°/80°, RAM 4GB, LPDDR4, Storage 16 GB eMMC, Ethernet RJ-45, USB Type C OTG, USB Type 2.0, Speakers 2 x 2W, Microphone Dual, Power POE RJ-45, POE 802.3af, 15.4W, Compliance UL, CE, CB, FCC Class B. along with POE enabled network switch.
17	**Cable Cubby**	SITC of flush-mount tabletop cable cubby with manual flip-top / pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications. The cable cubby shall be suitable for flush installation in conference tables and supplied complete with all required connectors, wiring, and mounting accessories.

18	**Wireless Presentation Device**	SITC of Wireless presentation devices supports video resolution up to 4K, with HDMI output, inbuilt Wi-Fi 2.4GHz/5GHz and MIMO antennas, Networking: 1 x Gigabit LAN Wi–Fi 802.11 ac/b/g/n dual band & Bluetooth, 1 Ethernet port, 3 USB port for connecting keyboard, mouse, etc, Supports iOS, Windows and Android operating systems, display minimum 4 users screen at a time, Supports DHCP, connect 100 participants simultaneously, wireless streaming of 4K video at 30 frame per second (FPS), 1024−bit encryption for secure use on the network, participants can share content using Airplay, Miracast & join through any web browser (Chrome, Edge, Firefox) without using device app, Main memory 16GB, Storage 128GB, Calendar widget displays information about meetings scheduled in the room, Certification: CE, FCC, UL, BIS, etc.
19	**USB Capture Card**	SITC of 4K HDMI to USB Capture Device, HDMI video input supports resolutions up to 4096×2160p@60 4:4:4, HDR, and 10-bit per channel Deep Color, USB 3.0 Capture - video output supports resolutions up to 3840×2160p@30fps, or 1920×1080p@60fps, Audio Input Embedded, Support for Popular OS Platforms - Windows 10 (64-bit), macOS (10.12 or newer), Software Compatible - Supports Zoom, Teams, WebEx, Skype, Slack, Discord, BlueJeans, GoToMeeting, VLC, and more, Video Inputs: 1 x HDMI 2.1, Video Outputs: 1 x USB 3.0; supports UVC 1.1, Audio Inputs: HDMI Embedded Audio / 3.5mm Analog Stereo Audio, Ports: HDMI Input: (1) HDMI Type A Socket; Analog Stereo Input: (1) 3.5 mm TRS audio jack; USB 3.0: (1) USB Type C Socket, Regulatory Compliance: FCC Part 15 Class B EN 55032, EN 55035, RoHS.
20	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby True HD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Should also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
21	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
22	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
23	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
24	**Network Switch**	SITC of 24-Port Network Switch.
25	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
26	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc.
DEMO & TEACHER TRAINING ROOM - 50 & 60 PAX		

1	**110" or better Interactive flat panel Display**	SITC of interactive flat panel display of minimum 110” size or better with 4K UHD resolution: 3840×2160, brightness of minimum 600 nits or better, high contrast ratio, 120 Hz refresh rate or better, and response time ≤5 ms or better, shall support multi-touch functionality a minimum 40 touch points or more, shall be based on Android OS (latest version) with minimum 8GB RAM or better and 128GB or better storage, powered by a high-performance multi-core processor, shall include integrated high-resolution camera and multi-microphone array with echo cancellation and noise suppression for video conferencing applications, Shall have built-in speakers and support connectivity including USB-C, HDMI, LAN, and wireless screen sharing. The unit shall be suitable for continuous operation and supplied complete with mounting accessories, required certifications, and minimum 3 years onsite warranty.
2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL) : 150 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
3	**Wireless Lavalier Microphone**	SITC of of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
4	**DSP**	SITC of Integrated Digital Sound Processor with following functionalities and specifications; Signal Processor shall be CPU-32-bit fixed/floating-point DSP + ARM, 456 MHz. The DSP shall have 8 Mic/Line inputs & 8 analog outputs, 8 Additional digital Outputs; Audio Latency 860 μs (analog in to analog out) or less, 24 Bit A-D and D-A Convertors; Sampling Rate : 48 kHz; THD : < 0.002 % ; Channel Separation (Crosstalk) : < -105 dB ; Frequency Response 20 Hz - 20 kHz ; Dynamic Range : > 115 dB; Phantom Power +48 VDC, selectable per input, 5 Control Inputs and Outputs; RS-232 and Ethernet Port for third party Control and Monitoring; inbuilt DSP features like automatic mic mixing, multiband graphic and parametric EQs, signal generators, routers, mixers, AGCs, duckers, gates, compressors, source selectors, and delays. etc. Shall Support at least 15 remote Zone controllers.

5	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
6	**Amplifier**	SITC of smart mixer amplifier high impedance Class D, with Amplifier Power as 2 x 160 W @ 70/100V ; Frequency Response - 20 Hz - 20 kHz ; THD+N ≤0.5 % (at full rated power); Channel Separation (Crosstalk) ≤ -58 dBu, Dynamic Range 88 dB or better; A/D and D/A Converters - 24-bit / 48 kHz; Audio Latency - 10.4 ms - (any input to speaker output or aux output) ; Audio Inputs : Line Inputs (2) balanced, (2) unbalanced; Page Inputs (1) balanced mic/line, Embedded quick-start QR code in the OLED screen simplifies installation Up to 30 selectable EQ presets ensure sound performance and long-term reliability, mixer amplifier must have Bluetooth 5.0 connectivity and RCA connectivity—no wire splicing required, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Bluetooth LED, Display OLED, 16-bit grayscale, 96 × 96 resolution. Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz)
7	**Wall-mounted AV control keypad**	SITC of 6 - 8 or more Button Keypad with volume knob; it should supplied with 3-Input Switching Wallplate Transmitter (2 HDMI, 1 USB-C) includes auto and manual switching modes, and support for transmission of uncompressed video and audio up to 40m/131ft at 4K or 70m/230ft at 1080P over shielded Cat 6/6A/7 cable; It should support supllied Multi-Function Receiver with Built-In 2x25W 4/8-ohm Amplifier, USB signal pass-through, RS232 control, Relay, IR, mic/line input, line out, remote mute, audio de-embedding, USB-AUDIO, ARC function, and CEC control (Embedded HDBaseT™ technology allows for full usage of HDMI and controls over Cat 6/6A/7 cable.); Web Configuration for simplified installation; should support OEM Specific Management PC tool included for campus wide room and device management; etc.
8	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.

9	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8-bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
10	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
11	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
12	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
13	**Network Switch**	SITC of 24-Port Network Switch.
14	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
15	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc
MULTIPURPOSE HALL - 200PAX		
1	**163" or better flat panel Display**	SITC of indoor LED video wall display with Flip-Chip Micro LED COB technology, having pixel pitch of approximately 1.8 mm (±0.1 mm) and configured to form a display of minimum 163” diagonal size (approx. 4.1 m) with 16:9 aspect ratio, and active display area of approximately 3.6 m (W) × 2.0 m (H) or better. shall provide minimum 600 nits brightness, contrast ratio of ≥20,000:1, wide viewing angles of ≥170° (H/V), and high refresh rate of ≥3840 Hz for flicker-free and high-quality image performance. System shall support 16-bit color processing, wide color gamut, brightness and color calibration (≥97% uniformity), and adjustable color temperature (3000K–10000K). display shall have seamless modular construction, surface flatness ≤0.1 mm, and robust protective COB layer suitable for indoor applications. shall be energy efficient with maximum power consumption ≤300 W/m², operate on AC 100–240V, 50/60Hz, and be designed for continuous 24×7 operation with lifetime ≥100,000 hours. The system shall support front access installation and maintenance, with IP rating suitable for indoor use, and shall be supplied complete with mounting structure, control system, required accessories, certifications, and minimum 3 years warranty.

2	**Wireless Handheld Microphone**	SITC of Digital Wireless UHF handheld microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine-tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have a minimum 100 meter transmission range. It should have a Cardioid pick-up pattern, Sound pressure level (SPL): 150 dB or more, System Latency: 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
3	**Wireless Lavalier Microphone**	SITC of Digital Wireless UHF lapel microphone set with Rack receiver having 56 MHz or higher of switching bandwidth and equidistant spacing enables up to 90 channels or more along with 2,240 selectable frequencies for fine tuning. It should have auto scan feature for efficient connections to reduce time and effort. It should have min 100 meter transmission range. It should have omni-directional pick-up pattern, Sound pressure level (SPL) : 130 dB or more, System Latency : 1.9 ms, Dynamic range: 130 dB and frequency response: 20Hz- 20000 Hz. The microphone system can be controlled through ios / Android applications via bluetooth. It should have 12 hours of operation life and more.
4	**Antenna Splitter**	SITC of Active Antenna Splitter with 2 x 1:4 or 1 x 1:8 active connections, which work on 56 MHz Bandwidth and allow for up to 90 channels, Supports Mobile App streamlines setup and operation and eliminates complicated menus, Frequency range: 470 – 694 MHz, along with Automated setup creates reliable connections with minimal time and effort.
5	**Directional Antennas**	SITC of Active directional antenna, Built-in ⅝" and ⅜" threads allow for easy mic stand mounting, Frequency range 470 – 866 MHz, Apex angle (-3 dB) approx. 100°, Front-to-back ratio > 14 dB, Gain typ. 5 dBi and Impedance 50 Ω.
6	**Gooseneck Microphone**	SITC of 450mm Gooseneck microphone with a programmable microphone button (Toggle on/ off, PTM, PTT, and permanent on) and a bi-color LED ring for status indication. 450mm length, condenser capsule with cardioid pickup pattern, Frequency response: 50 Hz - 20 kHz, Maximum sound pressure level: 130 dB SPL, Connectivity: XLR 3M. It should have TTL-logic output for camera control feature.
7	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.

8	**FOH Loudspeaker**	SITC of Digitally steerable Column Array Multidriver (At least 24 drivers) speaker. The loudspeaker shall meet the following criteria: Usable Frequency Range of 58Hz - 18 kHz or better. The Loudspeaker shall have a built-in amplifiers with a minimum of 1200W or better. The Loudspeaker shall have a Max. SPL (Peak) of >=102 dB or better at 20m. Horizontal dispersion pattern of 160º or better and a software controlled vertical beam steering of +/- 20 degrees or above and adjustable beam spreading of 40 degrees. The loudspeaker system shall be comprised of a Powder-coated aluminium grille; an integrated Digital signal process and shall be able to store upto 10 presets of beam positions for recall, shall offer analog as well Dante digital audio connectivity. Stacking of additional loudspeakers for increased SPL and effective throw shall be possible. Shall support up to two beams for optimized coverage of various audience areas with possibility of controlling the gain & have separate Equalization for both the beams individually; Shall include OEM wall/stacking bracket and other necessary hardware.
9	**30x Optical Zoom (Teacher & Student Camera)**	SITC of AI based Full 4K @ 60fps Presenter PTZ Tracking Camera with Dual Camera- one PTZ Camera for Presenter Tracking and second fixed lens Panoramic Camera. PTZ Presenter Camera should support min 30X Zoom and 8x Digital Zoom with Panning range of +170 deg to - 170 deg and Tilt Range of -30 to +90 Degrees, Field of View for PTZ Camera should be min 58 Degree and for Panoramic Camera min. 85 Degree, camera should support simultaneous outputs through HDMI, 3G-SDI, USB 3.0 and IP with 1x Audio In and can be controlled via RS232 and IP. Should support multiple video streams with PIP. Tracking Camera should support Everywhere Tracking, Partition Tracking, Auto Framing & Gesture Control. Should support PoE+ and Virtual USB Driver. Quoted model should be BIS, CE, FCC , Clickshare & RoHS Certified with Test Lab Reports.
10	**Recording and Streaming Hardware**	SITC of Recording, Streaming & Webcasting Hardware simultaneously, Built-in 4x HDMI & IP Inputs with 4x Line Inputs, 2x HDMI Outputs. The system should be capable to record upto any four inputs simultaneously in a single frame and as well as individual sources simultaneously. Should have minimum 1TB inbuilt storage and can be connected to local NAS storage. The system should be able to support minimum 3 unicast streams. The recorded files should have the option of time and date stamp.The device can be controlled and managed through centralised software on network .Quoted model should be CE, FCC & RoHS Certified with Test Lab Reports.
11	**IP+RS 232/VISCA based Joystick Controller**	SITC of Joystick with 3" LCD for Preview Monitoring, PAN/Tilt/Zoom Control, Communication via IP & RS232C/RS455 Interfaces, Auto Backlit Keys, Should be able to control minimum 200 Cameras on IP & 10 Cameras through RS232/422, Should support VISCA, VISCA Over IP protocols & PoE. Quoted model should be BIS, CE, FCC & RoHS Certified with Test Lab Reports.
12	**Camera Mount Kit**	Supply of Camera wall mount metal stand. It should be constructed with durable material and can be attached right side up or upside down, depending on camera configuration and requirement. OEM accessory will give a perfect fit and features pre-drilled installation hardware and cable holes.

13	**AVoIP Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
14	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder ,High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding ,Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport ,High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API .Digital Video Input Network video over Ethernet via RJ45 port ,Digital Video Output HDMI 2.1 ,Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
15	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
16	**Controller**	SITC of a hardware or software-based controller with on board 1 x RS232/422/485 ports and 3 x RS232 ports, 2 XUSB-A Host Ports, The unit must support on board 4 x IR, 4 x IO and 4 x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN , UL and RoHS certifications. The controller must have a secure platform.

17	**Touch Panel**	SITC of SITC of 8" or above Touch Panel; fully configurable; IPS LCD based Capacitive Multi-Touch with LED backlighting; Should support Any-Color Side LEDs; Ambient Light Sensor; Built-in UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), Book Scheduling, Web Kiosk; Adjustable Security Modes, Resolution (WH) Landscape: 1280x1200, Aspect Ratio (WH) Landscape: 16:10, Brightness 350 cd/m2, Contrast Ratio 800:1, RAM4 GB, storage 16 GB, Ethernet RJ-45, POE 802.3af, 15.4W, Speakers 2 x 2 Watt, Compliance: UL, CE, CB, FCC Class B (-5dB); etc. along with PoE Injector of above Tabletop GUI. It should be supplied by same OEM.
18	**HDMI Patch Cords**	Supply and Laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR,HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
19	**Digital Podium**	SITC of Digital Interactive Podium in Metallic Frame and Wooden Top with 21.5 inch Full HD (Electromagnetic + Capacitive) Interactive Display with Electromagnetic Pen, with Motorized Tilting of the Interactive Panel, with provision to install Gooseneck Microphone, Interactive panel, Keyboard Tray and space to store AV equipment, Interactive display with full HD resolution of 1920x1080, Technology IPS LCD, Aspect ratio16:9, Brightness 250 cd/m2, Contrast ratio1000:1, Pen Type shall be Pressure sensitive and cordless. Top connectivity plate with HDMI, USB x 2 and Power socket for external Laptop connectivity, built-in 4 x 2 HDMI Matrix Switcher with 4K@60Hz (4:4:4, 8-bit) as well as support for 16-bit Deep Colour, HDR (High Dynamic Range), 3D contents, HD audio and other features defined by HDMI 2.1 specification and Audio De-embedder for internal connectivity and as per technical specification.
20	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
21	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
22	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
23	**Network Switch**	SITC of 24-Port Network Switch.
24	**Equipment Rack**	SITC of 22U Rack with necessary accessories.

25	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc
STAFF CONFERENCE ROOM - 13 PAX		
1	**115" or better Display Panel**	SITC of a minimum 115-inch 4K UHD professional commercial display with a resolution of 3840 × 2160, suitable for continuous 24x7 operation in conference and boardroom environments. The display shall have a minimum brightness of 750 nits, contrast ratio of 18000:1 or better, and 10-bit color depth for superior image quality and wide viewing angles of 178° (H/V). The unit shall be powered by an inbuilt Android 14 or latest operating system with minimum 4 GB RAM and 16 GB internal storage, supporting integrated Wi-Fi, Bluetooth, LAN connectivity, and digital signage capability. The display shall support IP and RS232 control, Wake-on-LAN/WiFi features, and be compatible with standard AV control systems. The display shall have built-in speakers with minimum 100W–120W output, and a panel life of at least 50,000 hours. The system shall be complete with all necessary mounting accessories, cabling, and integration with existing AV/VC systems, and must be supplied with a minimum 3-year onsite warranty.
2	**Chairman/Delegate Unit**	Supply, Installation, Testing and Commissioning of Wired Table Embedded gooseneck Microphone which shall have Frequency Response: 90-20000Hz or better. It shall have impedance: 120Ω or better. It shall have sensitivity of -32dBV (25mA) @1Pa or better. It shall have Signal to noise ratio of 90dB or better. It shall have Gooseneck microphone length of 415 mm or more. It shall have max SPL of 120 dB (@1% THD, 1Khz). It shall have 3 PIN XLR interface. It shall have all metal shell with anti RF interference. It shall have either inbuilt pattern options of Omnidirectional, Cardioid and uni-directional or three separate microphones shall be supplied to use in multiple scenarios. It shall have THD of <0.1% or better. It shall support 24V to 48V Phantom power. It shall have condensor type microphone capsule. It shall have power consumption of 2 Watts or less.
3	**Microphone intergration Unit**	Supply, Installation, Testing and Commissioning of Microphone integration unit which shall have 120Ω output impedance. It shall have anti-vibration insulating rubber, effectively reducing vibration and mechanical noise on the mounting surface. It shall have 3 Pin XLR Input interface. It shall have 7 Pin Cannon/XLR output interface. It shall have feather touch Mic Mute/Unmute Button. It shall have ring and button indicators. It shall have 24dBA noise floor.
4	**Dual Microphone Control System**	Supply, Installation, Testing and Commissioning of Dual Microphone Control system which shall have frequency response of 40 Hz – 20000 Hz or better. It shall have less then .1 % distortion. It shall have 2 or more microphone interface. It shall have 2 or more RJ-45 Link interface. It shall be able to control and designate Microphone types as host or participant with indication. It shall have power consumption of 2 Watts or less. It shall be able to supply 24V phantom power to connected microphones. It shall be supplied with 2x RJ-45 cables which shall be 6' in length with protection caps. The OEM Shall have CE, RoHs, FCC, ISO 9001:2015, ISO 14001:2015 , ISO 27001:2022 , ISO 50001:2018 Certificates.
5	**Advanced Audio Feedback Suppressor**	Supply, Installation, Testing and Commissioning of Advanced Audio Feedback Suppression processor with XLR -3 & TRS 1/4 ” TRS , single channel Input and output interface. AFC & ANC Bypass switch, 20Hz-20kHz ,± 0.3dB Frequency response, 0.005% , 1kHz ; 20Hz-10kH , <0.01% , 10kHz-

		20kHz , <0.025% Total harmonic distortion.
6	**Audio Controller**	SITC of Central Audio control Unit which shall have fully digital conference technology with built in high performance processor. It shall have frequency response of 20 Hz – 20000 Hz or better. It shall support up to 40 Units via main controller and upto 128 units with optional Extension unit. It shall support PoE with category5 UTP distance upto 100 meters. It shall support IEEE 802.3af, IEEE 802.3at POE standards or better. It shall support 60 Watts non isolated POE Power or better. It shall support two channel Audio over IP or better. It shall have 1x RJ-45 AOIP interface. It shall have sampling rate of 48 KHz or better. It shall have ring type architecture. It shall have SNR of 85dB or more. It shall have 4x RJ-45 interface for connecting Microphone units or equivalent. It shall have 1x Balanced Audio Output interface. It shall have 2x RJ-45/RS-232 Control interface. It shall have 1x RJ-45 network Interface. It shall be supplied with 4" Control interface which shall be deployable upto 90 meters away from the main unit. It shall be rack mountable with 1U or less height. It shall be supplied with Power Cable, RJ-45 cable and operating manual.
7	**AEC Enabled DSP**	SITC of Conferencing digital audio DSP with high-performance 32-bit processing and integrated control, featuring minimum 12 mic/line inputs and 8 outputs, along with additional digital audio networking capability. The DSP shall support multi-channel AEC (minimum 12 channels), Dante or equivalent audio networking, USB audio interface, and Ethernet-based control and programming, shall provide comprehensive signal processing including mixing, routing, EQ, dynamics, delay, and room combining, with control interfaces such as GPIO, RS-232/RS-485, and phantom power per channel. The DSP shall support VoIP/PSTN integration, low latency operation, and high audio performance (wide frequency response, low distortion, and high dynamic range), complete with monitoring, diagnostics, and system expansion capability.
8	**Ceiling Speakers**	SITC of full range ceiling mounted music and PA loudspeaker. The loudspeaker shall meet the following performance criteria: Usable Frequency range (-10 dB) of 83Hz to 19kHz; Power handling of 80 Watt peak; Nominal Coverage Angle (1 – 4 kHz) 150°; Sensitivity of 86 dB SPL and Max SPL of 105 dB SPL peak; Nominal impedance of 16 ohms and Integral multi-tap Transformer with selectable tap settings of 2/4/8/16W@70V & 100V. The loudspeaker system shall be comprised of a 2.25-inch woofer; enclosed in engineered-plastics with integrated steel backcan and a powder-coated steel grille. UL-1480 rated and EN54-24 compliant for Life safety/VA applications.
9	**Column Speakers**	SITC of Wall Mountable with 12 mid/high drivers in an articulated array for wide dispersion. The loudspeaker shall meet the following performance criteria: Usable Frequency Range (-10 dB) of 100Hz - 16 kHz. Long-Term Power Handling 300 W (1200 W peak). The Loudspeaker shall have a Max. SPL (Peak) of 119 dB or more with a nominal dispersion of 145° H x 20° V. The loudspeaker system shall be comprised of a Powder-coated steel grille; Twelve 2.25-inch mid/high frequency drivers and and a nominal impedance of 8 ohms. Optional 70/100V OEM transformer module with tap settings of 150/75 W shall be available.

10	**Amplifier**	SITC of class D amplifier with 4 x 300 W Load-independent outputs deliver full channel power to either low-impedance (4-8 Ω) or high-impedance (70/100V) loads without bridging. Amplifier shall have frequency response of 20 Hz to 20 kHz, THD+N at rated power less than 0.04%. Dynamic Range ≥ 100 dBA (at rated power). Audio Latency < 1 ms (any analog or Digital input to loudspeaker output), The amplifier shall meet or exceed the following performance specifications: channel separation (crosstalk) greater than 80 dB. The amplifier shall have 4 line-level inputs with selectable input sensitivity settings (-10 dBV, 4 dBu and 14 dBu) for balanced line-level inputs and possibility of 8 or more no .of digital Audio channels . The amplifier shall offer a master mute connection for use with external dry contacts, normally open or normally closed, to mute all outputs of the amplifier, Indicators & Controls: Power LED, Input Signal LED, Output Limit LED, Mains Voltage 100 VAC – 240 VAC (±10%, 50/60 Hz).
11	**20X Zoom Camera**	SITC of PTZ camera with minimum 1/2.8" HD CMOS sensor, supporting auto/manual white balance, S/N ratio ≥55 dB, and minimum 20x optical zoom with digital zoom capability. shall support Full HD video (up to 1080p60) over USB 3.0, HDMI, and IP streaming, with dual H.264/H.265 encoding and configurable streaming protocols (TCP/IP, RTSP, HTTP), shall provide wide field of view (≥68°) with pan/tilt range of approximately ±170° and -30° to +90°, support multiple presets (minimum 200), and include RS232/RS422/485 and IP control interfaces. The system shall be supplied complete with mounting accessories, remote control, and required cables.
12	**Wall Plate Encoder**	SITC of 4K60 4:4:4 Encoder Wallplate, High-Quality, Low-Latency 4K60, Video Preview viewable from the built-in web interface or from a touch panel, USB 3.0 Transport, HDMI input and USB-C input that supports both video and USB 2.0, High security network support and features, including multicast, VLAN tagging and QoS, PoE powered with low-power mode for energy savings, Open Direct-Control API, Formats HDMI 2.1, HDCP 2.3, Video Input HDMI 2.1, DP IN /USB-C, resolutions up to 4096 x 2160, Color Space 4:4:4, YUV, Embedded audio on HDMI, USB-C or Analog Stereo (Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI or USB-C, HDMI Audio Formats 8ch PCM, Analog Audio Format Stereo 2-channel, HDCP, EDID management, audio 3.5mm connector, etc.
13	**AVoIP Encoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec, Dual-Stream Encoder, Shall have Video Preview viewable from the built-in web interface or from a touch panel , USB 3.0 Transport , Shall have Switchable Dual HDMI Inputs , High security network support and features, including multicast, VLAN tagging and QoS,PoE+ powered with low-power mode for energy savings. Open Direct-Control API ,Digital Video Input HDMI 2.1 ,Digital Video Output Network video over Ethernet via RJ45 port or HDMI, Color Space 4:4:4, YUV ,Streaming Protocols RTP, RTSP, RTMP, RTMP/S, MPEG2-TS, HTTP Live ,Input Signal Types Embedded audio on HDMI or Analog Stereo (Balanced or Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.

14	**AVoIP Decoder**	SITC of 4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding ,Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 3.0 Transport ,High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API .Digital Video Input Network video over Ethernet via RJ45 port ,Digital Video Output HDMI 2.1 ,Formats HDMI 2.1, HDCP 2.3 content protection support, Color Space 4:4:4, YUV ,Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
15	**Controller**	SITC of a hardware or software-based controller with on board 2 x RS232/422/485 ports and 6 x RS232 ports.. The unit must support on board 8 x IR, 8 x IO and 8x Relay ports. The unit must support two RJ45 ports, one can be on corporate network while the other can accommodate network devices to be controlled. The unit must be programmable using multiple scripting languages and should also support a low code – no code strategy. The unit must have on board eMMC storage for programs. The storage capacity must be upto or more than 8 GB. The controllers must support CE EN , UL and RoHS certifications. The controller must have a secure platform. External Power Adaptor of above Integrated Controller Unit. It should be from same OEM of integrated controller Unit as requested above.
16	**Touch Panel**	SITC of 10" or better Professional-Grade, Persona-Defined Touch Panel, Pre-loaded Web Kiosk, UC video-conferencing room controller (e.g., Zoom Rooms, Microsoft Teams Rooms, or equivalent), stand-alone room scheduling touch panel. customizable panel to serve the unique needs of any user, Mounting Flexibility, Advanced Security – Supports HTTPS, 802.1X, TLS 1.3, Modern Authentication or OAuth 2.0, and FIPS 140-3, Over 1 million programmatically selectable colors, Communication-enabling Technologies-Speakers, microphone, and Front-facing HD camera, Intelligence-enhancing Technologies – NFC Read/Write, Proximity Sensor, Ambient Light Sensor, Display Type TFT-LCD, IPS, Resolution 1920x1200, Aspect Ratio 16:10 Landscape, Brightness 350 nits (cd/m2), Contrast Ratio >800:1, Viewing Angle >80°/80°/80°/80°, RAM 4GB, LPDDR4, Storage 16 GB eMMC, Ethernet RJ-45, USB Type C OTG, USB Type 2.0, Speakers 2 x 2W, Microphone Dual, Power POE RJ-45, POE 802.3af, 15.4W, Compliance UL, CE, CB, FCC Class B. along with POE enabled network switch.
17	**Cable Cubby**	SITC of flush-mount tabletop cable cubby with manual flip-top / pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications. The cable cubby shall be suitable for flush installation in conference tables and supplied complete with all required connectors, wiring, and mounting accessories.

18	**Wireless Presentation Device**	SITC of Wireless presentation devices supports video resolution up to 4K, with HDMI output, inbuilt Wi-Fi 2.4GHz/5GHz and MIMO antennas, Networking: 1 x Gigabit LAN Wi–Fi 802.11 ac/b/g/n dual band & Bluetooth, 1 Ethernet port, 3 USB port for connecting keyboard, mouse, etc, Supports iOS, Windows and Android operating systems, display minimum 4 users screen at a time, Supports DHCP, connect 100 participants simultaneously, wireless streaming of 4K video at 30 frame per second (FPS), 1024−bit encryption for secure use on the network, participants can share content using Airplay, Miracast & join through any web browser (Chrome, Edge, Firefox) without using device app, Main memory 16GB, Storage 128GB, Calendar widget displays information about meetings scheduled in the room, Certification: CE, FCC, UL, BIS, etc.
19	**USB Capture Card**	SITC of 4K HDMI to USB Capture Device, HDMI video input supports resolutions up to 4096×2160p@60 4:4:4, HDR, and 10-bit per channel Deep Color, USB 3.0 Capture - video output supports resolutions up to 3840×2160p@30fps, or 1920×1080p@60fps, Audio Input Embedded, Support for Popular OS Platforms - Windows 10 (64-bit), macOS (10.12 or newer), Software Compatible - Supports Zoom, Teams, WebEx, Skype, Slack, Discord, BlueJeans, GoToMeeting, VLC, and more, Video Inputs: 1 x HDMI 2.1, Video Outputs: 1 x USB 3.0; supports UVC 1.1, Audio Inputs: HDMI Embedded Audio / 3.5mm Analog Stereo Audio, Ports: HDMI Input: (1) HDMI Type A Socket; Analog Stereo Input: (1) 3.5 mm TRS audio jack; USB 3.0: (1) USB Type C Socket, Regulatory Compliance: FCC Part 15 Class B EN 55032, EN 55035, RoHS.
20	**HDMI Patch Cords**	Supply and laying of 3.0 Meters 4K HDMI patch cord in existing conduit. It should support resolution upto 4K@60Hz (4:4:4); Deep Color, x.v. Color™, Lip Sync, 7.1 PCM, Dolby TrueHD, DTS−HD, CEC; 24K gold–plated connectors to resist corrosion, and offer the best possible connectivity; should also provide non-slip connections with atleast 15lbs of restraining force. It should be HDR, HDCP 2.3, EDID and CEC compliant. Shoudl also support audio formats like Dolby Digital Plus™, Dolby TrueHD™, DTS–HD Master Audio™, DVD Audio, SA–CD. Flammability Rating - CL3/FT4, RoHS 2011/65/ EU.
21	**Audio Cables**	Supply 2 core 16 AWG/1.5 Sq mm, Twisted, unshielded Speaker cable with stranded annealed bare copper conductors, Semi-rigid PVC insulation.
22	**Speaker Cables**	Supply of 2 core Twisted, shielded balanced Audio and control cable with 22AWG or better 7 strand annealed bare copper conductors, Semi-Rigid PVC insulation.
23	**Network Cables**	SITC of Category 6 Unshielded Twisted Pair 4 pair cable shall be compliant with ANSI/TIA/EIA-568-C.2
24	**Network Switch**	SITC of 24-Port Network Switch.
25	**Equipment Rack**	SITC of 22U Rack with necessary accessories.
26	**Connectors**	SITC of Connectors like LAN, CAT 6Sheilded, RCA, XLR etc.

SECTION 9: Access Control system

1. The Access Control System (EACS) is a physical access control system, designed to protect people, property and assets. With advanced alarm and identity management, the EACS shall provide superior control of access to facilities. Being a 100% browser-based solution offers the flexibility to respond to alerts from anywhere and at any time for better situational awareness and superior control of access to facilities.
2. The EACS system is to be available 24/7/365 from any internet accessible location, using any device with a browser, and can be managed by multiple operators simultaneously. All changes are automatically synced across the entire access system, displaying only the most up-to-date data.
3. Based on an open-source Linux® platform, EACS provides protection against network vulnerabilities. Optional hot standby-auto failover solution automatically saves policies, settings and identities from any one primary appliance to a standby appliance.
4. Designed to be quickly deployed and easy to use, the EACS shall provide operators with an intuitive turnkey solution so they can focus on what matters most - security.
5. Access control system shall be seamlessly integrated with VMS, either from the same OEM or through a certified, ONVIF/OSDP-validated third-party integration demonstrated by the Bidder

Key Features

B. Enterprise-class engineered solution from the ground up, with exceptional IT standards that easily integrate with an organization's existing physical or virtual IT environment.
C. Multi-Factor Authentication: Operators may configure a second authentication factor to their account for logging into the system, for additional security.
D. Identity management: Assign and manage role-based identities and display user ID profile pictures with access control events and alarms. Print employee and visitor badges and issue mobile credentials directly from within EACS.
E. Easy synchronization & role management: enforce policy restrictions, meet regulations and reduce the risk of duplicate data entry by integrating with external IT and HR identity management solutions. Map physical access to enterprise roles such as departments, locations and titles.
F. Alarm management: Prioritize alarms with audible alerts and colored indicators. View associated video, enter notes and acknowledge and clear alarms in one place.
G. Maps: View and manage all security objects, including identity, doors and alarms.
H. Replication and hot stand-by auto failover: Streamline identity management by replicating data on multiple EACS appliances across sites. Maximize system uptime with hot standby-auto failover to maintain multiple layers of redundancy and resiliency.
I. Mobile-enabled solution, allowing to lock and unlock doors, view their real-time status and issue global actions with a simple tap with EACS mobile app.
J. RESTful API that enables EACS to integrate with a vast range of devices and solutions to uniquely fit needs and provide an end-to-end security solution.
K. Open-field hardware support from leading manufacturers, including readers, wireless locks, controllers & sub-panels, power supplies & enclosures and more.
L. Map Interface: Provide interface for creating customizable layouts including floorplans, reader locations, and buttons that can trigger actions.
    1. Actions: Card readers indicate alarm via icon and allow for card only, card and pin, card or pin, pin only, facility code only, disable, unlock, lock, grant, restore, mask held, unmask held, and trace actions.
    2. Occupancy/Mustering: Maps will provide real-time occupancy of a defined area.
    3. Programmable Buttons: Maps will provide mapping of buttons and text to perform actions.
M. Verification Interface: Provide web-browser-enabled connection to access control software allowing a user to review information about card holders entering or exiting up to four (4) doors in real time. Information to include badge photo, transaction time, and date via any device with a compatible browser.

N. Virtual Verification Station: Provide web-browser-enabled connection to the access control software to allow a user to visually confirm the identity and authorization of a person attempting entry to a controller area via a mobile device such as a tablet or smartphone.
O. Access Control Software Reporting: Generate, filter, edit, and customize system reports including the automated generation and distribution of customized reports in PDF and CSV formats.
P. Software Interface
    1. Web-Based Access Support: Provide access control software with browser-based access to system applications including support for industry standard desktop and mobile web browsers.
    2. Tabbed User Interface: System supports the following functionality in a tabbed view:
        1. Monitor events, alarms, and hardware status in real time.
        2. Verify identities in real time.
        3. Search historical events and alarms.
    3. Events and Alarms: Provide a system that allows administrators the ability to create, configure, and prioritize events and alarms and communicate information about the generation of the event or alarm to the operator with guidance for responding to the event or alarm. Events will support two levels: system level events affect all objects in the system; field level events affect only the object they are configured on.
    4. Access Groups: Provide a system that allows administrators the ability to create groups of card readers and schedules such that card readers can allow or restrict access to areas based on schedules.
    5. Identity Records: Provide a system with integrated identity management, allowing imports of data from supported databases. Each identity supports access control based on groups and roles as well as individual overrides. Include functionality to customize identity and token forms in base software. Provide identity records capable of management and synchronization between multiple sites.
    6. Roles: Support a role-based permission method allowing one or more roles to be assigned to identities to determine physical and logical access.
    7. Anti-Passback: Provide access control software capable of designating areas to require a card to enter and exit the area before it is used to enter the area again.
        1. Soft and Hard Area APB: Tracks each badge that enters a specific area and defines which areas the badge may access next.
        2. Door-Based APB: Tracks each badge that enters and does not allow the same badge to enter twice in a row until after the APB time limit is reached.
        3. Token-Based, Timed APB: Tracks each door a badge has accessed. After the badge has accessed one door, it must access a second door or wait until the APB time limit is reached before it may access the first door again.
        4. Timed Area APB: Time based hard area APB. When the time limit expires, the hard area APB becomes a soft area APB.
    8. Badging: Provide a tool to support the creation of custom badge layouts including the following content:
        1. Static Information: Badge size, background color, text strings, and graphics common to every badge.
        2. Dynamic Information: Text fields and images from the identities database unique to each badge.
    9. Enrollment: Provide integrated identity management and enrollment functionality as part of the core system functionality.
    10. Macros: Provide a system capable of linking one or more events to macros such that a single event may execute up to 30 macros. System must support a minimum of 255 macros per intelligent field controller.
    11. Device Template Configuration: Provide an access control system that supports templates to automatically populate standard parameter fields in groups for new or existing doors, wires, readers, and input/output devices.
    12. Encryption: Provide access control system that supports the following encryption methods:

1. TLS 1.2: Require TLS encryption between the access control system and controller.
2. Custom Certificates: Require self-signed or certificate authority certificates to harden access control systems. Certificates will authenticate panels to the access control system.
3. FIPS 140-2: Require access control server to utilize FIPS 140-2 compliant ciphers only.
4. FIPS 201-2: Require large-encoded card formats for FIPS 201-2 certified pivClass readers.

13. Custom Device Mappings: Administrators may assign a unique group of alarm attributes to specific device-alarm combinations to override global settings of generic attributes.
14. Dashboard: Allow creation of a dashboard for real-time status and actions of hardware components on a single screen that can also filter by name, status, appliance, or group.
    1. Hardware Status:
        i. Panels: Communication, power, tamper, and battery.
        ii. Sub-Panels: Communication, power, and tamper.
        iii. Inputs: Inactive, active, trouble, and masked.
        iv. Outputs: Off, on, and trouble.
        v. Doors: Communication, tamper, battery, unlocked, help, masked, and forced.
        vi. Appliances: RAM, program, database, CPU load, and port status.

    a. Monitor:
        - Panels: Device status, security status, name, model, firmware, IP address, MAC address, cards in use, and last communication.
        - Sub-Panels: Device status, name, panel, type, port, address, and firmware.
        - Inputs: Device status, input name, subpanel, EOL resistance, and address.
        - Outputs: Device status, output name, subpanel, schedule, and address.
        - Power Supplies: Power supply name, installed status, status, and logs.
        - Access Control Doors: Status, name, panel, door state, door mode, and override status.

    a. Manipulate Access Control Doors:
        - Door actions: Grant, restore, unlock, locks no access, disable.
        - Door mode: Card only, card and PIN, card or PIN, PIN only, facility code only.
        - Door Forced: Mask forced, unmasked forced.
        - Door Held: Masked held, unmasked held.
        - Installed: Install, uninstall.

Intelligent Controllers

1. The family of intelligent controllers and peripheral interface devices must provide an open architecture family of products that enables a choice of host software system vendor without replacement of hardware.
2. The Linux based intelligent controller must provide decision making, event reporting, and database storage as a hardware platform. Two reader interfaces must provide control for two doors in addition to supporting an additional 62 doors, paired and or alternate reader configurations with peripheral interface devices.
3. The controller must communicate with the host via on-board 10BaseT/100BaseTX Ethernet port and support TLS encryption as a minimum-security implementation.

4. The intelligent controller must be capable of elaborate processes and procedures without host intervention. Once configured, the intelligent controller must function independently of the host, and must be capable of controlling access, managing alarms, interfacing with an array of hardware devices, all while providing the decision-making oversight that each system configuration requires.
5. The intelligent controller must provide centralized biometric template management and support a wide range of reader technologies, including OSDP, Wiegand, magnetic stripe and biometric.
6. Two physical barriers must be controlled. Each reader port must accommodate a read head that utilizes OSDP (RS-485), OSDP SC, Wiegand, magnetic stripe, or F2F protocol/electrical signaling standards, one or two wire LED controls, and buzzer control.
7. Controllers must support, as a minimum, the following open standards, PSIA Area Control, SNMPv3/v2c, OSDP and OSDP SC.
8. The controller must utilize a cryptographic module, like OpenSSL FIPS Object Module RE, that is validated to FIPS 140-2 thus providing a certified implementation of TLS.

• Where new card/biometric readers are installed, they shall support OSDP v2 (IEC 60839-11-5) with Secure Channel (AES-128 encryption) as the primary reader-to-controller protocol.

• Wiegand (an unencrypted, clear-text protocol susceptible to credential interception and replay) shall be permitted only where required for interoperability with existing installed readers, and shall not be the primary protocol for new installations.

• Where Wiegand is used, the controller shall be installed within the secured space (not in an unsecured ceiling/corridor void) to reduce exposure of the unencrypted reader-to-controller wiring.

9. Sub-Panels
    a. The family of intelligent controllers and peripheral interface devices must provide an open architecture family of products that enables a choice of host software system vendor without replacement of hardware.
    b. The peripheral interface device shall control two physical barriers and up to four readers (using OSDP).
    c. The peripheral interface device shall support a wide range of reader technologies and protocol/electrical signaling standards, including OSDP (RS-485), OSDP SC (RS-485), Wiegand (TTL), magnetic stripe, F/2F and biometric. Wiegand and magnetic strip protocols must support one or two wire LED controls, and buzzer control.
    d. The reader ports of the peripheral interface device shall be capable of supporting multi-dropped OSDP readers.
    e. The peripheral interface device shall be able to utilize a cryptographic module that can encrypt/decrypt communication with the intelligent controller, supporting AES encryption using a minimum 256-bit key length.
    f. The peripheral interface device shall utilize a crypto memory chip that provides hardened protection of secrets such as OSDP secure channel keys.

Proximity Readers

Card reading devices shall be available in Proximity and Pin and Proximity formats. A mullion variant will be available with pin and proximity options. Readers shall be tested to withstand 5 joules of impact to IK08 Standard. Configurable light bar indicators shall indicate power status, valid and invalid reads. The card reader will give an audible indication of each read. Readers will have a minimum read range of 25mm in normal operating conditions. Readers shall be suitable for indoor and outdoor use with a rating of IP55 or greater. A USB reader shall be available to be used with software application.

Reading Protocols

Card reading devices shall read contactless Smart Card 13.56MHz MIFARE DESFire EV2/EV3 (or equivalent AES-based secure credential) technology conforming to standards compliant ISO/IEC 14443-4. Proximity readers will support Open Supervised Device Protocol (OSDP). Readers may additionally support 125 kHz PROX formats for read-only migration of legacy credentials during a defined transition period. As 125 kHz PROX is unencrypted and readily cloned, it shall NOT be issued as a credential for new users or used to secure sensitive or restricted areas.

Readers shall support MIFARE® DESFire® EV2/EV3 (or equivalent AES-based secure credential technology from any manufacturer) as the primary credential. MIFARE Plus® may be supported in the secure (AES) security level. MIFARE Classic shall NOT be used for new credentials, its Crypto-1 cipher being publicly compromised; it may be read only for migration of existing cards during a defined transition period. Data encryption with 128-bit AES encryption and randomization should be supported.

Biometric Readers

Face Recognition Biometric Readers shall be installed and Readers shall support a 34-bit wiegand format and TCP/IP protocol.

UHF Integrated RFID Reader

Details	Specification
Operating frequencies	865.0-867.0 MHz, India
Read range	Up to 8 meters (26 ft.)
Housing	Aluminum housing UL94 certified plastic XENOY™ cover
Power supply	12–24 VDC supply
Output power	2 W
Input	3 isolated inputs
Output	3 isolated outputs shared with Wiegand
Relay	1 relay output, 60 VDC, 2 A
Interfaces	RS232, RS485, Wiegand/Magstripe, 2 pcs Ethernet and USB service interface
Standard	RAIN (EPC Gen2 ISO 18000-63)
Encrypted air interface	According to RAIN
EMC	EN 301489-1, EN 301489-3
Safety	EN 60950-1, EN 60950-22

TAG UHF-4

Read Range - Upto 8 mtrs

Operating frequencies - 865–868 MHz

Standard/encoding - RAIN (EPC Gen2, ISO 18000-63)

Dimensions - 106.4 x 28.6 mm (4.2 x 1.1 inch). Thickness 0.55 mm (0.022 inch)

All Tags supplied should be unique and should not be able to be duplicated using technology similar to TagMaster SecureMarkID or equivalent.

Boom Barrier Specification

Technical specification	**Boom Barrier**
Cabinet dimensions (L x W x B)	Not more than 255 x 340 x 1050 mm
Arm length	5 Mtrs
Operation Modes	Left / Right version
Raising / lowering time	3 - 5 sec
Mechanism	Servo-driven (BLDC)
Usage Rate	90%
Operation frequency	Minimum 300 cycles / hour
MCBF / MTTR	3000000 cycles / < 25 min
Temperature range	-40°C / + 60°C*
Maximum Power Consumption	240 W
Power Supply	220-240 V, 50/60 Hz
Indication	Standard - RGB indication on all sides of the cabinet
Material Construction	Galvanized steel with powder coating
Material of Arm	Powder coated aluminium
Remote Control	Yes using Keyfobs

SECTION 6:
SECURITIES AND OTHER FORMS

BID SECURITY (e-BANK GUARANTEE)

WHEREAS, _____[name of Bidder] (hereinafter called "the Bidder") has submitted his Bid dated_____[date] for the construction of [name of Contract hereinafter called "the Bid"].

KNOW ALL PEOPLE by these presents that We _____ _ [Name of Bank] of _____ [name of country] having our registered office at (hereinafter called "the Bank") are bound unto _____ [name of Employer] (hereinafter called "the Employer") in the sum of _____ * for which payment well and truly to be made to the said Employer the Bank itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this_____day of _____20.

THE CONDITIONS of this obligation are:

(1) If after Bid opening the Bidder withdraws his bid during the period of Bid validity specified in the Form of Bid;

OR

(2) If the Bidder having been notified to the acceptance of his bid by the Employer during the period of Bid validity:

(a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or

(b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders; or

(c) does not accept the correction of the Bid Price pursuant to Clause 27

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or any of the three conditions, specifying the occurred condition or conditions.

This guarantee shall also be operatable at our..... Branch at Bhubaneswar, from whom, confirmation regarding the issue of this guarantee or extension / renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked and payment thereunder claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

The guarantor/bank hereby confirms that it is on the SFMS (Structural Finance Messaging System) platform & shall invariably send an advice of this Bank Guarantee to the designated bank of Odisha Bridge & Construction Corporation Ltd details of which is as under:

Sl. No.	Particulars	Details
1	Name of Beneficiary	OB&CC Ltd.
2	Name of Bank	CANARA BANK
3	Account No	80073210000014
4	IFSC Code	CNRB0018007

This Guarantee will remain valid for a period of 45 (Forty-five) days beyond the final bid validity period.

Notwithstanding anything to the contrary contained hereinabove: -

1. Our Liability under this Bank Guarantees shall not exceed ……...
2. The Bank Guarantee shall be valid up to....; and
3. We are liable to pay up to the guarantee amount only and only if we receive from you a written claim or demand not later than dd/mm/yyyy ----------, at our Branch,
4. All your rights as well as our liability under this bank guarantee shall stand extinguished unless a written claim or demand is made under this guarantee not later than ----------

DATE _____ **SIGNATURE** _____

WITNESS _____ **SEAL**_____

[Signature, name and address]

* The Bidder should insert the amount of the guarantee in words and figures denominated in Indian Rupees. This figure should be the same as shown in Clause 16.1 of the Instructions to Bidders.

** 45 days after the end of the validity period of the Bid. Date should be inserted by the Employer before the Bidding documents are issued.

PERFORMANCE e-BANK GUARANTEE

To

_____[name of Employer]
_____[address of Employer]
_____

WHEREAS_____[name and address of Contractor] (hereafter called "the Contractor") has undertaken, in pursuance of Contract No._ dated _____to execute _____[name of Contract and brief description of Works] (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligation in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you on behalf of the Contractor, up to a total of_____ [amount of guarantee]*_____ (in words), such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of_____[amount of guarantee] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between your and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall also be operatable at our..... Branch at Bhubaneswar, from whom, confirmation
regarding the issue of this guarantee or extension / renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked and payment thereunder claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

The guarantor/bank hereby confirms that it is on the SFMS (Structural Finance Messaging System) platform & shall invariably send an advice of this Bank Guarantee to the designated bank of Odisha Bridge & Construction Corporation Ltd details of which is as under:

Sl. No.	Particulars	Details
1	Name of Beneficiary	OB&CC Ltd.
2	Name of Bank	CANARA BANK
3	Account No	80073210000014
4	IFSC Code	CNRB0018007

This guarantee shall be valid until 28 days from the date of expiry of the Defect Liability Period. Signature and Seal of the guarantor _
Name of Bank _____
Address_____
Date _____

* An amount shall be inserted by the Guarantor, representing the percentage the Contract Price specified in the Contract including additional security for unbalanced Bids, if any and denominated in Indian Rupees.

BANK GUARANTEE FOR ADVANCE PAYMENT

To

_____[name of Employer]
_____[address of Employer]
_____[name of Contractor]

Gentlemen :

In accordance with the provisions of the Conditions of Contract, sub-clause 47.1 ("Advance Payment") of the above-mentioned Contract, _____[name and address of Contractor] (hereinafter called "the Contractor") shall deposit with_____ [name of Employer] a bank guarantee to guarantee his proper_____and faithful performance under the said Clause of the Contract in an amount of____[amount of Guarantee] *_[in words].

We, the _____[bank or financial institution], as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to_____[name of Employer] on his first demand without whatsoever right of obligation on our part and without his first claim to the Contractor, in the amount not exceeding _____ [amount of guarantee]*_____[in words].

We further agree that no change or addition to or other modification of the terms of the Contractor or Works to be performed thereunder or of any of the Contract documents which may be made between _____ [name of Employer] and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall also be operatable at our Branch at Bhubaneswar, from whom, confirmation regarding the issue of this guarantee or extension / renewal thereof shall be made available on demand. In the contingency of this guarantee being invoked and payment thereunder claimed, the said branch shall accept such invocation letter and make payment of amounts so demanded under the said invocation.

The guarantor/bank hereby confirms that it is on the SFMS (Structural Finance Messaging System) platform & shall invariably send an advice of this Bank Guarantee to the designated bank of Odisha Bridge & Construction Corporation Ltd details of which is as under:

Sl. No.	**Particulars**	**Details**
1	Name of Beneficiary	OB&CC Ltd.
2	Name of Bank	CANARA BANK
3	Account No	80073210000014
4	IFSC Code	CNRB0018007

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until

_____[name of Employer] receives full repayment of the same amount from the Contractor.

Yours truly,

Signature and Seal :_____
Name of Bank / Financial Institution : _____
Address: _____
Date:_____

* An amount shall be inserted by the Bank or Financial Institution representing the amount of the Advance Payment and denominated in Indian Rupees.

Completion Certificate

1 I… ..... (Name of the Engineer), acting as the Engineer, under and in accordance with the Agreement dated ..... (the "Agreement"), for [construction of the ****) on Turn Key basis through (Name of Contractor), hereby certify that the Tests in accordance with Contract Agreement have been successfully undertaken to determine compliance of the Project with the provisions of the Agreement, and I am satisfied that the Project can be safely and reliably placed in service of the Users thereof.

2 It is certified that, in terms of the aforesaid Agreement, all works forming part of Project have been completed, and the Project is hereby declared fit for entry into operation on this the day of 20....., Scheduled Completed Date for
which was the….. day of... 20……

SIGNED, SEALED AND DELIVERED

For and on behalf of the Engineer by:

(Signature)

(Name)

(Designation)

(Address)

Taking Over Certificate

I, ...(Name and designation of the Employer's Representative) under and in accordance with the Agreement dated …….. (the "Agreement"), for [construction of ****] (the "Project") Turn Key basis through …… (Name of Contractor), hereby certify that the Tests on completion of Defect Liability Period in accordance with the Agreement have been successfully undertaken to determine compliance of the Project with the provisions of the Agreement and I hereby certify that the Employer has taken over the Project from the Contractor on this day……

SIGNED, SEALED AND DELIVERED

(Signature)

(Name and designation of Authority's

Representative)

(Address)

SECTION –7

DRAWINGS

Architecture Drawings

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Architecture	
	Overall	
1	MKCGB-DDF-OVL-SUR-PLN-1000	
2	MKCGB-DDF-OVL-ARC-PLN-1001	
3	MKCGB-DDF-OVL-ARC-PLN-1002	
4	MKCGB-DDF-OVL-ARC-PLN-1003	
5	MKCGB-DDF-OVL-ARC-PLN-1004	
6	MKCGB-DDF-OVL-ARC-PLN-1005	
	B01_Hospital	
1	MKCGB-DDF-B01-ARC-PLN-1100	
2	MKCGB-DDF-B01-ARC-PLN-1101	
3	MKCGB-DDF-B01-ARC-PLN-1102	
4	MKCGB-DDF-B01-ARC-PLN-1103	
5	MKCGB-DDF-B01-ARC-PLN-1104	
6	MKCGB-DDF-B01-ARC-PLN-1105	
7	MKCGB-DDF-B01-ARC-PLN-1106	
8	MKCGB-DDF-B01-ARC-PLN-1107	
9	MKCGB-DDF-B01-ARC-PLN-1108	
10	MKCGB-DDF-B01-ARC-PLN-1109	
11	MKCGB-DDF-B01-ARC-ELE-1110	
12	MKCGB-DDF-B01-ARC-ELE-1110A	
13	MKCGB-DDF-B01-ARC-ELE-1110B	
14	MKCGB-DDF-B01-ARC-SEC-1111	
	B02_ESS-A	
1	MKCGB-DDF-B02-ARC-PLN-1200	
2	MKCGB-DDF-B02-ARC-PLN-1201	
3	MKCGB-DDF-B02-ARC-ELE-1202	
	B03_INDOOR STADIUM	
1	MKCGB-DDF-B03-ARC-PLN-1300	
2	MKCGB-DDF-B03-ARC-PLN-1301	
3	MKCGB-DDF-B03-ARC-PLN-1302	
4	MKCGB-DDF-B03-ARC-PLN-1303	
5	MKCGB-DDF-B03-ARC-SEC-1304	
6	MKCGB-DDF-B03-ARC-ELE-1305A	
7	MKCGB-DDF-B03-ARC-ELE-1305B	
	B04_SURGEON MALE HOSTEL	
1	MKCGB-DDF-B04-ARC-PLN-1400	
2	MKCGB-DDF-B04-ARC-PLN-1401	
3	MKCGB-DDF-B04-ARC-PLN-1401A	
4	MKCGB-DDF-B04-ARC-PLN-1402	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Architecture	
5	MKCGB-DDF-B04-ARC-PLN-1403	
6	MKCGB-DDF-B04-ARC-PLN-1404	
7	MKCGB-DDF-B04-ARC-PLN-1405	
8	MKCGB-DDF-B04-ARC-ELE-1406A	
9	MKCGB-DDF-B04-ARC-ELE-1406B	
10	MKCGB-DDF-B04-ARC-ELE-1406C	
11	MKCGB-DDF-B04-ARC-ELE-1406D	
12	MKCGB-DDF-B04-ARC-SEC-1407	
	B05_SURGEON FEMALE HOSTEL	
1	MKCGB-DDF-B05-ARC-PLN-1500	
2	MKCGB-DDF-B05-ARC-PLN-1501	
3	MKCGB-DDF-B05-ARC-PLN-1501A	
4	MKCGB-DDF-B05-ARC-PLN-1502	
5	MKCGB-DDF-B05-ARC-PLN-1503	
6	MKCGB-DDF-B05-ARC-PLN-1504	
7	MKCGB-DDF-B05-ARC-PLN-1505	
8	MKCGB-DDF-B05-ARC-ELE-1506	
9	MKCGB-DDF-B05-ARC-SEC-1507	
	B06_UG GIRLS HOSTELS	
1	MKCGB-DDF-B06-ARC-PLN-1600	
2	MKCGB-DDF-B06-ARC-PLN-1601	
3	MKCGB-DDF-B06-ARC-PLN-1602	
4	MKCGB-DDF-B06-ARC-PLN-1603	
5	MKCGB-DDF-B06-ARC-PLN-1604	
6	MKCGB-DDF-B06-ARC-ELE-1605A	
7	MKCGB-DDF-B06-ARC-ELE-1605B	
8	MKCGB-DDF-B06-ARC-ELV-1605A	
9	MKCGB-DDF-B06-ARC-ELV-1605B	
10	MKCGB-DDF-B06-ARC-ELV-1605C	
11	MKCGB-DDF-B06-ARC-ELV-1605D	
12	MKCGB-DDF-B06-ARC-SEC-1606	
	B07_TYPE IV RESIDENCE	
1	MKCGB-DDF-B07A-07B-ARC-PLN-1700	
2	MKCGB-DDF-B07A-07B-ARC-PLN-1701	
3	MKCGB-DDF-B07A-07B-ARC-PLN-1702	
4	MKCGB-DDF-B07A-07B-ARC-PLN-1703	
5	MKCGB-DDF-B07A-07B-ARC-PLN-1704	
6	MKCGB-DDF-B07A-07B-ARC-PLN-1705	
7	MKCGB-DDF-B07A-07B-ARC-PLN-1706	
8	MKCGB-DDF-B07A-07B-ARC-PLN-1707	
9	MKCGB-DDF-B07-ARC-ELE-1707A	
10	MKCGB-DDF-B07-ARC-ELE-1707B	
11	MKCGB-DDF-B07-ARC-ELE-1707C	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Architecture	
12	MKCGB-DDF-B07-ARC-ELE-1707D	
	B08A-8B_TYPE II RESIDENCE	
1	MKCGB-DDF-B08A-8B-ARC-PLN-1800	
2	MKCGB-DDF-B08A-8B-ARC-PLN-1801	
3	MKCGB-DDF-B08A-8B-ARC-PLN-1802	
4	MKCGB-DDF-B08A-8B-ARC-PLN-1803	
5	MKCGB-DDF-B08A-8B-ARC-PLN-1804	
6	MKCGB-DDF-B08A-8B-ARC-PLN-1805	
7	MKCGB-DDF-B08A-8B-ARC-PLN-1806	
8	MKCGB-DDF-B08A-08B-ARC-ELE-1807	
9	MKCGB-DDF-B08A-08B-ARC-ELE-1807A	
10	MKCGB-DDF-B08A-08B-ARC-ELE-1807B	
11	MKCGB-DDF-B08A-08B-ARC-ELE-1807C	
12	MKCGB-DDF-B08A-08B-ARC-ELE-1807D	
	B09_CLUB HOUSE	
1	MKCGB-DDF-B09-ARC-PLN-1900	
2	MKCGB-DDF-B09-ARC-PLN-1901	
3	MKCGB-DDF-B09-ARC-PLN-1902	
4	MKCGB-DDF-B09-ARC-PLN-1903	
5	MKCGB-DDF-B09-ARC-PLN-1904	
6	MKCGB-DDF-B09-ARC-ELE-1905	
7	MKCGB-DDF-B09-ARC-ELE-1906	
8	MKCGB-DDF-B09-ARC-SEC-1907	
	B10_PHARMACY COLLEGE	
1	MKCGB-DDF-B10-ARC-PLN-2000	
2	MKCGB-DDF-B10-ARC-PLN-2001	
3	MKCGB-DDF-B10-ARC-PLN-2002	
4	MKCGB-DDF-B10-ARC-PLN-2003	
5	MKCGB-DDF-B10-ARC-PLN-2004	
6	MKCGB-DDF-B10-ARC-PLN-2005	
7	MKCGB-DDF-B10-ARC-PLN-2006	
8	MKCGB-DDF-B10-ARC-PLN-2007	
9	MKCGB-DDF-B10-ARC-ELE-2008	
10	MKCGB-DDF-B10-ARC-ELE-2008A	
11	MKCGB-DDF-B10-ARC-SEC-2009	
	B11_BOYS HOSTEL(PC)	
1	MKCGB-DDF-B11-ARC-PLN-2100	
2	MKCGB-DDF-B11-ARC-PLN-2101	
3	MKCGB-DDF-B11-ARC-PLN-2102	
4	MKCGB-DDF-B11-ARC-PLN-2103	
5	MKCGB-DDF-B11-ARC-PLN-2104	
6	MKCGB-DDF-B11-ARC-PLN-2105	
7	MKCGB-DDF-B11-ARC-PLN-2106	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Architecture	
8	MKCGB-DDF-B11-ARC-ELE-2107	
9	MKCGB-DDF-B11-ARC-ELE-2107A	
10	MKCGB-DDF-B11-ARC-ELE-2107B	
11	MKCGB-DDF-B11-ARC-ELE-2107C	
12	MKCGB-DDF-B11-ARC-ELE-2107D	
13	MKCGB-DDF-B11-ARC-SEC-2108	
	B12_GIRLS HOSTEL(PC)	
1	MKCGB-DDF-B12-ARC-PLN-2200	
2	MKCGB-DDF-B12-ARC-PLN-2201	
3	MKCGB-DDF-B12-ARC-PLN-2202	
4	MKCGB-DDF-B12-ARC-PLN-2203	
5	MKCGB-DDF-B12-ARC-PLN-2204	
6	MKCGB-DDF-B12-ARC-PLN-2205	
7	MKCGB-DDF-B12-ARC-PLN-2206	
8	MKCGB-DDF-B12-ARC-ELE-2207	
9	MKCGB-DDF-B12-ARC-ELE-2207A	
10	MKCGB-DDF-B12-ARC-ELE-2207B	
11	MKCGB-DDF-B12-ARC-SEC-2208	
	B13_DENTAL COLLEGE	
1	MKCGB-DDF-B13-ARC-PLN-2300	
2	MKCGB-DDF-B13-ARC-PLN-2301	
3	MKCGB-DDF-B13-ARC-PLN-2302	
4	MKCGB-DDF-B13-ARC-PLN-2303	
5	MKCGB-DDF-B13-ARC-PLN-2304	
6	MKCGB-DDF-B13-ARC-PLN-2305	
7	MKCGB-DDF-B13-ARC-PLN-2306	
8	MKCGB-DDF-B13-ARC-PLN-2307	
9	MKCGB-DDF-B13-ARC-PLN-2308	
10	MKCGB-DDF-B13-ARC-PLN-2309	
11	MKCGB-DDF-B13-ARC-ELV-2310	
12	MKCGB-DDF-B13-ARC-ELV-2310A	
13	MKCGB-DDF-B13-ARC-ELV-2310B	
14	MKCGB-DDF-B13-ARC-SEC-2311	
15	MKCGB-DDF-B13-ARC-SEC-2312	
	B14_BOYS HOSTEL(DC)	
1	MKCGB-DDF-B14-ARC-PLN-2400	
2	MKCGB-DDF-B14-ARC-PLN-2401	
3	MKCGB-DDF-B14-ARC-PLN-2401A	
4	MKCGB-DDF-B14-ARC-PLN-2402	
5	MKCGB-DDF-B14-ARC-PLN-2403	
6	MKCGB-DDF-B14-ARC-PLN-2404	
7	MKCGB-DDF-B14-ARC-ELV-2405	
8	MKCGB-DDF-B14-ARC-ELV-2405A	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Architecture	
9	MKCGB-DDF-B14-ARC-SEC-2406	
	B15_GIRLS HOSTEL(DC)	
1	MKCGB-DDF-B15-ARC-PLN-2500	
2	MKCGB-DDF-B15-ARC-PLN-2500A	
3	MKCGB-DDF-B15-ARC-PLN-2501	
4	MKCGB-DDF-B15-ARC-PLN-2501A	
5	MKCGB-DDF-B15-ARC-PLN-2502	
6	MKCGB-DDF-B15-ARC-PLN-2503	
7	MKCGB-DDF-B15-ARC-PLN-2504	
8	MKCGB-DDF-B15-ARC-ELV-2505	
9	MKCGB-DDF-B15-ARC-ELV-2505A	
10	MKCGB-DDF-B15-ARC-SEC-2506	
	B16_ESS 2	
1	MKCGB-DDF-B16-ARC-PLN-2600	
2	MKCGB-DDF-B16-ARC-PLN-2601	
3	MKCGB-DDF-B16-ARC-ELE-2602	
	Other Drawings	
1	MKCGB-DDF-ARC-DET-2701	

MEP Drawings

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
	Overall- Electrical	
1	MKCGB-DDF-OVL-EL-PLN-4000	
2	MKCGB-DDF-EL-SLD-4001	
3	MKCGB-DDF-EL-SLD-4002	
4	MKCGB-DDF-EL-SLD-4003	
	Overall- Fire Fighting	
1	MKCGB-DDF-OVL-FF-PLN-6000	
	Overall- HVAC	
1	MKCGB-DDF-OVL-HVAC-PLN-7000	
	Overall- Plumbing	
1	MKCGB-DDF-OVL-PLB-PLN-3000	
2	MKCGB-DDF-OVL-PLB-PLN-3001	
3	MKCGB-DDF-OVL-PLB-PLN-3002	
	B01_HOSPITAL BLOCK	
	ELECTRICAL	
1	MKCGB-DDF-B01-EL-PLN-4100	
2	MKCGB-DDF-B01-EL-PLN-4100A	
3	MKCGB-DDF-B01-EL-PLN-4100B	
4	MKCGB-DDF-B01-EL-PLN-4101	
5	MKCGB-DDF-B01-EL-PLN-4101A	
6	MKCGB-DDF-B01-EL-PLN-4101B	
7	MKCGB-DDF-B01-EL-PLN-4102	
8	MKCGB-DDF-B01-EL-PLN-4102A	
9	MKCGB-DDF-B01-EL-PLN-4102B	
10	MKCGB-DDF-B01-EL-PLN-4103	
11	MKCGB-DDF-B01-EL-PLN-4103A	
12	MKCGB-DDF-B01-EL-PLN-4103B	
13	MKCGB-DDF-B01-EL-PLN-4104	
14	MKCGB-DDF-B01-EL-PLN-4104A	
15	MKCGB-DDF-B01-EL-PLN-4104B	
16	MKCGB-DDF-B01-EL-PLN-4105	
17	MKCGB-DDF-B01-EL-PLN-4105A	
18	MKCGB-DDF-B01-EL-PLN-4105B	
19	MKCGB-DDF-B01-EL-PLN-4106	
20	MKCGB-DDF-B01-EL-PLN-4106A	
21	MKCGB-DDF-B01-EL-PLN-4106B	
22	MKCGB-DDF-B01-EL-PLN-4107	
23	MKCGB-DDF-B01-EL-PLN-4107A	
24	MKCGB-DDF-B01-EL-PLN-4107B	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
25	MKCGB-DDF-B01-EL-PLN-4108	
26	MKCGB-DDF-B01-EL-PLN-4108A	
27	MKCGB-DDF-B01-EL-PLN-4108B	
	FIRE FIGHTING	
1	MKCGB-DDF-B01-FF-PLN-5100	
2	MKCGB-DDF-B01-FF-PLN-5101	
3	MKCGB-DDF-B01-FF-PLN-5102	
4	MKCGB-DDF-B01-FF-PLN-5103	
5	MKCGB-DDF-B01-FF-PLN-5104	
6	MKCGB-DDF-B01-FF-PLN-5105	
7	MKCGB-DDF-B01-FF-PLN-5106	
8	MKCGB-DDF-B01-FF-PLN-5107	
9	MKCGB-DDF-B01-FF-PLN-5108	
10	MKCGB-DDF-B01-FF-PLN-5109	
	HVAC	
1	MKCGB-DDF-B01-HVAC-PLN-6100	
2	MKCGB-DDF-B01-HVAC-PLN-6101	
3	MKCGB-DDF-B01-HVAC-PLN-6102	
4	MKCGB-DDF-B01-HVAC-PLN-6103	
5	MKCGB-DDF-B01-HVAC-PLN-6104	
6	MKCGB-DDF-B01-HVAC-PLN-6105	
7	MKCGB-DDF-B01-HVAC-PLN-6106	
8	MKCGB-DDF-B01-HVAC-PLN-6107	
9	MKCGB-DDF-B01-HVAC-PLN-6108	
10	MKCGB-DDF-B01-HVAC-PLN-6109	
	PLUMBING	
1	MKCGB-DDF-B01-PLB-PLN-3100	
2	MKCGB-DDF-B01-PLB-PLN-3100A	
3	MKCGB-DDF-B01-PLB-PLN-3101	
4	MKCGB-DDF-B01-PLB-PLN-3102	
5	MKCGB-DDF-B01-PLB-PLN-3103	
6	MKCGB-DDF-B01-PLB-PLN-3104	
7	MKCGB-DDF-B01-PLB-PLN-3105	
8	MKCGB-DDF-B01-PLB-PLN-3106	
9	MKCGB-DDF-B01-PLB-PLN-3107	
10	MKCGB-DDF-B01-PLB-PLN-3108	
11	MKCGB-DDF-B01-PLB-PLN-3109	
	B02_ESS BLOCK	
	ELECTRICAL	
1	MKCGB-DDF-B02-ELE-PLN-4201	
2	MKCGB-DDF-B02-ELE-PLN-4202	
3	MKCGB-DDF-B02-ELE-PLN-4203	
	B03_INDOOR STADIUM	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
	ELECTRICAL	
1	MKCGB-DDF-B03-EL-PLN-4300	
2	MKCGB-DDF-B03-EL-PLN-4301	
3	MKCGB-DDF-B03-EL-PLN-4302	
4	MKCGB-DDF-B03-EL-PLN-4303	
	FIRE FIGHTING	
1	MKCGB-DDF-B03-FF-PLN-5300	
2	MKCGB-DDF-B03-FF-PLN-5301	
3	MKCGB-DDF-B03-FF-PLN-5302	
4	MKCGB-DDF-B03-FF-PLN-5303	
	HVAC	
1	MKCGB-DDF-B03-HVAC-PLN-6300	
2	MKCGB-DDF-B03-HVAC-PLN-6301	
	PLUMBING	
1	MKCGB-DDF-B03-PL-PLN-3300	
2	MKCGB-DDF-B03-PL-PLN-3301	
3	MKCGB-DDF-B03-PL-PLN-3302	
4	MKCGB-DDF-B03-PL-PLN-3303	
	B04_SURGEON MALE HOSTEL	
	ELECTRICAL	
1	MKCGB-DDF-B04-EL-PLN-4400	
2	MKCGB-DDF-B04-EL-PLN-4401	
3	MKCGB-DDF-B04-EL-PLN-4402	
4	MKCGB-DDF-B04-EL-PLN-4403	
5	MKCGB-DDF-B04-EL-PLN-4404	
6	MKCGB-DDF-B04-EL-PLN-4405	
	FIRE FIGHTING	
1	MKCGB-DDF-B04-FF-PLN-5400	
2	MKCGB-DDF-B04-FF-PLN-5401	
3	MKCGB-DDF-B04-FF-PLN-5402	
4	MKCGB-DDF-B04-FF-PLN-5403	
5	MKCGB-DDF-B04-FF-PLN-5404	
6	MKCGB-DDF-B04-FF-PLN-5405	
	HVAC	
1	MKCGB-DDF-B04-HVAC-PLN-6400	
2	MKCGB-DDF-B04-HVAC-PLN-6401	
3	MKCGB-DDF-B04-HVAC-PLN-6402	
4	MKCGB-DDF-B04-HVAC-PLN-6403	
5	MKCGB-DDF-B04-HVAC-PLN-6404	
6	MKCGB-DDF-B04-HVAC-PLN-6405	
	PLUMBING	
1	MKCGB-DDF-B04-PL-PLN-3400	
2	MKCGB-DDF-B04-PL-PLN-3401	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
3	MKCGB-DDF-B04-PL-PLN-3402	
4	MKCGB-DDF-B04-PL-PLN-3403	
5	MKCGB-DDF-B04-PL-PLN-3404	
6	MKCGB-DDF-B04-PL-PLN-3405	
	B05_SURGEON FEMALE HOSTEL	
	ELECTRICAL	
1	MKCGB-DDF-B05-EL-PLN-4500	
2	MKCGB-DDF-B05-EL-PLN-4501	
3	MKCGB-DDF-B05-EL-PLN-4502	
4	MKCGB-DDF-B05-EL-PLN-4503	
5	MKCGB-DDF-B05-EL-PLN-4504	
	FIRE FIGHTING	
1	MKCGB-DDF-B05-FF-PLN-5500	
2	MKCGB-DDF-B05-FF-PLN-5501	
3	MKCGB-DDF-B05-FF-PLN-5502	
4	MKCGB-DDF-B05-FF-PLN-5503	
5	MKCGB-DDF-B05-FF-PLN-5504	
	HVAC	
1	MKCGB-DDF-B05-HVAC-PLN-6500	
2	MKCGB-DDF-B05-HVAC-PLN-6501	
3	MKCGB-DDF-B05-HVAC-PLN-6502	
4	MKCGB-DDF-B05-HVAC-PLN-6503	
5	MKCGB-DDF-B05-HVAC-PLN-6504	
	PLUMBING	
1	MKCGB-DDF-B05-PL-PLN-3500	
2	MKCGB-DDF-B05-PL-PLN-3501	
3	MKCGB-DDF-B05-PL-PLN-3502	
4	MKCGB-DDF-B05-PL-PLN-3503	
5	MKCGB-DDF-B05-PL-PLN-3504	
	B06_UG GIRLS HOSTEL	
	ELECTRICAL	
1	MKCGB-DDF-B06-EL-PLN-4600	
2	MKCGB-DDF-B06-EL-PLN-4601	
3	MKCGB-DDF-B06-EL-PLN-4602	
4	MKCGB-DDF-B06-EL-PLN-4603	
	FIRE FIGHTING	
1	MKCGB-DDF-B06-FF-PLN-5600	
2	MKCGB-DDF-B06-FF-PLN-5601	
3	MKCGB-DDF-B06-FF-PLN-5602	
4	MKCGB-DDF-B06-FF-PLN-5603	
	HVAC	
1	MKCGB-DDF-B06-HVAC-PLN-6600	
2	MKCGB-DDF-B06-HVAC-PLN-6601	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
3	MKCGB-DDF-B06-HVAC-PLN-6602	
4	MKCGB-DDF-B06-HVAC-PLN-6603	
5	MKCGB-DDF-B06-HVAC-PLN-6604	
6	MKCGB-DDF-B06-HVAC-PLN-6605	
7	MKCGB-DDF-B06-HVAC-PLN-6606	
	PLUMBING	
1	MKCGB-DDF-B06-PL-PLN-3600	
2	MKCGB-DDF-B06-PL-PLN-3601	
3	MKCGB-DDF-B06-PL-PLN-3602	
4	MKCGB-DDF-B06-PL-PLN-3603	
	B07_TYPE IV RESIDENCE	
	ELECTRICAL	
1	MKCGB-DDF-B07-EL-PLN-4700	
2	MKCGB-DDF-B07-EL-PLN-4701	
3	MKCGB-DDF-B07-EL-PLN-4702	
4	MKCGB-DDF-B07-EL-PLN-4703	
5	MKCGB-DDF-B07-EL-PLN-4704	
	FIRE FIGHTING	
1	MKCGB-DDF-B07-FF-PLN-5700	
2	MKCGB-DDF-B07-FF-PLN-5701	
3	MKCGB-DDF-B07-FF-PLN-5702	
4	MKCGB-DDF-B07-FF-PLN-5703	
5	MKCGB-DDF-B07-FF-PLN-5704	
	PLUMBING	
1	MKCGB-DDF-B07-PLB-PLN-3700	
2	MKCGB-DDF-B07-PLB-PLN-3701	
3	MKCGB-DDF-B07-PLB-PLN-3702	
4	MKCGB-DDF-B07-PLB-PLN-3703	
5	MKCGB-DDF-B07-PLB-PLN-3704	
	B08_ 8A & 8B _TYPE II RESIDENCE	
	ELECTRICAL	
1	MKCGB-DDF-B08A-8B-EL-PLN-4800	
2	MKCGB-DDF-B08A-8B-EL-PLN-4801	
3	MKCGB-DDF-B08A-8B-EL-PLN-4802	
4	MKCGB-DDF-B08A-8B-EL-PLN-4803	
5	MKCGB-DDF-B08A-8B-EL-PLN-4804	
6	MKCGB-DDF-B08A-8B-EL-PLN-4805	
	FIRE FIGHTING	
1	MKCGB-DDF-B08A-8B-FF-PLN-5800	
2	MKCGB-DDF-B08A-8B-FF-PLN-5801	
3	MKCGB-DDF-B08A-8B-FF-PLN-5802	
4	MKCGB-DDF-B08A-8B-FF-PLN-5803	
5	MKCGB-DDF-B08A-8B-FF-PLN-5804	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
6	MKCGB-DDF-B08A-8B-FF-PLN-5805	
	PLUMBING	
1	MKCGB-DDF-B08A-8B-PLB-PLN-3800	
2	MKCGB-DDF-B08A-8B-PLB-PLN-3801	
3	MKCGB-DDF-B08A-8B-PLB-PLN-3801A	
4	MKCGB-DDF-B08A-8B-PLB-PLN-3802	
5	MKCGB-DDF-B08A-8B-PLB-PLN-3803	
6	MKCGB-DDF-B08A-8B-PLB-PLN-3804	
7	MKCGB-DDF-B08A-8B-PLB-PLN-3805	
	B09_ CLUB HOUSE	
	ELECTRICAL	
1	MKCGB-DDF-B09-EL-PLN-4900	
2	MKCGB-DDF-B09-EL-PLN-4901	
3	MKCGB-DDF-B09-EL-PLN-4902	
4	MKCGB-DDF-B09-EL-PLN-4903	
	FIRE FIGHTING	
1	MKCGB-DDF-B09-FF-PLN-5900	
2	MKCGB-DDF-B09-FF-PLN-5901	
3	MKCGB-DDF-B09-FF-PLN-5902	
4	MKCGB-DDF-B09-FF-PLN-5903	
	HVAC	
1	MKCGB-DDF-B09-HVAC-PLN-6900	
2	MKCGB-DDF-B09-HVAC-PLN-6901	
3	MKCGB-DDF-B09-HVAC-PLN-6902	
4	MKCGB-DDF-B09-HVAC-PLN-6903	
5	MKCGB-DDF-B09-HVAC-PLN-6904	
	PLUMBING	
1	MKCGB-DDF-B09-PL-PLN-3900	
2	MKCGB-DDF-B09-PL-PLN-3901	
3	MKCGB-DDF-B09-PL-PLN-3902	
4	MKCGB-DDF-B09-PL-PLN-3903	
	B10_PHARMACY COLLEGE	
	ELECTRICAL	
1	MKCGB-DDF-B10-EL-PLN-5000	
2	MKCGB-DDF-B10-EL-PLN-5000A	
3	MKCGB-DDF-B10-EL-PLN-5001	
4	MKCGB-DDF-B10-EL-PLN-5001A	
5	MKCGB-DDF-B10-EL-PLN-5001B	
6	MKCGB-DDF-B10-EL-PLN-5002	
7	MKCGB-DDF-B10-EL-PLN-5002A	
8	MKCGB-DDF-B10-EL-PLN-5002B	
9	MKCGB-DDF-B10-EL-PLN-5003	
10	MKCGB-DDF-B10-EL-PLN-5003A	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
11	MKCGB-DDF-B10-EL-PLN-5003B	
12	MKCGB-DDF-B10-EL-PLN-5004	
13	MKCGB-DDF-B10-EL-PLN-5004A	
14	MKCGB-DDF-B10-EL-PLN-5004B	
15	MKCGB-DDF-B10-EL-PLN-5005	
16	MKCGB-DDF-B10-EL-PLN-5005A	
17	MKCGB-DDF-B10-EL-PLN-5005B	
18	MKCGB-DDF-B10-EL-PLN-5006	
19	MKCGB-DDF-B10-EL-PLN-5006A	
20	MKCGB-DDF-B10-EL-PLN-5006B	
21	MKCGB-DDF-B10-EL-PLN-5007	
22	MKCGB-DDF-B10-EL-PLN-5007A	
23	MKCGB-DDF-B10-EL-PLN-5007B	
	FIRE FIGHTING	
1	MKCGB-DDF-B10-FF-PLN-6000	
2	MKCGB-DDF-B10-FF-PLN-6001	
3	MKCGB-DDF-B10-FF-PLN-6002	
4	MKCGB-DDF-B10-FF-PLN-6003	
5	MKCGB-DDF-B10-FF-PLN-6004	
6	MKCGB-DDF-B10-FF-PLN-6005	
7	MKCGB-DDF-B10-FF-PLN-6006	
8	MKCGB-DDF-B10-FF-PLN-6007	
	HVAC	
1	MKCGB-DDF-B10-HVAC-PLN-7000	
2	MKCGB-DDF-B10-HVAC-PLN-7001	
3	MKCGB-DDF-B10-HVAC-PLN-7002	
4	MKCGB-DDF-B10-HVAC-PLN-7003	
5	MKCGB-DDF-B10-HVAC-PLN-7004	
6	MKCGB-DDF-B10-HVAC-PLN-7005	
7	MKCGB-DDF-B10-HVAC-PLN-7006	
8	MKCGB-DDF-B10-HVAC-PLN-7007	
	PLUMBING	
1	MKCGB-DDF-B10-PLB-PLN-4000	
2	MKCGB-DDF-B10-PLB-PLN-4001	
3	MKCGB-DDF-B10-PLB-PLN-4002	
4	MKCGB-DDF-B10-PLB-PLN-4003	
5	MKCGB-DDF-B10-PLB-PLN-4004	
6	MKCGB-DDF-B10-PLB-PLN-4005	
7	MKCGB-DDF-B10-PLB-PLN-4006	
8	MKCGB-DDF-B10-PLB-PLN-4007	
	B11_BOYS HOSTEL PHARMACY	
	ELECTRICAL	
1	MKCGB-DDF-B11-EL-PLN-5100	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
2	MKCGB-DDF-B11-EL-PLN-5101	
3	MKCGB-DDF-B11-EL-PLN-5102	
4	MKCGB-DDF-B11-EL-PLN-5103	
5	MKCGB-DDF-B11-EL-PLN-5104	
6	MKCGB-DDF-B11-EL-PLN-5105	
7	MKCGB-DDF-B11-EL-PLN-5106	
8	MKCGB-DDF-B11-EL-PLN-5107	
9	MKCGB-DDF-B11-EL-PLN-5108	
10	MKCGB-DDF-B11-EL-PLN-5109	
	FIRE FIGHTING	
1	MKCGB-DDF-B11-FF-PLN-6100	
2	MKCGB-DDF-B11-FF-PLN-6101	
3	MKCGB-DDF-B11-FF-PLN-6102	
4	MKCGB-DDF-B11-FF-PLN-6103	
5	MKCGB-DDF-B11-FF-PLN-6104	
6	MKCGB-DDF-B11-FF-PLN-6105	
7	MKCGB-DDF-B11-FF-PLN-6106	
8	MKCGB-DDF-B11-FF-PLN-6107	
9	MKCGB-DDF-B11-FF-PLN-6108	
10	MKCGB-DDF-B11-FF-PLN-6109	
	PLUMBING	
1	MKCGB-DDF-B11-PLB-PLN-4100	
2	MKCGB-DDF-B11-PLB-PLN-4101	
3	MKCGB-DDF-B11-PLB-PLN-4102	
4	MKCGB-DDF-B11-PLB-PLN-4103	
5	MKCGB-DDF-B11-PLB-PLN-4104	
6	MKCGB-DDF-B11-PLB-PLN-4105	
7	MKCGB-DDF-B11-PLB-PLN-4106	
8	MKCGB-DDF-B11-PLB-PLN-4107	
9	MKCGB-DDF-B11-PLB-PLN-4108	
10	MKCGB-DDF-B11-PLB-PLN-4109	
	B12_ GIRLS HOSTEL PHARMACY	
	ELECTRICAL	
1	MKCGB-DDF-B12-ELC-PLN-5200	
2	MKCGB-DDF-B12-ELC-PLN-5201	
3	MKCGB-DDF-B12-ELC-PLN-5202	
4	MKCGB-DDF-B12-ELC-PLN-5203	
5	MKCGB-DDF-B12-ELC-PLN-5204	
6	MKCGB-DDF-B12-ELC-PLN-5205	
7	MKCGB-DDF-B12-ELC-PLN-5206	
8	MKCGB-DDF-B12-ELC-PLN-5207	
9	MKCGB-DDF-B12-ELC-PLN-5208	
	FIRE FIGHTING	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
1	MKCGB-DDF-B12-FF-PLN-6200	
2	MKCGB-DDF-B12-FF-PLN-6201	
3	MKCGB-DDF-B12-FF-PLN-6202	
4	MKCGB-DDF-B12-FF-PLN-6203	
5	MKCGB-DDF-B12-FF-PLN-6204	
6	MKCGB-DDF-B12-FF-PLN-6205	
7	MKCGB-DDF-B12-FF-PLN-6206	
8	MKCGB-DDF-B12-FF-PLN-6207	
9	MKCGB-DDF-B12-FF-PLN-6208	
	PLUMBING	
1	MKCGB-DDF-B12-PLB-PLN-4200	
2	MKCGB-DDF-B12-PLB-PLN-4201	
3	MKCGB-DDF-B12-PLB-PLN-4202	
4	MKCGB-DDF-B12-PLB-PLN-4203	
5	MKCGB-DDF-B12-PLB-PLN-4204	
6	MKCGB-DDF-B12-PLB-PLN-4205	
7	MKCGB-DDF-B12-PLB-PLN-4206	
8	MKCGB-DDF-B12-PLB-PLN-4207	
9	MKCGB-DDF-B12-PLB-PLN-4208	
	B13_DENTAL COLLEGE	
	ELECTRICAL	
1	MKCGB-DDF-B13-EL-PLN-5300	
2	MKCGB-DDF-B13-EL-PLN-5301	
3	MKCGB-DDF-B13-EL-PLN-5302	
4	MKCGB-DDF-B13-EL-PLN-5303	
5	MKCGB-DDF-B13-EL-PLN-5304	
6	MKCGB-DDF-B13-EL-PLN-5305	
7	MKCGB-DDF-B13-EL-PLN-5306	
8	MKCGB-DDF-B13-EL-PLN-5307	
9	MKCGB-DDF-B13-EL-PLN-5308	
10	MKCGB-DDF-B13-EL-PLN-5309	
	FIRE FIGHTING	
1	MKCGB-DDF-B13-FF-PLN-6300	
2	MKCGB-DDF-B13-FF-PLN-6301	
3	MKCGB-DDF-B13-FF-PLN-6302	
4	MKCGB-DDF-B13-FF-PLN-6303	
5	MKCGB-DDF-B13-FF-PLN-6304	
6	MKCGB-DDF-B13-FF-PLN-6305	
7	MKCGB-DDF-B13-FF-PLN-6306	
8	MKCGB-DDF-B13-FF-PLN-6307	
9	MKCGB-DDF-B13-FF-PLN-6308	
10	MKCGB-DDF-B13-FF-PLN-6309	
	HVAC	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
1	MKCGB-DDF-B13-HVAC-PLN-7300	
2	MKCGB-DDF-B13-HVAC-PLN-7301	
3	MKCGB-DDF-B13-HVAC-PLN-7302	
4	MKCGB-DDF-B13-HVAC-PLN-7303	
5	MKCGB-DDF-B13-HVAC-PLN-7304	
6	MKCGB-DDF-B13-HVAC-PLN-7305	
7	MKCGB-DDF-B13-HVAC-PLN-7306	
8	MKCGB-DDF-B13-HVAC-PLN-7307	
9	MKCGB-DDF-B13-HVAC-PLN-7308	
10	MKCGB-DDF-B13-HVAC-PLN-7309	
	PLUMBING	
1	MKCGB-DDF-B13-PLB-PLN-4300	
2	MKCGB-DDF-B13-PLB-PLN-4300A	
3	MKCGB-DDF-B13-PLB-PLN-4301	
4	MKCGB-DDF-B13-PLB-PLN-4302	
5	MKCGB-DDF-B13-PLB-PLN-4303	
6	MKCGB-DDF-B13-PLB-PLN-4304	
7	MKCGB-DDF-B13-PLB-PLN-4305	
8	MKCGB-DDF-B13-PLB-PLN-4306	
9	MKCGB-DDF-B13-PLB-PLN-4307	
10	MKCGB-DDF-B13-PLB-PLN-4308	
11	MKCGB-DDF-B13-PLB-PLN-4309	
	B14_BOYS HOSTEL DENTAL	
	ELECTRICAL	
1	MKCGB-DDF-B14-EL-PLN-5400	
2	MKCGB-DDF-B14-EL-PLN-5401	
3	MKCGB-DDF-B14-EL-PLN-5402	
4	MKCGB-DDF-B14-EL-PLN-5403	
5	MKCGB-DDF-B14-EL-PLN-5404	
6	MKCGB-DDF-B14-EL-PLN-5405	
7	MKCGB-DDF-B14-EL-PLN-5406	
	FIRE FIGHTING	
1	MKCGB-DDF-B14-FF-PLN-6400	
2	MKCGB-DDF-B14-FF-PLN-6401	
3	MKCGB-DDF-B14-FF-PLN-6402	
4	MKCGB-DDF-B14-FF-PLN-6403	
5	MKCGB-DDF-B14-FF-PLN-6404	
6	MKCGB-DDF-B14-FF-PLN-6405	
	PLUMBING	
1	MKCGB-DDF-B14-PLB-PLN-4400	
2	MKCGB-DDF-B14-PLB-PLN-4401	
3	MKCGB-DDF-B14-PLB-PLN-4402	
4	MKCGB-DDF-B14-PLB-PLN-4403	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	MEP	
5	MKCGB-DDF-B14-PLB-PLN-4404	
6	MKCGB-DDF-B14-PLB-PLN-4405	
7	MKCGB-DDF-B14-PLB-PLN-4406	
	B15_ GIRLS HOSTEL DENTAL	
	ELECTRICAL	
1	MKCGB-DDF-B15-ELC-PLN-5500	
2	MKCGB-DDF-B15-ELC-PLN-5501	
3	MKCGB-DDF-B15-ELC-PLN-5502	
4	MKCGB-DDF-B15-ELC-PLN-5503	
5	MKCGB-DDF-B15-ELC-PLN-5504	
6	MKCGB-DDF-B15-ELC-PLN-5505	
7	MKCGB-DDF-B15-ELC-PLN-5506	
	FIRE FIGHTING	
1	MKCGB-DDF-B15-FF-PLN-6600	
2	MKCGB-DDF-B15-FF-PLN-6601	
3	MKCGB-DDF-B15-FF-PLN-6602	
4	MKCGB-DDF-B15-FF-PLN-6603	
5	MKCGB-DDF-B15-FF-PLN-6604	
6	MKCGB-DDF-B15-FF-PLN-6605	
7	MKCGB-DDF-B15-FF-PLN-6606	
	PLUMBING	
1	MKCGB-DDF-B15-PLB-PLN-4500	
2	MKCGB-DDF-B15-PLB-PLN-4501	
3	MKCGB-DDF-B15-PLB-PLN-4502	
4	MKCGB-DDF-B15-PLB-PLN-4503	
5	MKCGB-DDF-B15-PLB-PLN-4504	
6	MKCGB-DDF-B15-PLB-PLN-4505	
7	MKCGB-DDF-B15-PLB-PLN-4506	
	B16_ ESS2	
	ELECTRICAL	
1	MKCGB-DDF-B16-ELC-PLN-5600	
2	MKCGB-DDF-B16-ELC-PLN-5601	
3	MKCGB-DDF-B16-ELC-PLN-5602	
	HVAC	
	MKCGB-DDF-B16-HVAC-PLN-7700	

Structure Drawings

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Structure	
	B01_Hospital	
1	MKCGB-DDF-B01-STR-PLN-2100	
2	MKCGB-DDF-B01-STR-PLN-2101	
3	MKCGB-DDF-B01-STR-PLN-2102	
4	MKCGB-DDF-B01-STR-PLN-2103	
5	MKCGB-DDF-B01-STR-PLN-2104	
6	MKCGB-DDF-B01-STR-PLN-2105	
7	MKCGB-DDF-B01-STR-PLN-2106	
8	MKCGB-DDF-B01-STR-PLN-2107	
9	MKCGB-DDF-B01-STR-PLN-2108	
10	MKCGB-DDF-B01-STR-PLN-2109	
	B02_ESS-A	
1	MKCGB-DDF-B02-STR-PLN-2200	
2	MKCGB-DDF-B02-STR-PLN-2201	
	B03_INDOOR STADIUM	
1	MKCGB-DDF-B03-STR-PLN-2301	
2	MKCGB-DDF-B03-STR-PLN-2302	
3	MKCGB-DDF-B03-STR-PLN-2303	
	B04_SURGEON MALE HOSTEL	
1	MKCGB-DDF-B04-STR-PLN-2400	
2	MKCGB-DDF-B04-STR-PLN-2401	
3	MKCGB-DDF-B04-STR-PLN-2402	
4	MKCGB-DDF-B04-STR-PLN-2403	
5	MKCGB-DDF-B04-STR-PLN-2404	
	B05_SURGEON FEMALE HOSTEL	
1	MKCGB-DDF-B05-STR -PLN-2500	
2	MKCGB-DDF-B05-STR -PLN-2501	
3	MKCGB-DDF-B05-STR -PLN-2502	
4	MKCGB-DDF-B05-STR -PLN-2503	
5	MKCGB-DDF-B05-STR -PLN-2504	
	B06_UG GIRLS HOSTELS	
1	MKCGB-DDF-B06-STR-PLN-2600	
2	MKCGB-DDF-B06-STR-PLN-2601	
3	MKCGB-DDF-B06-STR-PLN-2602	
4	MKCGB-DDF-B06-STR-PLN-2603	
5	MKCGB-DDF-B06-STR-PLN-2604	
6	MKCGB-DDF-B06-STR-PLN-2605	
	B07_TYPE IV RESIDENCE	
1	MKCGB-DDF-B07-STR-PLN-2700	
2	MKCGB-DDF-B07-STR-PLN-2701	
3	MKCGB-DDF-B07-STR-PLN-2702	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Structure	
	B08A-8B_TYPE II RESIDENCE	
1	MKCGB-DDF-B08A-8B-STR-PLN-2800	
2	MKCGB-DDF-B08A-8B-STR-PLN-2801	
3	MKCGB-DDF-B08A-8B-STR-PLN-2802	
4	MKCGB-DDF-B08A-8B-STR-PLN-2803	
5	MKCGB-DDF-B08A-8B-STR-PLN-2804	
	B09_CLUB HOUSE	
1	MKCGB-DDF-B09-STR-PLN-2900	
2	MKCGB-DDF-B09-STR-PLN-2901	
3	MKCGB-DDF-B09-STR-PLN-2902	
4	MKCGB-DDF-B09-STR-PLN-2903	
5	MKCGB-DDF-B09-STR-PLN-2904	
	B10_PHARMACY COLLEGE	
1	MKCGB-DDF-B10-STR-PLN-3000	
2	MKCGB-DDF-B10-STR-PLN-3001	
3	MKCGB-DDF-B10-STR-PLN-3002	
4	MKCGB-DDF-B10-STR-PLN-3003	
5	MKCGB-DDF-B10-STR-PLN-3004	
6	MKCGB-DDF-B10-STR-PLN-3005	
7	MKCGB-DDF-B10-STR-PLN-3006	
	B11_BOYS HOSTEL(PC)	
1	MKCGB-DDF-B11-STR -PLN-3100	
2	MKCGB-DDF-B11-STR -PLN-3101	
3	MKCGB-DDF-B11-STR -PLN-3102	
4	MKCGB-DDF-B11-STR -PLN-3103	
5	MKCGB-DDF-B11-STR -PLN-3104	
6	MKCGB-DDF-B11-STR -PLN-3105	
7	MKCGB-DDF-B11-STR -PLN-3106	
8	MKCGB-DDF-B11-STR -PLN-3107	
9	MKCGB-DDF-B11-STR -PLN-3108	
	B12_GIRLS HOSTEL(PC)	
1	MKCGB-DDF-B12-STR-PLN-3200	
2	MKCGB-DDF-B12-STR-PLN-3201	
3	MKCGB-DDF-B12-STR-PLN-3202	
4	MKCGB-DDF-B12-STR-PLN-3203	
5	MKCGB-DDF-B12-STR-PLN-3204	
6	MKCGB-DDF-B12-STR-PLN-3205	
7	MKCGB-DDF-B12-STR-PLN-3206	
8	MKCGB-DDF-B12-STR-PLN-3207	
	B13_DENTAL COLLEGE	
1	MKCGB-DDF-B13-STR-PLN-3300	
2	MKCGB-DDF-B13-STR-PLN-3301	
3	MKCGB-DDF-B13-STR-PLN-3302	

Redevelopment of MKCG Medical College & Hospital, Brahmapur, Ganjam (Phase-I)		
SL. No.	**Drawing No.**	**Remarks**
	Structure	
4	MKCGB-DDF-B13-STR-PLN-3303	
5	MKCGB-DDF-B13-STR-PLN-3304	
6	MKCGB-DDF-B13-STR-PLN-3305	
	B14_BOYS HOSTEL(DC)	
1	MKCGB-DDF-B14-STR-PLN-3400	
2	MKCGB-DDF-B14-STR-PLN-3401	
3	MKCGB-DDF-B14-STR-PLN-3402	
4	MKCGB-DDF-B14-STR-PLN-3403	
5	MKCGB-DDF-B14-STR-PLN-3404	
6	MKCGB-DDF-B14-STR-PLN-3405	
7	MKCGB-DDF-B14-STR-PLN-3406	
8	MKCGB-DDF-B14-STR-PLN-3407	
9	MKCGB-DDF-B14-STR-PLN-3408	
	B15_GIRLS HOSTEL(DC)	
1	MKCGB-DDF-B15-STR-PLN-3500	
2	MKCGB-DDF-B15-STR-PLN-3501	
3	MKCGB-DDF-B15-STR-PLN-3502	
4	MKCGB-DDF-B15-STR-PLN-3503	
5	MKCGB-DDF-B15-STR-PLN-3504	
6	MKCGB-DDF-B15-STR-PLN-3505	
	B16_ESS 2	
1	MKCGB-DDF-B16-STR-PLN-3600	
2	MKCGB-DDF-B16-STR-PLN-3601	

Link to download the Drawings

https://OBCC-NAS.quickconnect.to/d/s/19BYmPs1jNmEIT6b2yxYESi7oafEOnbn/VE1l0IHCasDQBu7rYerawXZkiRYYfXtw-hb3gheqZXw0

SECTION –8

TERMS OF REFERENCE, DESIGN BRIEF & SCOPE OF WORK

TERMS OF REFERENCE, DESIGN BRIEF & SCOPE OF WORK

The project shall be executed on a Lump Sum Turnkey basis, scope consisting of the survey, planning & design (architectural, structural, non-structural, MEP etc.), execution, completion, obtaining required clearances and handing over of the project to the Employer.

Bidders to note that the project is Turnkey Design and Build and following project definition shall be applicable.

"Turnkey Contract is a form of contract with a lot of uncertainties wherein the Contractor agrees to take all risks arising out of such uncertainties with the certainty of the final price of the Contact. In the case of Turnkey Contract, the agreed Contract Price is non-negotiable under any condition. Therefore, Price Escalation will not be applicable under Turnkey Contracts. Change of Scope will be allowed under extreme conditions, where the basic scope will be required to change to fulfil the intent of the Contract. Similarly, compensation of time if any, will be allowed under extreme conditions only, without any financial implications on the Employer. The agreed Contract Price can be modified in case of Change of Scope only and all other events for whatsoever cause, will not affect the Contract Price."

A. GENERAL INFORMATION:

The Maharaja Krishna Chandra Gajapati Medical College & Hospital (MKCG MCH), Berhampur, was established in 1962 as Berhampur Medical College and renamed in 1969 in honour of Maharaja Krishna Chandra Gajapati. It is the largest government medical college in southern Odisha, along with MBBS, postgraduate and super-specialty courses. As a major tertiary care referral hospital, it caters to the healthcare needs of Odisha and adjoining states and is presently being upgraded with modern infrastructure and super-specialty facilities.

The vision for MKCG is to transform it into a Best-in-Class Medical College and Hospital that embodies the principle of "Healthcare for All." The development plan aspires to establish a world-class public healthcare institution, envisioning an AIIMS+ institute.

The masterplan has been envisioned for the redevelopment of the existing campus into a well- integrated and sustainable best in class medical college and hospital will the following objectives

- To strengthen "Healthcare for ALL" by providing fully functional world class public healthcare facilities.
- Determined to provide quality health care services, particularly for those in remote and difficult areas in order to reduce morbidity and mortality.
- Gender and human right issues to disadvantaged groups and adolescents would be given highest priority, with the aim of eliminating discrimination in the provision of health care at all levels and in all sectors.
- To prepare a long-term plan for development of MKCG into a 2500 bed Tertiary Healthcare facility.
- To develop an ecosystem wherein best Medical Minds from Brahmapur and outside can

pursue excellence in Medical Education, Research and Tertiary Healthcare.

- To increase seats for courses in Post Graduate education and for Super Specialization.
- To introduce Best in Class technologies in fields of Medical Education, Research & Healthcare and make it ready to address challenges of future.
- To develop a vibrant campus by providing for accommodation, amenities and sports facilities.
- To improve access and provide sustainable mobility solutions to all stakeholders.

The Master Planning has been done considering the following key parameters:

- An integrated campus with dedicated zones for clinical, academic and residential areas encouraging efficient, compact and equitable distribution of campus facilities serving all users and meeting the future needs.
- An interconnected and pedestrian friendly campus providing comfortable and shaded pedestrian environments supporting universal access and handicapped friendly spaces.
- A green campus promoting sustainable mobility and transportation through use of electric vehicles (with charging facilities) across the campus for patient, visitor and staff movement and park and ride facilities.

B. ADDITIONAL DETAILS/ SCOPE:

i. The work must be carried out as per NBC-2026, applicable IS codes and relevant codal provisions and circular and instructions of Government issued from time to time.

ii. The Plant and machineries will be utilized as per applicable codal provisions, which will be installed/procured by the executing agency at its own cost.

iii. The documents/ information provided during the tender stage are indicative and for reference. Contractor must do their own due diligence before bidding. No additional cost and time shall be provided to the Contractor in this regard.

iv. **Utility Shifting:**

Utility shifting (live or dead, overhead or underground or any type of utility, any length within or associated length outside the project boundary, Extra Low Voltage Utilities etc.) shall be done by the Contractor in due consultation with the line department.

Contractor to do their due diligence before bidding for the details of existing utilities. Utilities must be relocated according to the actual site or project requirements. The Contractor will provide all necessary safety frameworks and protections, such as structures, for utilities including but not limited to gas/oil, water/sewage& drainage, Telephone pole & (OFCs), and electric cable lines etc. The contractor will arrange all necessary permissions and clearances for executing the utility shifting works but not limited to EHT/ HT, LT lines, gas-oil, and water/drainage/sewage pipelines from concerned line departments. No additional time shall be provided to the Contractor.

Notes:

(a) The type/ spacing/ size/ specifications of poles/towers/lines/cables/transformers/OFC etc. to be used in shifting work shall be as per the guidelines of utility owning line department. No change of scope shall be admissible and no cost shall be paid for using different type/spacing /size/specifications in shifted work in comparison to those in the existing or for making any overhead crossings to underground as per requirement of the utility department concerned and/or construction of project highway. The Contractor shall carry out joint inspection with concerned utility department and get the estimates sanctioned from concerned utility department for reimbursement. The assistance of the Employer is limited to giving forwarding letter on the proposal of Contractor to concerned utility department whenever asked by the Contractor. The decision/approval of the utility department concerned shall be binding on the Contractor.

(b) The dismantled material/ scrap of existing Utility to be shifted/dismantled shall be dispose-off as per the norms, practice and guidance of the concerned line Department.

The dismantled material/ scrap of existing Utility to be shifted/dismantled shall belong to the Contractor who would be free to dispose-off the dismantled material as deemed fit by them unless the Contractor is required to deposit the dismantled material to concerned utility department as per the norms and practice and, in that case the amount of credit for dismantled material may be availed by the Contractor as per the estimate agreed between them.

(c) The utilities shall be handed over after shifting work is completed to concerned utility department to their entire satisfaction. The maintenance liability shall rest with the concerned utility department after handing over process is complete as far as utility shifting works are concerned.

(d) No change of scope for any variation at the site. COS shall be applicable only under extreme conditions duly recommended by the Engineer/Employer and concerned line Department.

(e) It is obligation of successful bidder to keep all public utilities functional all time without any cost to Authority beyond quoted amount.

Contractor to obtain detailed estimate for the utility shifting duly prepared and approved by the respective line department and the same shall be reimbursed to the Contractor. No additional time and cost shall be allowed for the same.

v. **Tree Cutting:**

Tree cutting for the project shall be done by the Contractor. The work to be done in consultation with the OFDC/ Forest Department/ Development Authority/ Municipal Corporation etc.

The Contractor will provide all necessary safety frameworks and protections for job. The contractor will arrange all necessary permissions and clearances for Trees cutting.

All stumps and roots of cut trees are to be removed by the Contractor and such excavated portions shall be filled with sand and such cost shall deemed to be include in the Contractor's turnkey bid.

Notes:

(a) The Contractor shall carry out joint inspection with concerned Forest department and get the estimates sanctioned from concerned forest department for reimbursement. The assistance of the Employer is limited to giving forwarding letter on the proposal of Contractor to concerned forest department whenever asked by the Contractor. The decision/ approval of concerned forest department shall be binding on the Contractor.

(b) Work will be carried out as per the direction of concerned line department and as per their prevailing terms and conditions.

(c) The trees shall be handed over after shifting work is completed to concerned forest department to their entire satisfaction.

(d) No change of scope for any variation at the site. COS shall be applicable only under extreme conditions duly recommended by the Engineer/Employer and concerned line Department.

Contractor will obtain Estimate for the Tree cutting by the respective line Department and the same shall be reimbursed to the Contractor. No additional time and cost shall be allowed for the same.

vi. Turnkey Contractor shall be responsible for obtaining all necessary statutory clearances, statutory submission and approvals as per Schedule F. All statutory fees will be reimbursed by the Employer on submission of original receipt/bill/invoice by the Turnkey Contractor. Employer obligation is limited to forwarding letters to the departments upon request of the Contractor and reimbursement of applicable fees. No additional time shall be allowed to the Contractor.

vii. Strict, stringent and Specific clauses, language, specifications, and scopes shall be adhered to if there is any disparity/discrepancy between the scope and technical specifications found.

viii. Any change in contract terms such as but not limited to milestone shifting due to EOT, Contract price revision due to change of scope and breakdown of schedule of payment (only as per the discretion of Employer) shall warranted execution of a supplementary Agreement.

ix. Contractor to submit **Master Document list** of the project containing complete list of documents, design and drawings to be delivered across all disciplines throughout all phases of the project.

x. Start of warranty shall be from the date of issuance of completion Certificate to the Turnkey contractor.

xi. Maintenance of existing road and construction of diversion Road for vehicular movement including bituminous and granular work during construction shall be done by the Contractor at its own cost. No additional cost and time shall be provided to the Contractor in this regard.

xii. Dust management and Traffic Management during construction shall be done by the Contractor. No additional cost and time shall be provided to the Contractor in this regard.

xiii. Establishment of Labor Colony, Plants and stockyard etc. required for the construction shall be done by the Contractor. No land shall be provided to the contractor for the same.

xiv. Contractor to submit Drone Video and Photographs for all the project components in monthly basis. The Turnkey Contractor shall submit drone videos and photographs of the progress at the site for the complete battery limit every month not later than the 5th of each month. Good-quality photographs shall also be submitted by the Turnkey Contractor weekly for the work in progress for comparison with the previous week.

xv. Maintenance of Landscaping and Softscape

Contractor to comprehensively maintain the overall contract softscape and Landscape works during the entire Defects Liability Period.

xvi. **Construction Power and Water (Including Testing and Commissioning)**

Arranging Construction Power and Water shall be the responsibility of the Contractor. Arranging Power supply for the installation, testing and commissioning of all the MEP and its associated items shall be done by the Contractor. No additional cost and time shall be provided to the Contractor in this regard.

Contractor will arrange the power for their construction use. In case if there is interruption in authorities power, then the Contractor should arrange alternate DG power for their works and there shall be no compensation by Employer to the Contractor to this effect.

xvii. Contractor scope also is to provide water and sewer connections to main public system.

xviii. Contractor to provide adequate signages, lighting, retroreflective signages and stickers for work zone safety management. Contractor should deploy 24x7 traffic marshals to guide vehicles. Proper safety gears and PPEs shall be provided to the Traffic Personnels.

xix. **Built up area Calculation**

All Built-Up area calculations should be as per IS 3861.2002 Latest Edition and CPWD PAR 2025.Above terrace structures like Mumty, Lift Machine room, Water Tanks etc not to be included in Built-Up Area.

xx. **Waterproofing**

Waterproofing for all the structures in the project shall be done in accordance with the Technical Specifications provided.

The guarantee for waterproofing & Anti- Termite Treatment shall be submitted in the form of irrevocable bank guarantee, separately, for an amount equivalent to 10% each of the total sum paid to the Contractor for waterproofing work, Anti-termite Treatment valid for 10 years from the date of completion.

Appropriate water proofing system shall be considered at applicable locations in consultation with the Architect, Client and Supervision consultant.

a. Provisions for water proofing of STPs, sumps and water tanks, toilets, roof, expansion Joints, Raft, Retaining Wall must be considered by the bidder in the scope of the project and no deletion/ relaxation of waterproofing items shall be allowed in any of these items, under any circumstances.

b. Integral waterproofing to be mandatorily done in all wet areas.

c. In all basements/concrete walls below ground levels additional protection with required quality waterproofing membrane must be provided as per specifications and direction of Engineer In-charge.

xxi. **Ani Termite Treatment**

Anti Termite Treatment shall be done by the Contractor for all the facilities for the project in compliance with the Codal provisions and CPWD specifications.

xxii. **Establishing Site Laboratory and Testing of Materials**

Contractor to establish site Laboratory with all equipment's for performing quality checks for the project at their own cost as per Project requirement or as per instructions of Engineer -in-charge.

Equipment's for conducting necessary tests (as per latest CPWD Specifications) shall be provided and installed at site in the well-furnished site laboratory by the Contractor at his own cost.

xxiii. **Engineer/Employer Office**

EMPLOYER/ ENGINEER OFFICE
Stilt Parking + First Floor + Second Floor | Permanent Facility

1. Scope

The Contractor shall design, obtain statutory approvals for, construct, furnish, equip, connect permanent utilities to, test, commission, operate and maintain a permanent Employer's Office comprising stilt parking plus two office floors. The complete facility shall be operational during execution of the Project and shall be handed over to the Employer immediately upon issuance of the Completion Certificate for the main Project in fully functional, serviced, tested, clean and occupiable condition, without additional payment.

The office shall be permanent works with minimum 50-year structural design life. All planning, building construction, fire and life safety, accessibility, building services and occupancy provisions shall comply with National Building Construction Standards 2026 (NBCS 2026), including the applicable Parts, Sections and provisions relevant to the work, together with the Indian Standards and statutory requirements specified herein.

2. Building Configuration and Exact Area Schedule

The building configuration shall be Stilt + First Floor + Second Floor. The stilt shall be used only for parking, access, services and vertical circulation. The enclosed permanent office area shall be minimum 700 m², comprising 350 m² on the First Floor and 350 m² on the Second Floor. The stilt parking floor shall be 350 m². Total constructed floor area including stilt shall be 1,050 m². Room areas and stated capacities are mandatory minimum planning requirements; furniture layouts, clear circulation and accessibility shall be demonstrated in the Contractor's drawings.

Spec. No.	Floor	Space / Use	Specified Area (m²)	Minimum Occupancy / Capacity
A-01	Stilt	Parking bays, driveway, accessible parking, entrance lobby, staircase/lift core and services	350	Parking capacity as per approved layout; minimum 1 accessible car bay
A-02	First Floor	Reception and waiting	25	10 persons
A-03	First Floor	Open office / staff seating area (furniture only; no computers/laptops)	135	30 persons / 30 work positions
A-04	First Floor	4 enclosed officer rooms @ 12 m² each	48	3 persons/room (1 officer + 2 visitors); 12 persons total
A-05	First Floor	Main conference room	50	30 persons
A-06	First Floor	Pantry	10	3 persons
A-07	First Floor	Male toilet	10	Minimum 3 simultaneous users; fixtures as per applicable Indian requirements
A-08	First Floor	Female toilet	10	Minimum 3 simultaneous users; fixtures as per

Spec. No.	Floor	Space / Use	Specified Area (m²)	Minimum Occupancy / Capacity
				applicable Indian requirements
A-09	First Floor	Accessible toilet	5	1 wheelchair user with attendant access
A-10	First Floor	Circulation, walls, shafts and service balance	57	Not applicable
		FIRST FLOOR TOTAL	350	
A-11	Second Floor	4 enclosed officer rooms @ 12 m² each	48	3 persons/room (1 officer + 2 visitors); 12 persons total
A-12	Second Floor	Small meeting room	18	6 persons
A-13	Second Floor	Record room	25	3 persons
A-14	Second Floor	General store / material storage	25	2 persons
A-15	Second Floor	Server / network / UPS room	18	2 authorised technical personnel
A-16	Second Floor	Printer / copy / plot room	15	3 persons
A-17	Second Floor	Dining area with integrated pantry	35	16 persons seated + 2 pantry staff
A-18	Second Floor	Office support / filing room	15	3 persons
A-19	Second Floor	Driver / support staff rest room	12	4 persons
A-20	Second Floor	Male toilet	10	Minimum 3 simultaneous users; fixtures as per applicable Indian requirements
A-21	Second Floor	Female toilet	10	Minimum 3 simultaneous users; fixtures as per applicable Indian requirements
A-22	Second Floor	Janitor / housekeeping room	5	1 person
A-23	Second Floor	Project drawing / document review room	24	8 persons
A-24	Second Floor	Circulation, walls, shafts and service balance	90	Not applicable
		SECOND FLOOR TOTAL	350	
		TOTAL ENCLOSED OFFICE AREA	700	

3. Civil and Architectural Works

Spec. No.	Item	Minimum Specification
C-01	Structure	RCC framed permanent structure; minimum concrete grade M30 and reinforcement Fe550D; design to IS 456, IS 875, IS 1893 and IS 13920, as applicable.
C-02	Foundations	Designed on approved geotechnical investigation and structural loads; permanent waterproofing and termite protection to applicable Indian Standards.

Spec. No.	Item	Minimum Specification
C-03	Masonry	AAC blocks / approved permanent masonry system with cementitious internal and external plaster/finish as applicable.
C-04	Waterproofing	Terraces, toilets, wet areas, shafts and exposed joints complete with minimum 10-year system warranty.
C-05	Flooring	Vitrified tile flooring in office/common areas; anti-skid tiles in toilets/pantry; granite/approved stone at stairs and entrance; antistatic flooring in server room.
C-06	Ceiling	Modular mineral-fibre / gypsum ceiling as suitable, with access panels for services.
C-07	Doors	Factory-finished flush laminated doors to offices; glazed aluminium doors where required; fire-rated doors at fire compartments/staircase as per approved fire design.
C-08	Windows	Powder-coated aluminium windows with glazing, insect mesh and safety grill .
C-09	Painting	Low-VOC interior acrylic emulsion and exterior weather-resistant coating system.
C-10	Stilt Parking	Paved/finished parking surface with bay marking, wheel stops, accessible bay, signage, drainage, lighting and fire-safety provisions.

4. MEPF Services

Spec. No.	Service	Minimum Specification
M-01	HVAC	100% air-conditioning of occupied office areas. Indoor design 24±2°C. Dedicated 24x7 N+1 cooling for server/network room. Fresh-air and toilet/pantry exhaust complete.
M-02	Electrical	LT panels, DBs, FRLS copper wiring/cables, metering, protection, SPD, earthing and lightning protection complete. Minimum 20% spare capacity in distribution boards.
M-03	DG Backup	Automatic DG backup for 100% office load including server/network, lighting, lifts, security, fire systems and selected air-conditioning; minimum 8-hour fuel autonomy.
M-04	Lighting	LED lighting: open office 500 lux at work plane; enclosed offices 300 lux; conference/meeting 300-500 lux; drawing/document review room 500 lux; server/print room 300 lux; toilets 150 lux; parking 75 lux. (minimum average)
M-05	Water Supply	Permanent potable-water connection, storage and distribution complete; drinking-water treatment/cooler provisions included.
M-06	Plumbing	Permanent water supply, sanitary, soil/waste, vent, sewer and storm-water connections complete.
M-07	Fire & Life Safety	Fire detection, alarm, extinguishers, hydrant/sprinkler provisions where applicable, emergency lighting, exit signage, means of egress, fire-rated separation and other fire/life-safety provisions shall comply with the applicable Fire and Life Safety Part/Sections of NBCS 2026, relevant Indian Standards and statutory Fire Authority approval requirements.
M-08	Accessible Passenger Lift	Provide 1 No. permanent wheelchair-accessible passenger lift serving Stilt, First Floor and Second Floor. Rated capacity shall be minimum 8 persons / 544 kg. Lift car clear internal size shall be minimum 1100 mm wide x 1400

Spec. No.	Service	Minimum Specification
		mm deep, with minimum 900 mm clear automatic sliding-door opening. The lift shall permit independent entry and accommodation of a standard wheelchair with attendant and shall include accessible car and landing operating panels, controls at accessible height, tactile/Braille markings, audible and visual floor indication/annunciation, emergency alarm and two-way communication, handrail, non-slip flooring, mirror on rear wall where required for wheelchair reversing, automatic rescue device, battery-backed emergency lighting, overload indication, door safety curtain/sensor and accurate floor levelling. Complete lift installation shall include shaft, pit, guide rails, controller, drive, doors, electrical power supply, earthing and all associated civil/electrical interfaces. The lift shall be mandatory and shall comply with the applicable current Indian Standards/BIS lift standards, applicable accessibility and vertical-transport provisions of NBCS 2026, Harmonised Guidelines and Standards for Universal Accessibility in India, CPWD requirements and applicable State lift rules.

5. Server, Network and IT Infrastructure

No desktop computers, engineering workstations or laptops shall be supplied under this specification.

Spec. No.	Item	Quantity	Minimum Specification
IT-01	Rack Server	1+1 in fully redundant configurations)	Enterprise rack server; minimum 12 physical CPU cores; 64 GB ECC RAM expandable to minimum 128 GB; mirrored enterprise SSDs for OS; minimum 4 x 4 TB enterprise drives in RAID-5/6 for data; dual hot-plug power supplies; dual 10 GbE interfaces; remote management; minimum 5-year onsite OEM warranty.
IT-02	Server OS	1 Lot	Genuine Microsoft Windows Server 2025 Standard Edition, perpetual licence, licensed for all physical cores, with minimum 30 Windows Server User CALs; media/download entitlement and licence records to be handed over to Employer.
IT-03	Backup NAS	1 No.	Minimum 8-bay rack NAS with minimum 32 TB raw installed storage, RAID-6, hot-swap enterprise/NAS disks, snapshots, encryption, scheduled backup and minimum dual network interfaces.
IT-04	Server/Network UPS	1 No.	Online double-conversion UPS, minimum 5 kVA, sized for connected server/network load plus minimum 20% spare capacity; minimum 60-minute autonomy at actual commissioned server/network load; static bypass, maintenance bypass, SNMP monitoring and battery cabinet complete.
IT-05	Managed Core Switch	2 Nos.	24-port managed Gigabit switch with minimum 4 x 10G SFP+ uplinks; VLAN, STP/RSTP/MSTP, LACP, QoS, SNMP, IPv4/IPv6.
IT-06	Managed PoE+ Switch	2 Nos.	24-port Gigabit PoE+ managed switch with 10G uplinks and adequate PoE budget for APs, IP phones, CCTV and access-control devices.

Spec. No.	Item	Quantity	Minimum Specification
IT-07	Firewall	1 Nos.	Next-generation firewall appliances in high-availability configuration; dual WAN; minimum 2 Gbps firewall throughput and 1 Gbps threat-protection throughput; IPS, application control, web filtering, VPN and minimum 5-year security subscription.
IT-08	Wi-Fi Access Points	8 Nos. minimum	Enterprise Wi-Fi 6, centrally managed, PoE powered, WPA3. Additional APs shall be provided where required to achieve minimum -65 dBm coverage throughout occupied areas without additional cost.
IT-09	Network Rack	1 No.	27U or larger 19-inch floor-standing rack, minimum 800 mm wide x 1000 mm deep, lockable perforated doors, cable managers, shelves, earthing kit and dual vertical PDUs.
IT-10	Structured Cabling	48 active outlets minimum	Cat 6A permanent structured cabling with patch panels, faceplates, patch cords, labels and certification. Server, network, AV, IP phone, CCTV and access-control points shall be additional where required.
IT-11	Internet	2 Links	Two independent business-grade internet links, each minimum 300 Mbps symmetrical, configured for automatic failover.
IT-12	IP Telephony	30 handsets	PoE SIP/IP telephones with IP-PBX central system, minimum 30 extensions and capacity expandable to 50.

6. Printing, AV, Security and Office Equipment

Spec. No.	Item	Quantity	Minimum Specification
E-01	A3 colour multifunction printer/copier	1 No.	Networked A3/A4 colour laser MFP; print/copy/scan; automatic duplex; ADF; minimum 30 ppm A4; network scan; minimum 2 paper trays plus bypass.
E-02	A4 monochrome MFP	2 Nos.	Networked A4 laser MFP; print/copy/scan; automatic duplex; ADF; minimum 35 ppm.
E-03	A0 plotter/scanner	1 Set	36-inch/A0 colour technical plotter with A0 scanning capability, network connectivity, automatic roll feed and cutter.
E-04	Main conference display	1 No.	Minimum 86-inch 4K interactive commercial display with touch, speakers, HDMI, USB-C, LAN, wireless presentation, camera and conference microphone/speaker system.
E-05	Small meeting display	1 No.	Minimum 65-inch 4K commercial display with camera, microphone/speaker bar and wireless presentation.
E-06	Drawing / document review display	1 No.	Minimum 65-inch 4K commercial display with wall mount and HDMI/USB-C/LAN connectivity.
E-07	CCTV	12 cameras minimum	Minimum 4 MP IP cameras covering entrances, circulation, parking, server room and external approaches; NVR/storage for minimum 30-day continuous recording.
E-08	Access Control	4 doors minimum	Networked access control for main entrance, server room, record room and general store.

Spec. No.	Item	Quantity	Minimum Specification
E-09	Biometric Attendance	2 Nos.	Networked face/fingerprint/RFID attendance terminals with central reporting software.

7. Furniture, Store and Pantry

Spec. No.	Item	Quantity / Area	Minimum Specification
F-01	Open office desks	30 positions	Modular desks with cable management, storage pedestal and ergonomic task chairs. No computers/laptops included.
F-02	Officer rooms	8 sets	Each room: executive desk, ergonomic chair, 2 visitor chairs and storage unit; room capacity 3 persons.
F-03	Main conference	30 seats	Conference table(s), 30 ergonomic conference chairs, integrated power/data modules and AV console.
F-04	Small meeting room	6 seats	Meeting table, 6 chairs and integrated power/data.
F-05	Reception/waiting	1 set	Reception counter and seating for minimum 10 persons.
F-06	Dining with integrated pantry	16 seats + pantry	Dining tables and chairs for 16 persons with integrated pantry counter/cabinets, sink, minimum 200 L refrigerator, minimum 20 L microwave, water purifier/cooler and beverage vending machine.
F-07	Record room	1 lot	Minimum 15 linear metres heavy-duty storage racks plus minimum 10 lockable steel filing cabinets.
F-08	General store / material storage	25 m²	Heavy-duty adjustable storage racks providing minimum 18 linear metres of shelving, minimum 2 lockable storage cabinets, labelled storage zones and clear handling aisle.
F-09	Pantry equipment	Included in F-06	Pantry shall form an integral part of the dining area; no separate pantry room shall be provided.

8. Operation and Maintenance up to Project Completion

Spec. No.	O&M Item	Requirement
O-01	Facility Supervisor	1 person during working hours.
O-02	Housekeeping	Minimum 4 persons/day; daily cleaning of office, toilets, parking and common areas.
O-03	Pantry Support	1 person/day.
O-04	Office / Reprographic Support	1 person/day.
O-05	Security	Minimum 3 guards rostered to maintain 24x7 coverage.
O-06	MEP/IT Support	One skilled technician during working hours with 24x7 on-call support for critical breakdowns.
O-07	Utilities	All electricity, water, internet, DG fuel, LPG/PNG where used and recurring operational costs shall be borne by the Contractor until handover.
O-08	Consumables	Housekeeping consumables, printer toner/drums/maintenance kits, plotter inks/printheads, pantry consumables and routine maintenance consumables shall be included until handover.

Spec. No.	O&M Item	Requirement
O-09	Maintenance	OEM-recommended preventive maintenance and all breakdown repairs/replacements for civil, HVAC, electrical, plumbing, fire, lift, server/network, AV, security, printers and office equipment.
O-10	Response Time	Critical server/network/UPS/electrical/HVAC failures: attend within 2 hours and restore or provide standby arrangement within 8 hours. Other defects: rectify within 24 hours.

9. Testing, Commissioning and Permanent Handover

- All civil, structural, electrical, HVAC, plumbing, fire, lift, ICT, server, network, UPS, AV, security and office-equipment systems shall be tested and commissioned before occupation.
- Immediately upon issuance of the Completion Certificate for the main Project, the entire Employer's Office building, stilt parking, external works, permanent utility connections, furniture, server/network infrastructure, printers, plotter/scanner, AV systems, CCTV/access control, pantry equipment and all other supplied assets shall be handed over to the Employer in fully functional condition, free from lien, lease, hire-purchase obligation or encumbrance.
- Before handover, the Contractor shall complete a joint condition survey; rectify defects; replace failed, damaged or worn items; service all equipment; renew consumables necessary for immediate operation; and submit as-built drawings, structural drawings, MEPF drawings, network diagrams, cable-test reports, O&M manuals, statutory approvals, test certificates, asset register, warranties, software/licence records, configuration backups and all administrator credentials.
- All legally transferable licences and active support/warranty entitlements shall be transferred to the Employer. Rental or leased furniture, IT, AV, HVAC or other equipment shall not be accepted as part of final handover unless permanent ownership is transferred to the Employer.
- Defects-liability and warranty obligations shall continue after handover in accordance with the Contract.

10. Applicable Indian Standards and Specifications

Spec. No.	Discipline	Applicable Indian Standard / Specification
S-01	NBCS 2026 / Civil / Structural	National Building Construction Standards 2026 (NBCS 2026), applicable Parts/Sections; CPWD Specifications; IS 456; IS 875 series; IS 1893; IS 13920; IS 1786; IS 6313, all current applicable editions/amendments. Waterproofing to IS 3067 (code of practice for general design details and preparatory work for damp-proofing and waterproofing of buildings).
S-02	Electrical	CPWD General Specifications for Electrical Works Part-I (Internal), 2023; SP 30; IS 732; IS 3043, current applicable editions/amendments.
S-03	HVAC	CPWD General Specifications for HVAC Works, 2024, with current corrections/amendments.
S-04	Water	IS 10500 for drinking-water quality and applicable CPWD plumbing specifications.
S-05	UPS	IS 16242 (Part 1):2025 and IS 16242 (Part 2):2020, as applicable.
S-06	ICT Equipment	Applicable BIS/MeitY Compulsory Registration requirements and current notified IS/IEC 62368 (Part 1):2023 where applicable.
S-07	Structured Cabling	Applicable IS/ISO/IEC 11801 series.

Spec. No.	Discipline	Applicable Indian Standard / Specification
S-08	NBCS 2026 / Fire & Life Safety	National Building Construction Standards 2026 (NBCS 2026), applicable Fire and Life Safety Part/Sections and associated provisions; relevant Indian Standards and statutory Fire Authority requirements. Specifically including IS 2190 (portable fire extinguishers — selection, installation and maintenance) and IS 2189 (automatic fire detection and alarm systems), in addition to the local Fire Authority's specific requirements for this occupancy.
S-09	NBCS 2026 / Accessibility / Lift	National Building Construction Standards 2026 (NBCS 2026), applicable accessibility, barrier-free design and vertical-transport Part/Sections; Harmonised Guidelines and Standards for Universal Accessibility in India; applicable CPWD provisions; applicable BIS/Indian Standards for lifts; and State lift rules/statutory requirements, all current editions/amendments. Lift design/installation specifically to IS 14665 (Parts 1–5) — note that this series is currently under BIS revision to align with ISO 8100-1/8100-2; the Contractor shall confirm and design to the edition current at the time of lift procurement. Registration/licensing shall follow the applicable State Lift Act/Rules where enacted, or the prevailing Electrical Inspectorate lift registration and licensing requirements where the State has not enacted a dedicated Lift Act.
S-10	DG Backup / Genset	IS/ISO 8528 (all parts) — Reciprocating internal combustion engine driven alternating current generating sets; compliance with current Central Pollution Control Board (CPCB) genset noise (<75 dBA at 1 m, or as currently notified) and exhaust emission norms (currently CPCB Stage IV/CPCB IV+ or as applicable at the date of supply).

xxiv. The Turnkey Contractor has to facilitate themselves to update the project reporting in Employer PMIS, WAMIS and CDMS portal without any additional cost and time.

xxv. Pile integrity Test shall be done for all piles, and load test shall be done for required Number and Tyes of piles as per applicable IS codes for test pile and working pile.

xxvi. Drawings in compliance of the obligations set forth in this Agreement, the Contractor shall furnish to the Engineer, free of cost. Additional Drawings if the Engineer determines that for discharging its duties and functions under this Agreement. Upon receiving a requisition to this effect, the Contractor shall promptly prepare and furnish such drawings to the Engineer/ Employer free of cost.

xxvii. The Agency shall also provide 05 No. of Laptop 13th Generation Intel® Core™ i7 processor, Windows 11 Pro, 40.6 cm (16) diagonal WUXGA display with NVIDIA RTX A50,0 64 GB DDR5-5200 MHz RAM, 1 TB SSD, 5MP HD IR camera, Fingerprint Sensor, Spill-resistant & full-size, backlit keyboard with drain and Dura Keys. These laptops shall be perpetually handed over to OB&CC.

xxviii. The agency shall provide and install at least 2 No. of licenses for all software (Architectural Design, Structure Design, Electrical Design etc.) being used by the Contractor for Employers' use. Duration of the software license shall be shall same as project duration including the EOT period, if any.

xxix. Two number of vehicles (Bolero or Equivalent) is to be provided by the Agency/Contractor including driver and 150 litre of fuel per month for duration till successful taking over of contract works and additional 3 months thereafter for the site use and project official use with 24×7 shift including fuel and maintenance. The vehicle shall not be more than 1 years old.

xxx. **Third Party Reviewer (Structural)**

The Contractor shall prepare and submit the structural design, drawings, specifications, and all related engineering documents after due checking and vetting by an approved Third-Party Reviewer (TPR) from a reputed national institution, such as IITs. Contractor will submit alternatives options of minimum 3 No. TPR to choose and approved by the Employer. The TPRs should be authorized by the respective IITs.

The Contractor shall, at its own cost, obtain review and recommendations of the TPR for all components of the Project and submit the same to the Employer/Engineer for review. Engagement of the TPR Consultant shall be the sole responsibility of the Contractor and shall not entail any additional cost to the Employer.

Upon receipt of the duly vetted submissions, the Employer/Engineer shall review the drawings, reports, recommendations, and other proposals submitted by the Contractor

and communicate its observations and/or approval.

Notwithstanding any review, observation, or approval by the Employer/Engineer, the responsibility for the adequacy, accuracy, safety, and compliance of the design with the Contract requirements shall remain solely with the Contractor.

In the case of non-availability of suitable third-party reviewer to the Contractor, the Employer will nominate three personnel for TPR out of which the Contractor will select one.

All the TPR comments shall form part of Contractors Submittals.

xxxi. **Third Party Reviewer (MEPF)**

Contractor to appoint Third Party Reviewer/ Consultant for review of all MEPF design and drawings at Contractor's own cost. All the TPR comments shall form part of Contractors submittals.

xxxii. **Third Party Testing of Imported Items**

Third-Party Testing: Third Party testing and inspections shall be carried out for Indian &

imported materials. All expenses towards the testing and inspections of all material shall be borne by the Turnkey Contractor. For testing of imported equipment, the contractor shall hire a third-party inspection agency of international repute such as TUV, SGS, Lloyd, BVQJ or equivalent if mandated by the Employer. The cost of hiring such a party shall be borne by the Turnkey Contractor. All material to be incorporated in the works shall be delivered at site with the prior written consent of the Employer/ Engineer.

All the TPR comments shall form part of Contractors submittals.

xxxiii. The Employer will not provide office accommodation, vehicles, survey or any other equipment to the Contractor. The Bidder shall make his own arrangement for their office staff for each of the field supervision teams including furniture, equipment, operation and maintenance, vehicles, and equipment.

xxxiv. **Conducting Survey**

Contractor to carry out all field surveys and detailed engineering design, and development of drawings and construction documents for the project.

Contractor shall engage specialist surveying agency (ies) for conducting physical survey including but not limited to Topographical survey, GPR Survey, Topographical investigation, Hydrographical survey, and all relevant surveys necessary for execution of work at site at his own cost. Contractor shall submit 3 sets of survey report to Employer. Contractor shall be solely responsible for accuracy of all survey data and reports.

Benchmarking for the Topo Survey shall be done by the Contractor.

xxxv. Contractor to carry out Geotechnical Investigations and Sub-Soil Exploration as per

codal provision and conduct all relevant laboratory and field tests on soil and rock samples. Soil bore duly indicating the classification of soils within a bore log chart and soil test reports are to be conducted in Govt. of Odisha approved soil testing laboratory on undisturbed and disturbed samples for all the geo-technical parameters. Rock classification are to be done along with core recovery, RQD and UCS. Geotechnical Investigations shall be performed as IS 1892 and other relevant clauses of the different latest IS codes i.e., IS:16700 etc.

xxxvi. Samples of all materials required for testing is included in the cost of work. Similarly, expenditure for testing in house or through external laboratory shall be borne by the contractor.

xxxvii. The acceptable makes of various finishing items, fittings/ fixtures/ equipment/ components/ accessories have been mentioned in the List of Acceptable Makes. The Contractor shall get the samples of these items approved by the Engineer/Employer before their use/ utilization in the works. Alternate makes are not acceptable without the approval of Employer.

xxxviii. The contractor shall ensure all adequate safety measures for the prevention of erosion of the topsoil during the construction phase.

xxxix. The contractor shall not carry out any work which results in the blockage of natural drainage.

xl. Contractor shall reduce pollution and land development impacts from automobiles use during construction.

xli. The Contractor shall not do overloading of trucks which is unlawful and when loose materials like stone dust, excavated earth, sand etc. are moved, must ensure proper covering.

xlii. All building materials responsible for pollution shall be brought at site from sources covered by tarpaulin and shall take all precautionary measure to ensure that no dust particles are permitted to pollute the air quality. The contractor shall ensure that air pollution due to dust/generators is kept to a minimum, preventing any adverse effects on the workers and other people in and around the site.

xliii. The Contractor shall identify roads on-site that would be used for vehicular traffic and upgrade the vehicular roads, if they are used for hauling materials for the project.

xliv. Further, Contractor shall submit project schedule with detailed breakup containing all activities in structured manner with resource (Manpower and Material) linked. Planning of the project activities including work breakdown structure and their timelines thereof, in Primavera and submit the same to the Employer/ Engineer for progress monitoring throughout the span of the project. Submission of Daily Labour Report and Weekly / Monthly Labour Payment Report.

xlv. Taking up the works listed for Defects Liability Period and closing the project.

xlvi. The Contractor shall be responsible for usage of the BIM (350 LOD during the design

stage, and BIM 500 LOD for AS Built drawings) model in the project and CAD requirements in all stages of Design and Construction as per the requirements mentioned in Technical Specifications & Scope of Work. The contractor is to submit an undertaking within 1 week of the issuance of NTP stating that the Contractor is to adopt BIM for project delivery.

xlvii. It will be the contractor's responsibility to maintain the functionality of the existing hospital during the construction period. Any diversions/protections/traffic flow etc as may be required during the period are deemed to be included in the scope of the Turnkey Contractor.

xlviii. The prospective bidders to note that their engagement with the Design Consultant (in case of In-House Capability as per RFP is not available) should be unique. As such different bids submitted with the same design consultant shall be outrightly rejected. Memorandum of understanding for the pre-tender tie-up with design consultant to be engaged for the Project has to be submitted in the format attached. Refer **Annexure A.**

xlix. List of Statutory Clearances required for the project and responsibility is presented as **Annexure-E.**

l. **Drainage**

Stormwater drainage design and mitigation measures including construction/restorations of drains for the construction Area is in the scope of the Turnkey Contractor. The scope also includes a complete solution for the stormwater drainage till the point of discharge. Bidders are to do their due diligence on the final discharge point as per availability and present the same in the Technical Presentation. Contractor to also ensure no waterlogging and proper mitigation of the runoff for the construction area / battery limit.

li. Contractor to propose and submit credentials of NABL accredited 3rd party laboratories for testing which are located in the vicinity of the project site/ within Odisha. If the testing environment for a specific item is not available with the approved agency (as per Sl. No. a above) then only other NABL-accredited externally located testing agencies shall be permitted. The cost towards the testing shall be borne by the Contractor without any change of scope and additional time.

lii. Contractor to coordinate with DISCOM/ line Department for approval of Electrical SLD/ TDS/ Specifications etc. for the project. Submission and compliance to DISCOM/Line Department is in the scope of the Contractor. No additional time and cost shall be provided for the same. Compliance with the observations including testing of materials as desired by DISCOM/ Line Department is in the scope of the Contractor.

liii. Dewatering if required for the project during execution shall be done by the Contractor at their own cost and time.

liv. Any Software used in the project or proposed for the project shall have a perpetual license.

lv. Pond development, in accordance with the design intent set out in RFP, is in the scope of the Turnkey Contractor. This includes, but is not limited to, dredging, slush removal, cleaning, beautification works, retaining wall, pathway construction, landscaping, illumination, and safety precautions. Any work reasonably incidental to the above and necessary for the pond's complete and functional development shall also be deemed part of the Turnkey Contractor's scope.

lvi. Treatment of Area above False ceiling: All areas including the wall and roof slab above the false ceiling shall be finished with whitewash on neat clean finished concrete.

lvii. All residential and Hostel windows shall have 3 track windows with grill and mosquito net.

lviii. Contractor to do external painting as per the schedule of Finishes at the end of DLP period and handover the complete site to the Authority.

lix. **Storage (Cupboard) for Hostel Units:** Design and Construction of Cupboard for Hostel units fixed furniture with 18 mm thick BWP plywood with all external visible surface factory pasted laminate with 1mm thick and inside surface 0.80 mm thick white laminate factory pasted. 2mm PVC edge banding on edges with corner rounding in the exposed edges with through feed edge banding machine with help of hot melt glue above 200 degree Celsius. Magnetic close auto hinges chrome coated and locking arrangements. SS Pipe for hanger. Plywood and laminate shall be of ISI-marked/BIS-certified and shall be of same make. Design shall be approved by the Employer/ Engineer.

lx. Please note the details of Nodal Officer for Site visit only.

General Manager, Berhampur Division. OB&CC Ltd., Email: berhmdiv1@obcc.in , Ph- +91- 9338810017

C. Design Timeline

The time period for the design stage is 120 (One Hundred Twenty) days from the date of commencement. This period includes time period for all types of survey & investigation, soil exploration and laboratory testing, detail design, the draft and final design reports, drawings, technical specifications, methodology as required for the work and all other associated reports and documents.

Schedule for Submission: The reports must be submitted as per the following schedule:

Sl. No.	Description	Schedule for Submission
1	Complete Design for the Project including Survey, Investigation and submission and Approval of Good for Construction Drawings including the coordinated drawings for all disciplines for the project.	120 days from the date of commencement

Sl. No.	Description	Schedule for Submission
2	Inception Report, Quality Management Manual & Environment, Health and Safety Manual	15 days from the date of commencement
3	Monthly Progress Reports along with updated abstract of changes during construction	10th day of succeeding month
4	Consolidated Booklet Containing all Approvals, Clearances and NOCs in connection with the project including Maintenance manual	With as-built drawings
5	Inventory with Warranties and User Manuals	With as-built drawings
6	Changes during Construction	As and when referred by the Department

Non achieving the design milestone within the stipulated time shall attract withhold of 1% percent of contract price from RA Bill (s) as per the direction of Employer. Upon completion of the design drawings in all respect the withhold amount shall be returned without interest.

D. Final outputs (report, drawings etc.) Required from the Contractor during Design stage.

a) Good for Construction drawings: 7 copies.

b) Reports, Design, Drawings etc.: 7 Copies

c) Except inception report, all other reports as listed above shall be submitted by the Contractor to the Employer only after obtaining approval of the same from any India Institute of Technology (IIT) at Contractor's own cost. Such approved documents need to be furnished to the Employer within the stipulated datelines. No additional time shall be provided for any delay in selection of TPR or approval from TPR.

E. SERVICES TO BE PROVIDED BY THE EMPLOYER:

The Employer may provide the following data to the Bidder on request if available. Such documents should only be used as references. During the design stage, the contractor will do all necessary investigation and surveys as required for the design as per relevant codal provision.

- Sub-soil report and other associated data
- Soil bore log and test result
- Site plan
- Any other relevant secondary data, to the extent available in comprehensive manner

The Above documents shall only be used for reference purposes only and the Employer shall be indemnified from discrepancy if any, arising in future out of actual investigation done by the Contractor. The contractor will conduct all necessary surveys and investigations during the design phase in accordance with the applicable codal regulations.

F. SECRECY:

The contractor shall take all steps necessary that all persons employed on any work in connection with the contract have noticed that the Indian Official Secrets Act 1923 applies to them & will continue so to apply even after the execution of such works under the contract. The contract is confidential and must be strictly confined to the contractor's own use (except so far as confidential disclosure to sub-contractors or suppliers as necessary) and for the purpose of the contract.

All documents, copies thereof & extracts therefrom furnished to the contractor or submitted by the Contractor shall be returned to the Employer on the completion of the work / works or on earlier determination of the contract. All the drawings, designs and documents of this project shall be the property of the Employer and shall not be reproduced by the Contractor either full or by part, for any purpose whatsoever it may be, without written permission of the Employer, once the As-Built submission is over and complete. The Bidder may retain a copy of such documents but shall not use these documents for purposes unrelated to this Contract without the prior written approval of the Client.

G. Design Stages:

The contractor Submission of Detailed Design Calculations and Drawings in pursuant to GCC and shall be developed in conformity with the Specifications and Standards as in Section 5 Technical Specifications and (Section 8). The Design Phase shall immediately commence upon issuance of LOA to the Contractor. Contractor's submittals shall be done in the following stages; -

- Design Development (DD) stage
- Detailed Design Stage (DTD)
- Working Drawings (WD) or Good for Construction Drawings (GFC)
- Shop Drawings (SHD)
- As-Built Drawings (ABD)

Note: All drawings & details prepared by Turnkey Contractor shall be approved by Client/Engg. In charge prior to the construction.

The above-mentioned stages are elaborated below:

a) Design Development (DD) stage: Based on the concept drawings provided, with the Contract, the DD stage drawings shall be prepared. These shall be sufficiently detailed to show all the main elements of the design and documents required as per the scope of works. It shall include, but not be limited to, the following:

i. Reconciliations with the existing site conditions for the site plan/layout.

ii. Confirmation of the requirement of the end user/owner as advised by Employer and update the floor plans within the built-up area and outer profile of the buildings.

iii. Report on compliance with the design criteria and all applicable codes and statutory regulations.

iv. Submission of design manuals, if any.

v. References to the relevant design codes and standards.

vi. General arrangement drawings, plans, elevations, and sections at suitable scale along with the typical finishing details.

vii. Finishes Schedule for the works.

viii. Conformation to the specifications in the contract document.

b) Statutory Approval (SA) stage: The contractor shall prepare drawings and documents for statutory approval including Height clearance, BeMC, WATCO, TPCODL, EIA, etc. and will obtain the required statutory approval.

c) Good for Construction (GFC) Drawings: On the issue of an approval note with respect to the Design Development (DD) drawings, the Contractor shall produce the proposed GFC drawings. Based on the approved DD stage drawings, the GFC drawings shall include the coordinated construction details, provisions of all MEP requirements in the Architectural layouts, Elevations and sections, the setting out details of all the members to be constructed, typical details of finishes, Door & Window details, equipment installation details, finishing material list with specification and the like. All such drawings shall comply with the requirements of the Design Development submittal and scope of works as mentioned in Scope of Work.

d) Shop Drawings/Production Drawings (SHD): The Contractor shall coordinate and prepare shop drawings incorporating all the details/provisions/sleeves/conduits/inserts etc. to be provided. These should be based on the approved GFC drawings duly coordinated with MEP, Structure, Finishing and miscellaneous details. The contractor shall prepare shop drawings for all specialized work, such as doormats, glazing, railings, fixtures, expansion joints, MEP services, medical services, etc., and submit them for approval before execution.

e) As-Built Drawings (ABD) – After completion of Construction.

i. The Contractor shall maintain all records of the deviations in construction of permanent works from working drawings for the preparation of As-Built Drawings.

ii. These records shall be maintained in a single master copy (Hard copy) of the working drawings and subsequently updated in the CAD drawings. Upon completion of the works or at such time as agreed to or required by the Employer, the Contractor shall prepare drawings subject to the Employer Notice, which shall become As-Built Drawings.

iii. The Contractor shall endorse all such drawings as true records of the construction of the permanent works and all temporary works that are to remain on the Project site. The Contractor shall also show the locations of exposed and retained utilities.

iv. The Contractor will obtain the necessary licenses and connections for electricity, water, drainage, and sewerage, and will obtain the occupancy certificate from the local body.

Note: Any item or work missed from the above list & required to operationalize the Hospital project fully shall be within the scope of the Turnkey Contractor. Specification of required items shall be as per CPWD or EIC approval. No extra payment shall be made for the same.

H. GPR SURVEY

Contractor shall engage specialist surveying agency (ies) for conducting physical survey including but not limited to Topographical survey, GPR Survey, Topographical investigation, Hydrographical survey, and all relevant surveys necessary for execution of work at site at his own cost. Contractor shall submit 3 sets of survey report to Employer. Contractor shall be solely responsible for accuracy of all survey data and reports.

Un-interrupted Operation of the Existing facilities and utilities is an essential part of this package. Contractor to conduct the Ground Penetration Radar (GPR) Survey and identify all the metallic and non-metallic buried utilities lying within the scope of this package, plot them as is on a drawing, prepare a coordinated layout for re- routing of these services from the development area, submit the coordinated layout for approval from the Engineer in charge and re-route them as per the approved scheme for un-interrupted operations of the existing facilities and utilities. Any excavation, construction, re-development work in any area to start after obtaining a prior approval from the engineer in charge once the re-routing of the existing utilities is done as per the approved layout. Following existing Utilities to be identified, Mapped and re-routed using GPR survey:

a. Electric cables.
b. Telecoms cables.
c. Data Cables.
d. Gas and water mains.
e. Earthing strips.
f. Sewers.
g. Drainage lines.
h. Storage tanks, etc.
i. Utilities crossings below the roads
j. Utilities buried along the roads and boundary walls.
k. Fire Mains.
l. Recharge Pits.
m. Any other existing Utilities.

I. PROJECT DESIGN VISUALISATION (3D MODEL WALK-THROUGH)

Contractor, at their cost, shall develop and submit 3D Model Walk-Through video, photo realistic renderings for all building types considered in Package 1 capturing in detail both interior

and external features of the buildings/structures including landscape features in the near vicinity as wells as location of facility/building comprising of the following:

(a) Street Level Walk-Through

(b) Interior Walk-Through

The interior Walk-Through of all Clinical blocks with all different floor areas to be provided. Contractor shall submit 3D Model Walk-Through to Employer for approval before beginning construction of relevant structures.

J. CLINICAL LABORATORY DESIGN CONSULTANT

Contractor should appoint a Clinical Laboratory Design Consultant specialized for Clinical Laboratory Designing. Testing Laboratory shall be state of the art equipped with the apparatus needed for advanced clinical testing and shall comply with the Central/ State Govt regulatory requirements and NABL accreditation parameters. The contractor shall submit profile of 3 shortlisted consultants for approval of Engineer-in -charge.

K. MEDICAL EQUIPMENT COORDINATION WITH INFRASTRUCTURAL REQUIREMENTS

a. Contractor should provide room data sheets of medical equipment for all significant clinical rooms and get those approved from Engineer in Charge & approving authorities like AERB/ End user as required. Any approval from an external agency would be in the scope of the contractor at no additional cost to the client.

b. Contractor should provide detailed drawings, including elevations, of equipment placements for all significant clinical rooms. The list of the significant clinical rooms is to be prepared by the contractor after discussion and approval from Engineer in Charge.

c. Contractor should be responsible to coordinate and incorporate MEPST (Mechanical, Electrical, Plumbing, Structure & Technology), medical gas and other requirements of medical equipment at every location.

d. Contractor should coordinate with manufacturers/vendors approved by OB & CC/End User/ Govt nodal agency – OSMCL to get shop drawings in time for significant medical equipment to ensure all coordination and providing all infrastructural requirements including, but not limited to all utility connections, structural support; radiation, radio-frequency- and magnetic-shielding, as required; and adequate space for intended work flows are fulfilled as per manufacturer’s requirements and as recommended by competent / approving authority (AERB/ others) for seamless operations

e. Contractor shall provide required data points, electrical points, drain points integrated and

connected with overall MEP system along with providing the air-conditioning and ventilation system.

f. Contractor shall accept the delivery of equipment on behalf of client, keep the track of each delivery and timely update all concerned authorities about it.

g. Contractor shall provide a water-tight, climate-controlled as per the manufacturer's recommendations, secured and insured warehouse space for equipment when those come on site before installation.

h. Contractor shall be responsible for transporting medical equipment from warehouse to site of installation. Contractor should ensure availably of transportation vehicles (powered pallet carts, cranes etc.) in accordance with installation schedule.

i. Contractor shall coordinate equipment installation dates with Equipment Supplier and keep the site ready for installation as per manufacturer's recommendations on or before the start date of installation.

j. Contractor shall be responsible to oversee installation is completed in time.

k. Contractor shall confirm and approve satisfactory and timely completion of installation; commissioning (including all quality checks; required parameters etc.) and handover to end user. Contractor shall timely inform Engineer in charge about completion of installation/ other activities till handover to end user.

l. Contractor shall schedule and coordinate end user training on equipment with end users, manufacturers/vendors and concerned authorities.

L. Scope of Work for Building Information Modelling (BIM)

Implementation of BIM is in the Scope of the Contractor.

Details are provided in ***Annexure-B.***

M. Architecture Scope (Architecture Design Basis Report)

Arch Design Basis Report.

3D Renderings/ Design Intent is attached as Annexure-C



REDEVELOPMENT OF MAHARAJA KRISHNA CHANDRA GAJAPATI (M.K.C.G.) MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

450-BED HOSPITAL BLOCK, DENTAL COLLEGE (77 ADMISSIONS), PHARMACY COLLEGE (180 ADMISSIONS) AND ALLIED BUILDINGS.

SCOPE OF WORK & ARCHITECTURAL DESIGN BASIS REPORT

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4.6. CLINICAL PLANNING

4.7. ANNUAL REPORT

4.8. DOOR WINDOW SCHEDULE

4.9. SCHEDULE OF FINISHES

4.10. SANITARY AND CP FITTINGS

4.11. FURNITURE

4.12. SCULPTURE/ARTWORK

4.13. MEDICAL SERVICES

4.14. DENTAL CHAIRS

5. LANDSCAPE.....

6. FAÇADE LIGHTING

……...

7. SERVICES

……...

1. BACKGROUND

The Maharaja Krishna Chandra Gajapati Medical College & Hospital, popularly known as M.K.C.G. Medical College and Hospital, is a Government Medical College established by the Government of Odisha under the Health & Family Welfare Department, and is a pioneer medical institute in Eastern India in medical teaching, training, research, and patient care.

It has been named after the Late Maharaja of Parlakhemundi, Maharaja Krushna Chandra Gajapati. This being the only major medical institution in Southern Odisha, it not only imparts medical education but also serves as a referral hospital, providing multispecialty tertiary patient care in this part of the country.

It is located in the city of Berhampur with a sprawling campus. This Medical college has the largest campus of all three government medical colleges in Odisha. It has been recognised by the MCI (Medical Council of India) as an institution that facilitates M.B.B.S. education and training in Postgraduate speciality subjects (M.D./M.S.) in medical and surgical disciplines.

This Government Medical College was initially established as an extension wing of SCB Medical College, Cuttack, in 1961, with an annual intake of 40 students. In 1962, it began functioning as a medical college in Berhampur, and in 1966, as a hospital. “Berhampur Medical College,” as it was known at its inception, was subsequently renamed “Maharaja Krishna Chandra Gajapati Medical College” after the Late Maharaja of Parlakhemundi, Ganjam, who was committed to the cause of Odisha.

MKCG Medical College, during its more than fifty years of existence, has produced a large number of doctors, specialists, super specialists who have worked and are working in different parts of the country and abroad. The strong academic and practical foundations built during their studies at this institution have enabled them to demonstrate professional excellence across different specialities, not only in India but also in other parts of the world. In 2016, the Government of India granted a Letter of Permission to increase MBBS seats from 150 to 250.

This Design Basis Report (DBR) is being prepared as part of the design elaboration and various considerations adopted for the above-mentioned project to provide an overview and scope defined for the TURNKEY developer. The report covers project visualisation, highlights the issues discussed in the terms of reference, and provides details of the project's salient features, illustrated in the drawings and 3D views. The project comprises the Main Hospital in Phase 1 (450-bedded hospital), dental college (77 admissions), Pharmacy College (180 admissions), and their allied buildings. Building Services Ancillary Blocks. The DBR is based on the Project Brief, including various drawings and client inputs, as well as various factors such as local & statutory authorities' controls, climatology, availability of materials and technology, and consideration of green building and the prerequisite of IGBC certification, etc. The detailing/development of architectural layouts is an extension of the drawings provided by the Client during the tender stage.

MKCG Hospital & Medical College, Brahmapur, is 0.5 km from the bus Stand, 3.0 km from the railway station, and 8.6 km from the Rangeilunda Airstrip. The city is connected through the following Highways:

- National Highway 16 (NH 16) is a major National Highway in India that runs along the east coast of West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu.
- National Highway 59 (NH 59) is a National Highway in India connecting Khariar and Brahmapur in the state of Odisha. The Highway is connected with SH 42 of Odisha State near Bangomunda.

2. PROJECT OVERVIEW

2.1 LOCATION



Figure 1: Odisha Map

2.2NEIGBOURHOOD



Figure 2: Berhampur Map

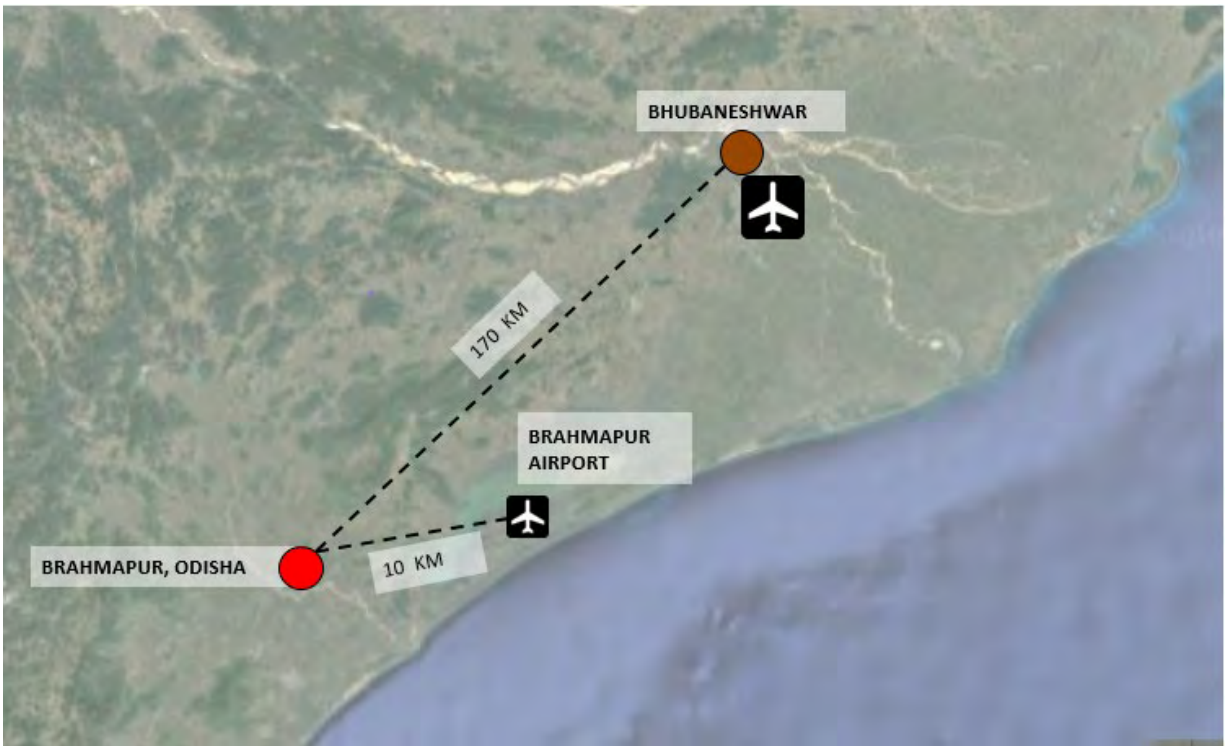


Figure 3: Location

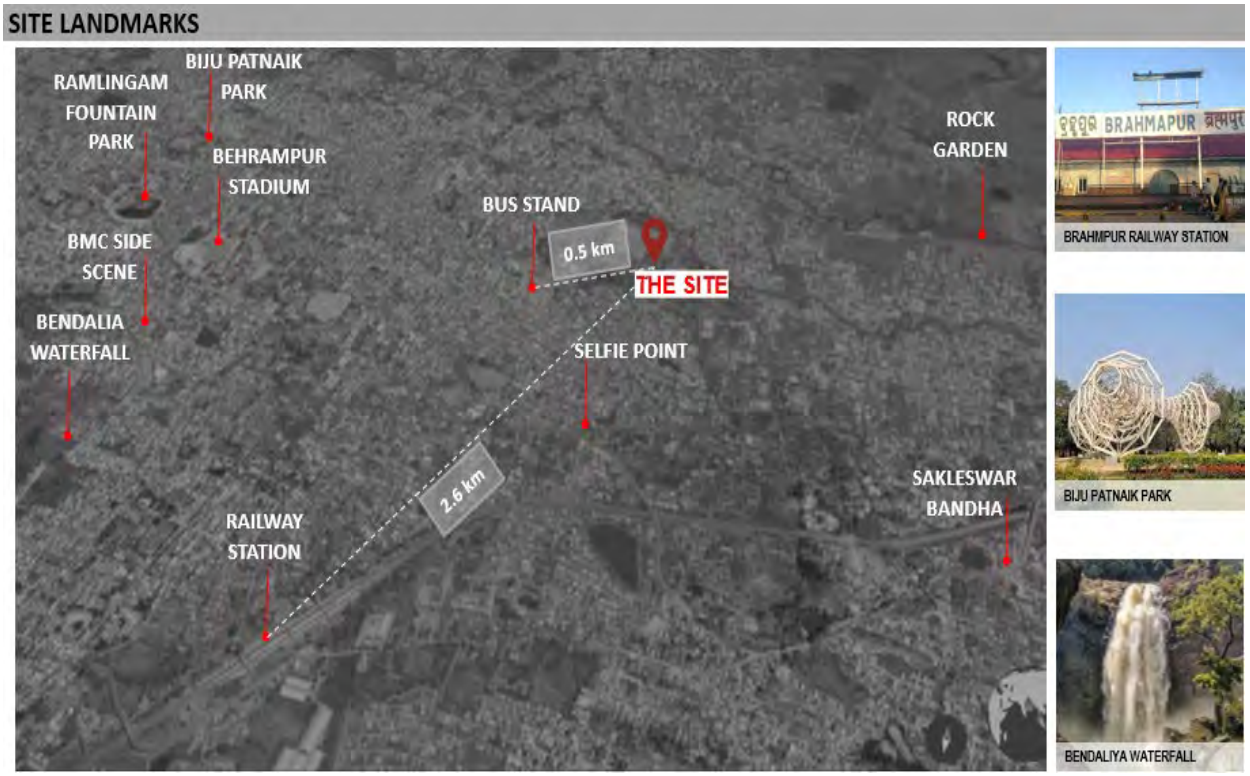


Figure 4: Site Landmarks

NORMS AND STANDARDS REFERENCE

The following codes and guidelines have been taken into reference for designing the campus:

The site falls under the jurisdiction of the Brahmapur Development Authority Planning and Building Standard Regulations, 2020.

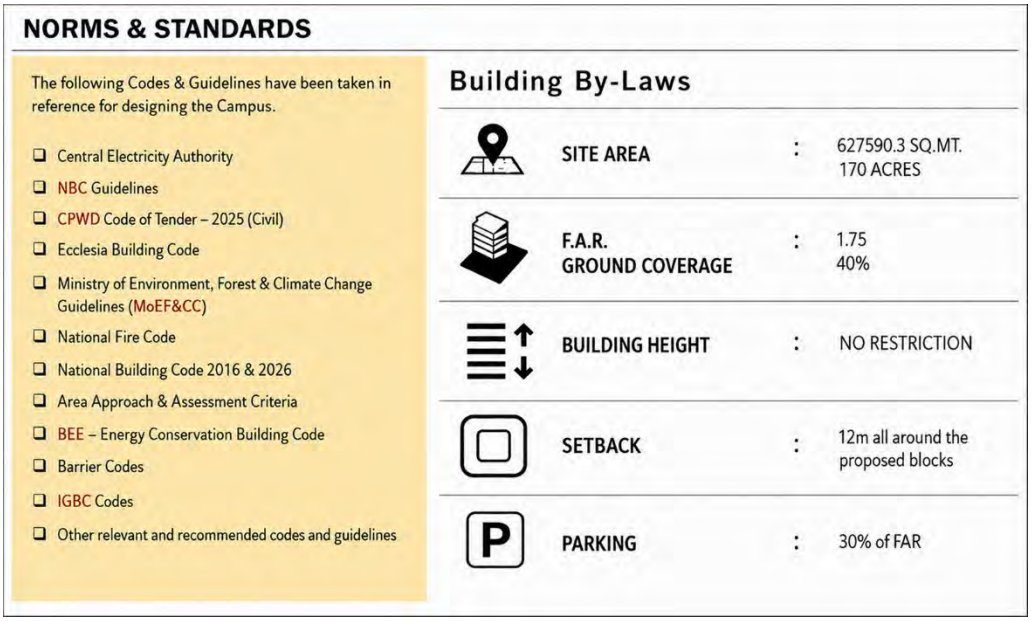


Figure 3: Norms

The major BDA norms prescribe the following:

S: No	Parameters	Permissible
1	Maximum Permissible F.A.R	1.75
A	Minimum Permissible FAR for Institutional Building	1.75
B	Maximum Permissible FAR for Residential and other Misc. Blocks	1.75
2	Maximum Permissible Ground Coverage	40% (of Net plot area)
3	Height	No Restriction
4	Existing Land use	Public Semi-Public

Other requirements as per applicable building bye-laws are as follows

- The minimum site setback from the site boundary on all sides will be 12 m.
- The minimum setback for basements will be 6m.
- Parking norms: 30% of the Proposed FAR for clinical areas, varying by residential type.

- Fire tender path of 7.5m around the building blocks.

2.3SITE

Circulation & Access: The site has 3 entries. Entry 1 is the main hospital entry from the south via National Highway 59 and will serve as the primary access to the site for visitors and patients. Entry 2 will be accessed as the residential gate from the Bus Stand Road. Entry 3 will be served for the service vehicles and staff access.

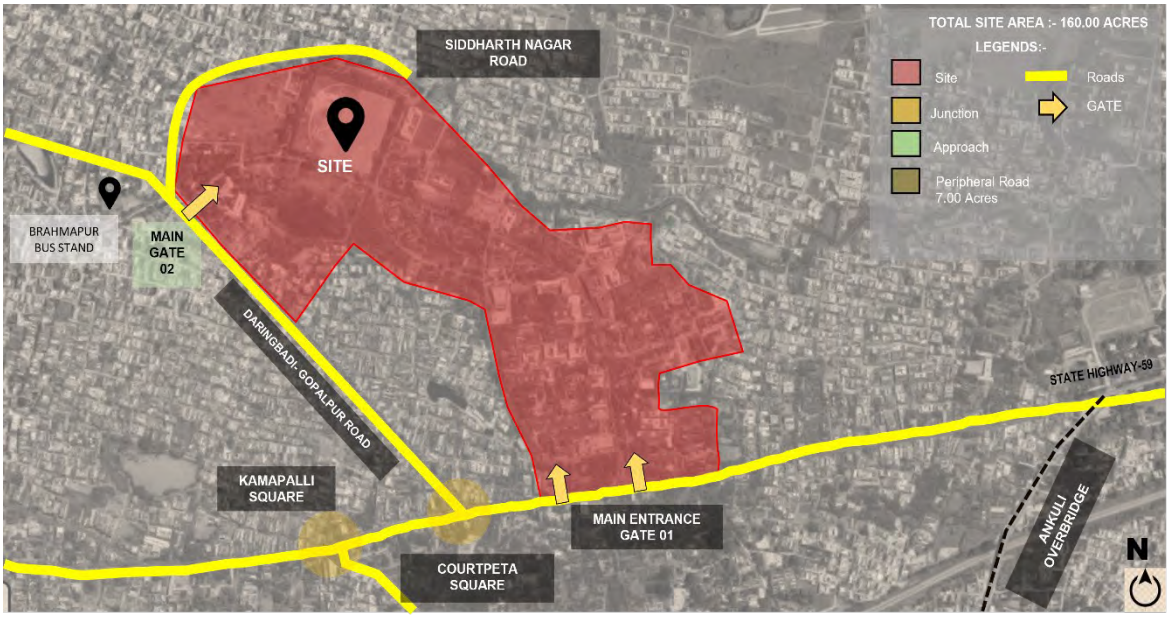


Figure 4: Site demarcation

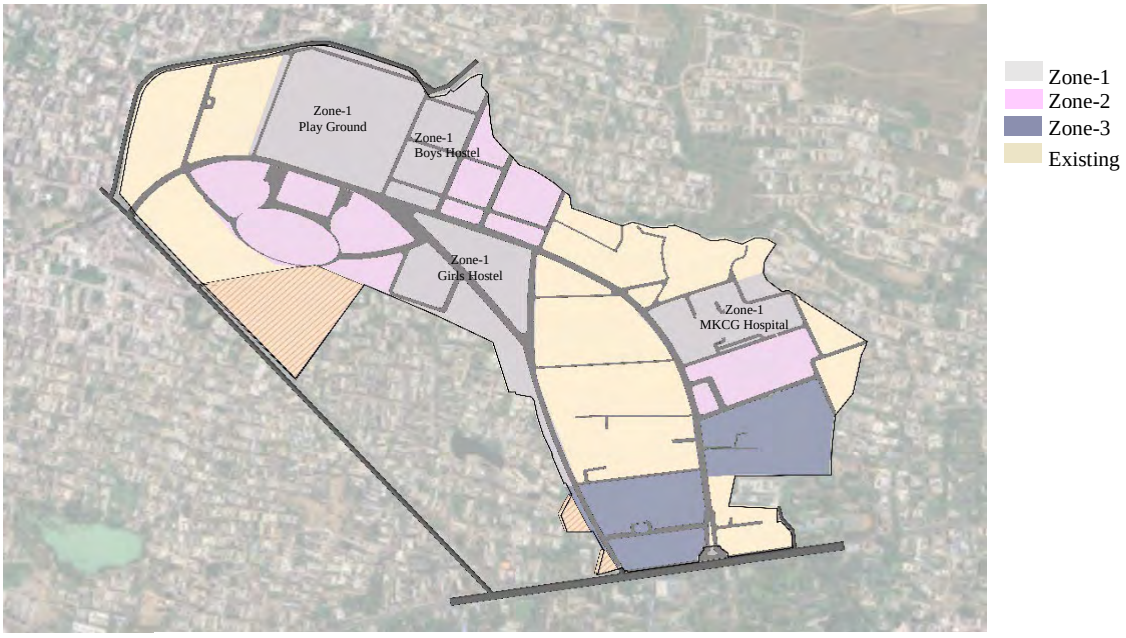


Figure 5: Site Land Availability

Total consolidated land: 160 acres (approx.) and Redevelopment Site area: 56.60 acres (approx.)

Zone 1 – Hospital block, Girls Hostel, Indoor Stadium, House Surgeon Hostel, Guest House and ESS.

3. CONTRACTOR'S SCOPE OF WORK

In accordance with the intent of this procurement, the Employer has developed the Tender Level Architecture and other Services & Structural Planning, including landscape drawings and other details, for the Hospital block, Service block, Hostels, Guest House, and other miscellaneous structures/Blocks for the above-mentioned locations, as shown in the tender drawings. The contractor shall execute the block in accordance with the existing running facilities of the Hospital, which will be demolished for the development of a new Hospital block of 450 Beds in Phase 1 & balance shall be constructed in Phase 2. The scope includes relocating all existing services to ensure the smooth functioning of the retained blocks of the Hospital campus. The conceptual Architecture and Planning include the following technical elements:

(a) Concept design drawings – Master plan, site plans, building floor plans, basement plans, building elevations and sections, etc.

(b) Construct the foundation per the building height shown in the tender drawings.

(c) Technical Specifications

(d) Schedule of Finishes – Architecture Works (See attached annexure)

S.NO.	BUILDING BLOCKS	NO. OF FLOORS	FACILITIES	TOTAL AREA (SQ.MT.)
1	HOSPITAL (450 BEDS)	B+G+10	CASUALTY BEDS (50 BEDS), EMERGENCY, OPDS – 11 NO. DEPT., 4 NOS. MAJOR OT, BURN WARD & ICU – 21 BEDS, ICU – 40 BEDS, HDU – 10 BEDS, GENERAL MEDICINE – 320 BEDS, 10 NO. PAYING WARDS, HOSPITAL SERVICES, GENERAL MEDICINE – DEPT. AND ADMINISTRATION.	71807.06
2	ELECTRICAL SUB STATION (ESS) - A	B+G+2	HT PANELS, LT PANELS, TRANSFORMERS & DG SETS WITH HVAC PLANT ROOMS, ETC	1982.34
3	INDOOR STADIUM	B+G+1	BASKET BALL, VOLLEYBALL & BADMINTON COURTS, GYMNASIUM, YOGA HALL	7516.00
4	SURGEON GENTS HOSTEL (150 UNITS) + GUEST HOUSE (25 UNITS)	B+S+8	SINGLE BED ROOM WITH ATTACHED TOILET, COMMON ROOM, RECREATION HALL, KITCHEN, DINING ETC.	10275.09
5	SURGEON LADIES HOSTEL (150 UNITS)	B+S+7	SINGLE BEDROOM WITH ATTACHED TOILET, COMMON ROOM, RECREATION HALL, KITCHEN, DINING ETC.	9345.95
6	UG GIRLS HOSTEL (300 CAPACITY)	B+S+12	SINGLE BEDROOM WITH COMMON TOILET, COMMON ROOM, RECREATION HALL, KITCHEN, DINING ETC.	22811.65
7	RESIDENCE - TYPE IVA (52 UNITS)	B+S+13	RESIDENCE WITH 03 BEDROOMS, DRAWING & DINING, STUDY ROOM, KITCHEN & TOILETS, ETC. (COMBINED BASEMENT)	11409.73
8	RESIDENCE - TYPE IVB (52 UNITS)	B+S+13	RESIDENCE WITH 02 BEDS ROOMS, 01 DRAWING ROOM, KITCHEN & TOILETS, ETC. (COMBINED BASEMENT)	11409.73
9	RESIDENCE - TYPE IIA 52 UNITS)	B+S+13	RESIDENCE WITH 02 BEDS ROOMS, 01 DRAWING ROOM, KITCHEN & TOILETS, ETC. (COMBINED BASEMENT)	7606.30
10	RESIDENCE - TYPE IIB (52 UNITS)	B+S+13	RESIDENCE WITH 02 BEDS ROOMS, 01 DRAWING ROOM, KITCHEN & TOILETS, ETC. (COMBINED BASEMENT)	7606.30
11	CLUB HOUSE	B+G+3	MULTIPURPOSE HALL, RECREATIONAL HALL, DAY CARE/CRECHE, INDOOR GAMES, GYM	4392.00
12	PHARMACY COLLEGE (180	B+G+5	PHARMACY COLLEGE (B PHARMA- 60 ADM.+ D PHARMA - 60 ADM.+ M PHARMA - 40 ADM.)	20174.00

	ADMISSIONS ANNUALLY)		180 ADMISSIONS	
13	BOYS HOSTEL PHARMACY (288 CAPACITY)	B+S+13	DOUBLE SHARING- 244 CAPACITY, SINGLE OCCUPANCY - 48 UNITS	14895.24
14	GIRLS HOSTEL PHARMACY (192 CAPACITY)	B+S+9	DOUBLE SHARING- 144 CAPACITY, SINGLE OCCUPANCY - 32 UNITS	11273.90
15	ELECTRICAL SUB STATION (ESS) - B	G+2	HT PANELS, LT PANELS, TRANSFORMERS & DG SETS WITH HVAC PLANT ROOMS, ETC	1982.34
16	DENTAL COLLEGE (77 ADMISSIONS ANNUALLY)	B+G+7	DENTAL COLLEGE (BDS-50 ADM. + MDS-27 ADM.) 77 ADMISSIONS	28729.00
17	BOYS HOSTEL DENTAL (152 CAPACITY)	B+S+11	SINGLE OCCUPANCY- 135 CAPACITY	13251.00
18	GIRLS HOSTEL DENTAL (152 CAPACITY)	B+S+11	SINGLE OCCUPANCY- 135 CAPACITY	13251.00
	TOTAL AREA (A+B+C)			269718.63

Other Facilities such as Employer Office, Gate, Guard/Security Room are additional and shall be in the scope of the Turnkey Contractor.

3.1 DESIGN

The Employer has provided concept design and master planning documents as stated in the above clause. These documents provide the Contractor with adequate information to clearly understand the Employer's design intent, goals and overall objectives in execution of the development Works. The Contractor shall adopt the concepts provided and expand, detail, and develop them to produce complete, thorough, comprehensive, and high-quality designs, coordinated GFC drawings, and specifications for review and approval by the Engineer in charge. While developing the final designs and specifications, the Contractor shall follow the concepts, design, and planning for betterments or improvements, which may then be incorporated after the Engineer in charge's approval, so as to fulfil the Employer's goals and enhancements, resulting in overall improved infrastructure and/or functionality. These betterments, if any, shall be submitted by the contractor to the Engineer in charge for review and approval during the design development stage before the final coordinated GFC set is completed. The design inputs required from the Contractor include, but are not limited to:

I. Complete floor plans with all the details of the spaces and areas clearly marked.
II. Detailed Design of all elevations, sections, and facades as per the detailed 3D view for all buildings and blocks, including specifications of the proposed materials and finishing palette.
III. Details of all elevation features, as proposed in the concept drawings, to be developed by the contractor, along with the material specifications suggested in the tender documents & drawings.
IV. Detailed design of all buildings & blocks, including main entrance porches and drop-off areas.
V. Detailed structural and building utilities analysis of all buildings on Geotech survey and analysis wherever expansions or augmentations are proposed. All augmentations must aim to integrate the

existing structure/utilities into the proposal. In case of any conflict, the same is to be brought to the notice of the Engineer and Engineer's approval is to be taken before commencement of work.

VI. Design of Doors (interior and exterior), windows/glazing, curtain glazing/structural glazing for all buildings and blocks, including type of glass, mullion sizing and spacing, etc.

VII. Interior design and fit-outs of all buildings and blocks including the following items

a) Flooring pattern design and details
b) False ceiling design and details
c) Lighting
d) Partition walls (AAC block/Fly Ash.)
e) Wall finishing, cladding and dado
f) Cabinetry and furniture
g) Modular Cabinet design for pantries and kitchens, including all finishes and fittings.
h) Design of Toilets, their wall elevations and sections with CP fittings and sanitary fixtures including counter & mirrors.
i) External and internal signage
j) Accessories and general ambience
k) Internal and external finishes
l) Developmental works and landscape

VIII. All building entrance lobby interior design, including flooring patterns, false ceilings, general and accent lighting, wall finishes, nameplates, signage, accessories, glazing, and access ramps.

IX. All Lift lobby details with all wall elevations and flooring patterns, false ceiling details including all the finishing proposed.

X. All Staircase details with all wall elevations and floor patterns, false ceiling details, and all proposed finishes.

XI. Design, detailing and finishes for outdoor terrace decks.

XII. Design and detailing of ramp, refuge terrace, open terrace, staircase and corridor railings

XIII. Design of fenestrations, projections, overhangs, pergolas, shading devices.

XIV. Design of service shaft coverings (vertical and horizontal) and screen walls

XV. Ramps, toilets and parking design for universal access.

XVI. The Contractor shall design and execute any other buildings specified in the Scope of Work, for which concept / schematic drawings have not been provided.

XVII. The Contractor shall incorporate in the final design and provide appropriate space for circulation, drop-offs, loading/unloading areas for service vehicles, and fire tender access for all buildings, with proper segregation between the main circulation and the supporting/service circulation.

XVIII. The contractor shall coordinate with all service, structural, and shop drawings and provide necessary cutouts, sleeves, inserts, etc.

XIX. A special agency engaged by the contractor should design acoustics. Shop drawings shall be submitted for approval before the construction.

XX. The built-up areas of the buildings/block, and any other building shall be as per the provision(s) of the Contract. Any increase in the built-up area due to construction detailing/value addition shall be carried out with the prior approval of the Engineer in charge and at no additional cost to the Employer. This applies to all the Contractor's submissions.

XXI. The Contractor shall develop the detailed furniture layout as per the provided furniture schedule, including detailed drawings for built-in furniture, nurse stations, etc.

XXII. Dismantling the existing building shall be carried out by the contractor after the construction of the transit camp.

XXIII. Contractors are responsible for the disposal of debris and construction waste at their own cost and time.

XXIV. Survey reference points to be taken from the Established Control Point.

XXV. The bidder must assess the actual requirements and planned construction based on vertical traffic analysis, without any additional time or cost to the Employer.

XXVI. The TURNKEY Developer is supposed to obtain confirmation from the end user before start of first floor construction.

XXVII. The Contractor must perform all coordination work at BIM 300 level during the design stage and at BIM 500 level during the GFC stage.

XXVIII. Contractor shall prepare external & internal animations based on the final approval drawings.

XXIX. Contractor shall submit a 3D model of an appropriate scale, approved by the client.

The Contractor shall be aware of and consider all site and local factors that may/will influence design, including topography, local weather (winds, monsoon season), a corrosive/salt environment, proximity to sea & river, panoramic views, etc. The Contractor's design scope of work also includes studying and reviewing the provided designs and ensuring the final designs comply with Local Building Byelaws/Regulations/National Building Code (NBC) 2016 & 2026. Any deviations or non-compliance with the same are to be brought to the notice of the Engineer before commencement of work.

3.2 SCOPE OF WORK INCLUDE

The execution scope of work includes the full, final, and complete completion of the building, infrastructure works, and services, based on the detailed design developed by the Contractor and handed over in proper condition in full accordance with the Employer's vision, as described. The building/structure works for Clinical blocks, utilities blocks & miscellaneous blocks include the following but are not limited to: Substructure –

Note: All items in the scope of work in ARCH DBR's, MEPF DBR's and STR DBRs shall be executed as per specification (Section 5) and Scope of Work (Section- 8) & Tender drawings (Section 7) & documents.

All Finishing (as per finishing schedule)

a) External and internal wall finish
b) Flooring, skirting and thresholds
c) Interior wall cladding as per SOF& tech. specification
d) Internal painting and wall finishing including enabling works
e) External finishing including enabling works
f) False ceiling and boxing
g) Railings (S.S. -316)
h) Doors (interior and exterior), windows glazing systems including hardware
i) Fire Doors (including hardware)
j) Stone countertops
k) Ledges and coping
l) Toughened Glass railings and partitions
m) Partition walls
n) Built-in furniture, Nurse stations, Reception desks and non-modular/Modular loose furniture.
o) Toilet, Pantry and kitchen fittings and fixtures (including mirror)
p) Internal and external signage including floor markings
q) Elevation features
r) All screens and duct/shaft covering systems.
s) Medical gas pipeline system
t) Modular Operation theatre & Minor OT
u) Lead lining Doors
v) Kitchen and cafeteria equipment’s
w) Information Display system in Common areas, lobbies
x) Pneumatic tube system
y) Automated waste & laundry tube system
z) Parking management system without revenue.
aa) Laundry System
bb) Curtain Track system
cc) Nurse call system
dd) Stretcher Guard & Corner Guard
ee) Complete CSSD
ff) Internal & external MEP Services
gg) Master Integrator system
hh) External development
ii) Gate & Guard rooms
jj) Road work C.C pavement as per approved Str. Design

Note: Any item or work missed from the above list & required to fully operationalise the Hospital project shall be within the scope of the Turn Key Contractor. Specification of required items shall be as per CPWD or EIC approval. No extra payment shall be made for the same.

The above list does not represent the total of all finishes to be completed by the Contractor and is only an indicative list of general items under finishing. Additional finish requirements are specifically described and detailed in the Technical Specifications, and the Schedule of Finishes & List of Approved Makes in the attached annexure. Through the design process, the Contractor shall expand and develop a comprehensive list of all finishes necessary to meet the Employer's requirements. All requirements under this section, together with the overall scope of work for this package, must be addressed and provided for successful project completion.

4. FUNCTIONAL REQUIREMENTS

4.1 MASTERPLAN AND PHASING

The masterplan has been envisioned for the redevelopment of the existing campus into a well-integrated, sustainable, best-in-class medical college and hospital, with the following objectives.

- To strengthen “Healthcare for ALL” by providing fully functional world-class public healthcare facilities.
- Determined to provide quality health care services, particularly for those in remote and difficult areas, to reduce morbidity and mortality.
- Gender and human rights issues affecting disadvantaged groups and adolescents would be given the highest priority, with the aim of eliminating discrimination in the provision of health care at all levels and across all sectors.
- To prepare a long-term plan for development of MKCG into a 2500 bed Tertiary Healthcare facility.
- To develop an ecosystem where the best Medical Minds from Brahmapur and beyond can pursue excellence in Medical Education, Research, and Tertiary Healthcare.
- To increase seats for courses in Post Graduate education and for Super Specialisation.
- To introduce Best in Class technologies in fields of Medical Education, Research & Healthcare and make it ready to address challenges of the future.
- To develop a vibrant campus by providing for accommodation, amenities and sports facilities.
- To improve access and provide sustainable mobility solutions to all stakeholders.

4.1.1 MASTER PLANNING PARAMETERS

The Master Planning has been done considering the following key parameters:

- An integrated campus with dedicated zones for clinical, academic and residential areas encouraging efficient, compact and equitable distribution of campus facilities serving all users and meeting the future needs.
- An interconnected, pedestrian-friendly campus providing comfortable, shaded pedestrian environments that support universal access and handicapped-friendly spaces.
- A green campus promoting sustainable mobility and transportation through use of electric vehicles

(with charging facilities) across the campus for patient, visitor and staff movement and park and ride facilities.

4.2CONCEPT

The masterplan has been envisioned for the redevelopment of the existing campus into a well-integrated and sustainable best-in-class medical college and hospital with the following objectives:

- To strengthen “Healthcare for ALL” by providing fully functional world-class public healthcare facilities.
- Determined to provide quality health care services, particularly for those in remote and difficult areas to reduce morbidity and mortality.

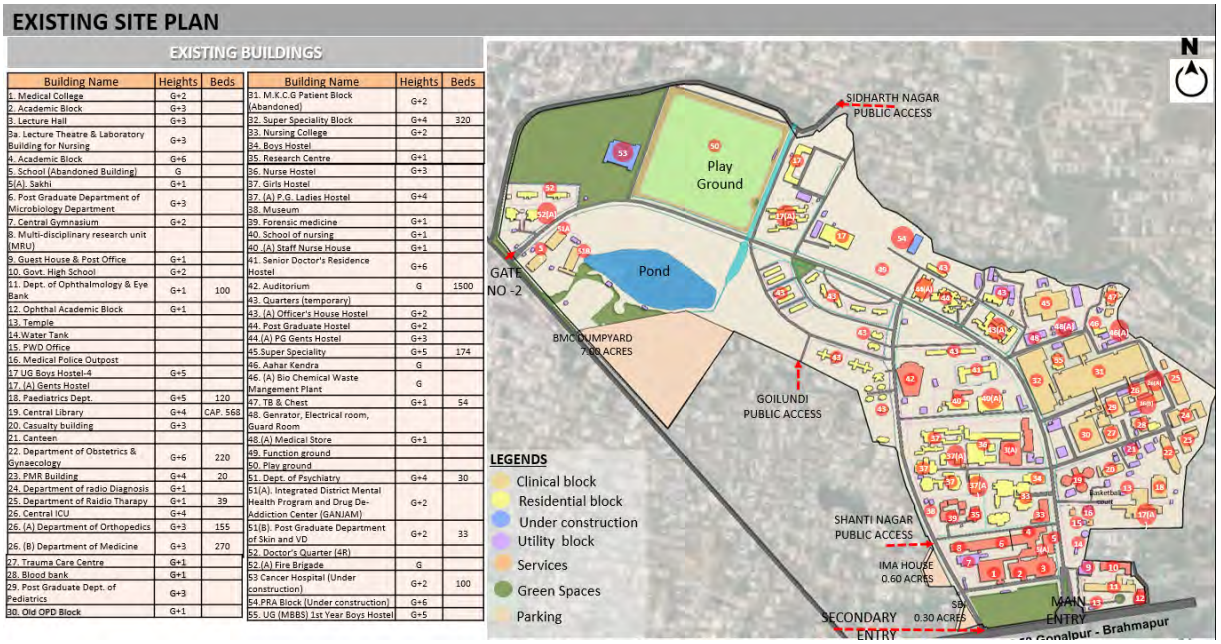


Figure 8: Existing Map

18 major and permanent blocks have to be constructed. These 18 permanent blocks are as follows, with a graphical view for clear understanding.

- Hospital Block (450 Beds) B+G+10
- ESS-01 (B+G+2)
- Indoor Stadium (B+G+1)
- Surgeon Gents Hostel (150 Units) + Guest House (25 Units) B+G+8
- Surgeon Ladies Hostel (150 Units) B+G+7
- UG Girls Hostel (300 Capacity) B+G+12
- Residence – Type -IVA (52 Units) B+G+13
- Residence – Type -IVB (52 Units) B+G+13
- Residence – Type -IIA (52 Units) B+G+13
- Residence – Type -IIB (52 Units) B+G+13
- Club House B+G+3
- Pharmacy College (180 Admissions Annually) B+G+5

- Boys Hostel (Pharmacy) (288 Capacity) B+S+13
- Girls Hostel (Pharmacy) (192 Capacity) B+S+9
- Dental College (77 Admissions Annually) B+G+7
- Boys Hostel (Dental) (152 Capacity) B+S+11
- Girls Hostel (Dental) (152 Capacity) B+S+11
- ESS– (G+2)
- Employer Office
- External Development

Turn Key Contractor shall take the necessary provisions in the Phase-1 structure of the Hospital block. The Turnkey Contractor shall ensure that Hospital authorities are informed and obtain formal confirmation before any relocation of any existing building or facilities proposed for construction.



Figure 5:Proposed buildings

4.3PROJECT COMPONENT

a) HOSPITAL BUILDING

The blocks proposed in the Phase 1 development are dedicated to major priority departments, which have been arrived at after extensive stakeholder interactions. The hospital building has been designed in accordance with the concept design and stacking provided in the RFP. The building would be a state-of-the-art healthcare facility, fully air-conditioned, with finishes as per the finishing schedule provided in the RFP and approved by the Client and its representative. The elevation and facade of the building are based on the 3D views provided during the tendering stage. The building will have IBMS and complete service integration for running healthcare equipment as per the existing retained structures in Phase 1 construction.

The building would be fitted with the following Medical/Engineering services:

- Complete Civil works

- Internal & External Electrical works
- Internal & External PHE works
- Internal & External Fire alarm & Fire suppression system
- HVAC system
- IBMS
- Medical Gas pipeline system
- Pneumatic chute system
- Automatic waste and laundry system (AWLS) (Vertical shaft with SS lining) in Hospital Building
- Nurse Call system
- Bed Head panels for all Patient Beds in all locations & Critical Care areas
- Curtain Track system with curtain
- Modular OTs
- Complete ELV system
- Interior and Fixed Furniture
- Information Display system in Common areas
- Pharmacy Distribution System
- CSSD
- Laundry & Kitchen
- Stretcher Guard Corner Guard

Note: Any item or work missed from the above list & required to fully operationalise the Hospital project shall be within the scope of the Turn Key Contractor. Specification as per Section 5/ CPWD/ NBCor as approved by EIC. No extra payment shall be made for the same.

b) DENTAL BUILDING

The building would be a state-of-the-art healthcare facility with college facilities for 50 admission for B.D.S. and 27 M.D.S. students per year. All finishes are as per the finishing schedule provided in the RFP and approved by the Client and its representative. The elevation and facade of the building are based on the 3D views provided during the tendering stage. The building will have IBMS and complete service integration for running healthcare equipment.
The building would be fitted with the following Medical/ Engineering services:

- Complete Civil works
- Internal & External Electrical works
- Internal & External PHE works
- Internal & External Fire alarm & Fire suppression system
- HVAC system
- IBMS
- Medical Gas pipeline system
- Pneumatic chute system
- Automatic waste and laundry system (AWLS) (Vertical shaft with SS lining) in Hospital Building
- Nurse Call system
- Bed Head panels for all Patient Beds in all locations & Critical Care areas

- Curtain Track system with curtain
- Modular OTs
- Complete ELV system
- Interior and Fixed Furniture
- Information Display system in Common areas
- Pharmacy Distribution System
- CSSD
- Laundry & Kitchen
- Stretcher Guard Corner Guard

Note: Any item or work missed from the above list & required to fully operationalise the Dental College & Hospital shall be within the scope of the Turn Key Contractor. Specification as per Section 5/ CPWD/ NBCor as approved by EIC . No extra payment shall be made for the same.

c) PHARMACY BUILDING

The pharmacy college is designed for 60 admissions in D. Pharma, 60 admissions in B. Pharma, and 40 admissions in M. Pharma. All finishes are as per the finishing schedule provided in the RFP and approved by the Client and its representative. The elevation and facade of the building are based on the 3D views provided during the tendering stage. The building will have IBMS and complete service integration for running healthcare equipment.

The building would be fitted with the following Medical/ Engineering services:

- Complete Civil works
- Internal & External Electrical works
- Internal & External PHE works
- Internal & External Fire alarm & Fire suppression system
- HVAC system
- IBMS
- Complete ELV system
- Information Display system in Common areas

Note: Any item or work missed from the above list & required to fully operationalise the Hospital project shall be within the scope of the Turn Key Contractor. Specification as per Section 5/ CPWD/ NBCor as approved by EIC. No extra payment shall be made for the same.

d) SITE DEVELOPMENT

The campus is divided by a central spine road that serves both campus users and the surrounding community. Due to increasing traffic from the hospital, academic institutions, residential facilities, and adjoining developments, the existing road requires widening and upgrading to improve connectivity and circulation.

The site includes key natural and recreational assets, namely an existing pond and playground, which have been retained and integrated into the overall planning framework. As a major portion of the proposed development lies within a greenfield area, site development, landscape enhancement, and beautification are integral to this phase.

The proposed development has been organised into the following zones:

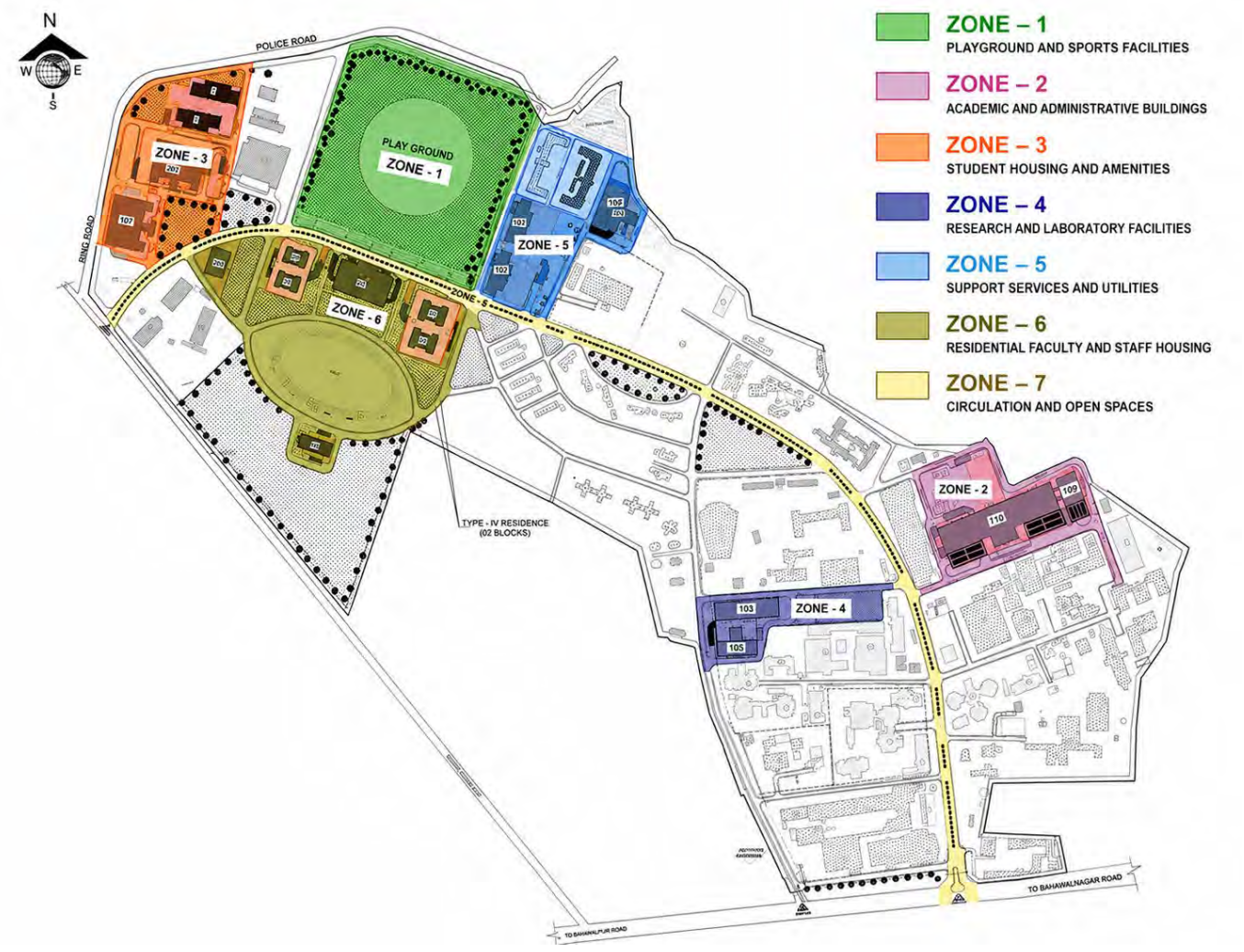
- **Zone 01:** Playground Zone (Cricket ground, Pitch, Ground Levelling & Spectator Stands, basketball court, volleyball court, and other outdoor games)

- **Zone 02:** Hospital Zone
- **Zone 03:** Pharmacy College, Dental College & Girls' Hostels
- **Zone 04:** Ladies' Hostel Zone
- **Zone 05:** Male Hostel Zone
- **Zone 06:** Residential Zone (including Pond Development)
- **Zone 07:** Central Spine Road & Infrastructure Corridor

The zoning strategy ensures efficient circulation, functional segregation, future expansion potential, and a sustainable, well-connected campus environment.

Total consolidated land: 160 acres (approx.)

Redevelopment Site area: 56.60 acres approx. (229075.47 sqm. approx.)



The Contractor shall carry out all works necessary for the development of the proposed campus infrastructure, including site preparation, earthworks, roads, utilities, landscape development, external services, and

construction works associated with the identified development zones. The scope shall include design coordination, procurement, construction, testing, commissioning, and defect liability obligations as specified in the contract documents

4.4INTERIOR

a) DESIGN BRIEF

- Design guidelines are provided with 3d visualization for your consideration. The contractor is to provide detailed design drawings, interior views, samples, a finishing schedule, and site mock-ups, as per the actual site conditions and building configurations.
- All mock-ups to be prepared after approval of the detailed design drawings, interior views, samples, and the finishing schedule.
- The assigned colour codes provided are as per the IGBC rating consideration.
- For all recommended shades assigned to different zones, the corresponding RAL colour to be matched and used, subject to the Engineer in charge's approval.
- The contractor is to provide all the samples for review and approval by the Engineer in charge before implementation.
- Specification of the furniture to be followed as per the furniture schedule.
- All electrical, LV, and internet connections to be provided as per standard practice and functional use.
- In all false ceilings, trap doors to be provided for maintenance purposes. The details of trap doors to be submitted for approval by the engineer in charge.
- For all reception tables, all tables, and inbuilt storage, they are to be built as per the actual dimensions in the plan.

a) COLOUR PALETTE FOR RESPECTIVE ZONE:

- Colour has a psychological and physiological impact on patients, staff, and visitors. Applying colour theory thoughtfully helps create spaces that promote healing, reduce stress, improve orientation, and support clinical functionality.
- **Maximise natural light wherever possible.**
- **Use of calming colour schemes and soft lighting.**
- **Colour contrast in flooring and walls for easy Navigation**

ZONE 1: ENTRANCE LOBBY, LIFT LOBBIES, CORRIDORS, CAFETERIA, WAITING AREAS , DOCTORa'S LOUNGES , ADMINSTRATION.

WARM & WELCOMING COLOR PALETTE:

ENCOURAGES EMOTIONAL COMFORT AND A HOME AN ALIKE FEEL.

- Terracotta Clay – warm and earthy
- Dusty Rose – gentle and comforting
- Ivory Cream – soft neutral backdrop
- Moss Green – balances warmth with calm
- Warm Gray – grounding without heaviness





ZONE 2: OPD CONSULTATION ROOM, ICU, IPD WARD, WAITING AREAS , MRI ROOMS , X-RAAY ROOMS , DIAGNOSTIC ROOMS, PHARMACY.

NATURE-INSPIRED COLOR PALETTE: REDUCE ANXIETY AND PROMOTE RELAXATION. KEEPS A STERILE ENVIRONMENT FROM FEELING COLD OR UNFRIENDLY.

- Soft Sage Green – evokes nature, calm.
- Warm Sand Beige – grounding neutral.
- Muted Sky Blue – soothing and airy.
- Warm White – clean, bright without being sterile.
- Light Wood Tones – adds warmth and natural feel.

ZONE 3: PHARMACY, OT SURGICAL ROOMS, LABS, BLOOD BANK.

COLOR PALETTE: REDUCE ANXIETY AND PROMOTE RELAXATION.

- Warm Sand Beige – grounding neutral.
- Warm White – clean, bright without being sterile.
- Muted Sky Blue – soothing and airy.
- Moss Green – balances warmth with calm
- Warm Gray – grounding without heaviness

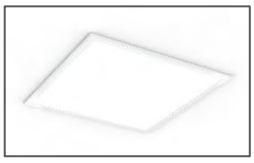


b) LIGHTING:

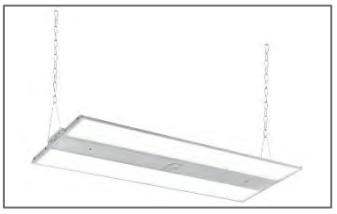
- **Support Healing and Recovery**
- Lighting impacts circadian rhythms, mood, and sleep.
- **Enhance Staff Performance**
- Clear visibility and reduced glare improve staff focus and reduce fatigue during long shifts.
- **Ensure Safety**
- Adequate lighting reduces the risk of falls and errors in critical care areas.
- **Energy Efficiency**
- Hospitals run 24/7, so energy-efficient lighting solutions are essential to lower operational costs.

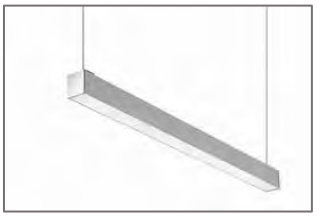
Daylighting Integration

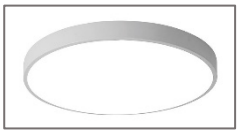
- **Use of Windows and Skylights:** Reduces reliance on artificial lighting.
- **Solar Control: Blinds, films, or smart glass to avoid glare and overheating.**









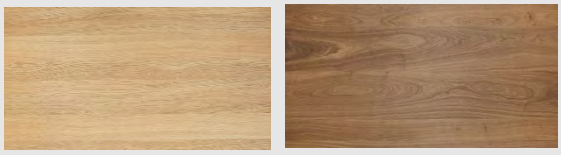


RECOMMENDED LUX LEVELS FOR RESPECTIVE AREAS

Room Type	Illuminance (lux)	Colour Temperature (K)	Colour Rendering Index (Ra)	Notes	Remarks
Patient Rooms	Variable, with separate zones for patients, caregivers, and family	Higher during the day (ideally with daylight), lower at night	At least 80	Dimmable lighting with patient control in the patient zone. 24-hour circadian lighting recommended.	Lux level of any room, and space will be taken on higher side recommended either in interior DBR or MEP DBR.
Examination and Treatment Rooms	1000-1500	Neutral or daylight white (3500K-5000K)	90-98	Glare control is crucial. Full-spectrum LEDs recommended.	
ICU (Around Beds)	100-200	N/A	90		
ICU (Checking Area)	500-1000	N/A	90		
Wards	100 between beds, 300 on the bed	4000K	At least 80	Glare reduction is important.	
Emergency Rooms	300-500	6000K	N/A	Bright, clean lighting for rapid diagnosis and treatment.	
Laboratories	300-500	N/A	N/A	Minimise glare. Consider light sensitivity of equipment.	
Corridors	100-200	N/A	80		

a) MATERIAL PALETTE

WALLS :



NON DECORATIVE VENEER OR PRELAM BOARD PANELLING



LACQUERED GLASS



ACRYLIC EMULSION PAINT SHADES

CEILINGS :



ALUMINIUM OPEN CELL CEILING



ACOUSTICAL FALSE CEILING



ALUMINIUM METAL GRID TILES

FLOORING :







TACTILE TILES



600 X 600 OR 600 X 1200 MM FULL BODY VITRIFIED / WALL TILES –BEIGE / GREY SHADE IN SATIN MATT FINISH

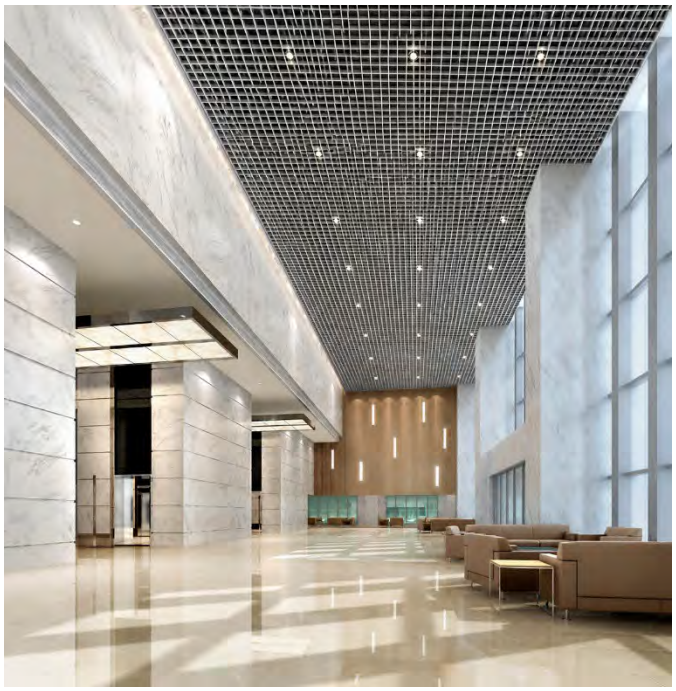


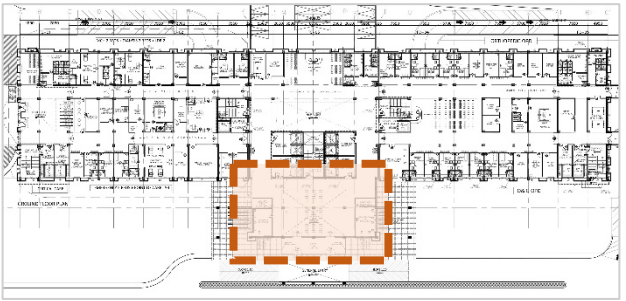
WOVEN VINYL TILES

PVC FLOORING



HOSPITAL BLOCK : DOUBLE HEIGHT ENTRANCE LOBBY





GROUND FLOOR PLAN

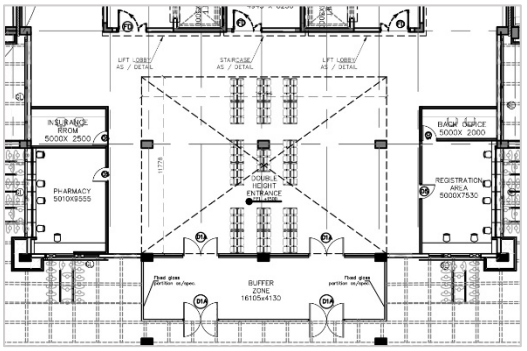


Figure 6: Double Height Entrance Lobby

HOSPITAL BLOCK : OPD ROOMS





FR.01

WAITING AREA METAL BENCH
PVC SEAT



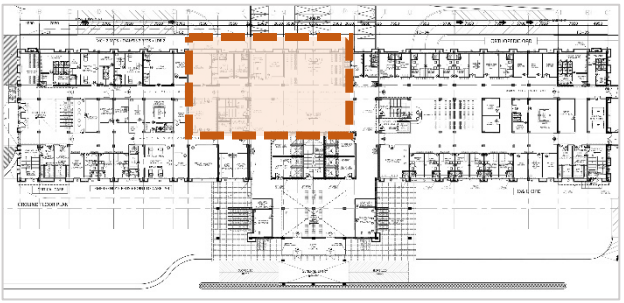




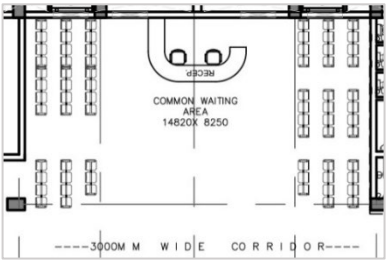
COMMON WAITING AREA – HELP DESK



Figure 7: Reception/Help Desk

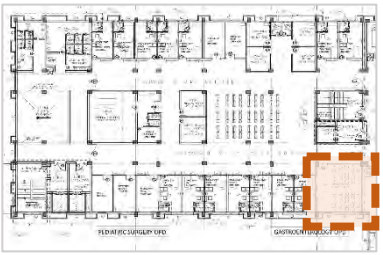


GROUND FLOOR PLAN

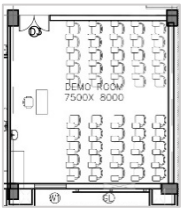


HOSPITAL BLOCK : DEMO ROOMS



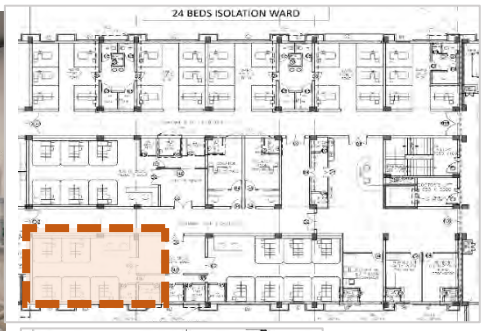


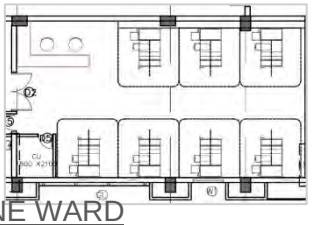
FIRST FLOOR PART PLAN



HOSPITAL BLOCK: ICU ROOMS

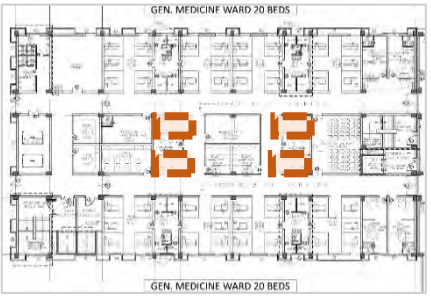


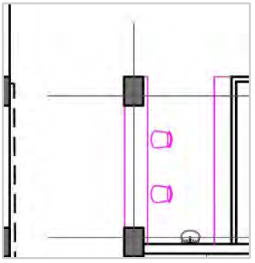




HOSPITAL BLOCK: NURSE STATION - GENERAL MEDICINE WARD

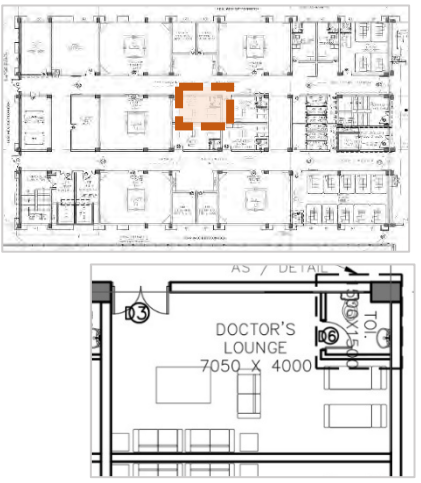






HOSPITAL BLOCK: DOCTOR'S LOUNGE





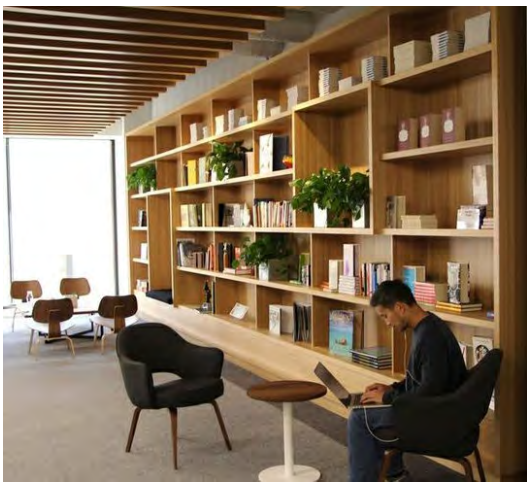
HOSPITAL BLOCK : GENERAL MEDICINE WARD



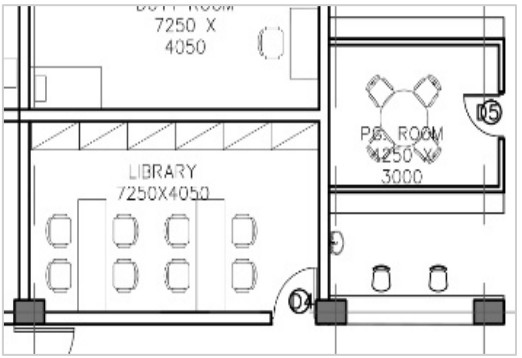
BED BAY VIEW



HOSPITAL BLOCK : LIBRARY & P.G. ROOM



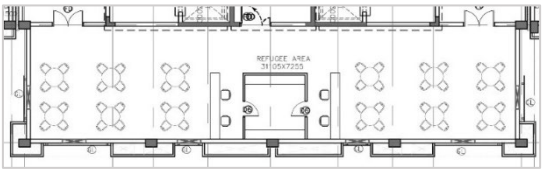




HOSPITAL BLOCK: CAFETERIA



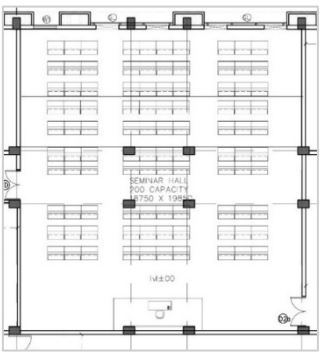




HOSPITAL BLOCK : SEMINAR HALL (200 PAX.)



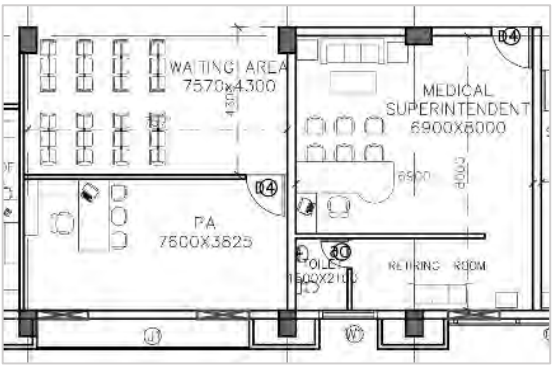




HOSPITAL BLOCK: MEDICAL SUPERINTENDENT ROOM

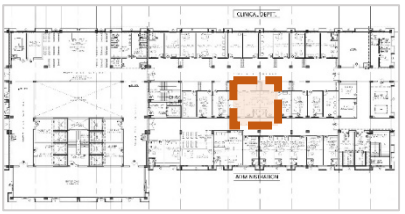


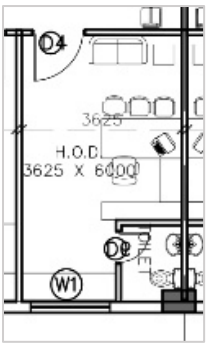




HOSPITAL BLOCK: HOD ROOM

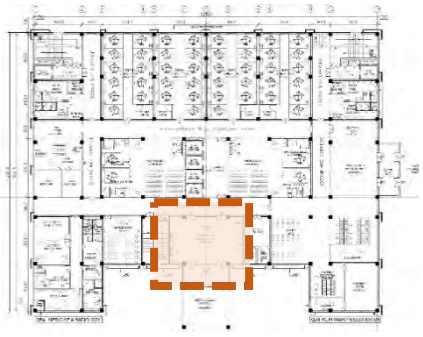


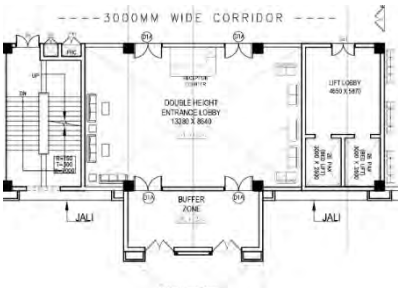




DENTAL BLOCK: DOUBLE HEIGHT ENTRANCE LOBBY





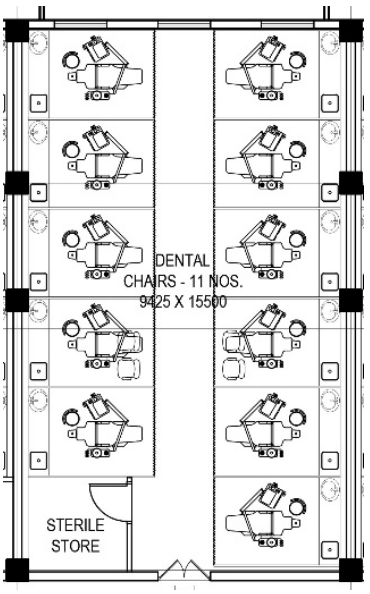


DENTAL BLOCK : DENTAL CONSULTATION ROOM



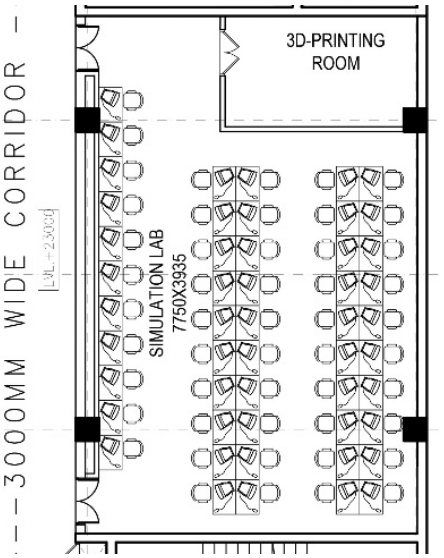
DENTAL BLOCK : DENTAL CHAIR ROOM





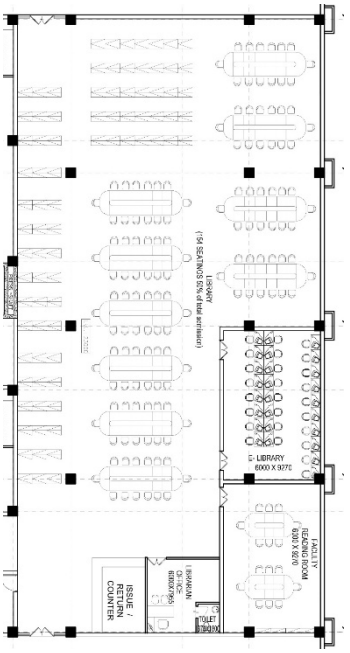
DENTAL BLOCK: SIMULATION LAB





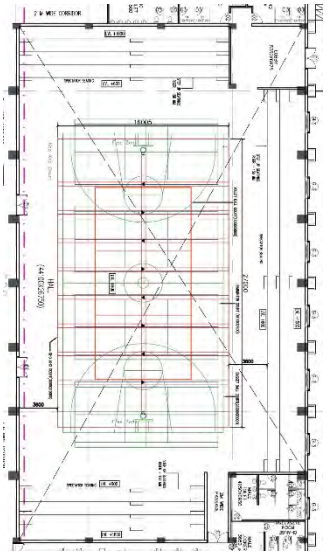
DENTAL BLOCK : LIBRARY





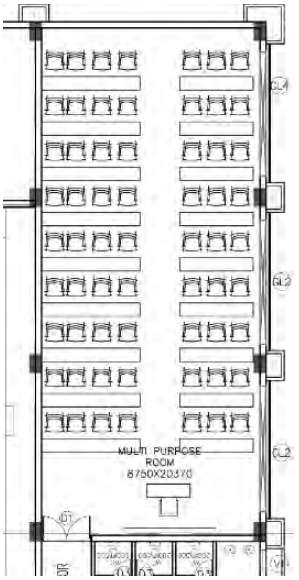
INDOOR STADIUM : STADIUM





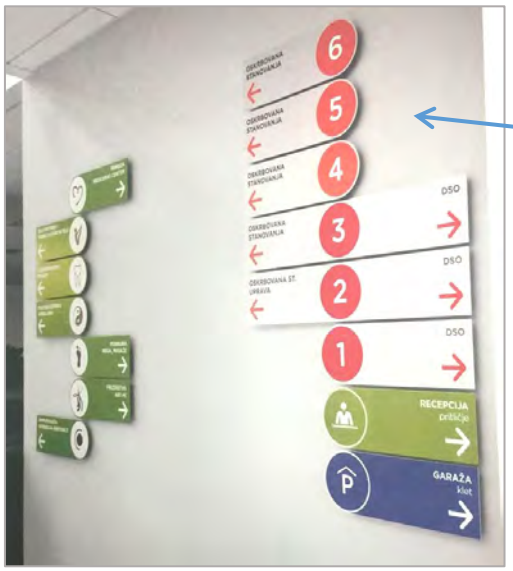
INDOOR STADIUM : MULTIPURPOSE ROOM



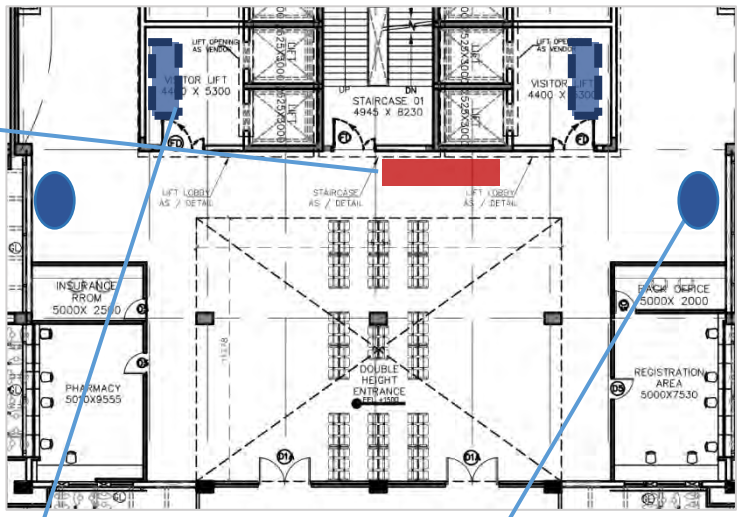


Note: The above are the interior views of a few locations specified for reference only, for further detailing and reference by the Turn Key Contractor.

FLOOR DIRECTORY / WAY FINDING



3M GRAPHIC / SS :
LIFT AREA SIGNAGE
DESIGN / MAKE : AS APPRVD..



GROUND FLOOR
LOBBY PLAN



SS SIGNAGE :
FLOOR INTERNAL SIGNAGE
DESIGN / SPEC : AS APPRVD.



INTERACTIVE SCREEN –
WAY FINDING
DESIGN / MAKE : AS APPRVD..

4.4. BUILDING COMPONENTS: (HOSPITAL, DENTAL COLLEGE AND PHARMACY COLLEGE.)

- PUBLIC AREAS: All public areas, waiting lobbies, courtyards, entry and exit areas, registration areas, and corridors are considered public areas and are designed for ease of public access, information, and communication. All level differences are planned with appropriate measures for disabled-friendly ramps at entry and exits, with Fire safety and security measures, and are provided with handrails, stretcher guards, and appropriate signage illuminating exit routes. These areas are planned with necessary provisions for TV and dish antenna connections for entertainment, tea/coffee vending machines, Wi-Fi routers, and IT connections (waiting lounges/courtyards, etc.). All corridors with colour-coded wayfinders, provision for mobile charging stations, and appropriate lighting for emergency escape routes. The space requirements comply with the NBC architectural standards.

- PUBLIC TOILETS: All public toilets proposed to include 1 disabled-friendly toilet (or as per the provisions of NBC) and provision of at least 1 Indian-type WC. The appropriate number of WC and Urinals is proposed as per NBC calculations, along with appropriate nos. of soap dispensers, Mirrors, wall-mounted washbasins, hand dryers, and space for a janitor's closet. The toilets have been designed to be easy to clean and maintain. The entry to the toilets is designed so that there is an indirect entry with no direct view inside the toilet from outside. Screen walls for toilet entry are provided.

- STAIRCASES: All staircases are designed as per local byelaws/Indian standards/NBC. The staircases will have equal riser heights and equal tread widths. The landings, entries, and exits will have appropriate signage and fire protection measures. The local Fire safety byelaws, along with the NBC, are considered in the design. The staircases are designed with handrails in accordance with the specifications and appropriate heights. Appropriate lux levels will be considered for stair lighting. Emergency lights are designed to illuminate emergency exit signage.

- LIFT LOBBY: All lift lobbies are designed per the individual requirements of Lift sizing. The lift lobbies are designed with enough space for the manoeuvring of stretchers and wheelchairs. All the lifts in the hospital building are bed lifts. The lift lobbies will have appropriate signage, including illuminating exit routes, Floor identification, Floor activity, etc. All lift lobbies shall have safety, security, and emergency provisions.

- DUMB WAITERS: Dumb waiters provided in the Dental college are for Dental chairs and OT (sterile and non-sterile supplies).

MKCG CAMPUS				
S.NO.	DESCRIPTION	NOS.	CAPACITY	REMARK
1	**Hospital (B+G+10)**			
	20 Passenger Bed Lift	12	20 Passenger Bed Lift	MRL
	04 Fireman's Lift	6	20 Passenger Bed Lift	MRL with one lift of minimum 2.0 Ton Capacity
	Total	18		
2	ESS (B+G+2)			
	Goods Lift	1	2.50 Ton Lift	
	Total	1		

3	**Indoor Games (B+G+1)**			
	13 Passenger Lift	1	13 Passenger Lift	MRL
	Goods Lift	1	2.00 Ton Lift	
	Total	2		
4	**Surgeon Gents Hostel +Guest House (B+G+8)**			
	13 Passenger Lift	3	13 Passenger Lift	MRL
	20 Passenger Lift	2	20 Passenger Lift	MRL
	Total	5		
5	**Surgeon Ladies Hostel (B+G+7)**			
	13 Passenger Lift	3	13 Passenger Lift	MRL
	20 Passenger Lift	2	20 Passenger Lift	MRL
	Total	5		
6	**UG Girls Hostel (B+G+12)**			
	20 Passenger Lift	1	20 Passenger Lift	MRL
	13 Passenger Lift	4	13 Passenger Lift	MRL
	Total	5		
7	**Type -IVA – B+S+13**			
	20 Passenger Bed Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	3	13 Passenger Lift	MRL
	Total	4		
8	**Type -IVB – B+S+13**			
	20 Passenger Bed Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	3	13 Passenger Lift	MRL
	Total	4		
9	**Type -IIA – B+S+13**			
	20 Passenger Bed Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	3	13 Passenger Lift	MRL
	Total	4		
10	**Type -IIB – B+S+13**			
	20 Passenger Bed Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	3	13 Passenger Lift	MRL
	Total	4		
11	**Club House (B+G+1)**			
	16 Passenger Bed Lift	2	16 Passenger Bed Lift	MRL
	Total	2		
12	**Dental College (B+G+7)**			
	20 Passenger Bed Lift	6	20 Passenger Bed Lift	MRL
	Fire Man’s Lift	2	20 Passenger Bed Lift	MRL
	Dumb Waiter	2	-	
	Total	8		
13	**Boys Hostel -Dental (B+G+11)**			
	20 Passenger Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	4	13 Passenger Lift	MRL
	Total	5		

14	**Girls Hostel -Dental (B+G+11)**			
	20 Passenger Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	4	13 Passenger Lift	MRL
	Total	5		
15	**Pharmacy college (B+G+5)**			
	20Passenger Lift	6	20 Passenger Bed Lift	MRL
	Fire Man's Lift	2	20 Passenger Bed Lift	MRL
	Total	8		
16	**Boys Hostel -Pharmacy (B+G+13)**			
	20 Passenger Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	4	13 Passenger Lift	MRL
	Total	5		
17	**Girls Hostel -Pharmacy (B+G+9)**			
	20 Passenger Lift	1	20 Passenger Bed Lift	MRL
	13 Passenger Lift	4	13 Passenger Lift	MRL
	Total	5		
18	**ESS (G+1)**			
	Total	0		
	TOTAL LIFTS	95		

Note: Turn-Key Contractor should submit a vertical transport analysis report, and any additional lifts required shall be within the scope of the Turn-Key Contractor.

MRL – Machine Room Less.

- CORRIDORS AND COMMON SPACES: All corridors are well-ventilated and lighted adequately. Drinking water coolers through a centralised RO supply shall be installed near all common toilets, pantries, cafeteria and Aahar Kendra.
- HOSPITAL ENTRANCE: The hospital caters for people with 2 entry gates for different departments, which are as follows: ▪ OPD entrance gate ▪ EMERGENCY entrance gate
- DENTAL ENTRANCE: The dental college has 2 entrances for different types of crowds; one will serve as the entrance for hospital/OPD, and the other will be used as the college entrance.
- PHARMACY ENTRANCE: The building is operated solely for college purposes; hence, there is one entrance lobby.
- CRITICAL AREA WARDS (HDU, PRE-OP, POST OP): All wards' areas are designed with the Area requirements as per the details in the area requirement; the location of the nursing station will be centrally located to have a direct view of patients; one nursing station is provided for not more than 10 beds. Each ward is provided with toilets for its occupants and visitor waiting areas, as per NBC requirements. The toilets are located for patient ease of access, with accessible toilets. Each Critical area ward bed is provided with a bedhead panel that includes all requirements, such as a nurse call system, medical gases, Vacuum, etc., and power socket (s). A nurse call point with an emergency alarm switch (panic alarm) is also provided. A curtain track system with a curtain is provided for each bed in the Critical area ward. All nursing stations are provided with appropriate Power sockets for Computers, mobile charging points, and equipment chargers, as required. Appropriate network points, at least two (2) per seat or as per RFP, are provided for nursing stations. Provision of all alarms and monitoring devices, including MGPS alarms, will also be made at nursing stations. Adequate

provision for the segregation, separation, and isolation of patients and the general public is carefully made while designing critical area wards. HDU and BMT will also consider avoiding cross-patient infection by proper patient isolation, as the patients are immunocompromised. HVAC, ducting, and service linkages will be completed with the above-mentioned important aspects in mind.

- WARDS: All wards' areas are designed with the Area requirements as per the details in the Area requirements; the location of the nursing station will be centrally located to have a direct view of patients in all 5-bed cubicle wards. Each ward is provided with toilets for its occupants and visitor waiting areas, as per NBC requirements. The toilets are located for patient ease of access, with toilets for differently abled patients. Each general ward bed is provided with an MGPS connection, a nurse call point, and a power socket(s). A curtain track system with a curtain is also provided for each bed in the General ward. All nursing stations will be provided with appropriate Power sockets for Computers, mobile charging points, and equipment chargers, as required. Appropriate network points, at least two (2) per seat, will be provided for nursing stations. Provision of all alarms and monitoring devices, such as MGPS alarms, will be made at the nursing station.

- OPD: All OPD consultation rooms with provision for seating of doctor and patient along with (if required) patient examination table. The room will have appropriate provision for power sockets for minor medical equipment, Gynac lamps, medical Pendants (wherever required), Computers, laptops, phone chargers, light switches and power points etc. and in dental hospital the chairs will be provided with at least one basin and one sink with provision for the power sockets all the appropriate equipment required by that particular dept, in accordance with RFP. At least two network connection points (the actual number of network connection points will be as per requirements), Wash basin, and provision for TV with DTH connection will be provided.

- REGISTRATION DESK/ HELP DESK: All general offices will have appropriate provision of Computers laptops, mobile charger power points, Network connectivity at least two (2) per seat or as per RFP, Visitors waiting, provision of modular work stations, space for keeping UPS etc. will be provided.

- TSSU/STERILE STORE: Plan and make provision for the installation of equipment in the CSSD and sterile store. All electrical, HVAC, plumbing, drainage, and water point provisions will be done as per the detailed planning of these areas for:

  1. Cleaning Area (Dirty equipment)
  2. Segregated Process Area
  3. Clean Assembly & Packaging Area
  4. Sterilisation Area
     a. Steam Area (Open Area)
     b. ETO & Plasma Sterilisation area
  5. Sterile Area (Clean Stores)

- **Central Sterile Supply Department (CSSD)** and **Central Laundry**:

  The Central Sterile Supply Department and Central Laundry DPR given below shall be read in conjunction with the Detailed Central Sterile Supply Department and Central Laundry Specification, List of Make & overall other contract documents forming part of the turnkey contract. In case of any variance, Central Sterile Supply Department and Central Laundry requirements given here in DPR or stringent among those shall supersede any other requirements mentioned in any other parts of turnkey contract document & the instructions / directions of engineer-in-charge will be binding on the contractor. EPC contractor will design; supply installation-testing

commissioning of Central Sterile Supply Department and Central Laundry. Scope of work broadly comprises but not limited to following specifications.

The **Central Sterile Supply Department (CSSD)** and **Central Laundry** are critical support services ensuring infection control, patient safety, and uninterrupted hospital operations.

This DBR defines the design, planning, equipment sizing, and technical requirements for:

- CSSD (Central Sterile Supply Department)
- Centralized Laundry System

Both systems shall be executed on a **turnkey EPC basis**, including **design, supply, and installation, testing, and commissioning (SITC)**.

CSSD (Central Sterile Supply Department)

Objective

CSSD is responsible for:

- Cleaning, disinfection, and sterilization of medical equipment
- Supplying sterile materials to OTs, ICUs, wards, and OPDs
- Preventing hospital-acquired infections (HAIs)

Location & Area

- **CSSD Room Size:** as per Drawing
- Layout shall ensure **unidirectional workflow** (dirty → clean → sterile)

Functional Activities

- Receiving and sorting contaminated materials
- Decontamination and cleaning
- Inspection and testing of instruments
- Assembly of instrument sets and linen packs
- Packing and sterilization
- Labelling and storage
- Distribution of sterile supplies

Zoning Requirement

CSSD shall be divided into **four functional zones**:

1. **Dirty / Decontamination Area**
    - Receiving contaminated items
    - Washing and cleaning

2. **Clean / Assembly Area**
    - Inspection, assembly, and packing
3. **Sterilization Area**
    - Sterilizers (steam & low temperature)
4. **Sterile Storage Area**
    - Storage and dispatch

Key Design Requirements

- Strict **physical barriers** between dirty and clean zones
- No cross movement of sterile and contaminated items
- Smooth, non-slip, chemical-resistant flooring
- SS / granite work surfaces
- Hands-free operation where possible

Central Laundry System:

- LAUNDRY: TURNKEY developer shall plan and make a provision for installation of equipment in the All electrical, HVAC, plumbing, drainage, and water points provisions will have to be done as per the detailed planning of these areas for:

1. Receiving Area
2. Separation Area
3. Washing machines, dryers, hydro-extractors, calendaring & pressing
4. Sluicing & autoclave
5. Mattress sterilizing & mending
6. Staff rooms & locker room
7. Issuing area.

Design Considerations

- Strict separation of dirty & clean linen flow
- Barrier washing system recommended
- Adequate ventilation & exhaust
- Anti-skid flooring
- Drainage system for wastewater
- Ergonomic workflow

General Requirements

- Compliance with **NABH / NMC guidelines**
- Vendor to provide:
    - Shop drawings
    - BOQ

- Technical datasheets
- Validation reports

- Complete SITC responsibility
- Training of hospital staff

- HOSPITAL KITCHEN: All electrical, HVAC, plumbing, drainage, and water points provisions will have to be done as per the detailed planning of these areas for:

1. Cooking Area
2. Preparation Zone
3. Trolley Parking Area
4. Staff Rooms & locker Room
5. Utensil wash area
6. Cold/dry storage.
7. Preparation Zone

All Kitchen equipment as required are to be provided by the contractor.

- LABORATORIES: laboratories rooms would have provision of medical equipment and machines as per employers requirements, appropriate provision should be made for energizing equipment and machines, The labs will have Modular Lab furniture, hence appropriate provision should be made while detailing all the laboratories for connection of all Gas, electrical power, wet points and drainage along with lab equipment should be done while designing the structure and detailing of lab areas. A modular plug-and-play setup for electrical points, wet points and drainage should be planned for all the labs. The detailed design of the Laboratory is to be carried out by a specialised agency appointed by the contractor, and after approval of the EIC in consultation with the Enduser.

- RADIOLOGY: The radiotherapy block has been designed in accordance with the detailed requirements provided. The functional analysis and patient flow are considered when designing these rooms. The equipment installation for all Radiotherapy rooms will be coordinated with the equipment vendor. The specifications and architectural, structural, and MEP provisions will be made as per the Equipment vendor's requirements, AERB guidelines, IS Codes, and international best practices.

4.5 STACK SECTION

4.5.1 HOSPITAL

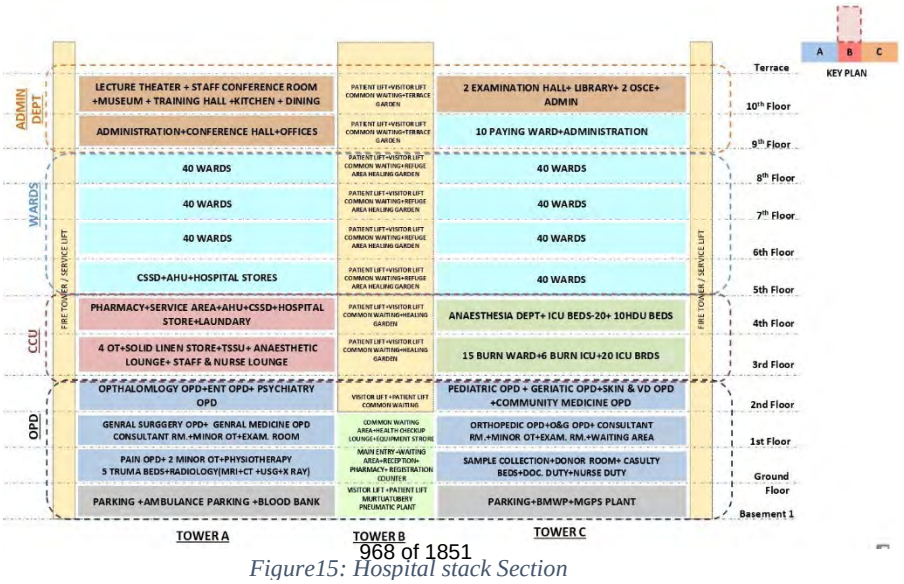


Figure15: Hospital stack Section

4.5.2. DENTAL COLLEGE:

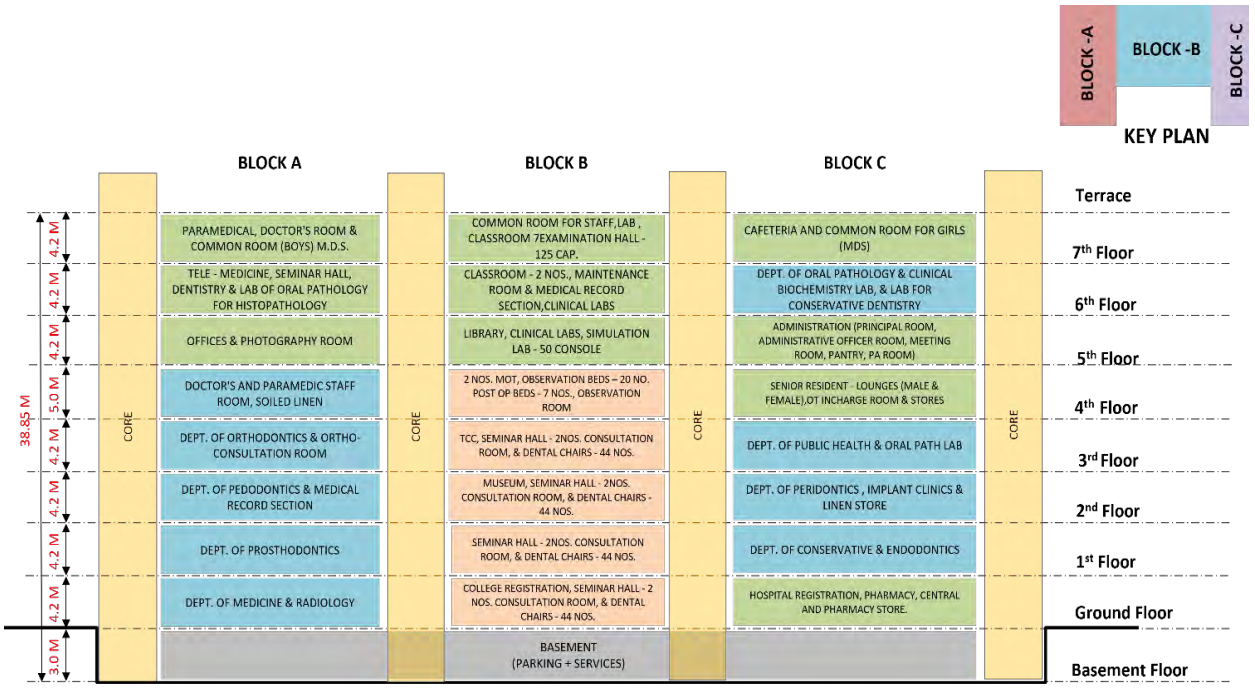


Figure 8: Stack Section: Dental College

4.5.3. PHARMACY COLLEGE:

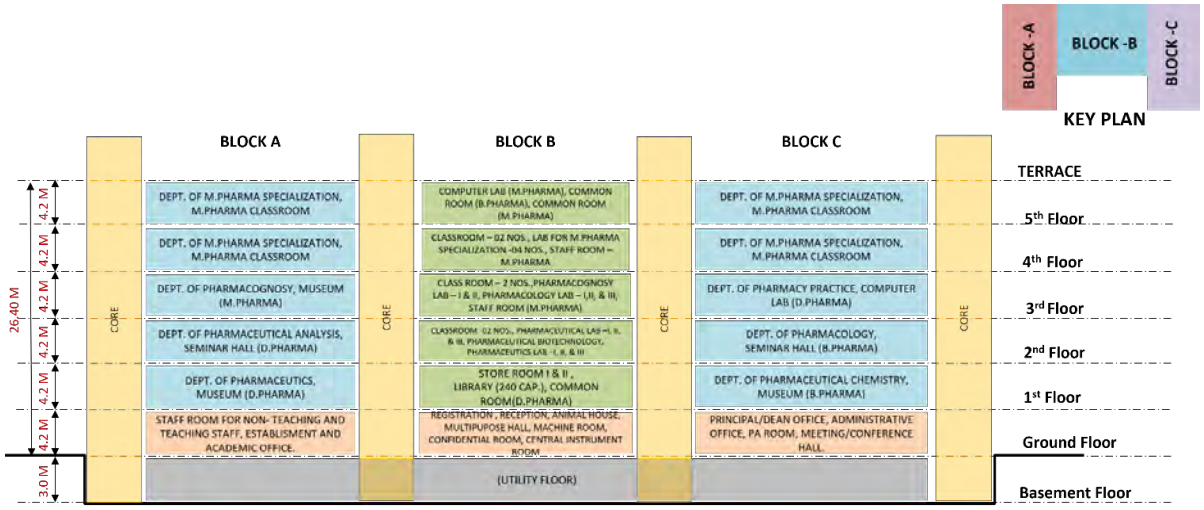


Figure 9: Stack Section: Pharmacy College

4.5.4. ELECTRICAL SUB-STATION

This block is a B+G+2 structure comprising MGPS plant room, DG sets, Transformers, HVAC chillers, L.T. and H.T. panel room, transformer and DG sets, and Engineering Workshop. It is an independent block, directly connected to the hospital via a connecting corridor.

4.5.6. INDOOR STADIUM

Indoor Stadium is located at the bottom of the playground and surrounded by the residential towers. It has the capacity of 250-300 people at a time. It includes five different sports activities, i.e., Volleyball,

Badminton, and Basketball, along with a gymnasium (Male and Female) and a yoga hall. It is purposely designed for the students and staff of the campus to engage more with the physical environment alongside academics.

4.5.7. UG GIRLS HOSTEL

It is a 300-bed hostel with a common area, kitchen & dining, gymnasium, recreational room, etc., for Undergraduate girls of MBBS with B+S+12 floors.

4.5.9. LADIES HOUSE SURGEON HOSTEL

It has 150 beds, a common area, kitchen & dining, a recreational room, etc., for female surgeons on B+S+7 floors.

4.5.10 GENTS HOUSE SURGEON HOSTEL+GUEST HOUSE

It is 150 beds with common areas, kitchen & dining, recreational room, etc., for male Surgeon with B+S+8, with 25 rooms/suites proposed for guest house floors.

4.5.12. TYPE IV RESIDENCE

Type IV residence is an B+S+13 structure comprising 104 units.

4.5.13. TYPE II RESIDENCE

Type II residence is an B+S+13 structure comprising 104 units.

Other services – S.T.P., E.T.P.U.G.T, H.S.D. Tank Rainwater Harvesting Tank (R.W.H.)

All these are the components of Phase-1 which is to be completed. The blocks, details, etc. mentioned herein for the Phase 1 development are only indicative and for information purposes, and are intended to complete all works in all respects for Phase 1. However, the Contractor should ensure that the design and construction works under the Scope of work assigned under the RFP document shall seamlessly integrate with subsequent works as proposed for Phase II and any other later Phase, which may be decided from time to time. The Scope of Work for Phase 1 includes the following works, to be completed in all respects, including, but not limited to, Civil & structures, Architecture, interior and exterior finishes, all MEP Services, ICT & Audio Visual, Landscaping, and Lighting, etc. The scope of work shall also include, but not be limited to, structural works, all interior finishing works, Electrical works, Mechanical works, IT works, Plumbing, Sanitary, Sewerage, stormwater drainage, Modular OT, Medical Gas, pneumatic tube system, Kitchen Equipment, Furniture, Signage & Fire-Fighting works, etc., including maintenance during the defect liability period. The execution of all interior and exterior spaces should accommodate all categories of medical equipment to be installed at a later stage. The scope of Contractor also includes preparation of all Detailed drawings, Good for Construction drawings, preparation of Coordinated service drawings, finishing drawings, detailed shop drawings, obtaining approvals from all local authorities, Fire department, pollution control department, electrical inspector, lift inspector and obtaining approval and connection for water supply, sewer, drainage, electricity connection from local bodies, permission/approval for tree replantation/Tree cutting etc. and all approvals related to operationalizing clinical facilities, to be executed as integral part of the project. The scope will include obtaining **IGBC Gold rating** for the campus and all related compliances.

4.6 CLINICAL PLANNING

EXISTING BED CHART

M.K.C.G. MEDICAL COLLEGE, BRAHMAPUR, ODISHA, INDIA

HOSPITAL- EXISTING BED DISTRIBUTIONS

S.NO.	NAME OF THE DEPARTMENT	Dept. of Medicine (G+3)	Pediatric Department (G+5)	TB & Chest (G+1)	Post Graduate Department of Skin and VD (G+2)	Department of Psychiatry (G+4)	Super Specialty Block (G+4)	Department of Orthopedics (G+3)	Dept. of Ophthalmology & Eye Bank (G+1)	Super Specialty Block (G+4)	Department of Obstetrics & Gynaecology (G+6)	Casualty Building (G+3)	Super Specialty Block (G+4)	Super Specialty Block (G+4)	P.M.R. Building (G+4)	Dept. of Radiotherapy (G+1)	Super Specialty Block (G+5) 174 beds	TOTAL BEDS
1	GENERAL MEDICINE	270																270
2	PEDIATRICS		120															120
3	TB & CHEST			54														54
4	SKIN				33													33
5	PSYCHIATRY					30												30
6	GENERAL SURGERY						240											240
7	ORTHOPEDICS							155										155
8	OPHTHALMOLOGY								100									100
9	ENT									40								40
10	OBSTETRICS AND GYNAECOLOGY										220							220
11	EMERGENCY MEDICINE											48						48
12	PEDIATRIC SURGERY												20					20
13	GASTROINTESTINAL (G.I.) SURGERY													20				20
14	PHYSICAL MEDICINE & REHABILITATION														20			20
15	RADIOTHERAPY															39		39
16	NEUROLOGY																174	174
17	ENDOCRINOLOGY																	
18	CARDIOLOGY																	
19	NEPHROLOGY																	
20	PLASTIC SURGERY																	
21	UROLOGY																	
22	NEUROSURGERY																	
23	CT & V SURGERY																	
24	DIALYSIS UNIT																	
	TOTAL BEDS	270	120	54	33	30	240	155	100	40	220	48	20	20	20	39	174	~~1579~~ 1583

Sanction Beds-400

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Berhampur

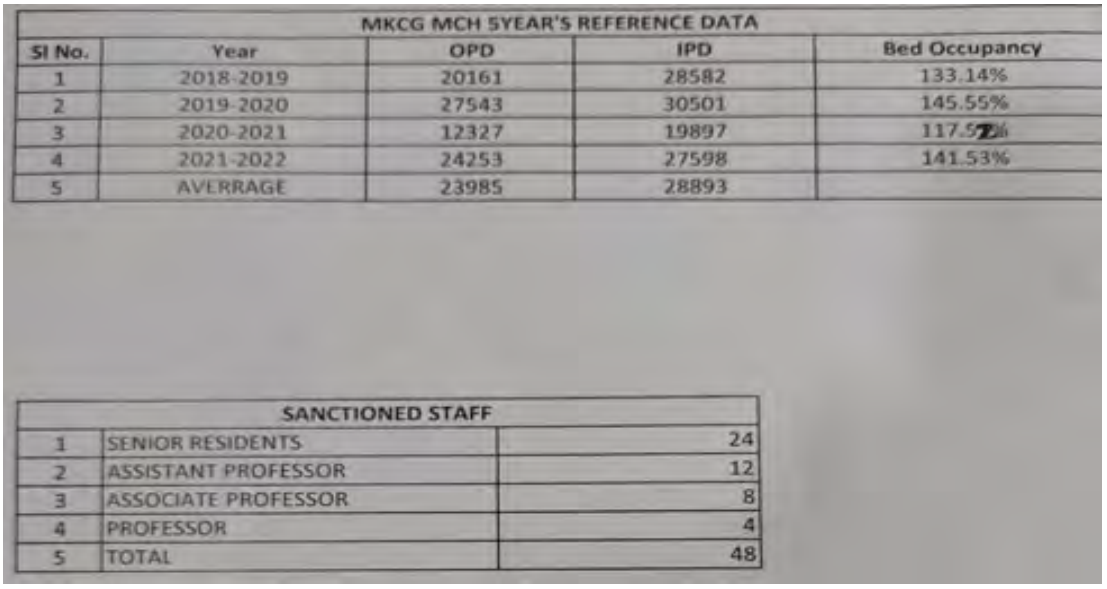
M.K.C.G. MEDICAL COLLEGE, BRAHMAPUR, ODISHA, INDIA

HOSPITAL- BED DISTRIBUTIONS

S.NO.	NAME OF THE DEPARTMENT	EXISTING LOCATION	YEAR OF CONSTRUCTION	STATUS	EXISTING BEDS	EXISTING OCCUPANCY (%)	EXISTING LOCATION RETAINED BEDS	RETAINED BEDS	PROPOSED BLOCKS (B+G+10) PHASE 1	PROPOSED BLOCKS (B+G+10) PHASE 2	PROPOSED BLOCKS (B+G+10) PHASE 3	TOTAL BEDS	REMARKS
1	GENERAL MEDICINE	Dept. of Medicine (G+3)	2007	Augmented	270	120%	Augmented as Obs. & Gynae dept. in Phase 3	0	280	120		400	Existing beds are planned in new proposed hospital in phases & current Dept. of Medicine to be converted int Obstetrics & Gynecology Orthopedics.
2	PEDIATRICS	Pediatric Department (G+5)	2018	Retained	120	100%		120				120	120 beds of Pediatrics are retained in existing Pediatric Dept.
3	TB & CHEST	TB & Chest (G+1)	1994	Retained	54	75%		54				54	54 beds of TB & Chest are retained in existing building
4	SKIN	Post Graduate Department of Skin and VD (G+2)	2022	Retained	33	75%		33				33	33 beds of Skin are retained in existing Post Graduate Department of Skin and VD
5	PSYCHIATRY	Department of Psychiatry (G+4)	2015	Retained	30	75%		30				30	30 beds of Psychiatry are retained in existing Dept. of Psychiatry
6	GENERAL SURGERY	Super Specialty Block (G+4)	2018	Retained	240	75%		240				240	240 beds of General Surgery are retained in existing Super Specialty Block
7	ORTHOPEDICS	Department of Orthopedics (G+3)	2010	Retained	155	100%		155				155	155 beds of Orthopedics are retained in existing Department of Orthopedics
8	OPHTHALMOLOGY	Dept. of Ophthalmology & Eye Bank (G+1)	1964	Demolish in Ph-2	100	75%		0	100			100	Existing beds are planned in new proposed hospital in phase 1 & current Dept. of Ophthalmology & Eye Bank be demolished in Phase-2 due to dilapidated condition
9	ENT	Super Specialty Block (G+4)	2018	Retained	40	75%		40				40	40 beds of ENT are retained in existing Super Specialty Block
10	OBSTETRICS AND GYNAECOLOGY	Department of Obstetrics & Gynaecology (G+6)	2016	Retained	220	110%	Augmented from Gen. Med. dept. in Phase 3	480				490	220 beds of Obs & Gynae. are retained in existing Department of Obstetrics & Gynaecology & 230 beds o Gen Med. Are augmented to it
11	EMERGENCY MEDICINE	Casualty Building (G+3)	2016		48	120%		48				48	
12	PEDIATRIC SURGERY	Super Specialty Block (G+4)	2018	Retained	20	75%		20				20	12 beds of
13	GASTROINTESTINAL (G.I.) SURGERY	Super Specialty Block (G+4)	2018	Retained	20	75%		20				20	20 beds of G.I. surgery are retained in existing Super Specialty Block
14	PHYSICAL MEDICINE & REHABILITATION	P.M.R. Building (G+1)	2019	Retained	20	50%		20				20	20 beds of PMR are retained in existing P.M.R Buildin
15	RADIOTHERAPY	Dept. of Radiotherapy (G+1)	1976	Retained	39	75%		39				39	39 beds of Radiotherapy are retained in existing P.M.R Building
16	NEUROLOGY	Super Specialty Block (G+5) 174 beds	2020	Retained	20	50%		20				20	174 beds of superspecialty are retained in existing Sup Specialty Block
17	ENDOCRINOLOGY				20	75%		20				20	
18	CARDIOLOGY				20	75%		20				20	
19	NEPHROLOGY				20	50%		20				20	
20	PLASTIC SURGERY				20	75%		20				20	
21	UROLOGY				20	75%		20				20	
22	NEUROSURGERY				20	50%		20				20	
23	CT & V SURGERY				20	50%		20				20	
24	DIALYSIS UNIT				14	100%		14				14	
25	CANCER HOSPITAL	Cancer Hospital (G+1)		Under-construction					100			100	Cancer beds under construction on site
26	CRITICAL CARE UNIT	Covid Care Hospital (G+4)		Under-planning by PWD					50			50	Covid Care Hospital under-planning by PWD
27	BURN CARE UNIT	Burn Care Unit		Under-planning by PWD					20			20	Burn Care Unit under-planning by PWD
28	TRANSFUSION MEDICINE UNIT	Transfusion Medicine Unit (G+0)		Under-planning by PWD					10			10	Transfusion Medicine Unit under-planning by PWD
29	DENTAL MEDICAL COLLEGE								20			20	Dental college to be proposed in Phase-I
30	TRAUMA CENTRE & DISASTER MANAGEMENT CELL	Trauma Centre & Disaster Management Cell (B+G+10)		Proposed in Ph-2						100		100	Trauma to be proposed in Phase-2
31	ADVANCED HEALTHCARE & RESEARCH CENTRE	Advanced Healthcare & Research Centre (B+G+10)		Proposed in Ph-3							250	250	Advanced Healthcare & Research proposed in Ph-3
	TOTAL BEDS				1583			~~1435~~ 1483	~~560~~	220	250	~~2465~~ 2533	

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4.7 ANNUAL REPORT



MKCG MCH 5YEAR'S REFERENCE DATA

Sl No.	Year	OPD	IPD	Bed Occupancy
1	2018-2019	20161	28582	133.14%
2	2019-2020	27543	30501	145.55%
3	2020-2021	12327	19897	117.5[illegible]%
4	2021-2022	24253	27598	141.53%
5	AVERRAGE	23985	28893	

SANCTIONED STAFF		
1	SENIOR RESIDENTS	24
2	ASSISTANT PROFESSOR	12
3	ASSOCIATE PROFESSOR	8
4	PROFESSOR	4
5	TOTAL	48

Fig.17 – Annual Report

4.8 DOOR WINDOW SCHEDULE

4.8.1 HOSPITAL BUILDING:

MKCG - HOSPITAL BLOCK							
DOOR- WINDOW SCHEDULE							
S.NO.	**NOMENCLATURE**	**SIZE**	**SILL LVL.**	**LINTEL LVL.**	**SPECIFICATION**	**LOCATION**	**REMARKS**
1	FD	2000X2100	-	2100	Metal glazed fire door	• Lift lobby • Staircase • Refuge area • Seminar hall • fire exit door	With vision panel 200x300mm (Lift Lobby doors will be Glass Fire Doors of specified ratings.)
2	FD1	1500X2100	-	2100	Metal fire door	• AHU • Electrical room	
3	FD2	3000X2100	-	2100	Metal fire door with vision panel	• Corridor • staff dining and visitors	With vision panel 200x300mm
4	HSD	1500X2100	-	2100	Hermetically sealed factory-made aluminium frame with both sides laminated flush door	• Minor OT • OT & minor OT • LDR Room	Sliding door with vision panel 200x300mm, Specification as per Vendor

			-		Hermetically sealed factory-made aluminium frame with both sides laminated Sliding door	• OT MAIN ENTRANCE (INSIDE GATE)	
5	D1A	2400X2550	-	2550	Structural glazed door	• IPD ENTRANC • EMERGENCY ENTRANCE	Specs. as per vendor
6	D2	2000X 2100		2100	Metal fire door with vision panel	• Corridor •Dirty corridor •Kitchen	With vision panel 200x300mm
7	D2a	2000X2100	-	2100	Acoustical door as per tender specification	• Seminar Hall • conference room • meeting room	With vision panel 200x300mm,
8	D3	1500X2100	-	2100	Factory-made aluminium frame with both sides laminated flush door	•central lab • Emergency •point care lab •TRIAGE •Dressing & plaster room •Dialysis room •Demo room •Patient attendent room •Pre & Post OP room •MCH •Visual acquity •PMT Room •Ultra sound •Natal clinic •Examination room •Dispensory room •Health checkup room •opd sub department room •ALL LOUNGES •PRE & POST OP	With vision panel 200x300mm
						• Sample room • Store • Unit head room • large equipment store • STI counselling room • second floor terrace •TSSU •CSSD and AHU at fifth floor	

9	D4	1200X2100	-	2100	Factory-made aluminium frame with both sides laminated flush door	• CCTV Room • Control Room • Equipment room • Enquiry record room • computerised registration room • Store • Cold chain room • OT Store •Library •Admin dept. room	
10						• on duty room • OT INCHARGE • HOD , PROFESSOR, ASST ROOM • ISOLATION ROOM • Duty room • Radiologist room • Instrument room •Examination and treatment room	With vision panel 200x300mm
11	D4B		-	2100		•opd 1&2 • counseling room • consultation room •Examination and treatment room • isolation room •dietcian room •Plaster room •Change room main door •burn ward sub department	With vision panel 200x300mm

12	D5	1050X2100	-	2100	Factory-made aluminium frame with both sides laminated flush door	• Fire control room •insurance room •CU/DU •Back office •Public toilet main entrance •RO room •Store •Pharmacy •Registration •Sterile instrument •OST Store •Attached patient toilet •ward (inside) •isolation room toilet •STERILE INSTRUMENT ROOM •PG room •ward pantry	
13	D6	750X2100	-	2100	Toilet cubicle doors made in 12mm modular HPL compact panels	• staff Toilet cubicles • change room •attached toilet	
14					Factory-made aluminium frame with both sides laminated flush door	• visitors Toilet cubicles	
15	D7	1800X2100	-	2100	Glass door as per tender specification	• BURN WARD	
16	SLD	1500X2100	-	2100	Factory-made aluminium frame with both sides laminated Sliding door	• ICU & HDU BUFFER	Sliding door, specification as per vendor
17	TD1	635X2100	-	2100	Powder-coated aluminium frame shutter with louvres	• External Shafts	
18	FHD	900X2100	-	2100		• FHC Shafts	
19	W1	1500X1650	900	2550	DGU based structural aluminium windows (OEM fabricated)	• All external windows	All ground floor windows to be provided with (SS 316) grill design as approved by Engineer In-charge
20	V	2000X600	3900	4500	structural aluminium ventilator (OEM fabricated)	• BASEMENTS	
21	V1	600X900	1650	2550		• Toilets	

22	J TO J1	AS PER SITE	GRC JAALI	• External Jaali work	
23	GL TO GL1	AS PER SITE	Structural Glazing	• External Glazing	

NOTE: -
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
4. ALL GROUND FLOOR WINDOWS TO BE PROVIDED WITH (SS 316) GRILL DESIGN AS APPROVED BY ENGINEER INCHARGE

4.8.2 ESS BUILDING:

MKCG - ELECTRICAL SUBSTATION BLOCK

DOOR- WINDOW SCHEDULE

S.NO.	NOMENCLATURE	SIZE	SILL LVL.	LINTEL LVL.	SPECIFICATION	LOCATION	REMARKS
2	D1	750X2100	-	2100	Factory-made aluminium frame with both sides laminated flush door	• Toilet • Isolater Room	
3	D2	1000X2100	-	2100		•Store	
4	D3	1800X2550	-	2550		•Terrace	
5	D5	3000X2550	-	2550		•Main Entry	
6	FD	2000X2100	-	2100	Metal fire door with vision panel	• Staircase •MGPS Room •Lobby •LT Panel •Corridor •HVAC Room •Workshop	With vision panel 200x300mm
7	R/S	3600X3000	-	3000	Rolling shutter(as/spec.)	•Transformer •HT Panel •LT Panel •MGPS Room	
8	W1	1500X1650	900	2550	DGU-based structural aluminium windows (OEM fabricated)	•Transformer •MGPS Room •Store •LT Panel •Utility •HVAC Room •Workshop •Toilet	
10	V1	600X600	1950	2550		•Transformer	

11	GL	AS PER SITE	Structural Glazing(as/spec.)	• External Glazing	

NOTE:-
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
GRILL-DESIGN AS APPROVED BY ENGINEER INCHARGE

4.8.3 INDOOR STADIUM BUILDING:

MKCGB - INDOOR STADIUM BLOCK

DOOR- WINDOW SCHEDULE

S.NO.	NOMENCLATURE	SIZE	SILL LVL.	LINTEL LVL.	SPECIFICATION	LOCATION	REMARKS
1	D	2000X2550	-	2550	Factory made aluminium frame with both side laminated flush door	•Lobby •Main Entrance	Aluminium Framed Glass Door in Lobby and Main Entrance
2	D1	2000X2100	-	2100		• Entrance •Gymnasium •Hall •Store •Table Game • Admin Office •Back office • Players rest room • Medical Room • Yoga & meditation hall •Multi purpose room	
3	D2	1000 X2100	-	2100		• All toilet corridor • All changing room • Locker room • Store • Utility	
4	D3	750 X2100	-	2100		•Toilets •Changing Room	
5	D4	1500X2100	-	2100		•Kitchen	
5	D5	1000X2100	-	2100	M.S DOOR	•Mumty	
6	FD	2000X2100	-	2100	Metal fire door with vision panel	• Staircase	With vision panel 200x300mm
7	FHD	900X2100	-	2100		•FHC SHAFT	
8	W1	3000X1650	900	2500	DGU based structural aluminium windows (OEM fabricated)	•Store Room •Gymnasium	
9	V1	850X600	1950	2550		•Toilet	
10	GL1	AS PER SITE			Structural Glazing	• External Glazing	

11	GL2	AS PER SITE	Structural Glazing	• External Glazing	Factory made aluminum doors/DGU windows
12	GL2A	AS PER SITE	Structural Glazing	• External Glazing	
13	GL3	AS PER SITE	Structural Glazing	• External Glazing	
14	GL4	AS PER SITE	Structural Glazing	• External Glazing	
15	J1	AS PER SITE	Structural Glazing	• External Glazing	
16	J2	AS PER SITE	Structural Glazing	• External Glazing	

NOTE:-
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
GRILL-DESIGN AS APPROVED BY ENGINEER INCHARGE

4.8.4 SURGEON HOSTEL (GENTS & LADIES) BUILDING:

MKCG - SURGEON HOSTEL BLOCK

DOOR- WINDOW SCHEDULE

S.NO.	NOMENCLATURE	SIZE	SILL LVL.	LINTEL LVL.	SPECIFICATION	LOCATION	REMARKS
1	DW	1200X2550	-	2500	AS PER SOF	•All Rooms	
2	DW1	1000X2550	-	2550		•All Rooms	
3	D1/GD	1500X2100	-	2100		•Main Entrance	
4	D2	1500X2100	-	2100		•Entry •Recreational Hall •Common Room •Reading Room •Dining Area	
5	D3	1000X2100	-	2100		•All Rooms •Electrical Room •Store Room •All Bedroom 2 •Luggege Room •Warden Room •Warden Office •Account Office •Sick Room •Loundary Room •Toilet	
6	D4	1000X2100	-	2100	M.S DOOR	•Mumty	
7	D5	750X2100	-	2100		•Toilet Cubicals	

8	FD	2000X2100	-	2100	Metal fire door with vision panel	• Staircase • Lift Lobby	With vision panel 200x300mm
9	FHD	1000X2100	-	2100		•FHC SHAFT	
10	W1	1800X1650	900	2550		•Break Out Space	
11	W2	1500X1650	900	2550		•Corridor •Store	
12	W3	1200X1650	900	2550	AS PER SOF	•Kitchen •Living Area •Store Room •All Bedroom 2 •Break out Space •Warden Room •Warden Office •Account Office •Dining Area •Loundary Room •Wash Area •Store Room •Common Room •Corridor •Recreation Hal	
13	V1	750X600	1950	2550		•All Toilet	
14	GL	AS PER SITE			Structural Glazing	• External Glazing	
15	J1	AS PER SITE			Structural Glazing	• External Glazing	

NOTE:-
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
GRILL-DESIGN AS APPROVED BY ENGINEER INCHARGE

4.8.5 UG HOSTEL (FEMALE) BUILDING:

MKCGB - U.G HOSTEL BLOCK

DOOR- WINDOW SCHEDULE

S.NO.	NOMENCLATURE	SIZE	SILL LVL.	LINTEL LVL.	SPECIFICATION	LOCATION	REMARKS
1	DW	3000X2550	-	2500	AS PER SOF	•All Single and double occupancy balcony.	
2	GLD	1500X2100	-	2100		•Double height lobby	
3	D	750X2100	-	2100		•Toilet Cubicals	

4	D1	1000X2100	-	2100		•Store Room •Toilet •Loundary Room •All Rooms •Electrical Room •Reading Room •Dry Storage •Cold Storage •Dish Wash Area •Utensil Room •Staff Room •Warden Office •Bedroom 2 •Warden Room •Bedroom 1 •Sick Room	
5	D2	1500X2100	-	2100		•Semi Open Terrace •Corridor •Kitchen •Buffer •Gymnasium •Common Room •Entry	
6	D3	1000X2100	-	2100	M.S DOOR	•Mumty	
7	FD	1500X2100	-	2100	Metal fire door with vision panel	• Staircase • Lift Lobby •Refuse Area	With vision panel 200x300mm
8	FHD	1000X2100	-	2100		•FHC SHAFT	
9	W	2000X1650	900	2550	AS PER SOF	•Dish Wash Area •Dining Area •Recreation Room •Gymnasium •Common Room •Sick Room •Bedroom 1 •Warden Room •Bedroom 2 •Warden Office •Utility Room •Kitchen	

						•Utensil Store •Staff Room	
10	W1	2100X1650	900	2550		•Corridor •Kitchen •Dry Storage	
11	V1	600X600	1950	2550		•Toilet Cubical	
12	V2	1200X600	1950	2550		•All Toilet	
13	GL	AS PER SITE			Structural Glazing	• External Glazing	
14	GL1	AS PER SITE			Structural Glazing	• External Glazing	
15	GL2	AS PER SITE			Structural Glazing	• External Glazing	

NOTE: -
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
GRILL-DESIGN AS APPROVED BY ENGINEER INCHARGE

4.8.6 TYPE IV RESIDENCE BUILDING:

MKCGB - RESIDENCE TYPE IV BLOCK							
DOOR- WINDOW SCHEDULE							
S.NO.	**NOMENCLATURE**	**SIZE**	**SILL LVL.**	**LINTEL LVL.**	**SPECIFICATION**	**LOCATION**	**REMARKS**
1	D1	750X2100	-	2100	AS PER SOF	• Toilet • Kitchen	
2	D2	1000 X2100	-	2100		• Bedroom 1,2&3 • Study Room	
3	D3	1200 X2100	-	2100		•Entry Unit	
4	D4	1000 X2100	-	2100	M.S DOOR	•Mumty & Machine	
5	FD	1500X2100	-	2100	Metal fire door with vision panel	• Lift lobby • Staircase	With vision panel 200x300mm
6	FHD2	820X2100	-	2100		•FHC SHAFT	

7	D/W1	1850X2550	450	2550	AS PER SOF	•Bedroom 2	
8	D/W2	2700X2550	450	2550		•Dining room	
9	D/W3	2000X2550	450	2550		•Bedroom 1	
10	TD1	550X2100	-	2100		•External Shaft	
11	W1	1350X1650	900	2550	AS PER SOF	•Bedroom 3	
12	W2	1200X1650	900	2550		•Study	
13	W3	2000X1650	900	2550		•Common Corridor	
14	W4	650X1650	900	2550		•Kitchen	
15	V1	600X600	1950	2550		•Toilet	
16	GL1 AND GL2	AS PER SITE			Structural Glazing	• External Glazing	

NOTE:-
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
GRILL-DESIGN AS APPROVED BY ENGINEER INCHARGE

4.8.7 TYPE II RESIDENCE BUILDING:

MKCGB - RESIDENCE TYPE II BLOCK							
DOOR- WINDOW SCHEDULE							
S.NO.	**NOMENCLATURE**	**SIZE**	**SILL LVL.**	**LINTEL LVL.**	**SPECIFICATION**	**LOCATION**	**REMARKS**
1	D1	1050X2100	-	2100	AS PER SOF	•Unit main entrance	
2	D2	900 X2100	-	2100		•Bedroom & Bedroom 2 balcony	
3	D3	750 X2100	-	2100		•Toilet	
4	D4	1000X2100	-	2100	M.S Door	•Mumty &Machine	
5	FD	1500X2100	-	2100	Metal fire door with vision panel	• Lift lobby • Staircase	With vision panel 200x300mm
6	FHD2	900 X2100	-	2100		•FHC SHAFT	

7	D/W1	1760X2550	450	2550	AS PER SOF	•Bedroom 1	
8	D/W2	1525X2550	450	2550	AS PER SOF	•kitchen	
9	W	1200X1650	900	2550	AS PER SOF	Common Corridor	
10	W1	1100X1650	900	2550	AS PER SOF	•Bedroom 2 / living / dinning	
11	W2	900X1650	900	2550		•kitchen	
13	V1	600X600	1950	2550		•Toilet	
14	GL1 AND GL2	AS PER SITE			Structural Glazing	• External Glazing	

NOTE:-
1. ALL DOOR WINDOW SIZE IN MM.
2. KITCHEN AND PANTRY WINDOW SILL LVL.1050MM FROM F.FL.
3. SHAFT TRAP DOOR AS PER TYPICAL SHAFT DETAIL
GRILL-DESIGN AS APPROVED BY ENGINEER INCHARGE

4.9 SCHEDULE OF FINISHES

4.9.1. HOSPITAL BUILDING

HOSPITAL BLOCK (450 BEDS)							
SL NO.	ROOM NAME	AS PROPOSED					REMARK
		FLOOR FINISH	WALL FINISH	CEILING	DOOR	WINDOW	
HOSPITAL BLOCK ROOM LIST - COMMON AREAS							
1	OPD & EMERGENCY MAIN ENTRANCE WAITING LOBBY	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500 MM + ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	Structural Glazed Doors	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED

2	CORRIDOR	FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	ALUMINIUM GRID CEILING OF 600 X1200 MM	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
3	PUBLIC LOBBY, COMMON WAITING AREA	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	GLAZED FIRE DOOR AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
4	STAIRCASE	18 MM THK. GRANITE FLOORING	1. GRANITE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. HAND RAIL AS PER SPECIFICATION.	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	TREAD GRANITE SHADE-JIRAWAL WHITE RISER GRANITE SHADE-LAKKA RED

5	LIFT LOBBY, STAIRCASE LOBBY	18 MM THK. GRANITE FLOORING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL+1500 MM HIGH GRANITE CLADDING WITH ARCHITRAVE ON ALL OTHER SIDES	OPEN CELL ALUMINIUM CEILING	GLAZED FIRE DOOR AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GLASS FIRE DOOR TO BE PROPOSED
6	OPD WAITING AREA & RECEPTION	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	ALUMINIUM GRID CEILING OF 600 X 1200 / 600 X 600 MM	Factory-made aluminium frame with both sides laminated flush door	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	PUBLIC TOILETS	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR 2. TOILETS - CUBICLES	DGU BASED STRUCTURAL ALUMINIUM VENTILATORS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'
8	ATTACHED TOILETS	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	Factory-made aluminium frame with both sides laminated flush door	DGU BASED STRUCTURAL ALUMINIUM VENTILATORS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'
9	COMMON STAFF TOILET	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR 2.	DGU BASED STRUCTURAL ALUMINIUM VENTILATORS (OEM FABRICATED)	TOILET CUBICLE TO BE MADE IN 12MM PARTITION BOARD AS PER TENDER SPECIFICA

					TOILETS - CUBICLES		TION COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'
10	AHU ROOM	25 THK. KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	ELECTRICAL ROOM	25 MM THK .KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	SCRUB	ANTI SKID VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	-	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WITH SCRUB STATION
13	TERRACE	HEAT RESISTANT TILES	N.A	N.A	N.A		
14	LOCKERS	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
15	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS

						FABRICATED)	SINK TO BE PROVIDED
16	DIRTY CORRIDOR	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	ANTI-BACTERIAL PAINT	AS PER ELEVATION	AS PER ELEVATION	
17	REFUGE AREA	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	OBD	AS PER ELEVATION	AS PER ELEVATION	
BASEMENT							
1	DRIVEWAY/RAMP	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	ACRYLIC EMULSION PAINT	-	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.
2	MGPS PLANT ROOM	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	PNEUMATIC TUBE SYSTEM	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

4	BMW- WASTE SEGGREGATION	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	BODY STORAGE	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 2400 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	FIRE CONTROL ROOM	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	ACRYLIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	CCTV ROOM	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	ACRYLIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
8	BLOOD BANK	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	ACRYLIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
GROUND FLOOR							

1	RECEPTION (EMERGENCY & OPD/IPD)	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	PHARMACY	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
3	REGISTRATION AREA/ HELP DESK/ NURSE STATION / INSURANCE ROOM/RADIOLOGY RECEPTION	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD	ALUMINIUM GRID CEILING OF 600 X 1200 / 600 X 600 MM	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED

			WITH HAND RAIL AS PER SPECIFICATION.				
4	BACK OFFICE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
5	CORRIDOR	15MM THK. FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	ALUMINIUM GRID CEILING OF 600 X1200 MM	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
5	STORE ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	POLICE ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE	DGU BASED STRUCTURAL ALUMINIUM WINDOWS	

			PAINT ABOVE		LAMINATED FLUSH DOOR	(OEM FABRICATED)	
7	FIRE ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	Metal Fire DOor	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
8	PHARMACY	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
9	CONSULTANT ROOOM & COUNSELLING ROOM	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	CASUALTY OPD	FULL BODY VITRIFIED TILES600 X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

11	NURSE ON DUTY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	CT SCAN/X-RAY/MRI	ANTISTATIC 4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	VINYL CLADDING UPTO FALSE CEILING + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	LEAD LINE DOOR AS/SPECIFICATION	LEAD LINE WINDOW AS/SPECIFICATION	
13	ULTRA SOUND	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
14	CONTROL ROOM	ANTISTATIC 4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	VINYL CLADDING UPTO FALSE CEILING + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

15	DOCTOR ON DUTY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
16	EXAMINATION	FULL BODY VITRIFIED TILES600 X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
17	TREATMENT	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	SAMPLE COLLECTION	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
19	DU	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	WITH SS SINK

						FABRICATED)	
20	CU	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
21	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
22	PLASTER ROOM	FULL BODY VITRIFIED TILES600 X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
23	CENTRAL LAB	600 X 600 MM ALKALI RESISTANT TILE	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND CERAMIC SINK TO BE PROVIDED

24	DRESSING ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
25	MINOR OT	AS/VENDOR			HERMATICALLY SEALED FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM FRAME WITH BOTH SIDE LAMINATED SLIDING DOOR WITH VISION PANEL 200X300MM	-	AS PER TECHNICAL SPECIFICATION.
26	CHANGE ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WALL TILES ONLY IN WET AREAS
27	DRUG DISTRIBUTION/ PHARMACY	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

28	ICU /HDU / CCU (ICU WARD) (CASUALTY BEDS)	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	WARD: - VINYL CLADDING UPTO 1500 MM HIGH+ ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT. CORRIDOR WALL - VINYL CLADDING UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 MM X600 MM ALUMINIUM METAL (ANTI-BACTERIAL) GRID CEILING (0.5 NRC MIN.)	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
29	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 THK. KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
FIRST AND SECOND FLOOR							
1	RECEPTION	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED

2	CORRIDOR	15MM THK. FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	ALUMINIUM GRID CEILING OF 600 X1200 MM	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
3	STORE	FULL BODY VITRIFIED TILES600 X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
4	EXAMINATION ROOM, TREATMENT & PROCEDURE ROOM, DRESSING ROOM	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

5	CONSULTANT ROOM & OPD ROOM	FULL BODY VITRIFIED TILES 600X600 MM	EXAMINATION BED - PRE-LAMINATED BOARD (12 MM THK) UPTO FALSE CEILING AS/DESIGN. REST OF THE WALLS - 600 X 1200 MM VITRIFIED TILES UPTO 2400 MM HEIGHT + ABOVE ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	DEMO ROOM	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	MINOR OT	AS/VENDOR			HERMATICALLY SEALED FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM FRAME WITH BOTH SIDE LAMINATED SLIDING DOOR WITH VISION PANEL 200X300MM	-	REFER DETAILED SPECIFICATION OF MODULAR OT AS PER TENDER DRAWING
8	ENQUIRY RECORD ROOM & COMPUTERISED ROOM	FULL BODY VITRIFIED TILES600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	

						FABRICATED)	
9	EXAMINATION & DRESSING ROOM	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	HOD / PROFESSOR ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	OT STORE	HEAVY DUTY FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 MM THK. KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
THIRD FLOOR							

1	RECEPTION	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UP TO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	CORRIDOR	15MM THK. FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UP TO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	ALUMINIUM GRID CEILING OF 600 X 1200 MM	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
3	STORE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

4	RESIDENT & DOCTOR ON DUTY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	NURSE ON DUTY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	CHANGE ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UP TO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WALL TILES ONLY IN WET AREAS
7	BURN WARD	FULL BODY VITRIFIED TILES 600X1200 MM	FULL BODY VITRIFIED TILE CLADDING UP TO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
8	CONSULTANT ROOM	FULL BODY VITRIFIED TILES600 X600 MM	EXAMINATION BED - PRE-LAMINATED BOARD (12 MM THK) UPTO FALSE CEILING AS/DESIGN. REST OF THE WALLS - 600 X 1200 MM VITRIFIED	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

			TILES UPTO 2400 MM HEIGHT + ABOVE ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.				
9	PHOTOGRAPHY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	ICU /HDU CORRIDOR	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	ICU /HDU WARD	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

12	ICU / HDU BUFFER SPACE	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
13	DRUG WASH ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
14	DRUG PREP ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
15	ISOLATION WARD	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
16	DU	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WITH SS SINK

17	CU	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	ISOLATION ROOM	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
19	BUFFER AREA	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
20	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TOBE PROVIDED
21	AHU ROOM	25 MM THK. KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

22	PATIENT ATTENDENT ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
23	CHANGE ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WALL TILES ONLY IN WET AREAS
24	DOCTOR'S LOUNGE	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
25	STAFF LOUNGE	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WALL TILES ONLY IN WET AREAS
26	ANESTHETIC LOUNGE	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
27	NURSE LOUNGE	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	

						FABRICATED)	
28	SOILED LINEN STORE	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
29	TSSU	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH PU FLOORING SKIRTING + ACRYLIC EMULSION PAINT ABOVE	0	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
30	OT	AS PER MINOR OT SPECIFICATION IN MEDICAL SERVICES					REFER DETAILED SPECIFICATION OF MODULAR OT AS PER TENDER SPECIFICATION
31	STERILE INSTRUMENT	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
32	TECHNICIAN ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	

						FABRICATED)	
33	OT INCHARGE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
34	PRE & POST OP	FULL BODY VITRIFIED TILES600 X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
35	PROCEDURE ROOM-O. T	AS PER MINOR OT SPECIFICATION IN MEDICAL SERVICES					
36	BUFFER AREA	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
37	DIRTY CORRIDOR TERRACE	HEAT RESISTANT TILES	N. A	N. A	N. A		
38	LINEN STORE	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC9 EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
FOURTH FLOOR							

1	RECEPTION & WAITING AREA	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	CORRIDOR	15MM THK. FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	ALUMINIUM GRID CEILING OF 600 X1200 MM	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
3	STORE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
4	AHU ROOM	15 MM THK. FULL BODY VITRIFIED TILES	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM	

		600X600 MM	EMULSION PAINT ABOVE			WINDOWS (OEM FABRICATED)	
5	OFFICE	15 MM THK FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	COUNTER AREA	GRANITE FLOORING	VITRIFIED TILE DADO UPTO 1500MM WITH GRANITE MOULDING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
7	CHANGE ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WALL TILES ONLY IN WET AREAS
8	CSSD	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH PU FLOORING SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WITH SS-316 COUNTER TOP
9	LAUNDRY	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+	ACRYIIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE	DGU BASED STRUCTURAL ALUMINIUM WINDOWS	

			ACRYLIC EMULSION PAINT ABOVE		LAMINATED FLUSH DOOR	(OEM FABRICATED)	
10	STORES	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYIIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	STORE MANAGER	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	BUFFER AREA	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	AS PER ELEVATION	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
13	SENIOR RESIDENT ROOM SENIOR & ASST PROFESSOR ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
14	WARD	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

15	CORRIDOR	FULL BODY VITRIFIED TILES600 X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
16	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
17	NURSE ON DUTY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	HOU ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
19	EXAMINATION	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

20	TREATMENT	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
21	ISOLATION ROOM	FULL BODY VITRIFIED TILE 600X1200 MM	FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	CALCIUM SILICATE TILE 600 X 600WITH CALCIUM SILICATE BOARD - PERIPHERY ONLY	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
22	NURSE STATION	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING		DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
23	PG ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
24	DEMO ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
TYPICAL FLOOR (FIFTH TO EIGHT FLOOR)							

1	RECEPTION & WAITING AREA	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	CORRIDOR	15MM THK. FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	ALUMINIUM GRID CEILING OF 600 X1200 MM	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
3	UTILITY ROOM	15 MM THK. FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

4	STORE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	SENIOR RESIDENT ROOM SENIOR & ASST PROFESSOR ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	WARD	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
8	NURSE ON DUTY ROOM	FULL BODY VITRIFIED TILES600 X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
9	HOU RIOOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	

			PAINT ABOVE			FABRICATED)	
10	EXAMINATION	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	TREATMENT	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	ISOLATION ROOM	FULL BODY VITRIFIED TILE 600X1200 MM	FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	CALCIUM SILICATE TILE 600 X 600WITH CALCIUM SILICATE BOARD - PERIPHERY ONLY	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
13	BUFFER AREA	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

14	NURSE STATION	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING		DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
15	PG ROOM	FULL BODY VITRIFIED TILES600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
16	LIBRARY	FULL BODY VITRIFIED TILE FLOORING 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
17	CAFETERIA SEATING	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	DEMO ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
19	PRIVATE WARD	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING		DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	

						FABRICATED)	
20	DOCTOR ON DUTY, NURSE ON DUTY, RESIDENT DOCTOR ON DUTY, CONSULTANT ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
21	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 MM THK. KOTA STONE 600 X 600MM	100 MM HIGH SKIRTING OF SAME MATERIAL + ACRYLIC EMULSION PAINT ABOVE IT.	600 X 600 ALUMINIUM METAL GRID CEILING	METAL FIRE DOOR WITH VISION PANEL 200 X300 MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
22	CONFERENCE ROOM, STAFF CONFERENCE ROOM	FULL BODY VITRIFIED TILES600 X600 MM	ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
23	NURSING SUPERINTENDENT, DEPUTY MEDICAL SUPERINTENDENT, ADMINISTRATIVE OFFICER, ACCOUNTS OFFICER	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
24	ALL OFFICES/ESTABLISHMENT.	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

25	PANTRY, CHANGE ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
26	STORE ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
NINTH FLOOR							
1	RECEPTION & WAITING AREA	18 MM THK. GRANITE FLOORING	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. STRETCHER GUARD WITH HAND RAIL AS PER SPECIFICATION.	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	UTILITY ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	STORE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION	ACRYLIC EMULSION PAINT	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE	DGU BASED STRUCTURAL ALUMINIUM WINDOWS	

			PAINT ABOVE		LAMINATED FLUSH DOOR	(OEM FABRICATED)	
4	SENIOR RESIDENT ROOM SENIOR & ASST PROFESSOR ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	PAYING WARD	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTER TOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
7	NURSE ON DUTY ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
8	HOU ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

9	EXAMINATION	FULL BODY VITRIFIED TILES600 X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	TREATMENT	FULL BODY VITRIFIED TILES 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	BUFFER AREA	ANTI SKID VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO 2100MM + ACRYLIC EMULSION PAINT ABOVE	CALCIUM SILICATE TILE 600 X 600WITH CALCIUM SILICATE BOARD - PERIPHERY ONLY	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	NURSE STATION	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING		DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
13	PG ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

14	SUPERINTENDENT OFFICES	FULL BODY VITRIFIED TILES 600X600 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
15	CONFERENCE ROOM	FULL BODY VITRIFIED TILES 600X600 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
16	RETIRING ROOM	FULL BODY VITRIFIED TILES600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
17	ADMINISTRATIVE OFFICER	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	ACCOUNTS OFFICER	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
19	SUPPORTING STAFF OFFICES	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

20	SEMINAR HALL / COFERENCE HALL	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
21	MEETING ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
22	ALL OFFICES/SECTIONS	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
23	ASST.PROF./ ASSO. PROF./H.O. D/ NTS.	FULL BODY VITRIFIED TILES600 X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
24	HOD	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
25	LOCKERS	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

26	STAFF CONFERENCE ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
27	MEDICAL SUPERINTENDENT+ LOUNGE	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
TENTH FLOOR							
1	RECEPTION & WAITING AREA	GRANITE FLOORING	100 MM HIGH GRANITE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	G.I POWDER COATED PLAIN METAL CEILING WITH CALCIUM SILICATE BOARD-PERIPHERY ONLY	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	CORRIDOR	15MM THK. FULL BODY VITRIFIED TILE OF SIZE 600 X 1200 OR 800 X 2400 OF SPECIFIED 2 SHADES (DARK AND LIGHT)	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	ALUMINIUM GRID CEILING OF 600 X1200 MM	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED

3	UTILITY ROOM	ANTI SKID VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO 2100MM + ACRYLIC EMULSION PAINT ABOVE	G.I POWDER COATED PLAIN METAL CEILING WITH CALCIUM SILICATE BOARD-PERIPHERY ONLY	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
4	STORE	KOTA STONE 600X600 MM	100 MM KOTA STONE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	CALCIUM SILICATE TILE 600 X 600WITH CALCIUM SILICATE BOARD - PERIPHERY ONLY	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	SEMINAR HALL / COFERENCE HALL	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
6	ASST.PROF./ ASSCO PROF./H.O. D/ NTS.	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	HOD/DIRECTOR ROOM/	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

8	LIBRARY	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
9	EXAMINATION HALL	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	OSCE ROOM	FULL BODY VITRIFIED TILES600 X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	LOBBY AREA (LIBRARY AND EXAMINATION ROOM)	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
12	KITCHEN AREA	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDIN	600 X 600 ALUMINIUM METAL GRID CEILING	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

			G +AEP ABOVE		LAMINATED FLUSH DOOR		
13	CAFETERIA SEATING	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
NOTE :-							
1) GROOVES OF SIZE 3MMX 3MM, WITH MINIMUM 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES							
2) ALL RAILING SHALL BE IN S.S.-316 AS PER CPWD SPECIFICATION							
3) ALL WALL DADO TILES SHALL BE WITH GRANITE MOLDING AT TOP WITH MINIMUM 15 CM WIDTH.							
4) ALL CORRIDOR AND FLOORING SHOULD BE INCORPORATED WITH THE TACTILE FOR ESPECIALLY ABLED PERSONS AS PER HARMONISED GUIDELINES AND STANDARDS FOR UNIVERSAL ACCESSIBILITY IN INDIA (2021)							
5) ALL GRANITE STONE FLOORING / DADO SHALL BE APPROVED PATTERN.							
6) ALL KITCHEN & TOILET DADO TILE WILL BE CLADDING APPROVED HIGHLIGHTER TILES.							
7) ALL ENTRY DOORS WILL BE GLAZED ALUMINIUM DOORS OR FRAMELESS GLASS DOOR.							
8) ALL FIRE DOOR AND COMPARTMENTATION TO BE PROPOSED AS /NBCS 26 & APPROVED BY THE LOCAL FIRE DEPARTMENT GUIDELINES.							
9) ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL							
10) ROLLAR BLINDS WILL BE PROVIDED IN ALL FACULTY ROOMS AS PER SPECIFICATION							

4.9.2. DENTAL BUILDING

DENTAL BUILDING							
SL NO.	ROOM NAME	AS PROPOSED					**REMARK**
		FLOOR FINISH	WALL FINISH	CEILING	DOOR	WINDOW	
DENTAL HOSPITAL/COLLEGE - COMMON AREAS							
1	WAITING	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UP TO 1500 MM + ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED

2	DOUBLE HEIGHT AREA	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500 MM + ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	DGU BASED STRUCTURAL ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES- JIRAWAL WHITE AND LAKKA RED
3	CORRIDOR	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500 MM + ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GRANITE SHADES- JIRAWAL WHITE AND LAKKA RED
4	STAIRCASE	18 MM THK. GRANITE FLOORING	1. GRANITE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE 2. HAND RAIL AS PER SPECIFICATION.	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	TREAD GRANITE SHADE- JIRAWAL WHITE RISER GRANITE SHADE- LAKKA RED
5	LIFT LOBBY	18 MM THK. GRANITE FLOORING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL+1500 MM HIGH GRANITE CLADDING WITH ARCHITRAVE ON ALL OTHER SIDES	OPEN CELL ALUMINIUM CEILING	METAL GLAZED FIRE DOOR AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	GLASS FIRE DOOR TO BE PROPOSED
6	PUBLIC TOILET	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR 2. TOILETS - CUBICLES	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'
7	ATTACHED TOILET	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS	DGU BASED STRUCTURAL ALUMINIUM VENTILATORS (OEM FABRICATED)	COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'

8	COMMON STAFF TOILET	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR 2. TOILETS - CUBICLES	DGU BASED STRUCTURAL ALUMINIUM VENTILATORS (OEM FABRICATED)	TOILET CUBICLE TO BE MADE IN 12MM PARTITION BOARD AS PER TENDER SPECIFICATION COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'
9	AHU ROOM	25 THK. KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	ELECTRICAL ROOM	25 MM THK .KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	SCRUB	ANTI SKID VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO 2100MM + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	-	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WITH SS SINK
12	TERRACE	HEAT RESISTANT TILES	N.A	N.A	N.A		
13	LOCKERS	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
14	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
16	DIRTY CORRIDOR	ANTI SKID VITRIFIED TILES	100 MM HIGH VITRIFIED TILE SKIRTING	OBD	AS PER ELEVATION	AS PER ELEVATION	

		600X600 MM					
17	REFUGE AREA	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	OBD	AS PER ELEVATION	AS PER ELEVATION	
BASEMENT							
1	DRIVEWAY	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	ACRYLIC EMULSION PAINT			FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.
2	CSSD	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH PU FLOORING SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WITH SS-316 COUNTERTOP
8	LAUNDRY	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYIIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
2	PLANT ROOM	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	PNEUMATIC TUBE SYSTEM	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

4	BMW- WASTE SEGGREGATION	25 MM THK. KOTA STONE 600X600 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
GROUND FLOOR							
1	DEPARTMENT (HOD , READER, LECTURER, DEP. LIBRARY)	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
2	SEMINAR ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
4	CONSULTANT ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	EXAMINATION BED - PRE-LAMINATED BOARD (12 MM THK) UPTO FALSE CEILING AS/DESIGN. REST OF THE WALLS -600 X 1200 MM VITRIFIED TILES UPTO 2400 MM HEIGHT + ABOVE ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	DENTAL CHAIRS CLINIC	FULL BODY VITRIFIED TILES 600X1200 MM	COUNTER WALL - 600X300 MM VITRIFIED TILES UPTO BOTTOM OF FALSE CEILING + ACRYLIC EMULSION PAINT (ANTI - BACTERIAL) ABOVE IT. PARTITION WALL - 1200 MM HIGH	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

			BRICK WALL PARTITION WITH CLADDING OF 600 X 1200 MM VITRIFIED TILES UPTO 1200 MM HEIGHT + 600 MM HIGH, 6 MM THK. GLASS PARTITION.				
6	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 MM THK. KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
12	RADIOLOGY (CBCT, X-RAY, OPG & LOBBY)	ANTISTATIC 4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	VINYL CLADDING UPTO FALSE CEILING + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	LEAD LINE DOOR AS/SPECIFICATION	LEAD LINE WINDOW AS/SPECIFICATION	***** SPECIFICATION TO BE CONFIRM FROM VENDER SHOP DRAWING**
FIRST, SECOND & THIRD FLOOR							
1	DEPARTMENTS (HOD, READER, LECTURER, DEP. LIBRARY)	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	SEMINAR ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
3	MUSEUM	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**

						FABRICATED)	
4	CONSULTANTS ROOM, SAMPLE COLLECTION ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	EXAMINATION BED - PRE-LAMINATED BOARD (12 MM THK) UPTO FALSE CEILING AS/DESIGN. REST OF THE WALLS -600 X 1200 MM VITRIFIED TILES UPTO 2400 MM HEIGHT + ABOVE ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	DENTAL CHAIRS CLINIC	FULL BODY VITRIFIED TILES 600X1200 MM	COUNTER WALL - 600X300 MM VITRIFIED TILES UPTO BOTTOM OF FALSE CEILING + ACRYLIC EMULSION PAINT (ANTI - BACTERIAL) ABOVE IT. PARTITION WALL - 1200 MM HIGH BRICK WALL PARTITION WITH CLADDING OF 600 X 1200 MM VITRIFIED TILES UPTO 1200 MM HEIGHT + 600 MM HIGH, 6 MM THK. GLASS PARTITION.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	RADIOLOGY (CBCT, X-RAY, OPG & LOBBY)	ANTISTATIC 4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER	VINYL CLADDING UPTO FALSE CEILING + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	METAL LEAD LINE DOOR AS/SPECIFICATION	METAL LEAD LINE WINDOW AS/SPECIFICATION	***** SPECIFICATION TO BE CONFIRM FROM VENDER SHOP DRAWING**

		APPROVAL OF EIC)					
8	MEDICAL RECORD SECTION, IMPLANT CLINIC & LINEN STORE	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYIIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
9	LABS	600 X 600 MM ALKALI RESISTANT TILE	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
FOURTH FLOOR							
1	DEPARTMENTS (HOD, READER, LECTURER, DEP. LIBRARY)	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	SEMINAR ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
4	DOCTOR ON DUTY, NURSE ON DUTY, & OT INCHARGE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	WARDS	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

					PANEL 200X300MM		
6	AHU, SERVICE ROOM, ELECTRICAL ROOM	25MM THK. KOTA STONE	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE RATED DOOR (2 HR)		FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM WINDOWS WITH DGU.
7	SENIOR RESIDENT LOUNGE (MALE & FEMALE), STAFF LOUNGE, NURSE'S & ANAESTHETIST'S LOUNGE	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED
2	STORE	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYIIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	CHANGE ROOM	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
14	PRE & POST OP	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

11	STERILE INSTRUMENT	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	OT	AS/VENDOR					REFER DETAILED SPECIFICATION OF MODULAR OT AS PER TENDER DRAWING
8	SOILED LINEN STORE	HEAVY DUTY VITRIFIED TILE 600X600 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
9	TSSU	4MM THICK POLYURETHANE RESIN FLOORING – PU FLOORING (COLOUR AS PER APPROVAL OF EIC)	100 MM HIGH PU FLOORING SKIRTING + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
29	OT STORE	HEAVY DUTY VITRIFIED TILE 600X600 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
11	SCRUB	ANTI SKID VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO 2100MM + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	-	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	WITH SS SINK
16	DIRTY CORRIDOR	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING	OBD	AS PER ELEVATION	AS PER ELEVATION	
FIFTH FLOOR							

1	PRINCIPAL/DEAN ROOM, ADMINISTRATIVE OFFICERS	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
2	CONFERENCE ROOM, STAFF CONFERENCE ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
3	ESTABLISHMENT OFFICE ROOM, ACCOUNT DEPT., P.A. ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	LABS (SIMULATION LAB + PROSTHODONTICS AND DENTAL MATERIAL LAB, ORTHODONTICS & PAEDODONTICS), PHOTOGRAPHY ROOM	600 X 600 MM ALKALI RESISTANT TILE	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
6	AHU, SERVICE ROOM, ELECTRICAL ROOM	25MM THK. KOTA STONE 600 X600	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
7	SERVER ROOM	KOTA STONE 600X600 MM (RAISED FLOOR)	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
8	STORE ROOM	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYIIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM	

						FABRICATED)	
9	LIBRARY	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
SIXTH FLOOR							
1	DEPARTMENTS (HOD, READER, LECTURER, DEP. LIBRARY)	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
	TELEMEDICINE	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
3	SEMINAR ROOM	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
4	MAINTENANCE ROOM, MEDICAL RECORD ROOM	HEAVY DUTY VITRIFIED TILE 600X1200 MM	100 MM HIGH HEAVY DUTY VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	LABS (PATHOLOGY, HISTOPATHOLOGY, CLINICAL LABS, ETC.)	600 X 600 MM ALKALI RESISTANT TILE	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	

6	CLASS ROOMS	FULL BODY VITRIFIED TILES 600X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
7	AHU, SERVICE ROOM, ELECTRICAL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
SEVENTH FLOOR							
1	COMMON ROOM (BOYS, GIRLS, NON-TEACHING STAFF, TEACHING STAFF ETC.)	FULL BODY VITRIFIED TILE 600X1200 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
2	TOILETS & PANTRY (COMMON ROOM, STAFF TOILET)	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY'
3	DOCTOR ROOM, PARAMEDIC ROOM, EXAMINER ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
4	CONFIDENTIAL ROOM, RECORD ROOM,	FULL BODY VITRIFIED TILE FLOORING 600X600 MM	100 MM VITRIFIED TILE SKIRTING + ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
5	LABS	600 X 600 MM ALKALI RESISTANT TILE	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 2400 MM HIGH + ACRYLIC EMULSION	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS.	35 MM THK. FLUSH DOOR WITH 1MM NON-DECORATIVE LAMINATE ON BOTHSIDE	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM WINDOWS WITH SGU.

			(ANTI-BACTERIAL) PAINT.			WITH VISION PANEL OF 200 X 450 OF 6 MM THK. GLASS.	
6	CLASS ROOMS AND EXAMINATION HALL	FULL BODY VITRIFIED TILES600 X1200 MM	PRE - LAMINATED ACOUSTIC WALL PANELING UPTO FALSE CEILING	ACOUSTIC BOARD CEILING WITH 600 X 600MM ACOUSTIC TILE	ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	**ACOUSTICAL DOOR TO BE PROVIDED AS PER TENDER SPECIFICATION**
7	AHU, SERVICE ROOM, ELECTRICAL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
18	KITCHEN AREA	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	METAL FIRE DOOR WITH VISION PANEL 200X300MM/ FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
9	CAFETERIA	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	
10	SERVING AREA	FULL BODY VITRIFIED TILES 600X1200 MM	1. FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	DGU BASED STRUCTURAL ALUMINIUM WINDOWS (OEM FABRICATED)	COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED

NOTE:

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1) GROOVES OF SIZE 3MMX 3MM, WITH MINIMUM 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES

2) ALL RAILING SHALL BE IN S.S.-316 AS PER CPWD SPECIFICATION

3) ALL WALL DADO TILES SHALL BE WITH GRANITE MOLDING AT TOP WITH MINIMUM 15 CM WIDTH.

4) ALL CORRIDOR AND FLOORING SHOULD BE INCORPORATED WITH THE TACTILE FOR SPECIALLY ABLED PERSONS AS PER HARMONISED GUIDELINES AND STANDARDS FOR UNIVERSAL ACCESSIBILITY IN INDIA (2021)

5) ALL GRANITE STONE FLOORING / DADO SHALL BE APPROVED PATTERN.

6) ALL KITCHEN & TOILET DADO TILE WILL BE CLADDING APPROVED HIGHLIGHTER TILES.

7) ALL ENTRY DOORS WILL BE GLAZED ALLUMINIUM DOORS OR FRAME LESS GLASS DOOR.

8) ALL FIRE DOOR TO BE PROPOSED AS / NBC- 2016 & 26 & APPROVED LOCAL FIRE DEPARTMENT GUIDELINES.

9) ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL

10) ROLLER BLINDS WILL BE PROVIDED IN ALL FACULTY ROOMS AS PER SPECIFICATION

4.9.2. PHARMACY BUILDING

PHARMACY

SL NO.	ROOM NAME	FLOOR FINISH	WALL FINISH	CEILING	DOOR	WINDOW	REMARK
PHARMACY COLLEGE - COMMON AREAS							
1	COLLEGE MAIN WAITING LOBBY	18 mm thk. Granite flooring	Granite cladding upto 1500 mm + Acrylic Emulsion paint above	open cell ALUMINIUM CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
2	DOUBLE HEIGHT AREA	18 mm thk. Granite flooring	Granite cladding upto 1500 mm + Acrylic Emulsion paint above	open cell ALUMINIUM CEILING	DGU based structural aluminium doors	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
3	CORRIDOR	18 mm thk. Granite flooring	Granite cladding upto 1500 mm + Acrylic Emulsion paint above	open cell ALUMINIUM CEILING	Metal fire door with vision panel 200x300mm/ factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
4	STAIRCASE	18 mm thk. Granite flooring	1. Granite cladding upto 1500 mm height with granite moulding +AEP above 2. hand rail as per specification.	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	Tread granite shade- Jirawal white Riser granite shade- Golden Galaxy

5	LIFT LOBBY	18 mm thk. Granite flooring	Full height granite cladding on lift entry facia wall+1500 mm high granite cladding with architrave on all other sides	OPEN CELL ALUMINIUM CEILING	Metal glazed fire door as per tender specification	DGU based structural aluminium windows (OEM fabricated)	Glass Fire door to be proposed
6	PUBLIC TOILET	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - factory made high performance aluminum frame with both side laminated flush door 2. TOILETS - CUBICLES	DGU based structural aluminium windows (OEM fabricated)	Counterto p granite to be of shade 'Golden Galaxy'
7	ATTACHED TOILET	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE HIGH PERFORMANCE ALUMINIUM DOORS	DGU based structural aluminium ventilators (OEM fabricated)	Counterto p granite to be of shade 'Golden Galaxy'
8	COMMON STAFF TOILET	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - factory made high performance aluminum frame with both side laminated flush door 2. TOILETS - CUBICLES	DGU based structural aluminium ventilators (OEM fabricated)	Toilet cubicle to be made in 12mm partition board as per tender specificat ion Counterto p granite to be of shade 'Golden Galaxy'
9	AHU ROOM	25 thk. Kota stone 600x600 mm	100 mm high Kota stone skirting+ Acrylic Emulsion paint above	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	
10	ELECTRICAL ROOM	25 mm thk .Kota stone 600x600 mm	100 mm high Kota stone skirting+ Acrylic	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows	

			Emulsion paint above			(OEM fabricated)	
12	TERRACE	Heat resistant tiles	N.A	N.A	N.A		
13	LOCKERS	Full body Vitrified tile flooring 600x600mm	100 mm vitrified tile skirting + Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	Factory-made high-performance aluminium frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
14	PANTRY	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy' and SS sink to be provided
16	DIRTY CORRIDOR	Anti skid Vitrified Tiles 600x600 mm	100 mm high Vitrified tile skirting	OBD	As per elevation	As per elevation	
BASEMENT							
1	DRIVEWAY	VDF flooring with surface hardener (non-ferrous)	-	Acrylic Emulsion Paint			Fire barrier to be provided as per NBCS 2026.
2	SERVICES, STORE	Heavy Duty Vitrified tile 600x1200 MM	100 mm high Heavy Duty Vitrified tile skirting+ Acrylic Emulsion paint above	AcryIic Emulsion Paint			
GROUND FLOOR							
19	LOBBY AREA	18 mm thk. Granite flooring	Full height granite cladding on lift entry facia wall+1500 mm high granite cladding with architrave	OPEN CELL ALUMINIUM CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red

			on all other sides				
1	PRINCIPAL/DEAN ROOM	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
6	ADMINISTRATIVEOFFICER	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
10	SEMINAR HALL / COFERENCE HALL	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
3	STAFF ROOM FOR NON-TEACHING STAFF, OFFICE -I & II (EASTABLISHMENT & ACADEMICS), PRINCIPAL'S OFFICE	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
4	CONFIDENTIAL ROOM, RECORD ROOM,	Full body Vitrified tile flooring 600x600mm	100 mm vitrified tile skirting + Acrylic Emulsion paint above	Acrylic Emulsion Paint	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
5	MULTIPURPOSE HALL	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	
6	SERVER ROOM	Kota stone 600x600 mm	100 mm high Kota stone skirting+	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows	

		(RAISED FLOOR)	Acrylic Emulsion paint above			(OEM fabricated)	
7	MACHINE ROOM, ANIMAL HOUSE, CENTRAL INSTRUMENT ROOM	Heavy Duty Vitrified tile 600x1200 MM	100 mm high Heavy Duty Vitrified tile skirting+ Acrylic Emulsion paint above	AcryIic Emulsion Paint	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
8	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 thk. Kota stone 600x600 mm	100 mm high Kota stone skirting+ Acrylic Emulsion paint above	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	
FIRST FLOOR							
1	DEPARTMENTS (HOD, PROFF. ASST., ASSO. PROF.)	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
3	SEMINAR HALL	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
3	MUSEUM	Full Body Vitrified Tiles 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
4	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 thk. Kota stone 600x600 mm	100 mm high Kota stone skirting+ Acrylic Emulsion paint above	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	

5	LABS	600 X 600 MM ALKALI RESISTANT TILE	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
6	COMMON ROOM (BOYS, GIRLS, NON- TEACHING STAFF, TEACHING STAFF ETC.)	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	OPEN CELL ALUMINIUM CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
7	TOILETS & PANTRY (COMMON ROOM, STAFF TOILET)	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy'
8	STORE ROOM I & II	600 X 1200 MM VITRIFIED TILES (ALKALI RESISTANT)	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	(CHEMICAL STORE ROOM)
9	LIBRARY	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
SECOND, THIRD AND FOURTH FLOOR							

1	DEPARTMENTS (HOD, PROFF. ASST., ASSO. PROF.), STAFF ROOMS	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
3	SEMINAR HALL	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
3	MUSEUM	Full Body Vitrified Tiles600x1200 mm	100 MM HIGH SKIRTING OF SAME MATERIAL + ACRYLIC EMULSION PAINT ABOVE IT.	600 X 600 ALUMINIUM METAL GRID CEILING	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
3	COMPUTER LAB	Full Body Vitrified Tiles 600x1200 mm	100 MM HIGH SKIRTING OF SAME MATERIAL + ACRYLIC EMULSION PAINT ABOVE IT.	600 X 600 ALUMINIUM METAL GRID CEILING	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
4	SERVER ROOM	(RAISED FLOOR) ABOVE CC FLOORING	100 MM HIGH SKIRTING OF SAME MATERIAL + ACRYLIC EMULSION PAINT ABOVE IT.	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM DOORS.	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM WINDOWS WITH SGU.	

5	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 thk. Kota stone 600x600 mm	100 mm high Kota stone skirting+ Acrylic Emulsion paint above	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	
6	LABS (department labs)	600 X 600 MM ALKALI RESISTANT TILE	600 X 1200 VITRIFIED TILES (ALKALI RESISTANT) UPTO 1500 MM HIGH + ACRYLIC EMULSION (ANTI-BACTERIAL) PAINT.	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
7	CLASS ROOMS	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
FIFTH FLOOR							
1	DEPARTMENTS (HOD, PROFF. ASST., ASSO. PROF.), STAFF ROOMS	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
3	CLASS ROOMS	Full Body Vitrified Tiles 600x1200 mm	Pre - laminated Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	**Acoustical door to be provided as per tender specification**
4	AHU, SERVICE ROOM, ELECTRICAL ROOM	25 thk. Kota stone 600x600 mm	100 mm high Kota stone skirting+ Acrylic Emulsion paint above	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	

5	COMMON ROOM (BOYS, GIRLS, NON- TEACHING STAFF, TEACHING STAFF ETC.)	Full body Vitrified tile 600x1200 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	OPEN CELL ALUMINIUM CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
6	TOILETS & PANTRY (COMMON ROOM, STAFF TOILET)	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy'
18	KITCHEN AREA	Full Body Vitrified Tiles 600x1200 mm	1. Full body Vitrified tile cladding upto 1500 mm height with granite moulding +AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	Metal fire door with vision panel 200x300mm/ factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
9	CAFETERIA	Full Body Vitrified Tiles 600x1200 mm	1. Full body Vitrified tile cladding upto 1500 mm height with granite moulding +AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
10	SERVING AREA	Full Body Vitrified Tiles 600x1200 mm	1. Full body Vitrified tile cladding upto 1500 mm height with granite moulding +AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy' and SS sink to be provided

NOTE:-

1) Grooves of size 3mmX 3mm, with minimum 3 nos shall be made in the treads of the staircases

2) All railing shall be in S.S.-316 as per CPWD Specification

3) All wall Dado tiles shall be with Granite molding at top with minimum 15 cm width.

4) All corridor and flooring should be incorporated with the tactile for specially abled persons as per Harmonised Guidelines and Standards for Universal Accessibility in India (2021)

5) All Granite stone flooring / Dado shall be approved pattern.
6) All Kitchen & Toilet Dado Tile will be cladding approved Highlighter tiles.
7) All Entry Doors will be Glazed Alluminium Doors or Frame less Glass Door.
8) All Fire door to be proposed as / NBC- 2016 & 26 & Approved Local Fire Department Guidelines.
9) All windows to be provided with SS 316 Grill
10) Rollar Blinds will be provided in all Faculty rooms as per specification

4.9.2. ESS BUILDING

SCHEDULE OF FINISHES FOR MKCG - ELECTRICAL SUBSTATION BLOCK							
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**	**AS PROPOSED**					**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	
GROUND FLOOR							
1	LT PANEL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	ROLLING SHUTTER/ FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZIED ALUMINIUM FRAME WINDOWS	
2	HT PANEL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT			
3	HT ISOLATOR ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT			
5	TRANSFORMER	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT			
FIRST FLOOR							

1	WORKSHOP	GRANITE FLOORING	VITRIFIED TILE DADO UPTO 1200MM + ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	ROLLING SHUTTER/ FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZIED ALUMINIUM FRAME WINDOWS	
2	TOILET	ANTI SKID VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	PLASTIC EMULSION PAINT			
3	TERRACE	HEAT RESISTING TILES	100 MM HIGH SKIRTING	EXTERIOR PAINT AS PER ELEVATION	N.A	N.A	
4	STORE / UTILITY	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	ROLLING SHUTTER/ FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZIED ALUMINIUM FRAME WINDOWS	
SECOND FLOOR							
1	HVAC PLANT ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	ROLLING SHUTTER/ FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZIED ALUMINIUM FRAME WINDOWS	
2	STORE / UTILITY	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING +ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT			
TERRACE FLOOR							
1	TERRACE	HEAT RESISTING TILES	100 MM HIGH SKIRTING	EXTERIOR PAINT AS PER ELEVATION	N.A	N.A	
COMMON AREA							

1	STAIRCASE	GRANITE FLOORING	FULL BODY VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GRANITE MOULDING +AEP ABOVE	ACRYLIC EMULSION PAINT	METAL FIRE DOOR WITH VISION PANEL 200X300MM	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS	
2	CONNECTING CORRIDOR	GRANITE FLOORING	VITRIFIED TILE CLADDING UPTO 1500 MM HEIGHT WITH GROOVE ABOVE IN DOUBLE PLASTER +AEP ABOVE	ACRYLIC EMULSION PAINT	NA	NA	
NOTE: -							
1) GROOVES OF SIZE 3MMX 3MM, MINIMUM 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES							
2) ALL RAILING SHALL BE IN S.S.-316 AS PER CPWD SPECIFICATION							
3) ALL FIRE DOOR TO BE PROPOSED AS / NBC- 2016 & APPROVED LOCAL FIRE DEPARTMENT GUIDELINES.							

4.9.4. INDOOR STADIUM

INDOOR SPORTS							
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**	**AS PROPOSED**					**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	
BASEMENT							
1	DRIVEWAY	VDF flooring with surface hardener (non-ferrous)	-	Acrylic Emulsion Paint			Fire barrier to be provided as per NBCS 2026.
GROUND FLOOR							
1	ENTRANCE LOBBY	Granite flooring	Granite cladding upto 1500 mm +	OPEN CELL ALUMINIUM CEILINGS	factory made high performance	DGU based structural	Granite shades- Jirawal white

			Acrylic Emulsion paint above		aluminum frame with both side laminated flush door	aluminium windows (OEM fabricated)	and Lakka Red
2	LOBBY	Granite flooring	Granite cladding upto 1500 mm + Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
3	PUBLIC TOILET	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - factory made high performance aluminum frame with both side laminated flush door 2. TOILETS - CUBICLES	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy'
5	LIFT LOBBY	Granite flooring	Full height granite cladding on with architrave on lift entry facia wall+1500 mm high granite cladding on all other sides	OPEN CELL ALUMINIUM CEILINGS	Metal glazed fire door	DGU based structural aluminium windows (OEM fabricated)	Glass Fire door to be proposed
6	GYMNASIUM	Vinyl & Rubber flooring	Vinyl Cladding upto 3000mm+AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	factory-made high-performance aluminum frame with both sides laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
7	TABLE GAMES	PVC sheet with necessary backing over the CP floor.	PVC sheet 1000mm cladding +AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
8	CHANGE ROOM	Anti skid Vitrified Tiles 600x600 mm	Ceramic tile cladding upto 2100mm+AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	

9	COURT	Vinyl flooring	Vinyl Cladding upto 3000mm+AEP above	TRUSS	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
10	STORE	Kota stone 600x600 mm	100 mm high Kota stone skirting	AcryIic Emulsion Paint	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
11	MEDICAL ROOM	Full Body Vitrified Tiles 600x600 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	
12	CORRIDOR	Granite flooring	Full body Vitrified tile cladding upto 1500 mm height with granite moulding +AEP above	600 X 600 / 600X 1200 / 300 X1200 ALUMINIUM METAL GRID CEILING	Metal fire door with vision panel 200x300mm/ factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
13	PLAYERS REST ROOM	Full Body Vitrified Tiles 600x600 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
14	ADMIN OFFICE & STAFF BACK OFFICE	Full Body Vitrified Tiles 600x600 mm	100 mm high Vitrified tile skirting+ Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
15	LOCKERS	Full body Vitrified tile flooring 600x600mm	100 mm vitrified tile skirting + Acrylic	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with	DGU based structural aluminium windows	

			Emulsion paint above		both side laminated flush door	(OEM fabricated)	
16	STAIRCASE	Granite flooring	Full body Vitrified tile cladding upto 1500 mm height with granite moulding +AEP above	AcryIic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	Tread granite shade-Jirawal white Riser granite shade- Golden Galaxy
FIRST FLOOR							
1	LOBBY	Granite flooring	Granite cladding upto 1500 mm + Acrylic Emulsion paint above	OPEN CELL ALUMINIUM CEILINGS	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
2	PUBLIC TOILET	Anti skid Vitrified Tiles 600x600 / 600 x 1200 mm	Vitrified Tile dado upto false ceiling lvl.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - factory made high performance aluminum frame with both side laminated flush door 2. TOILETS - CUBICLES	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy'
4	MULTI PURPOSE HALL	Flotex Carpet flooring	Acoustic wall paneling upto False ceiling	Acoustic board ceiling with 600 x 600mm Acoustic tile	Acoustical door to be provided as per tender specification	DGU based structural aluminium windows (OEM fabricated)	
5	STAIRCASE	Granite flooring	Granite cladding upto 1500 mm height with granite moulding +AEP above	Acrylic Emulsion Paint	Metal fire door with vision panel 200x300mm	DGU based structural aluminium windows (OEM fabricated)	Tread granite shade-Jirawal white Riser granite shade- Golden Galaxy
7	YOGA & MEDITATION ROOM	Vinyl flooring	Vinyl Cladding upto 3000mm+AEP above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
8	STORE / UTILITY	Kota stone 600x600 mm	100 mm kota stone skirting + Acrylic Emulsion paint above	AcryIic Emulsion Paint	factory made high performance aluminum frame with	DGU based structural aluminium windows	

					both side laminated flush door	(OEM fabricated)	
9	CAFETERIA	Full Body Vitrified Tiles 600x600 mm	Vitrified tile upto 1500 mm + Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
10	SERVING AREA	Full Body Vitrified Tiles 600x600 mm	Vitrified tile dado upto 1500mm + Acrylic Emulsion paint above	600 X 600 ALUMINIUM METAL GRID CEILING	factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Countertop granite to be of shade 'Golden Galaxy' and SS sink to be provided
11	CORRIDOR	Granite flooring	granite cladding upto 1500 mm height with granite moulding +AEP above	600 X 600 / 600X 1200 / 300 X1200 ALUMINIUM METAL GRID CEILING	Metal fire door with vision panel 200x300mm/ factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	Granite shades- Jirawal white and Lakka Red
12	KITCHEN	Anti skid Vitrified Tiles 600x600 mm	Vitrified tile upto 2100 mm + Acrylic Emulsion paint above	Acrylic Emulsion paint	Metal fire door with vision panel 200x300mm/ factory made high performance aluminum frame with both side laminated flush door	DGU based structural aluminium windows (OEM fabricated)	
TERRACE FLOOR							
1	MACHINE ROOM	KOTA STONE	100 mm high skirting	OBD ABOVE	M.S DOOR		NA
2	TERRACE	HEAT RESISTING TILES	101 mm high skirting	OBD ABOVE	NA		
NOTE: -							
1) Grooves of size 3mmX 3mm, minimum 3 nos shall be made in the treads of the staircases							
2) All railing shall be in S.S.-316 as per CPWD Specification							
3) All wall Dado tiles shall be with Granite molding at top minimum 15 cm in width.							
4) All Granite stone flooring / Dado shall be approved pattern.							
5) All Kitchen & Toilet Dado Tile will be cladding approved Highlighter tiles.							
6) All Fire door to be proposed as / NBC- 2016 & Approved Local Fire Department Guidelines.							

4.9.5. SURGEON HOSTELS

SCHEDULE OF FINISHES FOR MKCG - SURGEON HOSTEL (GENTS & LADIES)							
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**	**AS PROPOSED**					**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	
COMMON AREA							
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	GLAZED FIRE DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL
2	FIRE STAIRCASE & STAIRCASE	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	METAL FIRE DOOR WITH VISION PANEL 200X300MM		STAIRCASE GRANITE JIRAWL WHITE AND GOLDEN GALAXY
3	COMMON LOBBY	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	600 X 600 / 600X 1200 / 300 X1200 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		FACTORY MADE MS DOORS FRAME / WINDOWS
4	TOILET & LAUNDRY ROOM	ANTI SKID VITRIFIED TILES 600X600 MM	300X600MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
5	STORE & LUGGAGE ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
6	ELECTRICAL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OBD	METAL FIRE DOOR		
BASEMENT FLOOR							
1	DRIVEWAY/RAMP	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	PLASTIC EMULSION PAINT	-		FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.
STILT FLOOR							

1	GYM /YOGA & MEDITATION HALL	VINYL FLOORING	VINYL CLADDING UPTO 3000MM+AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM WINDOWS WITH FLY WIRE MESH	
2	PARKING	VDF FLOORING	NA	PLASTIC EMULSION PAINT	NA		
3	SICK ROOM	FULL BODY VITRIFIED TILE 600X600MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM WINDOWS WITH FLY WIRE MESH	
4	AHU, SERVICE ROOM, ELECTRICAL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OBD	METAL FIRE DOOR	FACTORY MADE ANODIZED ALUMINIUM WINDOWS WITH FLY WIRE MESH	
5	TOILETS & PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - FACTORY MADE HIGH PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR 2. TOILETS - CUBICLES	FACTORY MADE ANODIZED ALUMINIUM WINDOWS WITH FLY WIRE MESH	
FIRST FLOOR							
1	DINING AREA	GRANITE FLOORING	100 MM HIGH GRANITE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM WINDOWS WITH FLY WIRE MESH	FLOORING GRANITE SHADES- JIRAWAL WHITE AND LAKKA RED
2	KITCHEN & WASH AREA	ANTI SKID VITRIFIED TILES 600X600 MM	300X600MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
3	SERVING AREA	FULL BODY VITRIFIED TILES 600X600 MM	VITRIFIED TILE DADO UPTO 1500MM + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		COUNTERTOP GRANITE TO BE OF SHADE 'GOLDEN GALAXY' AND SS SINK TO BE PROVIDED

4	WARDEN OFFICE & ACCOUNTS OFFICE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
5	LIVING ROOM	FULL BODY VITRIFIED TILE 600X600MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
6	KITCHEN	ANTI SKID VITRIFIED TILES 600X600 MM	300X600MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
7	BEDROOM & SICK ROOM	FULL BODY VITRIFIED TILE 600X600MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
8	RECREATIONAL HALL	VINYL FLOORING	VINYL CLADDING UPTO 3000MM+AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
10	COMMON ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
TYPICAL FLOOR (2ND TO 7TH FLOOR)							
1	ROOMS	FULL BODY VITRIFIED TILE 600X600MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM WINDOWS WITH FLY WIRE MESH	
2	BREAK OUT SPACE	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		FACTORY MADE MS DOORS FRAME / WINDOWS
3	BALCONY	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	EXTERIOR PAINT AS PER ELEVATION	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE		

					LAMINATED FLUSH DOOR		
TERRACE FLOOR							
1	MACHINE ROOM	KOTA STONE	100 MM HIGH SKIRTING	OBD ABOVE	M.S DOOR	NA	
2	TERRACE	HEAT RESISTING TILES	101 MM HIGH SKIRTING	OBD ABOVE	NA		

NOTE:-

1) GROOVES OF SIZE 3MMX 3MM, MINIMUM 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES

2) ALL RAILING SHALL BE IN S.S.-316 AS PER CPWD SPECIFICATION

3) ALL WALL DADO TILES SHALL BE WITH GRANITE MOLDING AT TOP. MINIMUM 15 CM WIDTH

4) ALL GRANITE STONE FLOORING / DADO SHALL BE APPROVED PATTERN.

5) ALL KITCHEN & TOILET DADO TILE WILL BE CLADDING APPROVED HIGHLIGHTER TILES.

6) ALL ENTRY DOORS WILL BE GLAZED ALLUMINIUM DOORS OR FRAME LESS GLASS DOOR.

7) ALL FIRE DOOR TO BE PROPOSED AS / NBC- 2016 & APPROVED LOCAL FIRE DEPARTMENT GUIDELINES.

8) ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL

4.9.5. HOSTELS (UG GIRLS, DENTAL – BOYS & GIRLS, PHARMACY – BOYS & GIRLS)

SCHEDULE OF FINISHES FOR MKCG - HOSTELS (UG, DENTAL AND PHARMACY HOSTEL'S)							
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**	**AS PROPOSED**					**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	
COMMON AREA							
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	GLAZED FIRE DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
2	FIRE STAIRCASE & STAIRCASE	18 MM THK. GRANITE FLOORING (GRANITE SHADES-	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	METAL FIRE DOOR WITH VISION PANEL 200X300MM		

		JIRAWAL WHITE AND LAKKA RED)					
3	COMMON LOBBY	18 MM THK. GRANITE FLOORING (GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
3	CORRIDOR	18 MM THK. GRANITE FLOORING (GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
4	TOILET & LAUNDRY ROOM	ANTI SKID VITRIFIED TILES 600X600 MM	300X600MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY '.
5	STORE & LUGGAGE ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
6	ELECTRICAL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OBD	METAL FIRE DOOR		
BASEMENT FLOOR							

1	DRIVEWAY/RAMP	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	PLASTIC EMULSION PAINT	-		FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.
GROUND FLOOR							
1	GYM /YOGA & MEDITATION HALL	VINYL FLOORING	VINYL CLADDING UPTO 3000MM+AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		
2	PARKING	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	NA	PLASTIC EMULSION PAINT	NA	NA	
3	SICK ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
4	AHU, SERVICE ROOM, ELECTRICAL ROOM	KOTA STONE 600X600 MM	100 MM HIGH KOTA STONE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	OBD	METAL FIRE DOOR		
5	TOILETS & PANTRY	ANTI SKID VITRIFIED TILES 600X600 / 600 X 1200 MM	VITRIFIED TILE DADO UPTO FALSE CEILING LVL.	600 X 600 ALUMINIUM METAL GRID CEILING	1. MAIN DOOR - FACTORY-MADE HIGH-PERFORMANCE ALUMINUM FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR 2. TOILETS - CUBICLES	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY ' AND SS SINK TO BE PROVIDED .
FIRST FLOOR							

1	DINNING AREA & ITS BUFFER	18 MM THK. GRANITE FLOORING	100 MM HIGH GRANITE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY ' AND SS SINK TO BE PROVIDED .
2	KITCHEN & WASH AREA	ANTI SKID VITRIFIED TILES 600X600 MM	300X600MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY ' AND SS SINK TO BE PROVIDED .
3	SERVING AREA	18 MM THK. GRANITE FLOORING	VITRIFIED TILE DADO UPTO 1200MM + ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
4	KITCHEN STAFF ROOM	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
5	WARDEN OFFICE & ACCOUNTS OFFICE	FULL BODY VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	

6	LIVING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
7	KITCHEN	ANTI SKID VITRIFIED TILES 600X600 MM	300X600MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
8	BEDROOM & SICK ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
9	RECREATIONAL HALL & GYMNASIUM	VINYL FLOORING	VINYL CLADDING UPTO 3000MM+AEP ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
10	COMMON ROOM	FULL BODY VITRIFIED TILES600 X600 MM	100 MM HIGH VITRIFIED TILE SKIRTING+ ACRYLIC EMULSION PAINT ABOVE	600 X 600 ALUMINIUM METAL GRID CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	

TYPICAL FLOOR (2ND TO 7TH FLOOR)							
1	ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
2	BREAK OUT SEATING SPACE	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	BALCONY TO BE PROVIDE WITH FLY WIRE MESH
3	READING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
4	SEMI OPEN TERRACE	HEAT RESISTING TILES	101 MM HIGH SKIRTING	OBD ABOVE	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY WIRE MESH	
5	BALCONY	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	EXTERIOR PAINT AS PER ELEVATION	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE ANODIZED ALUMINIUM FRAME WINDOWS WITH FLY	BALCONY TO BE PROVIDE WITH FLY WIRE MESH

						WIRE MESH	
TERRACE FLOOR							
1	MACHINE ROOM	KOTA STONE	100 MM HIGH SKIRTING	OBD ABOVE	M.S DOOR	NA	
2	TERRACE	HEAT RESISTING TILES	101 MM HIGH SKIRTING	OBD ABOVE	NA		
NOTE: -							
1) GROOVES OF SIZE 3MMX 3MM, 3 NOS HALL BE MADE IN THE TREADS OF THE STAIRCASES							
2) ALL RAILING SHALL BE IN S.S.-316 AS PER CPWD SPECIFICATION							
3) ALL WALL DADO TILES SHALL BE WITH GRANITE MOLDING AT TOP 15 CM WIDTH.							
4) ALL GRANITE STONE FLOORING / DADO SHALL BE APPROVED PATTERN.							
5) ALL KITCHEN & TOILET DADO TILE WILL BE CLADDING APPROVED HIGHLIGHTER TILES.							
6) ALL ENTRY DOORS WILL BE GLAZED ALLUMINIUM DOORS OR FRAME LESS GLASS DOOR.							
7) ALL FIRE DOOR TO BE PROPOSED AS / NBC- 2016 & APPROVED LOCAL FIRE DEPARTMENT GUIDELINES.							
8) ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL							

4.9.6. RESIDENCE TYPE -IV

RESIDENCE TYPE - IV								
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**	**AS PROPOSED**						**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	**RAILING**	
BASEMENT FLOOR								
1	DRIVEWAY/RAMP	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	PLASTIC EMULSION PAINT	-			FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.
STILT FLOOR								
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (FLOORI	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	METAL FIRE DOOR WITH VISION PANEL	FACTORY MADE UPVC FRAME WINDOWS	SS RAILING	FULL HEIGHT GRANITE CLADDING ON LIFT

		NG GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)			200X300MM	WITH SGU GLASS		ENTRY FACIA WALL
2	FIRE STAIRCASE	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500 MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	METAL FIRE DOOR WITH VISION PANEL 200X300MM		SS RAILING	FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
2	COMMON LOBBY	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500 MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING				FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
TYPICAL FLOOR (1ST TO 13TH FLOOR)								
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500 MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	METAL FIRE DOOR WITH VISION PANEL 200X300MM	FACTORY MADE UPVC FRAME WINDOWS WITH SGU GLASS	SS RAILING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL
2	STAIRCASE	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1500 MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	METAL FIRE DOOR WITH VISION PANEL 200X300MM		SS RAILING	STAIRCASE GRANITE JIRAWL WHITE AND LAKKA RED
3	LIVING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR	FACTORY MADE UPVC FRAME WINDOWS WITH FLY WIRE MESH		

4	DINING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR			
5	KITCHEN	ANTI SKID VITRIFIED TILES 600X600 MM	600 X 1200 MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR			COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY ' AND SS SINK TO BE PROVIDED.
6	BEDROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR			
7	BALCONY	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	EXTERIOR PAINT AS PER ELEVATION	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDES LAMINATED FLUSH DOOR		SS RAILING	
8	TOILET	ANTI SKID VITRIFIED TILES 600X600 MM	300X600 MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	600X600MM Aluminium Metal Grid Ceiling	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR			COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY '.
10	CORRIDOR	18 MM THK. GRANITE FLOORING	GRANITE CLADDING UPTO 1200MM + AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINAT			FLOORING GRANITE SHADES-JIRAWAL WHITE AND

					ED FLUSH DOOR			LAKKA RED
11	MACHINE ROOM	KOTA STONE	100 MM HIGH SKIRTING	OBD ABOVE	M.S DOOR		MS RAILING	
NOTE: -								
1) GROOVES OF SIZE 3MMX 3MM, 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES								
2) ALL STAIRCASE RAILING SHALL BE IN S.S-316 AS PER CPWD SPECIFICATION.								
3)ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL								

4.9.6. RESIDENCE TYPE -II

SCHEDULE OF FINISHES FOR MKCG - RESIDENCE TYPE -II								
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**	**AS PROPOSED**						**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	**RAILING**	
BASEMENT FLOOR								
1	DRIVEWAY/RAMP	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	PLASTIC EMULSION PAINT	-	FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.		
STILT FLOOR								
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	GLAZED FIRE DOOR	FACTORY MADE UPVC FRAME WINDOWS WITH SGU GLASS	SS RAILING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL
2	FIRE STAIRCASE	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	METAL FIRE DOOR WITH VISION PANEL 200X300MM		SS RAILING	STAIRCASE GRANITE JIRAWL WHITE AND LAKKA RED

		AND LAKKA RED)						
2	COMMON LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING				
TYPICAL FLOOR (1ST TO 13TH FLOOR)								
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	METAL FIRE DOOR WITH VISION PANEL 200X300MM	FACTORY MADE UPVC FRAME WINDOWS WITH SGU GLASS	SS RAILING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL
2	STAIRCASE	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		SS RAILING	STAIRCASE GRANITE JIRAWL WHITE AND LAKKA RED
3	LIVING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE UPVC FRAME WINDOWS WITH FLY WIRE MESH		
4	DINING ROOM	FULL BODY VITRIFIE	100 MM HIGH VITRIFIE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR			

		D TILE 600X600 MM	D SKIRTIN G		FRAME WITH BOTH SIDE LAMINAT ED FLUSH DOOR			
5	KITCHEN	ANTI SKID VITRIFIE D TILES 600X600 MM	600 X 1200 MM FULL BODY VITRIFIE D TILE CLADDI NG UPTO 2100 MM HIGH	PLASTIC EMULSIO N PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINAT ED FLUSH DOOR			COUNTE R TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY ' AND SS SINK TO BE PROVIDE D.
6	BEDROOM	FULL BODY VITRIFIE D TILE 600X600 MM	100 MM HIGH VITRIFIE D SKIRTIN G	PLASTIC EMULSIO N PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINAT ED FLUSH DOOR			
7	BALCONY	ANTI SKID VITRIFIE D TILES 600X600 MM	100 MM HIGH VITRIFIE D SKIRTIN G	EXTERIO R PAINT AS PER ELEVATI ON	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINAT ED FLUSH DOOR		SS RAILIN G	
8	TOILET	ANTI SKID VITRIFIE D TILES 600X600 MM	300X600 MM FULL BODY VITRIFIE D TILE CLADDI NG UPTO 2100 MM HIGH	600X600M M AluMinium metal ceiling	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINAT ED FLUSH DOOR			COUNTE R TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY '.
10	CORRIDOR	18 MM THK. GRANITE FLOORIN G.	GRANITE CLADDI NG UPTO 1500MM + AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINAT ED FLUSH DOOR			FLOORIN G GRANITE SHADES- JIRAWAL WHITE AND LAKKA RED

11	MACHINE ROOM	KOTA STONE	100 MM HIGH SKIRTING	OBD ABOVE	M.S DOOR		MS RAILING	
NOTE:-								
1) GROOVES OF SIZE 3MMX 3MM, 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES								
2) ALL STAIRCASE RAILING SHALL BE IN S.S-316 AS PER CPWD SPECIFICATION								
3)ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL								

4.9.6. CLUB HOUSE

SCHEDULE OF FINISHES FOR MKCG - RESIDENCE TYPE -II								
SL NO.	**ROOM NAME AS PER ORIGINAL LAYOUT**							**REMARK**
		FLOOR FINISH	**WALL FINISH**	**FALSE CEILING**	**DOOR**	**WINDOW**	**RAILING**	
BASEMENT FLOOR								
1	DRIVEWAY/RAMP	VDF FLOORING WITH SURFACE HARDENER (NON-FERROUS)	-	PLASTIC EMULSION PAINT	-	FIRE BARRIER TO BE PROVIDED AS PER NBCS 2026.		
STILT FLOOR								
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	GLAZED FIRE DOOR	FACTORY MADE UPVC FRAME WINDOWS WITH SGU GLASS	SS RAILING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL
2	FIRE STAIRCASE	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	METAL FIRE DOOR WITH VISION PANEL 200X300MM		SS RAILING	STAIRCASE GRANITE JIRAWL WHITE AND LAKKA RED

2	COMMON LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1350MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING				
TYPICAL FLOOR (1ST TO 13TH FLOOR)								
1	LIFT LOBBY	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	OPEN CELL ALUMINIUM CEILING	METAL FIRE DOOR WITH VISION PANEL 200X300MM	FACTORY MADE UPVC FRAME WINDOWS WITH SGU GLASS	SS RAILING	FULL HEIGHT GRANITE CLADDING ON LIFT ENTRY FACIA WALL
2	STAIRCASE	18 MM THK. GRANITE FLOORING (FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED)	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	ACRYLIC EMULSION PAINT ABOVE	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		SS RAILING	STAIRCASE GRANITE JIRAWL WHITE AND LAKKA RED
3	LIVING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR	FACTORY MADE UPVC FRAME WINDOWS WITH FLY WIRE MESH		
4	DINING ROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE			

					LAMINATED FLUSH DOOR			
5	KITCHEN	ANTI SKID VITRIFIED TILES 600X600 MM	600 X 1200 MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR			COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY ' AND SS SINK TO BE PROVIDED.
6	BEDROOM	FULL BODY VITRIFIED TILE 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR			
7	BALCONY	ANTI SKID VITRIFIED TILES 600X600 MM	100 MM HIGH VITRIFIED SKIRTING	EXTERIOR PAINT AS PER ELEVATION	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR		SS RAILING	
8	TOILET	ANTI SKID VITRIFIED TILES 600X600 MM	300X600 MM FULL BODY VITRIFIED TILE CLADDING UPTO 2100 MM HIGH	600X600MM Aluminium METAL CEILING	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR			COUNTER TOP GRANITE TO BE OF SHADE ' GOLDEN GALAXY '.
10	CORRIDOR	18 MM THK. GRANITE FLOORING.	GRANITE CLADDING UPTO 1500MM + AEP ABOVE	PLASTIC EMULSION PAINT	FACTORY MADE G.I. TUBULAR FRAME WITH BOTH SIDE LAMINATED FLUSH DOOR			FLOORING GRANITE SHADES-JIRAWAL WHITE AND LAKKA RED
11	MACHINE ROOM	KOTA STONE	100 MM HIGH SKIRTING	OBD ABOVE	M.S DOOR		MS RAILING	
NOTE: -								

1) GROOVES OF SIZE 3MMX 3MM, 3 NOS SHALL BE MADE IN THE TREADS OF THE STAIRCASES
2) ALL STAIRCASE RAILING SHALL BE IN S.S-316 AS PER CPWD SPECIFICATION
3)ALL WINDOWS TO BE PROVIDED WITH SS 316 GRILL

4.9.1. EXTERNAL FINISHES

SCHEDULE OF EXTERNAL FINISHES -MKCG												
S.NO			**AS PROPOSESD**									
			HOSPITAL	**ESS BLOCK**	**INDOOR STADIUM**	**HOSTELS**	**RESIDENCE TYPE II**	**RESIDENCE TYPE IV**	**CLUB HOUSE**	**PHARMACY**	**DENTAL**	**REMARK**
1	EXTERNAL FACADE MATERIALS	STRUCTURAL GLAZING	YES	NO	YES	NO	NO	NO	YES	YES	YES	As per Architectural elevation
2		TEXTURE PAINT	YES (2.5 MM TO 3.00 MM)	YES (1.8~2.0 MM)	YES	YES (1.8~2.0 MM)	YES (1.8~2.0 MM)	YES (2.5 MM TO 3.00 MM)	YES (2.5 MM TO 3.00 MM)	YES (2.5 MM TO 3.00 MM)	YES (2.5 MM TO 3.00 MM)	
3		SOLID CLAY FAÇADE	YES	NO	YES	YES	YES	YES	YES	YES	YES	
4		GRC JALI	YES	YES	YES	YES	YES	YES	YES	YES	YES	
5		ALUMINIUM JALI	YES	NO	YES	YES	YES	YES	YES	YES	YES	
6		EXPOSED CONCRETE	NO	YES	NO	YES	YES	YES	NO	NO	NO	
7		ZINC COMPOSITE PANEL/SHEET	YES	YES	YES	YES	YES	YES	YES	YES	YES	
NOTE: - ALL MATERIAL TO BE USED ONLY AFTER SELECTION BY ARCHITECT AND CLIENT.												
SCHEDULE OF INTERNAL FINISHES -MKCG												
S.NO			**AS PROPOSESD**									
		TYPE OF PLASTERS	**HOSPITAL**	**ESS BLOCK**	**INDOOR STADIUM**	**HOSTELS**	**RESIDENCE TYPE II**	**RESIDENCE TYPE IV**	**CLUB HOUSE**	**PHARMACY**	**DENTAL**	**REMARK**
1	INTERNAL PLASTER	12- AND 15-MM CEMENT PLASTER 1:6	YES	YES	YES	YES	YES	YES	YES	YES	YES	
2	WET AREA	12- AND 15-MM CEMENT PLASTER 1:6	YES	YES	YES	YES	YES	YES	YES	YES	YES	
3	EXTERNAL PLASTER	15 MM READY MIX PLASTER	YES	YES	YES	YES	YES	YES	YES	YES	YES	



4.9.11 EXTERNAL DEVELOPMENT

OBCC ODISHA						
SCHEDULE OF EXTERNAL DEVELOPMENT-MKCG						
SL. NO.		AS PROPOSED				REMARKS
		HOSPITAL BLOCK	RESIDENCE, HOSTELS 7 INDOOR STADIUM BLOCK	ESS, GATE & GUARD ROOM	RAMP & PARKING	
1	EXTERNAL DEVELOPMENT MATERIALS	Concrete Grass Pavers	Concrete Grass Pavers	Concrete Grass Pavers	Vacuum dewatered flooring (VDF)	
2		External grade Vitrified tile with anti-skid finish	External grade Vitrified tile with anti-skid finish	External grade Vitrified tile with anti-skid finish	Granite	
3		Rough/ Polished Granite	Rough/ Polished Granite	Rough/ Polished Granite	Concrete	
4		Sandstone	Sandstone	Sandstone		
NOTE: - ALL MATERIAL TO BE USED ONLY AFTER SELECTION BY ARCHITECT AND CLIENT.						
All block terrace Heat reflective tile / Pidilite-Water proof to be used.						

4.10 SANITARY AND CP FITTINGS

STAFF MALE WASHROOM



Manual Concealed Cistern





Fragrance Dispenser



Twin Coat Hook



Automatic Hand Sanitizer Dispenser



Auto Tap (Wall Mount)



Wall Hung Closet



Urinal With Inbuilt Sensor



Washbasin Table Top



Hand Dryer



Paper Dispenser



Auto Soap Dispenser

Other Accessories



Paper Holder



Two Way Angle Cock



Health Faucet



Waste Coupling- 32 mm

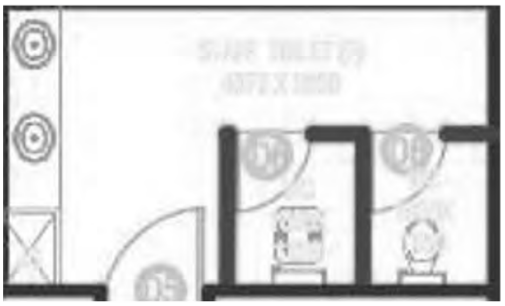


Floor Drain with Cockroach Trap(With Hole)

STAFF FEMALE WASHROOM



Manual Concealed Cistern





Fragrance Dispenser



Twin Coat Hook



Automatic Hand Sanitizer Dispenser



Auto Tap (Wall Mount)



Wall Hung Closet



Sanitary Napkin Hygiene Panel



Washbasin Table Top



Hand Dryer



Paper Dispenser



Auto Soap Dispenser

Other Accessories



Paper Holder



Two Way Angle Cock



Health Faucet



Waste Coupling- 32 mm

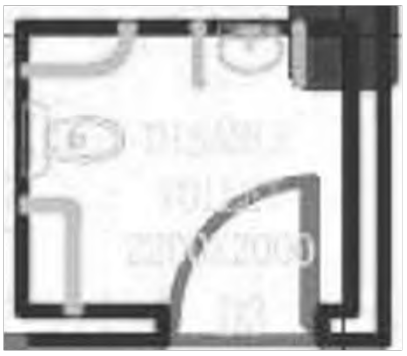


Floor Drain with Cockroach Trap(With Hole)

SPECIALLY ABLED TOILETS



Manual Concealed Cistern





Fragrance Dispenser



Auto Tap (Basin Mount)



CP Bottle Trap



Anti Slip Grip Grab Bar



U-Shaped Disabled Grab Bar



600MM Straight Grab Bar



Economical Water Closet



Sanitary Napkin Hygiene Panel



Wall Hung Washbasin



Hand Dryer



Urinal With Inbuilt Sensor



Paper Dispenser



Auto Soap Dispenser

Other Accessories



Twin Paper Holder



Two Way Angle Cock



Health Faucet



Waste Coupling- 32 mm

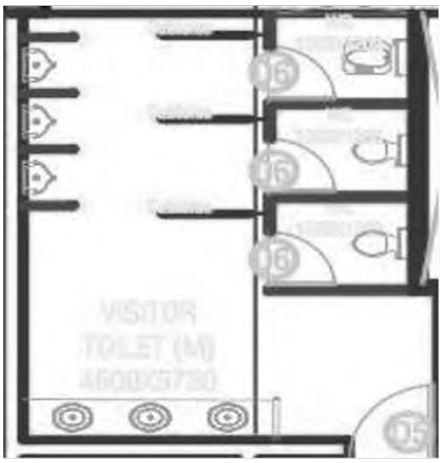


Floor Drain with Cockroach Trap(With Hole)

PUBLIC WASHROOM - MALE



Manual Concealed Cistern







Auto Soap (Basin Mount)



Auto Tap (Basin Mount)



Fragrance Dispenser

(Auto Paper Dispenser + Hand Dryer + Waste Receptacle)



Urinal With Inbuilt Sensor



Wall Hung Closet



Washbasin Under Counter

Other Accessories



Paper Holder



Two Way Angle Cock



Health Faucet



Waste Coupling- 32 mm



Floor Drain with Cockroach Trap(With Hole)

PUBLIC WASHROOM - FEMALE



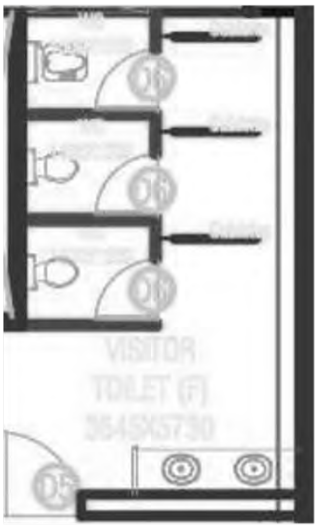
Manual Concealed Cistern



Auto Soap (Basin Mount)



Auto Tap (Basin Mount)





Fragrance Dispenser



(Auto Paper Dispenser + Hand Dryer + Waste Receptacle)



Sanitary Napkin Hygiene Panel

Wall Hung Closet



Washbasin Under Counter



Baby Diaper Changing Station

Other Accessories



Paper Holder



Two Way Angle Cock



Health Faucet



Waste Coupling- 32 mm

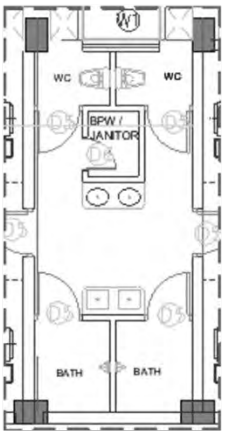


Floor Drain with Cockroach Trap(With Hole)

PATIENT WASHROOM



Manual Concealed Cistern







Auto Soap (Basin Mount)



Auto Tap (Basin Mount)



Fragrance Dispenser



Height Adjustable Support Arm

(Auto Paper Dispenser + Hand Dryer + Waste Receptacle)



Urinal With Inbuilt Sensor



Wall Hung Closet



Washbasin Under Counter



Height Adjustable Shower Seat

Other Accessories



Paper Holder



Two Way Angle Cock



Health Faucet



Waste Coupling- 32 mm



Floor Drain with Cockroach Trap(With Hole)

HOSTEL & STAFF QUARTERS



Manual Concealed Cistern





Auto Soap Dispenser



Wall Hung Closet



Urinal



Twin Dispenser



Diverter (Regular Flow)



Washbasin Table Top



Tap (Basin Mount)



Shower Arm



Shower Head

Other Accessories



Concealed Part of Single Lever Diverter



Towel Rack



Towel Ring



Soap Dish











MISCELLANEOUS



AUTOMATIC SHOE COVER DISPENSER



SINGLE LEVER BASIN & SINK MIXER



WALL MOUNTED SINK COCK AND MIXER



ANGLE COCKS



BATH SPOUTS



BIB COCKS



CENTER HOLE BASIN MIXERS





DIVERTERS

REFERENCE IMAGES





4.10.1. SANITARYWARE SPECIFICATION

S.NO.	CATEGORY	SPECIFICATION	IMAGE
1	Water Closet	Vitreous Wall Hung China Water Closet (European Type W.C. Pan) Complete with Propriety Square Seat and Cover (Soft Close), With Rimless Design, Pan Connector, Suitable Mounting Brackets/Chair Including Cutting and Making Good the Walls and Floors Wherever Required, White in Color, Dimensions (Mm):550(L) X 375(W) X 355(D) Note: Wc Is Suitable for Low Water Flushing	
		Vitreous Wall Hung China Water Closet (European Type W.C. Pan) Complete With Proprietry Oval Seat And Cover (Soft Close), With Rimless Design, Pan Connector, Suitable Mounting Brackets/Chair Including Cutting And Making Good The Walls And Floors Wherever Required, White In Colour, Dimension (Mm):485(L) X 360(W) X 360(D), Note: Wc Is Suitable For Low Water Flushing	
		Vitreous Wall Hung China Water Closet (European Type W.C.Pan) Complete With Proprietry Oval Seat And Cover (Soft Close), With Rimless Design, Pan Connector, Suitable Mounting Brackets/Chair Including Cutting And Making Good The Walls And Floors Wherever Required, White In Colour. Dimension (Mm):480(L) X 320(W) X 350(D) Note: Wc Is Suitable For Low Water Flushing	
		Vitreous Economical Water Closet, Floor Mounted (European Type W.C.Pan) Complete With Proprietry Square Seat And Cover (Soft Close), Dimensions (Mm) :550(L) X 355(W) X 410(H)Mm	
2	Urinal		
		Urinal Without Sensor: Dimension (Mm):358(L) X 320(W) X 635(D) and push button flushing	
3			
4			

5	Cistern	Concealed Cistern - Full Frame With Tank (With Accessories) Full Flush- 6 L (Can Be Controlled To 4 L), Half Flush – 3 L (Can Be Controlled To 2 L), Igbc Certified	
		Concealed Cistern - Half Frame With Tank (With Accessories), Half Flush –3 L (Can Be Controlled To 2 L).	
6	Washbasin	Washbasin Table Top, Shape: Round, Color: White, Tap Hole: No, Dimension (Mm):395(L) X 395(W) X 160(D)	
		Under Counter Basin With Collar, Shape: Oval, Color: White, Dimension (Mm) 570(L) X 410(W) X 200(D).	
		Under Counter Basin Without Collar), Shape: Oval, Dimension (Mm):570(L) X 410(W) X 200(D), Color: White.	
		Under Counter Basin (Without Collar), Dimension (Mm) 380(L) X 490(W) X 170(H) Shape: Rectangle, Color: White.	
		Washbasin Table Top, Dimension(Mm): 500(L) X 385(W) X 145(D), Shape: Rectangle, Color: White,Tap Hole: No	
		Wall Hung Basin With Ci/Ms, Brackets, 32 Mm C.P. Brass Waste Of Standard Pattern, Dimensions (Mm):415(W) X 400(L) X255(D), Warranty: 10 Years, Tap Hole: Yes	
~~7~~	~~Auto Sensor Tap~~	~~Automatic Sensor Tap (Electrical & Battery) Operation: Infrared Sensor, Voltage: Dc6v Or Ac220v-240v (6v Output), Battery Consumption (Dc): 4xaa Alkaline Batteries (Up-To 1.5yr Lifespan), Power Consumption: =0.3mw, Sensing Distance: 10-20cm, Respond Time: 1 Second Flow, Rate: 1.0l – 1.5l/Min, Igbc Certified~~	

			
		~~Automatic Sensor Tap Product Auto Tap (Basin Mount) Operation Automatic Infra-Red Sensor, Power Electrical (Ac 220v, 50 Hz) Inlet Water Pressure 0.2-0.6 Mpa Material Brass Finish Chrome Plated Sensing Range 09 - 20 Cm~~	
		~~Automatic Sensor Tap- (Counter Mount, Long) (Made In India) Operation: Automatic, Infra-Red Sensor, Inlet Water Pressure:1.5 To 4.0 Bar, Sensing Range: 09 - 20cm, Power: Electrical (Ac 220v, 50 Hz, 0.67w) + Battery (4 X Aa Duracell)~~	
		~~Wall Mounted Sensor Tap (Battery + Electric Operated), Operation: Automatic Infra-Red Sensor, Power: Battery (4 X Aa Duracell), Water Pressure: 1.0 To 4.0 Bar, Sensing Range:08 - 12cm, Battery: Dc6 4aa Alkaline Batteries~~	
		~~Basin Mounted Sensor Tap: Operation: Automatic Infra- Red Sensor, Sensing Range :09 - 20 Cm, Power: Electrical (Ac 220- 240 V / 50- 60 Hz) + Battery (4 X Aa Size), Battery Consumption:30,000 Shots (4 X Aa Duracell Batteries), Material: Brass, Finish: Chrome Plated.~~	
		~~Automatic Sensor Tap, (Long Body) Operation: Infrared Sensor, Dual Operation: Electrical + Battery, Voltage: Dc6v Or Ac220v-240v, 0.67w (6v Output), Battery Consumption (Dc): 4xaa Alkaline Batteries (Up To 1.5yr Lifespan), Flow Rate: 1.0l - 1.5l/Min,~~	
8	~~Soap Dispenser~~	~~Auto Tap + Auto Soap (2 In 1, Basin Mount) Operation Automatic Infra-Red Sensor Power Electrical (Ac 220v, 50 Hz) Or Battery (4 X D Size Alkaline Batteries) Inlet Water Pressure 1.5 To 4.0 Bar (Min 1 Bar Working Pressure Required) Material Brass Finish Chrome Plated Supply Volume Per Drop (Soap Dispenser) 2ml Liquid Volume (Soap Dispenser) 1500 Ml Detecting Distance (Soap Dispenser) 09 - 20 Cm Detecting Distance (Faucet) 09 - 20 Cm Dimension (Mm) 200(L) X 45(W) X 165(H)~~	
		~~Soap Dispenser (Under Counter Type), Operated Through Infra-Red Sensor For Touch-Free Activation. The Unit Is Powered Electrically At Ac 220- 240v / 50- 60hz And Is Constructed From High- Quality Brass With A Chrome-Plated Finish. It Has A Capacity Of 1000 Ml And Features An Under-Counter Mechanism For Concealed Installation. Dimensions: 145(L) X 35(W) X 80(H) Mm. Product Warranty: 6 Months.~~	

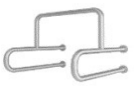
		~~Auto Soap Dispencer: Operation: Automatic Infra- Red Sensor, Power: Electrical (Ac 220v/50hz), Material: Brass, Finish Chrome-Plated, Capacit:1000 Ml, Mechanism: Under The Counter.~~	
		~~Automatic Soap Dispenser (Under Counter Type), Operated With Automatic Infra-Red Sensor For Touch-Free Use. The Unit Is Powered Electrically At Ac 220-240v / 50-60hz And Is Made Of High-Quality Brass With A Chrome-Plated Finish. It Has A Capacity Of 1000 Ml And Features An Under-Counter Mounting Mechanism For Concealed Installation. Product Warranty: 6 Months. Origin: Made In India.~~	
		S. Steel Soap Dispenser (Heavy Traffic), Soap Dispenser (S. Steel), Operation: Manual, Container: 18-8 S, Type-304, Stainless Steel, Material: Non-Corrosive Steel, Capacity: 400 Ml, Dispense Volume: 2 Ml	
		~~Automatic Hand Sanitizer Dispenser: Operation: Automatic Infra-Red Sensor, Material :304 Stainless Steel, Capacity :1100 Ml, Power: Battery Operated (4 X Aa Alkaline Duracell), Sensing Range :10 Cm, Dimension :137(L) X 96(W) X 267(H) Mm.~~	
		Twin Dispenser (Wall Mount) Operation – Manual Material – Abs Plastic Capacity – 300 Ml X 2 Pump Option – Gel/Liquid Refill Type – Refillable Bottle Installation – Wall-Mounted Dimension (Mm) – 138(L) X 85(W) X 222(H)	
		Automatic Infra- Red Sensor Material – 304 Stainless Steel Capacity – 1100 Ml Power – Battery (4 X Aa Alkaline) Sensing Range – 05~09cm Dimension(Mm) – 124(L) X 103(W) X 278(H)	
9	Panel	Hand Dryer With Paper Towel Dispenser & Waste Receptacle : Mounting : Recessed, Construction :304 Grade Stainless Steel, Finish :Stainless Steel, Hand Dryer Motor :Brushless, Paper Dispenser Power :Electrical Or Battery Operated (4 X D Size Alkaline Batteries), Waste Receptacle Capacity :23 Litres, Hand Dryer Power :1350 W, Voltage :220–240 V / 50–60 Hz, Motor Speed :25,000 Rpm, Blowing Volume :270 M^3/H, Air Speed :95 M/S, Sensor Range :12–15 Cm, Protection Class :Ipx1, Wall Opening Required :428(W) X 1700(H) X 379(D) Mm	
		Washroom Panel/Recessed/S.Steel (3in1) Manual Paper Dispenser / High Speed Hand Dryer / Waste Receptacle), Capacity: 600 C-Fold Or 800 Multi Fold Paper Towel, Hand Dryer: 1350w, Waste Container: 18-8, Type- 304, Stainless Steel, Capacity: 21 Litres Wall Opening Required: 315mm (W) X 1665mm (H) X 126mm (D)	

		2 In 1 Panel Recess Mounting Recessed, Construction 304 Grade Stainless Steel, Finish: Steel, Satin Finish, Paper Dispenser Power: Electrical Or, Battery Operated (4 X D Size Alkaline Batteries), Waste Receptacle Capacity: 35 Litres, Wall Opening Required: 335mm (W) X 1435mm (H) X 165mm (D)	
10	Jet Hand Dryer	Steel Jet Hand Dryer On Brush-Less Motor, Construction: Stainless Steel # 304 Grade, Motor: Brush Less Dc Type, Suitable Traffic: High, Mounting: Wall Mounted, Operation: Touch-Free Infra- Red, Hand Dry Time: 7-10 Seconds, Auto Cutoff: 30 Seconds Speed: 24,000 Rpm, Voltage: 220v / 50hz, Hepa Filter: Yes, Weight: 13 Kgs, Color: Stainless Steel Matt Finish	
		Hi - Speed Hand Dryer (Black) Construction: Poly-Carbonate Abs Casing, Mounting: Wall Mounted, Operation: Touch-Free Infrared Activation, Hand Dry Time: Less Than 15 Seconds, Auto Cutoff: 15 Seconds, Air Speed: 90 M/S, Weight: 5 Kgs, Color: Grey, Black	
		S. Steel Hand Dryer (Brush Motor) Casing: Stainless Steel # 304 Grade Mounting: Wall Mounted Operation: Touch-Free Infra-Red Activation Hand Dry Time: 20 Sec Auto Cutoff: 60 Seconds Motor: Brush Type Rpm: 36,000 Rpm Rated Power: 500w Protection Class: Ipx1 Air Speed: 110m/S Dimension(Mm): 263(L) X 97.9 (W) X 306.5(H) Uv Lights Details Wavelength: 280nm Power Consumption: 2 To 3 Mw	
11	Hand Dryer	Hand Dryer (Brushless Motor) Casing: Stainless Steel # 304 Grade Mounting: Wall Mounted Operation: Touch-Free Infra-Red Activation Hand Dry Time: 7-10 Sec Auto Cutoff: 60 Seconds Motor: Brushless Speed: 26,000 Rpm Rated Power: 400w-1150w Protection Class: Ipx4 Air Speed: 110m/S Dimension(Mm): 254(L) X 105 (W) X 322(H) Uv Lights Details Wavelength: 280nm Power Consumption: 2 To 3 Mw	
		S. Steel Hand Dryer (Brush Motor) Casing: Stainless Steel # 304 Grade Mounting: Wall Mounted Operation: Touch-Free Infra-Red Activation Hand Dry Time: 20 Sec Auto Cutoff: 60 Seconds Motor: Brush Type Rpm: 36,000 Rpm Rated Power: 500w Protection Class: Ipx1 Air Speed: 110m/S Dimension(Mm): 263(L) X 97.9 (W) X 306.5(H) Uv Lights Details Wavelength: 280nm Power Consumption: 2 To 3 Mw	
		Paper Dispenser Operation – Manual Material – 304 Stainless Steel Application – Washbasin Area Capacity – 200 C-Fold/ Multifold Dimension (Mm) – 276(L)X 97(W)X 273(H)	
12	Paper Dispenser	Mounting –Recessed Cabinet – 304 Grade, Stainless Steel Operation – Infrared Sensor, Adjustable Dispense Length Power –Electricity + Battery (D Size 4 Pcs) Application – Washbasin Area Adjustable Dispense Length Paper Roll Size – Width 200 Mm	

		Paper Towel Dispenser: Operation: Auto, Material :304 Grade Stainless Steel, Application: Washbasin Area, Capacity :300 C-Fold / Multifold Towels, Dimension :310(L) X 225(W) X 392(H) Mm,	
		Paper Towel Dispenser: Operation: Manual, Material :304 Grade Stainless Steel, Application: Washbasin Area, Capacity :300 C-Fold / Multifold Towels, Dimension :250(L) X 92(W) X 370(H) Mm	
		Tissue Paper Dispenser: Mounting: Exposed, Cabinet:304 Grade Stainless Steel, Application: Washbasin Area, Capacity :750 Tissues, Dimension :240(L) X 89(W) X 590(H) Mm	
13	Sanitary Napkin Hygeine Panel	Sanitary Napkin Hygiene Panel (4in1) - For Feminine Washroom Combination: Sanitary Napkin Dispenser / Toilet Paper Holder / Disposable Bag Dispenser /Waste Receptacle Sanitary Napkin Capacity: 20-25 Pcs, Waste Receptacle Capacity: 4.6 Litres, Equipped With Full-Length Stainless Steel Piano Flap, Disposable Bags Capacity: 50 Bags, Dimension: 600mm (H) X 330mm (W) X 130mm (D)	
		Sanitary Napkin Hygiene Panel (3in1) - For Feminine Washroom Combination: Toilet Paper Holder / Disposable Bag Dispenser / Waste Receptacle, Stainless Steel, Waste Receptacle Capacity: 4.6 Litres, Equipped With Full-Length Stainless Steel Piano Flap, Disposable Bags Capacity: 50 Bags, Dimension: 490mm (H) X 316mm (W) X 130mm (D)	
14	Tap	Pillar Cock Extended Body,Material: Brass, Size(Mm):130(L) X 30(W) X 302(D)	
		Single Lever Sink Mixer Table Mounted, With All Accessories As Per Approved Specifications, Material: Brass, Finish: Steel, Mounted: Table Mounted, Size(Mm):185(L) X 21(W) X 350(D), Spout Length(Mm):170	
		C.P Wall Mounted Swivel Spout Kitchen Sink Mixer With All Accessories As Per Approved Specifications, Material: Brass, Size(Mm):180(L) X 185(W) X 225(D), Spout Length(Mm):135, Mounted: Wall Mounted.	
		C.P Bib Cock (Long Body) With Wall Flange And All Accessories As Per Approved Specifications, Material: Brass, Size(Mm):160(L) X 33(W) X 65(D), Mounted: Wall Mounted	
15	Shower Head	Shower Head Specifications: Abs Overhead Shower Shape Round Material Abs Plastic Finish Type Chrome Colour Silver Ball Joint Plastic Ball Shower Arm Not Available Dimensions (Mm) 260l X 20w X 60h Item Weight 830 G Dia 260 Mm	

		Shower Head Name Abs Top Shower Shape Round Material Abs Plastic Finish Type Chrome Colour Silver Ball Joint Brass Ball Shower Arm Not Available Dimensions (Mm) 100l X 30w X 120h Item Weight 170 G Dia 100mm	
		Overhead Shower, Material: Abs Plastic Finish Type Chrome Colour Silver Ball Joint Plastic Ball Shower Arm Not Available Dimensions (Mm) 139l X 26w X73h Item Weight 240 G	
		Abs Overhead Shower Material Abs Plastic Finish Type Chrome Colour Silver Ball Joint Brass Ball, Shower Arm Not Available Dimensions (Mm) 45.58l X 17.71w 45.58 H, Item Weight 600 G	
16	Shower Arm	Shower Arm Range Allied Material Stainless Steel 304 Dimension(Mm) 145(L) X 18(W) X 60(H)	
17	Diverter	C.P Exposed Part Kit (Regular Flow Diverter) With All Accessories As Per Approved Specifications, Material: Brass, Size(Mm):35(L) X 150(W) X 165(D)	
		C.P Exposed Part Kit (High Flow Diverter) With All Accessories As Per Approved Specifications, Material: Brass, Size(Mm):35(L) X 150(W) X 188(D)	
18	Concealed Part Of Diverter	Concealed Part Of Single Lever Diverter-40 Mm Specifications Range Allied Material Brass Description Concealed Part Of Single Lever Diverter-40 Mm Dimension (Mm) 150(L) X 75(W) X 135(H)	
		Concealed Part Of Single Lever Hi Flow Diverter 46 Mm Sp Range Allied Material Brass Description : Concealed Part Of Single Lever Hi Flow Diverter 46 Mm Dimension (Mm) 140(L) X 65(W) X 135(D)	
19	Baby Diaper Changing Section	Baby Diaper Changing Station - S. Steel Equipped With Safety Belt To Secure Baby When Changing Diapers, Material: Stainless Steel #304, Satin Finish, Unit Dimensions: 905mm (W) X 520mm (H), Depth (Closed): 104 Mm, Extension (Open): 495 Mm, Maximum Load: 25 Kgs	
		Baby Diaper Changing Station(Recess): Equipped With Safety Belt To Secure Baby When Changing Diapers: Mounting: Recess, Material: Stainless Steel #304, Satin Finish, Unit Dimensions: W-940 Mm X H-585 Mm, Warranty:1 Year	
20	Hand Sanitizer Dispenser	Automatic Hand Sanitizer: Compound Used: Ipa Soft Gel, Operation : Automatic, Capacity :700 Ml, Sensing Range :5~15 Cm, Battery :6 X Aa Alkaline Duracell, Dispense Volume :1~2 Ml, Warranty:6 Months	

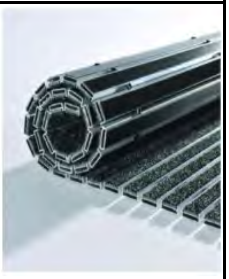
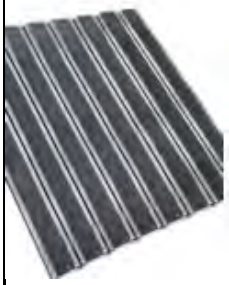
		Automatic Hand Sanitizer Dispenser: Material :304 Stainless Steel, Operation: Automatic Infra-Red Sensor, Capacity :1000 Ml, Sensing Range :8 Cm, Power Supply :4 X Aa Alkaline Duracell Batteries, Installation Height :15~18 Cm (From Counter), Dimension :135(L) X 93(W) X 241(H) Mm	
		Automatic Hand Sanitizer Dispenser: Operation: Automatic Infra-Red Sensor, Material :304 Stainless Steel, Capacity :1100 Ml, Power :4 X Aa Alkaline Duracell Batteries, Sensing Distance :5~15 Cm, Dimension :108(L) X 107(W) X 268(H) Mm	
		Automatic Hand Sanitizer Dispenser: Operation: Automatic Infra-Red Sensor, Material: 304 Stainless Steels, Capacity: 1100 Ml, Power: 4 X Aa Alkaline Duracell Batteries, Sensing Distance: 5 – 15 Cm, Dimension: 108(L) X 107(W) X 268(H) Mm	
21	Towel Ring	Towel Ring Material Ss 304 Description Towel Ring	
22	Towel Rack	304 Grade Stainless Steel Towel Rack Dimensions (Mm) - 621(L) X 223(W) X 90(H)	
23	Soap Dish	Supplying Of Soap Dish Dimension (Mm) 117(L) X 97(W) X 67(H) Material 304 Grade Stainless Steel	
24	Toilet Paper Holder	Abs Twin Paper Holder (With Mobile Stand) Model: Eph09a, Twin Toilet Paper Holder, Material: Abs, Roll: Two, Application: Wc Cubicle Area	
		S. Steel Toilet Paper Holder (With Flap) Material: 18-8 S, Type-304, Stainless Steel, Application: Wc Cubicle Area	
		S. Steel Toilet Paper Holder Material: 18-8 S, Type-304, Stainless Steel, Application: Wc Cubicle Area (Made In India)	
		Paper Holder With Flap Range Bathroom Accessories Material 304 Grade Stainless Steel Description Toilet Paper Holder Dimension (Mm) 130(L) X 60(W) X 105(H)	
		S. Steel Twin Paper Holder (With Mobile Holder), Twin Toilet Paper Holder, Material: 18-8 S, Type-304, Stainless Steel, Application: Wc Cubicle Area	
		S. Steel Paper Holder (With Mobile Holder) Material: 18-8 S, Type-304, Stainless Steel, Application: Wc Cubicle Area (Made In India)	

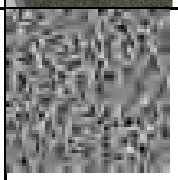
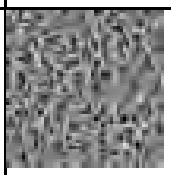
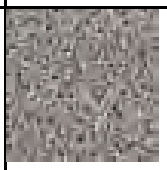
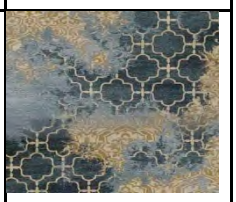
		Supplying Of Twin Paper Holder Material: 304, Stainless Steel, Application: Wc Cubical Area (Made In India)	
25	Health Faucet	Health Faucet Material 304 Grade Stainless Steel Operational Pressure 1bar~6bar Mini Recommended Pressure 1 Bar Flow Rate 7.3lpm@3 Bar Pressure	
		Health Faucet Material Abs Operational Pressure 1bar~6bar Mini Recommended Pressure 1bar Flow Rate11.3lpm@3 Bar Pressure	
		Material Operational Pressure Mini Recommended Pressure Flow Rate Abs 1bar~6bar 1bar 10.5lpm@3 Bar Pressure Included Accessories 1 Mtr. Abs Hose With Tube And Abs Holde	
26	Grab Bar	Disabled S. Steel Grab Rail – 600mm,32mm Dia.Material: 18-8 S, Type-304, Stainless Steel, Application: Wc Area, Diameter: 32 Mm (Made In India)	
		Swing Handicap Grab Bar - S. Steel Material: 18-8 S, Type-304, Stainless Steel, Operation: Movable (Horizontally & Vertically), Diameter: 32mm, Application: Wc Area (Made In India)	
		Casing: High-Quality Aluminum Alloy Mounting: Wall Mounted Operation: Foldable & Height Adjustable Certified Load: 150 Kg Fixing: Solid Metal Wall Fixing Length: 682 Mm Surface Finish: Chrome	
		Seat Material: High-Quality Uf Plastic Mounting: Wall Mounted Operation: Foldable & Height Adjustable Certified Load: Seat: 150kg, Each Arm: 40kg Maximum User Mass: 225kg Finish: Chrome Seat Width: 423mm Seat Depth: 445mm	
		Stainless Steel Grab Bar Made Of 304 Grade Stainless Steel, Equipped With An Anti-Slip Grip For Enhanced Safety And Comfort. The Grab Bar Shall Be Wall-Mounted And Foldable Up To 90 Degrees, Designed To Withstand A Maximum Load Capacity Of 200 Kg. It Is Suitable For Senior Citizens, Persons With Limited Mobility, And Expectant Mothers. The Unit Shall Have Overall Dimensions Of 650mm (L) X 100mm (W) X 120mm (H) And Shall Be Supplied With All Necessary Fittings And Fixtures For Complete Installation.	
		Disabled Grab Bar (U Shape) - (Set Of 2) Material: 18-8 S, Type-304, Stainless Steel, Application: Washbasin Or Urinal Area, Diameter: 32 Mm Application: Wc Area (Made In India)	
		Disabled Urinal Safety Steel Grab Bar-Material: 18-8 S, Type-304, Stainless Steel, Application: Urinal Area, Diameter: 32 Mm Application: Wc Area	
27	Coat & Robe Hook	Robe Hook Range Bathroom Accessories Material Ss 304 Description Robe Hook	

		Twin Coat Hook Material 18-8 S, Type-304, Stainless Steel Application Wc Cubicle Area	
~~28~~	~~Fragnance Dispenser~~	~~Fragrance Dispenser (Lcd-With Digital Programming (Timer)) Construction: 304 Grade Stainless Steel Battery: 2 X Aa Size Spray Interval: Digital Programming (Timer) Installation: Wall Mounted Refill Low Reminder: Yes, Battery Low Reminder: Yes, Key And Lock: Yes Dimensions: 80(L) X 55(W) X 235(H)~~	
		~~Aerosol Perfume Dispenser (Day/Night) Construction: Polycarbonate Abs Casing, Battery: 2 X D Size Alkaline Batteries, Spray Interval :7.5/15/30 Min Mins, Option: Day / Night / 24hrs, Refill Can: 100ml/270ml~~	
		~~Fragrance Dispenser (Lcd-With Digital Programming (Timer)) Construction: Polycarbonate Abs Casing Battery: 2 X Aa Size Spray Interval: Digital Programming (Timer) Installation: Wall Mounted Refill Low Reminder: Yes, Battery Low Reminder: Yes, Key And Lock: Yes Warranty: 1 Year~~	
29	Waste Coupling	Waste Coupling – Half Thread32 Mm, Range: Allied, Material: Bras S, Description: Waste Coupling – Half Thread 32mm	
		Waste Coupling – Full Thread32 Mm, Range: Allied, Material: Bras S, Description: Waste Coupling – Full Thread 32mm	
		Full Thread Waste Coupling 5' Inches	
		Full Thread Waste Coupling 5 Inches Material Brass Description Full Thread Waste Coupling 5 Inches Dimension (Mm) 120(L) X 63 (W) X 75(D)	
		Pop Up Waste Coupling 6 Inches Dimension (Mm) 150(L) X 63(W) X 75(D)	
30	Urinal Coupling	Urinal Waste Coupling: Material: Brass, Dimension: 75(L) X 63(W) X 75(D) Mm	
31	Bottle Trap	Washbasin Bottle Trap Material Brass Dimension (Mm) 290(L) X 55 (W) X 300(H)	
32	Floor Drain	Floor Drain With Hole And Cockroach Trap, Dimensions -6x6 Inch, Material: Stainless Steel 304, Finish: Steel	

		Floor Drain With Cockroach Trap, Dimensions 5x5 Inch, Material: Stainless Steel 304, Finish: Steel	
		Floor Drain With Cockroach Trap, Dimensions: 6x6 Inch, Material: Stainless Steel 304, Finish: Steel	
		Floor Drain Dimensions: 5x5 Inch, Material: Stainless Steel 304, Finish: Satin	
		Floor Drain, Dimension: 6x6 Inch, Material: Stainless Steel 304, Finish: Satin	
		Floor Drain Without Trap Code Efg06-66 Size 6×6(Inch) 150×150(Mm) Material Ss304	
		Floor Drain Without Trap, Dimensions: 6x6 Inch, Material: Stainless Steel 304, Finish: Satin	
		Floor Drain, Dimensions: 4x4 Inch, Shape: Round Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 5x5 Inch, Shape: Round Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 6x6 Inch, Shape: Round Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 4x4 Inch, Shape: Verticle Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 5x5 Inch, Shape: Verticle Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 6x6 Inch, Shape: Verticle Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 4x4 Inch, Shape: Square Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 5x5 Inch, Shape: Square Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	

		Floor Drain, Dimensions: 6x6 Inch, Shape: Square Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
		Floor Drain, Dimensions: 4x4 Inch, Shape: Round Flat Cut, Material: Stainless Steel 304, Finish: Gloss/Matt	
33	Angle Valve	Flush Valve, Range: Allied, Material: Brassdescription: Flush Valve Wc 32m	
		C.P 2 Way Angle Cock With Wall Flange And All Accessories As Per Approved Specifications, Material: Brass, Size(Mm):127(L) X 30(W) X 110(D)	
		C.P Angle Valve With Wall Flange All Accessories As Per Approved Specifications, Material: Brass, Size(Mm):90(L) X 30(W) X 63(D), Mounted: Wall Mounted	
34	Auto Shoe Cover Dispenser	Automatic Shoe Cover Dispenser (160 Plastic Shoe Cover/C1p - Free) Operation: Fully Automatic, Voltage: 220v / 50hz, Rated Power: 20 W, Automatic: Shoe Counting Function, Loading Capacity:50 Covers (Non-Woven), Loading Capacity: 80 Covers (Plastic), Dimensions: 750 X 300 X 630 Mm, Code: C1n, Non – Woven Shoe Covers Code: C1p, Plastic Shoe Covers	
35	Air Curtain	S. Steel Air Curtain (4 Feet / High Velocity) Dimension (Mm): 900 X 230 X 212, No. Of Blowers: 3, No. Of Motors:2, Weight Kgs:22	
		S. Steel Air Curtain (4 Feet / High Velocity) Dimension (Mm): 1200 X 230 X 212, No. Of Blowers: 4, No. Of Motors:2, Weight Kgs:22	
		S. Steel Air Curtain (5 Feet / High Velocity) Dimension (Mm):1500 X 230 X 212, No. Of Blowers: 5, No. Of Motors:3, Weight Kgs:26	
36	Air Curtain Sensor	Sensor Slim Air Curtain (1 Door)	
		Sensor Air Curtain (2 Doors)	
		Sensor Industrial Air Curtain (1 Door)	

37	Queue Manager	Queue Manager Pole (Stainless Steel #304) Material: Stainless Steel Height Of Pole: 1130mm Diameter Of Base: 350 Mm Belt Length: 2 Meters Belt Color: Black/Red	
		Queue Manager (Stainless Steel) Material: Stainless Steel Height Of Pole: 1130mm Diameter Of Base: 350 Mm Belt Length: 2 Meters Belt Color: Black/Red	
38	Steel Queue Manager	S.Steel Q Manager (For Rope) Material: Stainless Steel, Height Of Pole: 1000 Mm, Diameter Of Base: 350 Mm, Weight: 9.5 Kgs, Belt Length: 1.5 Meters, Belt Color: Blue/Black/Red	
		Golden Q Manager Pole (For Rope) Height Of Pole: 1100 Mm, Diameter Of Base: 350 Mm, Weight: 7.5 Kgs, Belt Length: 1.5 Meters, Belt Color: Blue/Black/Red	
39	Entrance Matting	Dust Buster Recess - Aluminium Matting (Options- Grey Carpet, Brown Carpet) Position Of Matting : Inside/Foyer Area, Material : Aluminium Profile With Carpet, Area : High Traffic, Trolley Crossings : Heavy Trolley, Maintenance : Easy To Clean, Application : Recessed / Surface	
		Interconnected Rolling - Aluminium Matting Profile Colors : Silver Or Black, Position Of Matting : Inside/Foyer Area, Material : Aluminium Profile With Carpet, Area : High Traffic, Trolley Crossings : Heavy Trolley, Maintenance : Easy To Clean, Application : Recessed / Surface	
		Interconnected Rolling Thinline Aluminium Matting Profile Colors : Silver, Position Of Matting : Inside/Foyer Area, Material : Aluminium Profile With Carpet, Area : Medium Traffic, Trolley Crossings : Medium Trolley, Maintenance : Easy To Clean, Application : Recessed / Surface, Profile Height : 7.8 Mm Total Height : 15.2 Mm Recess Required : 9.5 Mm Pedestrian Traffic : Upto 8 Lakh (Annually)	

		Carpet Matting - Heavy Duty	
		Carpet Matting - Medium Duty	
		Carpet Matting -Low Duty	
		Trapper Matting (Heavy Duty)-18 Month Warranty Material - Pvc Vinyl, Shape - Loop, Backing - Hard, Tear - Difficult, Trolly Crossing -Light, Width - 4ft	
		Trapper Matting (Medium Duty) Material - Pvc Vinyl, Shape - Loop, Backing - Hard, Tear - Difficult, Trolly Crossing -Light, Width - 4ft	
		Trapper Matting (Low Duty), Material - Pvc Vinyl, Shape - Loop, Backing - Soft, Tear - Easy, Trolly Crossing - Not Advisable, Width - 4ft	
40	Carpet Tiles	Broadloom Carpet : Material :100% Nylon Cut Pile, Digitally Printed, Pile Height :7–7.5 Mm (±1 Mm), Total Height :9–9.5 Mm (±1 Mm), Stitch Density :37 Per 10 Cm (±2%), Pile Weight :Not Less Than 1000 Gsm (±5%), Total Weight :1900–2000 Gsm (±5%), Secondary Backing :Pp Mesh, Gauge :1/8 Cut Pile, Eco Friendly :100% Azo Free Dyes Used In Printing, Flammability :Passes 16 Cfr 1631 (Ff-2-70):2010, Colour Fastness To Washing And Water :≥4 As Per Cpsd-Sl-31042-Mthd, Colour Fastness To Rubbing :≥4 (Aatcc 165:2008), Colour Fastness To Light :≥4 (Aatcc 16:2004 Option 3), Formaldehyde :Approved (Non Hazardous), Installation :Carpet With Minimum 6 Mm Underlay Fixed Using Standard Sr 998 / Sr 505 / Mapei Adhesives	
		Carpet Plank/Tiles : Yarn :Multi Level Loop 100% Solution Dyed Universal Nylon 6, Gauge :1/10 Inch, Stitches :10 Per Inch, Pile Weight :645 Gsm, Pile Thickness :2.5–6.5 Mm (±0.5 Mm), Total Thickness :6.0 Mm (±0.5 Mm), Pvc With Fibreglass , Tile Size :50 Cm X 50 Cm / 25 Cm X 100 Cm, Packing :20 Pieces Per Carton (53.8 Sqft), Flammability :Passes Astm E648, Smoke Density :Passes Astm E662	

Note:
All fixtures and layouts are indicated for reference only. Final fixtures/samples shall be approved by Engineer In charge

HOSPITAL IN MKCGH			
S.NO	**DESCRIPPTION**	**INDICATIVE**	**REMAR**
GENERAL TOILET MALE / FEMALE			
1	C.P 2 WAY BIB COCK with Wall Flange		
2	PNEUMATIC FLUSH VALVE		
3	Soap dispenser		
4	European Water Closet		
5	Stainless Steel 304 grade V shape Matt Finish Hand dryer with brush motor		
6	Urinal Sensor		
7	Urinal		

8	C.P KITCHEN FAUCET- CENTER HOLE BASIN MIXER		
9	Washbasin With Tap Hole		
10	Exposed Paper Towel Dispenser		
TYPICAL STAFF TOILET (MALE & FEMALE)			
1	vitreous One peice closet - floor mounted (European type W.C.pan)		
2	PNEUMATIC FLUSH VALVE		
2	Ultra thin Stainless Steel Hand dryer with brush AC type motor		

3	Manual Soap dispenser made up of 304 grade Stainless Steel		
4	FLOOR DRAIN WITH COCKROACH TRAP		
6	Single Lever Tall Body Basin Mixer Without Pop-Up Waste With Braided HoseRange		
7	HEALTH FAUCET		
6	Urinal Sensor		

7	Urinal		
8	Exposed Paper Towel Dispenser.		
HANDICAP TOILET			
1	vitreous One peice closet - floor mounted (European type W.C.pan)		
2	PNEUMATIC FLUSH VALVE		
3	Washbasin With Tap Hole		
3	Manual Soap dispenser made up of 304 grade Stainless Steel		

5	straight disabled grab bar made of stainless steel		
6	nylon-coated stainless steel tube-based Swing Grab Bar		
7	Disabled Grab Bar Material : Stainless Steel Tube Coated with Nylon		
8	Urinal Safety Steel Grab Bar with a steel mat finish a		
9	U Shaped Disabled Grab Bar made		
10	L Shaped Disabled Grab Bar		

11	Straight Nylon Grab Bar Material		
ISOLATION ROOM TOILET			
1	vitreous Wall hung china water closet (European type W.C.pan)		
2	PNEUMATIC FLUSH VALVE		

3	WASHBASIN TABLE TOP		
4	WASHBASIN P TRAP		
5	WASHBASIN BOTTLE TRAP		

6	S.STEEL TOILET PAPER HOLDER (WITH FLAP)		
7	Manually operated Soap dispenser		
8	SINGLE LEVER SINK MIXER Table Mounted		
11	Disabled Folding Shower Seat		
6	SOAP DISH		

12	Straight Nylon Grab Bar Material		
13	Urinal Safety Steel Grab Bar with a steel mat finish		
14	U Shaped Disabled Grab Bar made		
'DOCTOR'S TOILET			
1	vitreous One peice closet - floor mounted (European type W.C.pan)		
2	PNEUMATIC FLUSH VALVE		
2	WASHBASIN TABLE TOP		

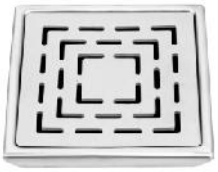
3	Urinal		
4	Exposed Paper Towel Dispenser		

5	Stainless Steel 304 grade V shape Matt Finish Hand dryer with brush motor.		
6	Rain Shower		
7	SPOUT		
8	Recessed Urinal Flusher		

9	Manual Soap dispenser made up of 304 grade Stainless Steel		
10	HEALTH FAUCET		
11	SHOWER ARM WITH FLANGE 8 INCHES ROUND		
6	SOAP DISH		
12	C.P 2 WAY BIB COCK with Wall Flange		
13	stainless steel coat hooks		

14	Exposed Jumbo Roll Tissue Dispenser in 304 Grade Stainless Steel		
15	C.P Towel rail		
WARD TOILET MALE/FEMALE			
1	white vitreous wall hung wash basin		
2	C.P SINGLE LEVER BASIN MIXER with Wall Flange		

3	vitreous Wall hung china water closet (European type W.C.pan)		
4	PNEUMATIC FLUSH VALVE		
5	Urinal		
6	SOAP DISH		

7	Health Faucet Material Brass		
8	Automatic soap dispenser made up of 304 grade Stainless Steel		
9	SHOWER ARM WITH FLANGE 8 INCHES ROUND		
10	FLOOR DRAIN WITHOUT TRAP		
11	C.P Towel ring		

12	Disabled Folding Shower Seat		
13	Straight Nylon Grab Bar Material		
14	Urinal Safety Steel Grab Bar with a steel mat finish a		
15	U Shaped Disabled Grab Bar made		

NOTE: ALL ITEM SHALL BE AS PER TENDER DOCUMENT.

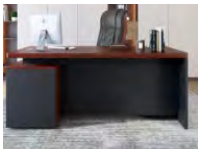
4.11 FURNITURE

Sl.	Area	Total Qty	Tender Specification	Ref. Image
1	Reception For Common Waiting Area/Orth Opd/Genral Surgery Opd/Radiology Enquiry Registration	17	Made Of (L)2400mm X (D)900mm X (H)750mm X 25mm Thick Table Top Of Prelaminated Particle Board In Sapeli Colour.Above Table 18 Mm Thick Counter Top With Glass Height From Table Top @ 350mm,10 Mm Thick Clear Glass Diamond Cut Finish On Edges Based On Stainles Steel Stud Grade 304. One Mobile Pedestal (2 Drawers 1 Filing Cabinet) Size Is 400 Mm(L)X 450 Mm(D)X 600 Mm(H).	
2	Reception For Common Waiting Area	16	Made Of (L)1800mm X (D)600mm X (H)750mm X 25mm Thick Table Top Of Prelaminated Particle Board In Sapeli Colour.Above Table 18 Mm Thick Counter Top With Glass Height From Table Top @ 350mm,10 Mm Thick Clear Glass Diamond Cut Finish On Edes Based On Stainles Steel Stud Grade 304. One Mobile Pedestal (2 Drawers 1 Filing Cabinet) Size Is 400 Mm(L)X 450 Mm(D)X 600 Mm(H).	
3	Reception Chair Fr Common Waiting Area	30	Medium Back Office Revolving Chair Size - 675mm(W)X 660mm(D)X1110mm(H) With Cushioned Seat And Adjustable Armrest. Back:- Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black) Mechanisam:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black	
4	Sofa For Common Waiting Area/Double Height Entrance/Genral Surgery Opd/Orth Opd/Passage/Radiology Common Waiting Area	534	Metal Visitor Bench Length 2300mm X Depth 690mm X Height 770mm. Seat & Back Single Section, Seat Is 430 Mm From Ground,Perforated Mild Steel Powder Coated.Seat Thickness 1.2 Mm. Seat Width 520 Mm.Beam Mild Steel With Black Power Coating Thickness 1.6mm. Mild Steel Border With Chrome Plating For Every Seat & Back. Mild Steel Handles Chrome Plated & Die Pressed Legs At The End Of Chairs. Gross Weight Of Regular 4-Seater Will Be 23 Kg.	
5	Reception Chair Fr Radiology Enquiry Registration	2	Medium Back Office Revolving Chair Size - 675mm(W)X 660mm(D)X1110mm(H) With Cushioned Seat And Adjustable Armrest. Back:- Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black) Mechanism:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black	
6	Counter Fr Double Height Entrance	3	Made Of (L)2400mm X (D)900mm X (H)750mm X 25mm Thick Table Top Of Prelaminated Particle Board In Sapeli Colour.Above Table 18 Mm Thick Counter Top With Glass Height From Table Top @ 350mm,10 Mm Thick Clear Glass Diamond Cut Finish On Edes Based On Stainless Steel Stud Grade 304. One Mobile Pedestal (2 Drawers 1 Filing Cabinet) Size Is 400 Mm(L)X 450 Mm(D)X 600 Mm(H).	
7	Chair Fr Double Height Reception	5	Medium Back Office Revolving Chair Size - 675mm(W)X 660mm(D)X1110mm(H) With Cushioned Seat And Adjustable Armrest. Back: - Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black)	

			Mechanism:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black	
8	Nursing Station	22	Reception Desk Made Of 1800 Mm(L)X 600 Mm(D)X 750 - 1050 Mm(H) X 25mm Thick Prelam Particle Board, Table Top 18 Mm Thick Counter Top To Table Top Height Is @ 300mm, Overall Reception Desk Height Is @ 1050mm With Counter Top. One Mobile Pedestal (2 Drawers, 1 Filing Cabinet) Size Is 400 Mm(L)X 450 Mm(D)X 600 Mm(H). To be fabricated on site with a handwash basin, equipment and services	
9	Chair Fr Nursing Station	84	Black Mesh Back Chair Size - 685mm(W)X 690mm(D)X1110mm(H) Nylon Adjustable Handle Without Pad Pu Armpad (Alto) – Black Techno Syncro Mechanism Nylon Base, Castor (55mm) Telescopic Hydraulic Cover Gaslift 80 Mm Class 4	
10	Patient Examination Beds/Wardroom/Opd /Osce Room	121	Hospital Furniture - Examination Couch Supplying And Placing In Position Of Examination Couch (F): Overall Dimension 1975 Mm (L) X 560 Mm (W) X 805 Mm (H). Examination Couch With Three Drawers With Three Cabinets, Inbuilt Step Stool And Bp Tray Holder. The Base Frame Is Made Of 30 mm x 30 mm x 1.6 Mm ERW Tube. The Cabinets Are Made Of 1 Mm Thick CRCA Sheet With Recessed Plastic Handles, A Lock, And A Plastic Door Latch. The Hinges Of The Cabinet Are Made Of Sheet Metal And Pin Arrangement. The internal dimensions of the two side cabinets are 422 Mm (W) X 455 Mm (D) X 540 Mm (H).	
11	Table Fr Opd Consultant / Nurse On Duty Room/Radiology/Incharge Technical Room/Demo Room	85	Director Desk Size Should Be 1500mm(L)X 750mm(D)X 750mm(H) In Brown- Walnut Colour, Table Top Made Mm Thick Made In Prelaminated Particle Board With Side Runner Size Should Be 750mm(L)X 450mm(D)X 760mm(H).	
12	Chair Fr Opd Consultant	73	High Back Office Revolving Chair Size - 675mm(W)X 660mm(D)X1305mm(H) With Cushioned Seat And Adjustable Armrest. Back:- Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black) Mechanisam:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black	
13	Patient Stool	73	Providing And Placing/Installation In Position Attendant Stool Of Overall Size - Diagonal Leg Dia 538mm X 470min - 655max (H). Top Plate Should Made Of Stainless Steel (Ss 304) Made Sheet With Spin Section Of Thickness 1mm & Should Be Non-Corrosive. It Should Have A Diameter Of 305mm, Seat Base Should Made Of Ms Ring And Rectangular Tube. En8 Screw Having Dia Of 22mm Should Be Used For Height Adjustment Of The Seat Base. The Round Hub Should Be Made Of Ms Erw Tube Having Dia Of 38mm And Thickness 2mm. The Hub Should Be Welded With The Legs And It Should Accommodate And Cover The Lead Screw Mechanism. The Under Structure Should Consist Of 4 Legs Made Up Of Ms Erw Tube Of Diameter Of Minimum 25 Mm And 1.6mm Thick. The Press Formed Pipe	

			Leg Should Give A Round & Clean Look. All The Legs Should Be Provided With 4 No's Of Nylon-6 Bush. All Metal Components Should Be Pretreated With Zinc Phosphating And Then Powder Coated With Anti- Microbial Epoxy Polyester Powder Coating To Fulfil The Requirements For Bacterial Protection Against At Least 2 Commonly Found Bacteria In Hospital Environment. Working Load Must Be 135kg. All Complete As Per Approved Sample And As Per The Direction Of Engineer-In Charge.	
14	Visitor Chair Fr Opd Consultant/	146	Medium Back Office Revolving Chair Size - 675mm(W)X 660mm(D)X1110mm(H) With Cushioned Seat And Adjustable Armrest. Back:- Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black) Mechanisam:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black	
15	Sofa Fr Radiology/Ultrasound/Nurse On Duty	3	2-Seater Lounge Sofa With Overall Dimensions Of (W)1410mm X (D)890mm X (H)870mm, Providing An Approximate Seating Area Of 900 Mm (W) × 510 Mm (D). The Internal Framework Shall Be Constructed From 12 Mm Thick, Anti-Termite-Treated Plywood	
16	Sofa Fr Ultasound Room	1	1-Seater Lounge Sofa With Overall Dimensions Of (W)960mm X (D)890mm X (H)870mm, Providing An Approximate Seating Area Of 420 Mm (W) × 510 Mm (D). The Internal Framework Shall Be Constructed From 12 Mm Thick, Anti-Termite-Treated Plywood (Tentatively Grade 303 As Per Indian Standards For Commercial, Common, And Moisture-Proof Plywood) With A Controlled Moisture Content Of Less Than 10–12% To Ensure Long-Term Structural Stability And Durability.	
17	Centre Table Ultasound Room	1	Ct Dimension - (W)1200mm X (D)600mm X (H)460mm Table Top Thickness - 36mm Colour & Colour Family - Brown - Wenge Material & Subtype - Veneer, Solid Wood - Steam Beech Wood Table Top Material - Veneer Leg Material - Solid Wood Finish - Matte	
18	Chairs For Pharmacy/Registration/Backoffice/Insurance/Health Checkup Lounge	19	Size: (W)625mm X (D)485mm X (H)995mm Black Color - Medium Back - Mesh Chair Fixed Arms - Single Locking Mechanism Nylon Base.	
20	Sofa Fr Sample Collection Room/Health Checkup Lounge	9	Two Seater Loral Sofa Dimension - (W)1360mm X (D)760mm X (H)790mm Made By Premium Leatherette In Brown-Camel Brown Colour With The Matte Finish.Two Seater Sofa That Shall Be Constructed From Natural Hard Wood And Commercial Plywood Having Inner Frame. The Legs Shall Be Made Up Of Powder Coated Round Pipe Of Dia. 25. 4mm With 1. 6mm Thick.	
21	Centre Table Fr Sample Collection Room	4	Ct Dimension - (W)1200mm X (D)600mm X (H)460mm Table Top Thickness - 36mm Colour & Colour Family - Brown - Wenge Material & Subtype - Veneer, Solid Wood - Steam Beech Wood Table Top Material - Veneer Leg Material - Solid Wood	

			Finish - Matte	
22	Side Table	3	St Dimension - (W)650mm X (D)500mm X (H)460mm Table Top Thickness - 36mm Colour & Colour Family- Brown - Wenge Material & Subtype - Veneer/Solid Wood - Steam Beech Wood Table Top Material - Veneer Leg Material- Solid Wood Finish - Matte	
23	Chair For Sample Collection Casuality/Nurse Station	15	Size: (W)625mm X (D)485mm X (H)995mm Black Color - Medium Back - Mesh Chair Fixed Arms - Single Locking Mechanism Nylon Base.	
24	Examination Beds Fr Donour/Nurse Duty	8	Hospital Furniture - Examination Couch Supplying And Placing In Position Of Examination Couch (F): Overall Dimension 1975 Mm (L) X 560 Mm (W) X 805 Mm (H). Examination Couch With Three Drawers With Three Cabinets, Inbuilt Step Stool And Bp Tray Holder.The Base Frame Is Made Of 30 Mm X 30 Mm X 1.6 Thick Erw Tube.	
25	Table Fr Nurse On Duty Room Casuality	7	Director Desk Size Should Be 1500mm(L)X 750mm(D)X 750mm(H) In Brown- Walnut Colour, Table Top Made Mm Thick Made In Prelaminated Particle Board With Side Runner Size Should Be 750mm(L)X 450mm(D)X 760mm(H).	
26	Sofa For Common Waiting Area/Double Height Entrance/Genral Surgery Opd/Orth Opd/Passage/Radiology Common Waiting Area	143	Metal Visitor Bench Length 1820mm X Depth 690mm X Height 790mm. Seat & Back Single Section, Seat Is 430 Mm From Ground,Perforated Mild Steel Powder Coated.Seat Thickness 1.2 Mm. Seat Width 520 Mm.Beam Mild Steel With Black Power Coating Thickness 1.6mm. Mild Steel Border With Chrome Plating For Every Seat & Back. Mild Steel Handles Chrome Plated & Die Pressed Legs At The End Of Chairs. Gross Weight Of Regular 3-Seater Will Be 23 Kg.	
27	Nursing Station Casuality Area	6	Reception Desk Made Of 2400 Mm(L)X 900 Mm(D)X 750 - 1050 Mm(H) X 25mm Thick Prelam Particle Board, Table Top 18 Mm Thick Counter Top To Table Top Height Is @ 300mm ,Overall Reception Desk Height Is @ 1050mm With Counter Top. One Mobile Pedestal (2 Drawers 1 Filing Cabinet) Size Is 400 Mm(L)X 450 Mm(D)X 600 Mm(H).To be fabricated on site as per given dimensions and materials.	
28	Tablet Chair Fr Demo Room/Examination Hall	736	Size:(W)490mm X (D)360mm X (H)820mm Black Color - Medium Back - Fabric Chair - Without Arms - Black Powder Coated Legs.	

29	Faculty Table Fr Demo Room/Nurse On Duty Room	9	Office Desk Size Should Be 1200mm(L)X 600mm(D)X 750mm(H) In Maple/Dark Grey Colour, Table Top Made 25 Mm Thick Made In Prelaminated Particle Board.	
30	Chair Fr Demo Room/Nurse On Duty Room	9	Size: (W)640mm X (D)670mm X (H)1100mmBlack Color - Medium Back Chair Mesh Back And Fabric Seat Adjustable Arms Self Weighted Multi Locking Mechanism Chrome Base.	
31	Main Table For Hod Professor/Associate Professor/Examiner Room	45	Executive Desk With Pedestal~ Size : 2400w X 2000d X 760h Mm~ Colour : Hs-01 Walnut / Pt-04 Grey~ Side Cabinet Direction : Right-Hand Side~ C/W Pedestal Tar-Cah-0406~ Size : 400w X 480d X 655h Mm 7 HOD Tables	
32	Main Chair For Hod Professor/Associate Professor	27	High Back Premium Leatherette Chair, Dimension (W)655mm X (D)500mm X (H)1230mm Maximum Seating Height 530 Material & Subtype Premium Leatherette Upholstery Material Premium Leatherette Seat Material Premium Leatherette Leg Material Chrome Finish Glossy Colour & Colour Family Brown Mechanism Synchro Multi Locking Seating Capacity 1 Seater Seating Height 470mm Function Pneumatic Height Lift,Tilt Tension Control,Revolving Size Standard Style Contemporary Assembly Type Knock Down	
33	Visitor Chair For Hod Professor/ Associate Professor	80	Premium Leatherette Chair, Low Back, Material & Subtype Premium Leatherette, Upholstery Material Premium Leatherette, Seat Material Premium Leatherette, Leg Material Chrome, Finish Glossy, Colour & Colour Family Brown, Dimension (W)555mm X (D)500mm X (H)1105mm, Mechanism Synchro Multi Locking Seating Capacity 1 Seater, Seating Height 480mm Maximum Seating Height 540, Function Pneumatic Height Lift,Tilt Tension Control,Revolving, Size Standard, Style Contemporary, Assembly Type Knock Down	
34	Sofa For Hod Professor/Associate Professor	27	Seater Lounge Sofa With Overall Dimensions Of Size (W)1530mm X (D)710mm X (H)770mm, Providing An Approximate Seating Area Of 1400 Mm (W) × 570 Mm (D). The Internal Framework Shall Be Constructed From 12 Mm Thick, Anti-Termite-Treated Plywood (Tentatively Grade 303 As Per Indian Standards For Commercial, Common, And Moisture-Proof Plywood) With A Controlled Moisture Content Of Less Than 10–12% To Ensure Long-Term Structural Stability And Durability.	
35	Sofa For Hod Professor/Associate Professor	13	Seater Lounge Sofa With Overall Dimensions Of Size (W)800mm X (D)710mm X (H)770mm, Providing An Approximate Seating Area Of 670 Mm (W) × 570 Mm (D). The Internal Framework Shall Be Constructed From 12 Mm Thick, Anti-Termite-Treated Plywood (Tentatively Grade 303 As Per Indian Standards For Commercial, Common, And Moisture-Proof Plywood) With A Controlled Moisture Content Of Less Than 10–12% To Ensure Long-Term Structural Stability And Durability.	

36	Centre Table For Hod Professor/Associate Professor/Waiting Area	15	The Item Shall Consist Of Supplying And Placing In Position A Knock Down Centre Table Product Of Overall Size 1200mm Length X 600mm Depth X 400mm Height. Type: Centre Table (Rectangular Shape) Overall Structure: Knock-Down (Kd) Construction Comes With Complete Hardware And Fittings, Table Top And Shelf Material: 18mm Thick Veneer Mdf Top With Veneer Edgebanding, Top Comes With 20mm Thick Steam Beech Wooden Framing And Supported On 45mm Thick Steam Beech Wooden Leg. Legs Material: 45mm Thick Seasoned Steam Beech Wood (Solidwood). Assembly Type: Knock-Down (Kb) Assembly With Alenkey Bolts And Screws.	
37	Side Table Fr Hod Professor/Associate Professor	18	The Item Shall Consist Of Supplying And Placing In Position A Knock Down Side Table Product Of Overall Size 600mm Length X 600mm Depth X 450mm Height. Type: Side Table (Square Shape) Overall Structure: Knock-Down (Kd) Construction Comes With Complete Hardware And Fittings, Table Top And Shelf Material: 18mm Thick Veneer Mdf Top With Veneer Edgebanding, Top Comes With 20mm Thick Steam Beech Wooden Framing And Supported On 45mm Thick Steam Beech Wooden Leg. Legs Material: 45mm Thick Seasoned Steam Beech Wood (Solidwood). Assembly Type: Knock-Down (Kb) Assembly With Alenkey Bolts And Screws.	
38	Sofa For Nurse Lounge/Staff Lounge	6	Dimension (W)1400mm X (D)930mm X (H)890mm Seating Height 440mm Material & Subtype- Pvc, Fabric - Linen Colour & Colour Family Beige - Pecan Composition - Polyester Frame Material- Solid Wood Upholstery Material - Fabric - Linen Filling Material - Foam Seat Material - Fabric - Linen Leg Material - Pvc Add On- 2 Throw Cushions Seating Capacity 2 Seater Finish Matte	
39	Centre Table For Nurse/Staff Lounge	2	Dimension (W)1130mm X (D)630mm X (H)410mm Material & Subtype Solid Wood - Beech Wood Table Top Material Clear Glass Frame Material Solid Wood Leg Material Solid Wood Finish Matte Colour & Colour Family Brown – Walnut.	
40	Side Table For Nurse/Staff Lounge	4	Dimension - (W)680mm X (D)530mm X (H)450mm Colour & Colour Family - Brown – Walnut Material & Subtype - Solid Wood - Beech Wood Table Top Material - Solid Wood Leg Material - Solid Wood Finish - Glossy	
41	Bed For Nurse/Staff Lounge	4	Single Bed Size Is 2000 Mm(L) X 890 Mm(D) X 900 Mm(H), Bed Head Board Shall Be Made Out Of 25 Mm Thick Prelaminated Particle Board With Pvc Edge Banding And Tail Boar Of Bed Shall Be Made Of 18mm Thick Pre-Laminated Particle Board With All Exposed Edges Edge Banded With 0.8mm Thick Pvc Edge Banding.From Mattress Panel To Headboard Top Height Is @ 500 Mm, Mattress Panel Structure Are Made Out Of Moisture Content Shall Be Less Than (10-12)%.The Mattress Holding Ply Comes With Ms Powder Coated Strips.	

42	Sofa For Doctor Lounge/Anesthetic Lounge	6	Two Seater Sofa Dimension (W)1200mm X (D)720mm X (H)845mm Made By Kiln-Dried Wood Framing In Premium Leatherette/Classic Button-Tufting In Green-Advo Green Colour, Firm Cushioned Seat With Kiln-Dried Wood Legs.	
43	Centre Table For Doctor Lounge/Anesthetic Lounge	2	Ct Dimension (W)1130mm X (D)630mm X (H)410mm Material & Subtype Solid Wood - Beech Wood Table Top Material Clear Glass Frame Material Solid Wood Leg Material Solid Wood Finish Matte Colour & Colour Family Brown – Walnut.	
44	Bed For Doctor Lounge/Anesthetic Lounge	4	Without Storage King Size Bed Size Is 2050 Mm(L) X 1890 Mm(D) X 1200 Mm(H), The Mattress Panel Comes In 2 Part Over All Mattress Panel Ply Size Is 1996 Mm(L) X 1844 Mm(D) X From Ground To Mattres Panel Height Is @ 400 M.	
45	Side Table For Doctor Lounge/Anesthetic Lounge/Private Room	32	St Dimension - (W)680mm X (D)530mm X (H)450mmColour & Colour Family - Brown – WalnutMaterial & Subtype - Solid Wood - Beech WoodTable Top Material - Solid WoodLeg Material - Solid WoodFinish - Glossy.	
46	Main Table For Asst Professor/Resident Room	16	Premium Suites Size Should Be 2000mm(L)X 900mm(D)X 755mm(H) In Brown-Walnut Colour, Table Top Made 45 Mm Thick Made In Prelaminated Particle Board With Side Runner Size Should Be 1200mm(L)X 500mm(D)X 750mm(H).	
47	Chair For Asst Professor/Resident Room	44	Size: (W)630mm X (D)675mm X (H)1300mm Black Color - High Back Chair Mesh Back And Fabric Seat Adjustable Arms Self Weighted Multi Locking Mechanism Chrome Base.	
48	Visitor Chair For Asst Professor/Resident Room	88	Size: (W)630mm X (D)675mm X (H)1115mm Black Color - Medium Back Chair Mesh Back And Fabric Seat - Adjustable Arms Self Weighted Multi Locking Mechanism Chrome Base.	
49	Library Table Size 2400x900	20	Supplying And Placing In Potision Of 8 Seater Dining Table Size Taken : 2400mm(L) X 900mm(D) X 750mm(H). Tabletop Made Of 25mm Thk Plpb. Tabletop Supported With C Legs Of 50x50 And Connectors 40x40 In Black Powder Coating As Per Reference Image.	

50	Library Table Size 3000x1500	6	Supplying And Placing In Potision Of 8 Seater Dining Table Size Taken : 3000mm(L) X 1500mm(D) X 750mm(H). Tabletop Made Of 25mm Thk Plpb. Tabletop Supported With C Legs Of 50x50 And Connectors 40x40 In Black Powder Coating As Per Reference Image.	
51	Chair For Library	128	Non Rotatable Wooden Office Visitor Chair, With Armrest Size – 500mm(W)X550mm(D)X850mm(H). Seat Height 430mm Back Size – 480mmx 260mm Foam 25mm Thick With 28 Density. Weight – 9 Kg, Primium Material – Rubber Wood. Upholstery Material – Fabric Covered Foam. Seat Foam 32d(35mm) Back Foam 28d (25mm). Capacity – 100kgs.	
52	Storage For Library	80	Metal Storage Of Size 900mm(L)X 480mm(D)X 1200mm(H) Body Made Out In 22 Gague(0.8mm) & Door 19 Gague(1mm) Crca Sheet. 4 Adjustable Shelve In 22 Gague(0.8mm) & Pedestal 18 Gague 1.2mm Crca Sheet. Having Four Shelves Making Five Compartment, Fitted With Ms Body Lock & Handle. Vertical Sliding Glass Door , The Glass Used Shall Be 4mm Thick Clear. Uniformly Distributed Load Capacity Of Each Shelf Shall Be 30 Kg Maximum.Each Rack Shall Be Provided With Stiffener At Bottom For Strength. The Entire Body Panel And Shelf Shall Be Made Of High Yield Strength,The Complete Steel Structure Shall Be Constructed By Welding And Provide Finishing With Epoxy Polyester Powder Coated To The Thickness 50-60 Microns(/-5 Micron) In Color Grey-Light Grey.	
53	Sofa For Private Room	28	2-Seater Lounge Sofa With Overall Dimensions Of (W)1410 Mm X (D)740mm X (H)720mm, Providing An Approximate Seating Area Of 1140 Mm (W) × 550 Mm (D). The Internal Framework Shall Be Constructed From 12 Mm Thick, Anti-Termite-Treated Plywood (Tentatively Grade 303 As Per Indian Standards For Commercial, Common, And Moisture-Proof Plywood) With A Controlled Moisture Content Of Less Than 10–12% To Ensure Long-Term Structural Stability And Durability.	
54	Main Table Forsupritendent Room Chamber/Medical Supritendent	2	Premium Suites Size Should Be 2800mm(L)X 2330mm(D)X 770mm(H) In Red- Cherry Colour, Table Top Made 45 Mm Thick Made In Prelaminated Particle Board With Side Unit Size Should Be 1200 Mm (L) X 595 Mm (D) X 770 Mm (D).	
55	Supritendent Room Chamber Main Chair	2	Hb : Dimension (W)650mm X (D)480mm X (H)1300mm Brown Color - High Back - Leather Chair Fixed Arms - Synchro Multi Locking Mechanism Chrome Base.	
56	Supritendent Room Vistor Chair	12	Supplying And Placing In Position Of Low Back Natural Leather Chair In Red-Burgandy Colour With Matte Finish Specification : Durian- Office Seating- Alpha Chair , Type : * Low Back 360ã¸ Degree Revolving Chair Sku : Alpha2/Lb , All Over Size Is : 650mm Lx 510mm Dx 1150mm H.	

57	Supritendent Room Sofa	4	Supplying And Placing In Position A Modernist-Design Upholstered Martha 3-Seater Lounge Sofa With Overall Dimensions Of (W)1800mm X (D)890mm X (H)940mm, Providing An Approximate Seating Area Of 1460 Mm (W) × 520 Mm (D).	
58	Supritendent Room Centre Table	2	Size - 1200l X 600d X 472h, Centre Table With 2 Drwaer & 1 Shelf At The Bottom. Top - 17mm Thk Mdf With Osv Steam Beech Veneer With 17mm Thk Mdf Border To Show Thicker In Walnut Pu Polish For Top. Legs - 45mm Thk Steam Beech Wood In Walnut Pu Polish For Legs Shelf - 17mm Thk Mdf With Osv Steam Beech Veneer With 17mm Thk Mdf Border To Show Thicker In Walnut Pu Polish For Shelf. Drawer - 17mm Thk Osv Steam Beech Veneer Mdf In Walnut Pu Polish For Facia Drawer Size - 513mm(W) X 106mm(H)	
59	Main Table Fr Deputy Supridentt/Additiona l Supritendent Room/Registrar Officer/Librarian Office	4	Office Table With Leatherette Desk Pad,Side Runner And Pedestal, Size : 2400w X 1150d X 760h Mm, Material : Mdf, Colour : Walnut. Table Top Thickness Is 80mm Thick. A Movable Pedestal Unit Features 3 Spacious Drawers. A Side Runner Features A Dedicated Cpu Shelf, 1 Trolley, 1 Shelf, 1 Drawer And 1 Cabinet. Circular Cable Organisers Keep The Tabletop Clutter-Free.	
60	Chair For Deputy Supritendent/Additi onal Supritendent/Regist rar Officer	4	Supplying And Placing In Position Of High Back Leatherette Chair In Black Colour With Matte Finish. Type : * High Back 360ã¸ Degree Revolving Chair, * All Over Size Is : 660mm Lx 520mm Dx 1250mm H , * The Chair Made Of Full Leatherette In Black Colour . It Will Comes In Matte Finsih In Contemporary Style .	
61	Visitor Chair For Deputy Supritendent/Additi onal Supritendent/Regist rar Officer	8	Supplying And Placing In Position Of Medium Back Leatherette Chair In Black Colour With Matte Finish Specification: Type: * Medium Back 360ã¸ Degree Revolving Chair, All Over Size Is : 660mm Lx 525mm Dx 995mm H , The Chair Made Of Full Leatherette In Black Colour. It Will Come In Matte Finsih In Contemporary Style.	
62	Sofa 2 Seater For Deputy Supritendent/Additi onal Supritendent/Regist rar Officer	3	Lounge Sofa (W)1638mm X (D)902mm X (H)915mm) Seating Capacity 2 Persons Frame Structure Frame Shall Be Reinforced With Minimum 12mm Thick Moisture Resistant (Mr) Grade Plywood. Seat Platform Supported With Elastic Webbing Straps For Superior Comfort And Long Life. Foam High-Density Pu Foam; Seat: 40±2 Kg/M³, Backrest: 32±2 Kg/M³. Armrest & Backrest Fully Upholstered Curved Armrests Integrated With Back Frame. Upholstery Premium Dual-Tone Fabric — Outer Shell In Dark Navy Blue; Seat And Back Cushions In Beige. Legs/Base Metal Legs, Powder-Coated Black Matte Finish.	
63	Side Table For Deputy Supritendent/Additi onal Supritendent/Regist rar Officer	3	Sku : Hopper/A/St Dimension - (W)680mm X (D)530mm X (H)450mm Colour & Colour Family - Brown – Walnut Material & Subtype - Solid Wood - Beech Wood Table Top Material - Solid Wood Leg Material - Solid Wood Finish - Glossy	

64	Main Table For Pa To Medical Supritendent & Supritendent	2	Sku : Dws/34756 Director Desk Size Should Be 1800mm(L)X 900mm(D)X 750mm(H) In Brown- Wenge Colour, Table Top Made 50 Mm Thick Made In Prelaminated Particle Board With Side Runner Size Should Be 1200mm(L)X 400mm(D)X 760mm(H).	
65	Chair For Pa To Medical Supritendent & Supritendent	2	Sku : Nature-I/Hb/Premium : Size: (W)630mm X (D)675mm X (H)1300mm Black Color - High Back Chair Mesh Back And Fabric Seat Adjustable Arms Self Weighted Multi Locking Mechanism Chrome Base.	
66	Visitor Chair For Pa To Medical Supritendent & Supritendent	6	Size: (W)610mm X (D)660mm X (H)1130mm Black Color - Medium Back Chair Mesh Back And Fabric Seat Fixed Arms - Single Locking Mechanism Nylon Base.	
67	Main Table For Section Officer/Establishment Officer/Medical Officer/Deputy Medical Supritendent/Nursing Supritendent	6	Premium Suites Size Should Be 2200mm(L)X 1000mm(D)X 750mm(H) In Brown-Wenge Colour, Table Top Made 45 Mm Thick Made In In Prelaminated Particle Board Laminate Finish With Side Unit Size Should Be 1800mm(L)X 500mm(D)X 720mm(H).	
68	Main Chair For For Section Officer/Establishment Officer/Medical Officer/Deputy Medical Supritendent/Nursing Supritendent	6	Sku : Fenix/Hb/Black Size - 685mm(W)X 690mm(D)X1310mm(H) High Back Chair Mechanism - Self Weight Adjusting Mechanism Arms - 1d Handle (Black) With Pu Pad (Black) Base- Nylon Base Black Mesh Black & Seat Bottom Black Cover Gas Lift – 80mm	
69	Visitor Chair For For Section Officer/Establishment Officer/Medical Officer/Deputy Medical Supritendent/Nursing Supritendent	18	Size - 685mm(W)X 690mm(D)X1310mm(H) Medium Back Chair Mechanism - Self Weight Adjusting Mechanism Arms - 1d Handle (Black) With Pu Pad (Black) Base- Nylon Base Black Mesh Black & Seat Bottom Black Cover Gas Lift – 80mm	
70	2 Seater Sofa For Section Officer/Establishment Officer/Medical Officer/Deputy Medical Supritendent/Nursing Supritendent	6	Dimension - (W)Mm X (D)940mm X (H)895mm Seating Height - 495mm Material & Subtype - Premium Leatherette, Solid Wood - Steam Beech Wood Frame Material - Solid Wood, Plywood Upholstery Material - Premium Leatherette Seat Material - Premium Leatherette Leg Material - Solid Wood Colour & Colour Family - Red – Burgundy	

71	Side Table For Section Officer/Establishment Officer/Medical Officer/Deputy Medical Supritendent/Nursing Supritendent	6	The Item Shall Consist Of Supplying And Placing In Position A Knock Down Side Table Product Of Overall Size 600mm Length X 600mm Depth X 450mm Height.	
72	Confference Table Size 11200x3600	1	Supplying And Placing In Potision Of U - Shape Modern Design Conference Table Over All Size :- 11400mm X 3600mm X 750mm. Cp Material : Prelaminated Particle Board Size : 600mm(L)X 600mm(D)X 750mm(H) (Nos-2), Sp 1 Size : 1350mm(L)X 600mm(D)X 750mm(H) (Nos)-16), Sp 2 Size : 2400mm(L)X 600mm(D)X 750mm(H) (Nos-1), Table Top Made Of 36mm Thk. Prelaminated Particle Board Tabletop With Pvc Edge Banding.	
73	Conffference Table Size 4570x3600	1	Supplying And Placing In Potision Of U - Shape Modern Design Conference Table Over All Size :- 4650mm X 3600mm X 750mm. Cp Material : Prelaminated Particle Board Size : 600mm(L)X 600mm(D)X 750mm(H) (Nos-2), Sp 1 Size : 1350mm(L)X 600mm(D)X 750mm(H) (Nos)-6), Sp 2 Size : 2400mm(L)X 600mm(D)X 750mm(H) (Nos-1), Table Top Made Of 36mm Thk. Prelaminated Particle Board Tabletop With Pvc Edge Banding.	
74	Confference Chair	2	Supplying And Placing In Position Of A High Back Mesh Revolving Office Chair In Grey Colour Designed Ergonomically For Executive And Office Seating Application. The Overall Dimensions Of The Chair Shall Be 690mm Width X 685mm Depth X 1310mm Height.	
75	Confference Chair	41	Supplying And Placing In Position Of A Mid Back Mesh Revolving Office Chair In Greyk Colour Designed Ergonomically For Executive And Office Seating Application. The Overall Dimensions Of The Chair Shall Be 690mm Width X 685mm Depth X 1110mm Height.	
76	Sofa For Waiting Hall/Lobby	7	3-Seater Lounge Sofa With Overall Dimensions Of (W)1660mm X (D)740mm X (H)720mm, Providing An Approximate Seating Area Of 1400 Mm (W) × 550 Mm (D). The Internal Framework Shall Be Constructed From 12 Mm Thick, Anti-Termite-Treated Plywood (Tentatively Grade 303 As Per Indian Standards For Commercial, Common, And Moisture-Proof Plywood) With A Controlled Moisture Content Of Less Than 10–12% To Ensure Long-Term Structural Stability And Durability.	
77	Centre Table For Waiting Hall/Lobby	7	Dimension (W)1130mm X (D)630mm X (H)410mm Material & Subtype Solid Wood - Beech Wood Table Top Material Clear Glass Frame Material Solid Wood Leg Material Solid Wood Finish Matte Colour & Colour Family Brown – Walnut.	
78	L Shape Workstation For Doctor Establishment Room/Nursing Establishment/Class Iv Establishment/Nhm Section	36	Sku : Smart-Ultra/5x5 : Modular Workstation Size Is 1500-1500mm(L)X 600mm(D)X1200mm(H), 25mm Thick Table Top Prelaminated Board, Slanted Shape Metal Legs Of Size 50mm X 50mm And Connectors Of Size 40mm X 40mm In Metal Powder Coated. Soft Board / White Board In Partition Above Table Top	

79	Workstation Chair	36	Size - 675mm(W)X 660mm(D)X1110mm(H) With Cushioned Seat And Adjustable Armrest. Back:- Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black) Mechanisam:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black	
80	Lecture Theatre Seating/Seminar Hall	46	Desk :-W1100xD900xH750mm Worksurfaces Standard worksurface tops are nominal with 25mm overall thickness. Minimum worktop depth to be of 500 mm. Structure The table top in University seating is supported by center post. Front post is made up of MS tube 100*50mm. Vertical post and center post are welded with Metal plate 150*125mm*5mm thick fixing to table top and the bottom plate 200*150*12mm fixing to ground. The bottom plate size of post will vary based on customer requirements with respect to floor finishing. Seating is fixed into swing arms which can be revolved 360 degrees by end user while getting in or out from seat and also to carry discussions and collaborating with other students. Rigid EN8 material pivot pins are used to hold the swing arms and can sustain the load of up to 180-200kgs. Working Compression spring are used to bring the swing arms back to its original position. Seats are 360 Degree rotatable when necessary. Rotation of seat is being achieved by high end engineering plastics which are guided by EN-8 Centre rod connected to seat bottom.	
81	Refugee Area Table 4200x600	2	Supplying And Placing In Position Of Office Desk Table Size: 4200mm(L)X 600mm(D)X 750mm(H). 25mm Thk. Prelaminated Particle Board Tabletop With Pvc Edge Banding. Tabletop Supported On An Understructure Of 18mm Thk Prelaminated Particle Board Side And 18mm Thk Modesty Panel With Pvc Edge Banding.	
82	Refugee Area Table Chair	4	Sku : Medium Back Office Revolving Chair Size - 675mm(W)X 660mm(D)X1110mm(H) With Cushioned Seat And Adjustable Armrest. Back:- Upholstered With Mesh Seat:- Plywood Hot Compressed Upholstered With Fabric. Armrest:- 2d Adjustable With Pu Pad, 1d Handle (Black) With Pu Pad (Black) Mechanisam:-Synchro With Single Locking And Tension Adjustment. Base:- Nylon Base Black Change, Government Of India, Sedex Certified. The Bidder Should Also Be A Member Of Bifma Since Last 18 Years And One Or More Products Of The Oem Should Be Certified As Bifma Complaint As Well As Bifma Level -1(One) Certified And An Official Product Link/Screenshot Of The Product Listing's Must Be Provided From Www.Bifma.Org" In Each Case. Also, The Oem Should Be Zed Gold Certified (Msme Sustainable (Zed) Certification).	

83	Staff & Visitor Dinning Table Size 900x900	16	Supplying And Placing In Position Of 4 Seater Modern Design Meeting Table Material : Prelaminated Particle Board Size : 900mm Lx 900mm Dx 750mm H , Colour : Brown-Classic Walnut / Finish : Laminated. Providing And Supplying Four Seater Modern Design Meeting Table A Combination Of Metal And Wood Make	
84	Staff & Visitor Dinning Chair	112	Sku : Coco Size 381mm(L)X 419mm(D)X 839mm(H) Seat In Pvc Moulded Chair With Ss 202 Grade Frame.3*4 Round Pipe - 16 Gauge With Fitting , Shell Color Black, Stackable Modern Design Cafeteria Chair.	
85	Staff & Visitor Dinning Table Size 2400x900	6	Supplying And Placing In Potision Of 8 Seater Dining Table Size Taken : 2400mm(L) X 900mm(D) X 750mm(H). Tabletop Made Of 25mm Thk Plpb. Tabletop Supported With C Legs Of 50x50 And Connectors 40x40 In Black Powder Coating As Per Reference Image.	
86	Locker	33	Sku : Vault/4/8 760w X 450d X 1855h* Height Mentioned Excluding Leveler Height Of 15mm. Type Of Construction - Complete Knock Down Material Specification Top, Side, Back Made Of 0.6mm Thk. Crca Sheet (Is 513 : Grade - Cr2) Shelves, Bottom & Doors Made Of 0.8mm Thk. Crca Sheet (Is 513 : Grade - Cr2) All Other Components Are Made Of 0.8mm Thk. Crca Sheet (Is 513 : Grade - Cr2) Handle - Plastic Handle Concealed Type Lock Cam Lock With Lever Hanging Arrangement Hanging Arrangement Provided Bracket Made Of Plastic And Hanging Tube Is Made Of Ss Oblong Section. Finish Coated With Epoxy Polyster Powder To Dft 60-80 Microns(+/-5 Micron)	
87	Back Unit For Hod / P.A Medicle Supretendent / Officers	9	Supplying And Placing In Position Of Back Unit Storage Material : Prelaminated Particle Board/Veneer - Mdf/Steam Beech Veneer , Back Unit Size : 1600 Mm (Lx 450 Mm (Dx 750 Mm (H. Colour : Red - Cherry Dark & Finish : Glossy . * Providing & Suppling Placing Position Of Modular Back Unit Top Shall Be Made From 25 Mm Thick Prelaminated Particle Board/Veneer - Mdf/Steam Beech Veneer Of Grade Ii Type Iii	

Note:-

The final furniture shall be approved as per the shop drawing & sample shall be physically approved by the Engineer In charge. Quantity. shall be as per Shop drawings any additional Furniture item required by Client will be in the scope of Turn Key Contractor

4.12. **SCULPTURE/ART WORK**

Turn Key Contractor shall prepare a comprehensive scheme for internal & external artwork as below. Engineer In-charge shall approve the same.
MKCG- EXTERIOR – SCULPTURES

LOCATION – HOSPITAL, DENTAL COLLEGE & PHARMACY COLLEGE

HOSPITAL INSIGHTS:

- OVERALL STYLE: modern/ neutral
- COLOR PALETTE: Blues, Beiges
- NO OF SCULPTURES: 3 (S1, S2, S3)

RECOMMENDATIONS:

- FORMAT: SCULPTURES
- MATERIAL: Stone, Wood, Metal
- COMPOSITION: Structured
- MOOD: Peace / Welcoming / Educational

CONCEPT NOTE: The proposed sculpture installations for M.K.C.G. Medical College & Hospital are envisioned as meaningful landmarks that reflect the institution's legacy of healthcare, education, and service. Rooted in Odisha's cultural heritage, the concepts draw inspiration from local artforms, temple architecture, and symbols of healing, knowledge, and human connection.

Sl. No.	Location		Representative Images	Description
1	S1: NEAR PLAYGROUND & COLLEGE			**OPTION - 1: TREE OF LIFE** This large Tree of Life sculpture symbolizes growth, healing, and knowledge. Inspired by Odisha's cultural heritage, the form incorporates motifs from Pattachitra and the geometric detailing of Konark Sun Temple. Crafted in metal with a brass powder-coated finish, the installation creates a welcoming and culturally rooted landmark at the entrance. **METAL TREE OF LIFE**

				SCULPTURE (Brass Powder Coated)
2	S2/S3: NEAR HOSPITAL BLOCKS		 	**OPTION 2: LOTUS EMERGING FROM WATER** This installation is envisioned as a serene lotus rising from water, symbolizing hope, purity, and recovery—an especially meaningful presence within a hospital environment. The sculpture will feature a partially open lotus form, emerging from a shallow water body or fountain. Material Composition: Stainless steel Natural stone for the base or surrounding edges Integrated fountain system
				**OPTION 3: MAHARAJ KRUSHNA CHANDRA GAJAPATI STATUE** This sculpture installation honors Krushna Chandra Gajapati and his contribution to education, healthcare, and public welfare. Designed for the hospital named after him, the sculpture

				represents leadership, service, and compassion
				**OPTION 4: RISHI SUSHRUTA STATUE** This installation features a statue of Sushruta, regarded as the father of surgery performing surguries, created as a tribute to India's rich medical heritage within a hospital setting.
			 	**OPTION 5: TEMPLE KNOWLEDGE TO MODERN SCIENCE** Inspired by Konark Sun Temple, this sculpture symbolizes the journey from ancient wisdom to modern medicine. An open book represents knowledge and learning, while temple-inspired forms rise into a DNA helix, reflecting science, innovation, and progress. Crafted in metal and stone, the installation becomes a landmark for the academic block. Materially, the

				installation combines: Stone for the base, grounding the sculpture in the materiality of Odisha's temple architecture Stainless steel or bronze for the rising forms and DNA helix, introducing a contemporary contrast and reflecting the precision of modern medicine.

Note: - The location and design of artwork/sculpture shall be approved as per the shop drawing prepared by the specialised agency & approved by the Client/Engineer In-Charge.

MKCG- INTERIOR – ARTWORKS

CORRIDORS – HOSPITAL, DENTAL COLLEGE & PHARMACY COLLEGE

HOSPITAL INSIGHTS:

- OVERALL STYLE: modern/ neutral
- COLOR PALETTE: Warm Neutrals
- DIMENSION OF THE WALL: 10ft x 20-25ft (approx not same for every corridor)
- NO OF CORRIDORS: 43, including college & hospital
- SURROUNDED BY: Waiting Rooms/Patients Wards/Labs/Seminar Halls mainly

RECOMMENDATIONS:

- FORMAT: STATEMENT / CLUSTER
- DIRECTION: Traditional - Odisha Culture
- INTENSITY: Balanced / Subtle
- MOOD: Calm/ Welcoming/ Educational
- COLOR PALETTE: Neutral/ Pop Colour



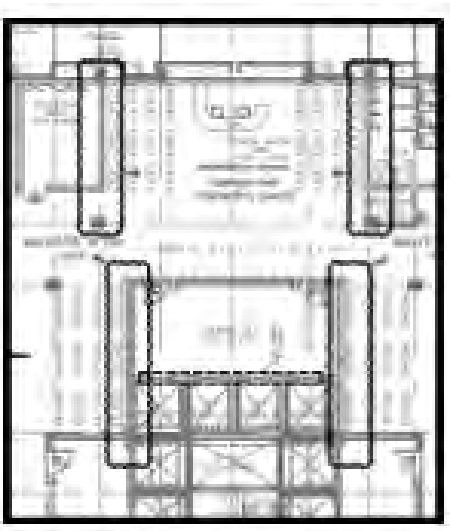


This comprehensive DBR presents a strategic artwork placement plan for MKCG Brahmapur, integrating authentic Odisha art forms, including Pattachitra, Saura Painting, and Tala Pattachitra. The artwork will serve both aesthetic and therapeutic purposes, celebrate local cultural heritage, and provide economic opportunities for local artisans.

LOBBIES, WAITING ROOMS, DINING HALL – HOSPITAL, DENTAL COLLEGE & PHARMACY COLLEGE

HOSPITAL INSIGHTS

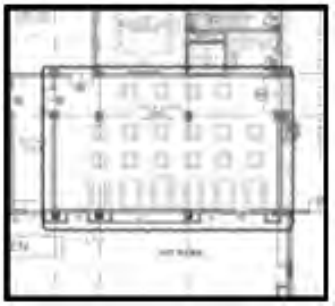
- OVERALL STYLE: modern/ neutral
- COLOR PALATTE: Blues & Warm tones
- NO OF AREAS: 40 including college & hospital
- SURROUNDED BY: Patients Wards/Labs/Chambers/Seminar Halls mainly



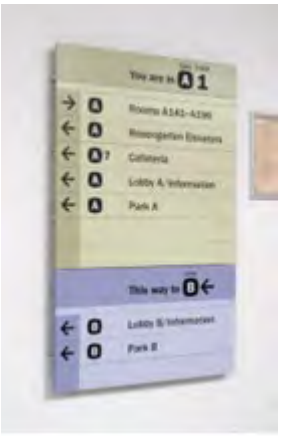
RECOMMENDATIONS:

- FORMAT: STATEMENT / CLUSTER
- DIRECTION: Traditional - Odisha Culture
- INTENSITY: Balanced
- MOOD: Calm/ Welcoming/ Educational
- COLOR PALATTE: Neutral/ Pop Color

The proposed artworks for the waiting rooms, lobbies, and common areas of M.K.C.G. Medical College & Hospital aim to create calming and culturally rooted spaces within the hospital environment. Inspired by Odisha's artistic traditions such as Pattachitra, Tala Pattachitra, Sambalpuri Ikat, and Saura painting, the concepts reinterpret traditional visual languages through contemporary murals, installations, and framed artworks.



Sl. No.	Location	Representative Images	Description
3	ENTRANCE LOOBY/REGISTRATION COUNTERS/ OPD REGISTRATION	 	KONARK RHYTHM Inspired by the architectural language of Konark Sun Temple, this installation reinterprets the temple's rhythmic geometry, circular forms, and carved detailing into a contemporary visual language for the hospital environment. Executed through murals, textured wall panels, or laser-cut installations in earthy stone-inspired tones, the concept creates a calm and immersive spatial experience while bringing Odisha's architectural heritage into a modern healthcare setting at M.K.C.G. Medical College & Hospital.

	OPD LOBBY/WARD CORRIDORS	 	HEALING THROUGH KNOWLEDGE E This installation reimagines the conventional hospital information poster as a culturally immersive and emotionally engaging experience. A culturally rooted information system that combines healthcare awareness with Odisha's artistic identity; Inspired by Pattachitra, Tala Pattachitra, Sambalpuri Ikat, and Saura painting. The panels are designed to educate, guide, and reassure visitors while transforming hospital corridors into thoughtful and visually engaging learning spaces.
	ALL CENTRAL LOBBY		SANSKRITI & SWASTHYA (CULTURE & HEALING) A corridor installation that explores how culture, community, and traditional knowledge contribute to wellbeing and healing. The corridor becomes a cultural journey in which manuscript-inspired drawings, textile geometries,

				tribal rhythms, botanical motifs, and temple-inspired patterns merge into a single visual narrative. Artform Inspirations: Pattachitra, Tala Pattachitra, Sambalpuri Ikat, Saura painting, Odisha temple geometry and carving traditions. Materials: Mixed media panels, framed artworks, textured surfaces, metal detailing, layered prints, and acrylic-mounted graphics, interactive signage.

Note: - The location and design of artwork/sculpture shall be approved as per the shop drawing prepared by a specialised agency & approved by Client/Engineer In-charge

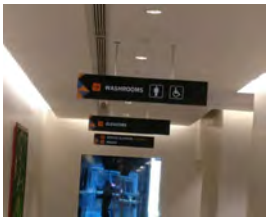
4.13. SIGNAGES:

Sign Name	Products	Product Dimensions (LXHXD)	Mounting Type	Illumination / Media Appearance	Content Type	Reference Images
Building Facade Sign	Channel Letters	1200mm Letters Height	Facade	Illuminated	Identification	

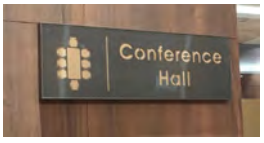
	The signage will consist of individual channel letters with internal LED illumination, designed for visibility and durability. Each letter will have a front face made of 3–5mm acrylic, optionally overlaid with vinyl for colour accuracy, and sides (returns) made of 1–1.5mm powder-coated aluminium. The back panel will be aluminium or translucent acrylic, depending on whether the letters are backlit. Waterproof LED modules (IP65 or higher) will provide illumination, powered by 12V drivers housed in weatherproof enclosures. The letters will be mounted on a mild steel or galvanised iron frame, treated with an anti-rust coating, and anchored to the building using stainless steel fasteners and chemical anchors. The entire setup will be designed with UV-resistant materials for long-term outdoor use. Optional features include photoelectric sensors for auto on/off, surge protection, and maintenance access panels.					
Main Gate Sign (Entry)	Channel Letters	600mm Letters Height	Above Gates	Illuminated	Identification	
	The signage will consist of **individual channel letters** with **internal LED illumination**, designed for visibility and durability. Each letter will have a **front face made of 3–5mm acrylic**, optionally overlaid with vinyl for colour accuracy, and **sides (returns) made of 1–1.5mm powder-coated aluminium**. The back panel will be aluminium or translucent acrylic, depending on whether the letters are backlit. **Waterproof LED modules (IP65 or higher)** will provide illumination, powered by 12V drivers housed in weatherproof enclosures. The letters will be mounted on a **mild steel or galvanised iron frame, treated with an anti-rust coating,** and anchored to the building using **stainless steel fasteners and chemical anchors**. The entire setup will be designed with UV-resistant materials for long-term outdoor use. Optional features include photoelectric sensors for auto on/off, surge protection, and maintenance access panels.					
Entry/Exit Totem	Lino 100mm Profile	900 x 4000 x 100	RCC Foundation	Illuminated	Informative/Way finding	

	Providing and fixing a freestanding totem signage for internal navigation, designed for outdoor use with internal LED illumination. The signage is made of ModSign make Lino 100mm depth double-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060 grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. The signage is internally supported by an anti-rust-treated mild steel frame made from 60mm x 40mm x 4mm tube. The front and back panels are made of 5mm-thick ACP/acrylic sheet, with artworks to be vinyl-printed on them. All electrical components are weatherproof (IP65 or higher), ensuring visibility and reliability in various environmental conditions.					
Internal Navigation Totem	Lino 100mm Profile	450 x 1800 x 100	RCC Foundation	Illuminated	Informative/Wayfinding	
	Providing and fixing a freestanding totem signage for internal navigation, designed for outdoor use with internal LED illumination. The signage is made of ModSign make Lino 100mm depth double-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060 grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. The signage is internally supported by an anti-rust-treated mild steel frame made from 60mm x 40mm x 4mm tube. The front and back panels are made of 5mm-thick ACP/acrylic sheet, with artworks to be vinyl-printed on them. All electrical components are weatherproof (IP65 or higher), ensuring visibility and reliability in various environmental conditions.						

Speed Limit Sign	Lino 25mm profile on Creo Post	Post Size: 1500mm & Frame Size: 300mm x 300mm (h)	RCC Foundation	Retro Reflective	Informative	
	Providing and installing a freestanding post-mounted sign designed for outdoor use. The signage is made of ModSign's Creo 80mm octagonal post and 50mm double-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. The signage consists of a double-sided frame with a 50mm depth, and the frame is to be screw-fitted to an 80mm octagonal aluminium post, internally supported by an anti-rust treated mild steel structure made from 70mm x 40mm x 4mm tube. The artwork is to be vinyl-printed on a 5mm-thick ACP/acrylic sheet and pasted on the frame using a double-sided VHB tape. The signage shall be mounted in an RCC foundation provided by the client.					
Assembly Area Sign	Lino 25mm profile on Creo Post	Post Size: 1500mm & Frame Size: 400mm x 300mm (h)	RCC Foundation	Retro Reflective	Identification	
	Providing and installing a freestanding post-mounted sign designed for outdoor use. The signage is made of ModSign's Creo 80mm octagonal post and 50mm double-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. The signage consists of a double-sided frame with a 50mm depth, to be screw-fitted to an 80mm octagonal aluminium post, internally supported by an anti-					

	rust treated mild steel structure made from 70mm x 40mm x 4mm tube. The artwork is to be vinyl-printed on a 5mm-thick ACP/acrylic sheet and pasted on the frame using double-sided VHB tape. The signage shall be mounted in an RCC foundation provided by the client.					
Entry Sign	Lino 20mm Profile	400 x 200 x 10	Wall/Door	Non-illuminated	Identification	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Wayfinding Large Suspended Sign	Lino 25mm profile	1200 x 300 x 25	Ceiling Suspended	Non-illuminated	Informative/Wayfinding	
	Providing and fixing signs made of ModSign, a Lino 25mm depth double-sided aluminium profile with 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are suspended using a suspension kit at the site, plumb and level, at the specified location, as per the drawing, to the satisfaction of the engineer-in-charge.					

Wayfinding Small Suspended Sign	Lino 25mm profile	900 x 200 x 25	Ceiling Suspended	Non-illuminated	Informative/Wayfinding	
	Providing and fixing signs made of ModSign, a Lino 25mm depth double-sided aluminium profile with 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are suspended using a suspension kit at the site, plumb and level, at the specified location, as per the drawing, to the satisfaction of the engineer-in-charge.					
Building Directory Sign	Creo Flat Panels	(1500 x 3000 x 15) Sizes can vary as per content & requirement	Wall	Non-illuminated	Informative	
	Providing and fixing signs made of ModSign Creo modular aluminium profiles crafted from high-quality 6060 grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. The sign is single-sided, with aluminium side tracks and common click clips for panel fitting. Sign includes all plastic injection-moulded black clips that slide in side tracks; media to be vinyl-printed or flat-bed UV-printed on profiles. Panels to be fitted and installed at site, plumb and level, at the specified location, as per the drawing, to the satisfaction of the engineer-in-charge.					

Floor Directory Sign	Creo Flat Panels	(610 x 1200 x 15) Sizes can vary as per content & requirement	Wall	Non-illuminated	Informative	
	Providing and fixing signs made of ModSign Creo modular aluminium profiles crafted from high-quality 6060 grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. The sign is single-sided, with aluminium side tracks and common click clips for panel fitting. Sign includes all plastic injection-moulded black clips that slide in side tracks; media to be vinyl-printed or flat-bed UV-printed on profiles. Panels to be fitted and installed at site, plumb and level, at the specified location, as per the drawing, to the satisfaction of the engineer-in-charge.					
Wall Directional Sign	Lino 25mm Profile	400 x 200 x 25	Wall	Non-illuminated	Informative	
	Providing and fixing signs made from ModSign's 25mm depth aluminium profile to form a single-sided frame with a 2.5mm front visible border, crafted from high-quality 6060 grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					

Wall Projected Sign	Lino 25mm Profile	300 x 200 x 25	Wall	Non-illuminated	Identification	
	Providing and fixing signs made of ModSign, a Lino 25mm depth double-sided aluminium profile with 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using another male/female wall mounting bracket made from an aluminium profile and fixed using grub screws. The brackets are screw-fitted at site, plumb and level, at the specified location, as per the drawing, to the satisfaction of the engineer-in-charge.					
Room No Sign	Lino 10mm Profile	300 x 150 x 10	Wall/Door	Non-illuminated	Identification	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Toilet Door Sign	Lino 10mm Profile	178 x 178 x 10	Wall/Door	Non-illuminated	Identification	

	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Lift No Sign	Lino 10mm Profile	300 x 150 x 10	Wall	Non-illuminated	Identification	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Vinyl printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Lift Fire Instructions	Lino 10mm Profile	200 x 200 x 10	Wall	Photoluminescent	Mandatory	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Photo-luminescent printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with help of dual lock tape. Signages are wall-mounted at site using countersunk screws,					

	plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Fire Hydrant Cabinet	Lino 10mm Profile	150 x 200 x 10	Wall/Door	Photoluminescent	Mandatory	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Photo-luminescent printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Fire Extinguisher Sign	Lino 10mm Profile	150 x 200 x 10	Wall	Photoluminescent	Mandatory	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Photo-luminescent printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted at site using countersunk screws, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					

Fire Evacuation Plan	Lino 10mm Profile	300 x 400 x 10	Wall	Photoluminescent	Mandatory	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Photo-luminescent printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Fire Evacuation Plan Small	Lino 10mm Profile	200 x 300 x 10	Wall	Photoluminescent	Mandatory	
	Providing and fixing signs made up of ModSign, a Lino 10mm depth single-sided aluminium profile with a 2.5mm front-visible border, crafted from high-quality 6060-grade alloy extrusion that adheres to the EN755-2-2016 European standard, delivering a tensile strength of 190 MPa and a hardness of 70 BHN. This profile is sourced from a virgin aluminium homogeneous billet and finished with premium-grade anodising, boasting a thickness of 15–20 microns for enhanced durability, resistance to wear, UV exposure, and harsh conditions, while maintaining flatness and twist tolerances within 1.5mm per meter. The product is backed by a 10-year warranty under normal working conditions, reflecting its reliability for long-term use. Photo-luminescent printed ACP/acrylic sheet of 3mm thickness to be pasted or mounted with the help of dual lock tape. Signages are wall-mounted using countersunk screws at site, plumb and level, at the specified location as per the drawing, to the satisfaction of the engineer-in-charge.					
Emergency Exit sign	Battery Operated Sign	300 x 150 x 40	Ceiling	Illuminated	Mandatory	

	Providing & fixing at location a ModSign/Eaton make emergency exit sign-illuminated, surface mount (wall or ceiling) Dual sided made up of FR grade plastic material, battery backup of 3 hours (180 mins). Battery life: 300 cycles of charge & discharge for Li-ion battery. Charge time of 24 hours. Input voltage 220-240 Volt A.C, 50/60 Hz. Viewing distance: 30 meters, degree of protection IP20. Sign a 12-month warranty for the electrical circuit & 6 months warranty for the battery. Sign is provided with a triple mounting arrangement: wall-hung, wall-projected, and ceiling-suspended (with a mounting mechanism included with the material). Sign includes all connection wires (upto 1 mtr) & high-tensile-strength zinc-coated self-tapering screws (4 nos with screw wall plastic packing), installed at site in plumb and level at the specified location as per drawing, to the satisfaction of the engineer-in-charge.

4.14. INDOOR AND OUTDOOR SPORTS/GYM EQUIPMENTS:

1.1. GYMNASIUM EQUIPMENTS

S no	Item description
1	**Motorized Treadmill – 7 nos.**
	• Dimension: 90″ (L) X 41″ (W) X 66″ (H).
	• Motor: AC Motor, 4.5 HP Continuous Duty, 8.0 HP Peak Duty.
	• Speed: 1 To 22 Kmph.
	• Power Requirements: 220V AC.
	• Max User Weight: 175 Kgs.
2	**Elliptical Cross Trainer - 3 nos.**
	• Dimension: 88” (L) X 27”(W) X 63”(H)
	• Strides: 20 Inches natural strides.
	• Resistance Level: 40 Levels.
	• Flywheel: 10 kg, precision-balanced.
	• User Weight: 175 Kgs.
3	**Spin Bike – 3 nos.**
	Dimension : 48” (L) x 24”(W) x 52”(H)
	Spin Wheel: 20 kg high-inertia spin wheel.
	Drive System: Centre-drive, Smooth, quiet belt drive mechanism.
	Seat: Horizontally and vertically adjustable saddle with quick release.
	User Weight: 200 Kgs
4	**Lat Pull Down – 2 nos.**
	• Dimensions: 1565 (L) x 1030 (W) x 1455 (H) MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	High tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Guide Rods: 20 mm, chrome-plated solid steel, highly polished for smooth movements.
	• Weight Plate: Cast iron, machine drilled to exact specs and oversized nylon bushings for super smooth operations.
	• Cable: 5.0 mm dia., 2500 lbs rated, mil. spec., nylon-coated steel cable
	• Pulley: 85 mm diameter

	• Metal protective weight enclosures
	• Seat, Pads & Grips: Ergonomic and adjustable design shape meets all user requirements for comfort and stability.
	• Weight Stack: 242 lbs / 110 Kgs.
5	**mid row – 2 nos.**
	• Dimensions: 1565 (L) x 1030 (W) x 1455 (H) MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	High tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Guide Rods: 20 mm, chrome-plated solid steel, highly polished for smooth movements.
	• Weight Plate: Cast iron, machine drilled to exact specs and oversized nylon bushings for super smooth operations.
	• Cable: 5.0 mm dia., 2500 lbs rated, mil. spec., nylon-coated steel cable
	• Pulley: 85 mm diameter
	• Metal protective weight enclosures
	• Seat, Pads & Grips: Ergonomic and adjustable design shape meets all user requirements for comfort and stability.
	• Weight Stack: 242 lbs / 110 Kgs.
6	**functional trainer – 2 nos.**
	Dimensions
	Folded: (In) • Length 48″ • Width 80″ • Height 91″
	Weight Stack
	440 lbs (both sides) / Effective Weight = 220 Lbs / 100 Kgs (Each Side)
	Frame
	High Tensile Strength Steel, Continuously Welded, Factory Assembled Weight Frame.
	Cable
	Heavy-Rated Steel Cable With Nylon Coating.
	Tube
	Round Tubing (Wicket Combination Or Weight Stack Frame) And Oval Tubing (Main Frame).
	Pulley
	Fibre Glass Reinforced Nylon Pulleys With ‘V’ Grooved Channel
7	**Leg curl & ext – 2 nos.**
	• Dimensions: 1565 (L) x 1030 (W) x 1455 (H) MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	High tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Guide Rods: 20 mm, chrome-plated solid steel, highly polished for smooth movements.
	• Weight Plate: Cast iron, machine drilled to exact specs and oversized nylon bushings for super smooth operations.
	• Cable: 5.0 mm dia., 2500 lbs rated, mil. spec., nylon-coated steel cable
	• Pulley: 85 mm diameter
	• Metal protective weight enclosures
	• Seat, Pads & Grips: Ergonomic and adjustable design shape meets all user requirements for comfort and stability.

	• Weight Stack: 242 lbs / 110 Kgs.
8	**Pec Ply – 2 nos.**
	• Dimensions: 1860 (L) x 1310 (W) x 2020 (H) MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	High tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Guide Rods: 20 mm, chrome-plated solid steel, highly polished for smooth movements.
	• Weight Plate: Cast iron, machine drilled to exact specs and oversized nylon bushings for super smooth operations.
	• Cable: 5.0 mm dia., 2500 lbs rated, mil. Spec., nylon-coated steel cable
	• Pulley: 85 mm diameter
	• Metal protective weight enclosures
	• Seat, Pads & Grips: Ergonomic and adjustable design shape meets all user requirements for comfort and stability.
	• Weight Stack: 242 lbs / 110 Kgs.
9	**Smith Machine – 1 nos.**
	• Dimension: 43”(L) X 86”(W) X 91”(H).
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Counterbalance: Zero kg bar with counterbalance for Smith Machine.
	• Adjustable safety stand for squat rack.
	• Open Squat Rack with J Cups Handles to stack weight
	• Cable: 5.0 mm dia., 2500 lbs rated, mil. Spec., nylon-coated steel cable
	• Machine width suitable for an 8-foot Olympic bar for wider space.
	• Pulley: 85 mm diameter
	• Weight Stack: Free Weight.
10	**Leg Press/Hack Slide –2 nos.**
	• Dimensions: 96” (L) x 65” (W) x 58” (H)
	• Tube Gauge: 3.0mm, with rectangular tubing high tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Stack: Free Weight
11	**TPU Plates 28/50 mm** (Per Kg) – 50 set
	Sizes: 2.5 Kgs, 5 Kgs, 7.5 Kgs, 10 Kgs,
	15 Kgs, 20 Kgs, 25 Kgs
12	**TPU H Designed – 50 set**
	Sizes: 2.5 Kg, 5 Kg, 7.5 Kgs, 10 Kg, 12.5 Kg,
	15 Kg,17.5 Kg, 20 Kg, 22.5 Kg, 25 Kg, 30 Kg,
	35 Kg, 40 Kg
13	**Plain Olympic Rod - 50 mm – 5 nos.**
	7 Feet
	Weight Capacity 250 Kg
14	**Plain Olympic Rod - 50 mm – 5 nos.**
	4 Feet
	Weight Capacity 150 Kg
15	**Zig Zag Olympic Rod** - 50 mm – 2 nos.
	4 Feet
16	**Incline Bench – 2 nos.**

	• Dimension : 75"(L) X 65"(W) X 32"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
17	**Decline Bench – 2 nos.**
	• Dimension : 75"(L) X 65"(W) X 32"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
18	**Flat Bench - 1 nos.**
	• Dimension : 75"(L) X 65"(W) X 32"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
19	**Super Bench – 1nos.**
	• Dimension : 64"(L) X 30"(W) X 32"(H).
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Stack: Free Weight.
20	**Multi-Purpose Bench – 2nos.**
	• Dimension : 65"(L) X 45"(W) X 32"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
21	**Flat Bench – 1nos.**
	• Dimension : 88"(L) X 45"(W) X 40"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
	• Weight Stack: Free Weight.
22	**Preacher Curl – 1 nos.**
	• Dimension : 1300"(L) X 800"(W) X 970"(H) MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
23	**Back Extension – 1nos.**
	• Dimension : 65"(L) X 45"(W) X 32"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.
24	Rod Stand
25	Hammer Rod
26	**Decline Bench – 1 nos.**
	• Dimension : 88"(L) X 45"(W) X 40"(H). MM
	• Tube Gauge: 3.0mm, with Capsule tubing
	high tensile steel.
	• Rust Proof: Electro statically powder coated.

	• Weight Stack: Free Weight.
27	Plate Stand
28	Stair Climber
	• Dimension: 58″ (L) x 35″ (W) x 85″ (H).
	• Step area: 10″ (L) x 22″ (W)
	• Maximum speed: 120 steps per minute.
	• Max load weight: 200 kg.
29	Air Rower
	• Air Resistance Technology For Highly Effective Workout Which Targets Every Major Muscle Group.
	• High Strength Nylon Pedal Strap For A Smooth & Quiet Pull.
	• Resistance: 9 Resistance Level.
	• Requires 8 X 3-Ft. Space; 2-Piece Design For Storage.
	• Max. User Weight: 130 Kgs.
30	Gym Mirror (size 7ft X 4ft)
31	Gym Tiles
	Thickness – 10mm

1.2. INDOOR STADIUM EQUIPMENTS

INDOOR AREAS	
1	Multipurpose Sports Hall 01 (Volleyball, basketball & Badminton)
	For Indoor Surfaces Supply and installation of point-elastic sports floor multipurpose synthetic flooring cast-in-situ approved by IHF, BWF, FIBA&FIVB of required thickness as per the design and drawings
2	Multipurpose Hall 02 - Table Game
	For Indoor Surfaces Supply and installation of Point elastic sports floor multipurpose synthetic flooring cast-in-situ approved by IHF, BWF, FIBA&FIVB of required thickness as per the design and drawings
3	Gymnasium
	For Indoor Surfaces Supply and installation of point-elastic sports floor multipurpose synthetic flooring cast-in-situ approved by IHF, BWF, FIBA&FIVB of required thickness as per the design and drawings
4	Yoga & Meditation
	For Indoor Surfaces Supply and installation of point-elastic sports floor multipurpose synthetic flooring cast-in-situ approved by IHF, BWF, FIBA&FIVB of required thickness as per the design and drawings
5	Multipurpose room at 1St floor
	For Indoor Surfaces Supply and installation of Point elastic sports floor multipurpose synthetic flooring cast-in-situ approved by IHF, BWF, FIBA&FIVB of required thickness as per the design and drawings

1.3. FOOTBALL GROUND

SL.NO	METHODOLOGY
1	Earth work:
1.1	Banking excavated earth in layers not exceeding 20 cm in depth, breaking clods, watering, rolling. each layer with ½ tonne roller, or wooden or steel rammers, and rolling every 3rd and top-most layer with power roller of minimum 8 tonnes and dressing up, in embankments for roads, flood banks, marginal banks, and guide banks etc., lead up to 50 m and lift to 1.5 m: All kinds of soil
1.2	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m: All Kinds of Soil.
1.3	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : All kinds of soil : Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia.
1.4	Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth up to 30 cm measured at a height of 1 m above ground level and removal of rubbish up to a distance of 50 m outside the periphery of the area cleared.
1.5	Supplying and stacking at site : good earth
2	CONCRETE WORK
2.1	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:2:4 (1 cement : 2 coarse sand (zone-III) : 4 graded stone aggregate 20 mm nominal size).
2.2	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III) : 6 graded stone aggregate 20 mm nominal size)
3	REINFORCED CONCRETE WORK
3.1	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level : 1:1.5:3 (1 cement : 1.5 coarse sand (zone-III): 3 graded stone aggregate 20 mm nominal size)
3.2	Centering and shuttering including strutting, propping etc. and removal of form for all heights :
3.2 A	Foundations, footings, bases of columns, etc. for mass concrete
3.2 B	Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.
3.3	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. : Thermo-Mechanically Treated bars of grade Fe- 500D or more.
4	STEEL WORK - Fencing work
4.1	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required : In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works

4.2	Providing and fixing G.I. chain link fabric fencing of required width in mesh size 50x50 mm including strengthening with 2 mm dia wire or nuts, bolts and washers as required complete as per the direction of Engineer-in-charge. Made of G.I. wire of dia 4 mm
4.3	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade : Two or more coats on new work
5	BRICK WORK
5.1	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in: Cement mortar 1:4 (1 cement : 4 coarse sand)
6	FINISHING
6.1	Cement plaster 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement : 12 mm cement plaster
6.2	Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade :
6.2A	New work (two or more coats) over and including water thinnable priming coat with cement primer
6.3	Finishing walls with Acrylic Smooth exterior paint of required shade : New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)
7	ROAD WORK
7.1	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth with lead upto 50 metres.
7.2	Supplying and stacking of good earth at site including royalty and carriage all leads & lifts complete.
7.3	Providing and laying 60mm thick factory made cement concrete interlocking paver block of M - 30 grade made by block making machine with strong vibratory compaction, of approved s;ze, design & shape, laid in required colour and pattern over and including 50mm thick compacted bed of coarse sand, filling the joints with line sand etc. all complete as per the direction of Engineering- charge.
8	DRAINAGE WORK
8.1	Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete : 300 mm dia. R.C.C. Pipe
9.1	Supply and laying RCC drain cover of size 600 x 600 x 60 mm with 8mm rods @ 100mmc/c over the walls of drain at proper level for ease flow of water
9.2	Construction of Brick masonary Water collection chamber to connect the water outlets of ground (0.9x0.9x2)m
9.3	Providing and laying perforated ISI mark PVC pipe (10 kg/cm2) , including end cap & jointing , as per direction of Engineer-in-charge : 150mm ID
9.4	Providing and laying of polypropylene fibers Geotextile separation barrier of 140/150 GSM, as per the standard procedure, complete as required.
9.5	Supplying, laying and compacting of gradedstone aggregate 40mm nominal size to form a contour and elevation to the desired level.-100mm thick compacted layer
9.6	Supplying, laying and compacting of gradedstone aggregate 20mm nominal size to form a contour and elevation to the desired level.-100mm thick compacted layer

9.7	Supplying, laying and compacting of gradedstone aggregate 10mm with stone dust nominal size specification to form a contour and elevation to the desired level. - 75mm thick compacted layer
9.8	Supply and installation of grassing with selection no. 1 doob grass including watering and Maintenance of the lawn for 30 days or more till the grass forms a thick Lawn, free from weeds and fit for mowing including supplying good earth, If needed.
9.1	Supply of Ball roll ramp equipment.

1.4. CRICKET GROUND AND PITCH

CRICKET GROUND – NATURAL GRASS WORK (LOCAL GROUND & PRACTICE PITCH STANDARD)

1. Supply of Farm Yard Manure (FYM)

Supply at site well-decomposed farm yard manure from approved sources, screened through 4.75 mm IS sieve, including transportation, stacking, handling, and all incidental works complete as directed by the Engineer-in-Charge.

2. Spreading of Farm Yard Manure

Spreading of screened farm yard manure uniformly over the ground in the required thickness as directed, complete in all respects.

3. Mixing of Soil and Farm Yard Manure

Mixing of existing soil with farm yard manure in the specified proportion through manual or mechanical means, including breaking clods and preparing a homogeneous growing medium suitable for turf development.

4. Fine Dressing of Ground

Fine grading, dressing, leveling, removal of stones, debris, vegetation, and undulations to obtain a smooth and uniform playing surface complete in all respects.

5. Supply and Planting of Grass

Supply and planting of approved natural turf grass (Doob Grass/Cynodon dactylon or equivalent approved variety) including ploughing, harrowing, breaking of clods, removal of rubbish, fine grading, planting at 100 mm spacing, watering, maintenance during establishment period, and all incidental works complete.

6. Earth Filling and Ground Formation

Excavating, supplying, transporting, spreading, watering, and compacting selected local earth, including royalty, complete in layers not exceeding 200 mm thickness to achieve the required formation level and slopes as per approved drawings.

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7. CRICKET PITCH CONSTRUCTION

(a) Preparation of Pitch Area

Excavation and preparation of cricket pitch area of approximately 30.0 m length and 3.05 m width, including removal of unsuitable soil and preparation of subgrade complete.

(b) Supply and Filling of Approved Soil

Supplying and filling approved cricket pitch clay soil/black cotton soil and selected earth from approved sources, including stacking at site.

(c) Carriage of Soil

Transportation of approved clay soil and earth by mechanical means including loading, unloading, stacking, and handling complete.

(d) Sand Layer

Supplying and laying coarse sand layer of required thickness below pitch formation including watering, compaction, consolidation, and dressing complete.

(e) Manual Compaction

Extra for manual compaction by hand rammer and roller in layers not exceeding 250 mm thickness, including watering and dressing complete.

(f) Surface Dressing

Surface dressing of pitch area including removal of vegetation, leveling, disposal of surplus material, and preparation of surface for clay laying complete.

(g) Skilled Labour for Pitch Preparation

Providing skilled labour for drying, breaking, spreading, shaping, laying, watering, rolling, and compacting clay soil to obtain proper cricket pitch dimensions, levels, hardness, and playing characteristics as approved by the Engineer-in-Charge.

8. SPRINKLER SYSTEM

8.1 Piping Network

Providing, laying, jointing, testing, and commissioning HDPE pipes conforming to IS 4984/4985 complete with fittings, couplings, tees, bends, reducers, adapters, excavation, laying, refilling, and testing complete.

(a) HDPE Pipe 110 mm OD, PN-6

(b) HDPE Pipe 90 mm OD, PN-6

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9. SPRINKLERS & ACCESSORIES

(a) Providing and fixing medium-radius pop-up sprinklers suitable for sports turf irrigation with operating pressure of 2–4 bar and throw radius of 10–15 m complete.

(b) Pop-up sprinkler connecting assembly complete.

(c) Providing and fixing 1" Brass Quick Coupling Valve (QCV) complete with auto-closing rubber cover and stainless-steel spring.

(d) Providing and fixing 1" Brass QCV Key with handle and outlet.

(e) Providing and fixing Brass swivel elbow complete.

(f) Providing and fixing metallic service saddle complete.

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10. VALVES & ACCESSORIES

(a) Providing and fixing Butterfly Valve, 100 mm dia, complete with rubber lining and operating lever.

(b) Providing and fixing rectangular valve box with cover made of UV-stabilized high-density polyethylene.

(c) Providing and fixing circular valve box with cover made of UV-stabilized high-density polyethylene.

(d) Providing and fixing pressure relief valve complete with bypass arrangement and fittings.

(e) Providing and fixing double-acting air release valve complete with accessories.

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11. FILTRATION UNIT

(a) Providing and fixing Disc Filter, 120 mesh, suitable for irrigation system, complete with inlet, outlet, flushing arrangement, and accessories.

(b) Providing and fixing glycerine-filled pressure gauge complete.

(c) Providing and fixing MS header assembly with protective coating including foot valve and accessories complete.

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12. PUMPING UNIT

(a) Providing and fixing centrifugal pump capable of delivering approximately 20–25 m^3/hr discharge at 30–40 m head, complete with base frame, mechanical seal, coupling, suction and delivery piping.

(b) Providing and fixing 10–15 HP, 3-phase TEFC motor suitable for above pump.

(c) Providing and fixing control panel with starter, ammeter, voltmeter, overload protection, MCB, and all necessary electrical accessories complete.

(d) Providing and fixing constant voltage transformer for controller operation.

(e) Providing and fixing water level sensor complete.

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13. UNDERGROUND WATER STORAGE TANK & PUMP ROOM

Providing and constructing RCC underground water storage tank of required capacity (minimum 50 KL to 75 KL) including excavation, PCC, RCC walls, slab, waterproofing treatment, backfilling, manhole cover, MS ladder, pump room, disposal of surplus earth, and all incidental works complete as per approved design and direction of Engineer-in-Charge.

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14. CRICKET PRACTICE NET / BOUNDARY NET

Supplying and fixing UV-stabilized nylon netting of approved mesh size and thickness complete with GI support poles, foundations, tensioning arrangements, fixing accessories, and all incidental works complete.

Recommended Design Parameters

Item	Specification
Ground Type	Institutional / Community Cricket Ground
Grass Type	Doob Grass / Bermuda Grass
Pitch Length	30.0 m
Pitch Width	3.05 m
Pitch Soil	Clay Soil / Black Cotton Soil
Pitch Thickness	150–200 mm Compacted
Irrigation Type	Semi-Automatic Sprinkler System
Pump Capacity	20–25 m^3/hr
Water Storage Tank	50–75 KL
Boundary / Practice Net Height	4–6 m
HDPE Pipe Class	PN-6

This specification is suitable for institutional campuses, educational institutes, medical colleges, residential townships, district-level sports grounds, and community cricket facilities.

5.0. LANDSCAPE

The Landscape Masterplan of MKCG has been envisioned as a well-integrated hospital within the existing campus, intended to create a comfortable external environment and soften the impact of the surrounding built structures.

Landscape Design Guidelines have been established in the form of a Tender Design Document. These guidelines facilitate the development of a cohesive, consistent and efficient landscape and Controlling key design parameters to achieve the desired vision and ensuring a strong integration Of the proposed design into its existing context.

1. OBJECTIVES:

The key objectives of the proposed landscape concept are as follows:

a) To create ease of access and discipline in movement for all users, such as patients, workers, and other visitors.

b) To encourage flexible multi-use spaces to maximise the utilisation of outdoor spaces, a limited resource available for creating a green environment.
c) To create a clean, green and sustainable environment by using modern techniques and materials to overcome the constraints of the site.
d) To design and apply accepted landscape and sustainable best management practices to achieve a visually appealing, experiential and easy to maintain landscape.

2. OPEN SPACES:

Landscape open spaces available on the site include:

- Fringe open space along the peripheral existing road.
- Open pockets at the entrances of the building.
- Spaces between the building and the internal road, at instances placed above the basement slab.
- Open-to-sky courtyards, inside the building.
- Parking areas

3. DESIGN GUIDELINES:

Detailed designs for the above-mentioned areas should be developed based on the following guidelines and supporting drawings.

a) Fringe open space along the peripheral existing road

The periphery of the site along the main road should be treated as an opportunity to develop a green belt with native and flowering trees. The site boundary should be demarcated by sturdy, evergreen, and flowering hedges to avoid the built aspect of the compound wall, and by understorey vegetation of flowering shrubs to be planted to create an experiential and appealing landscape.

b) Open pockets at the entrances of the building.

Open space in front of the main entry of the buildings should be treated as a focal area, along with the assembly area when the situation arises. These areas should be highlighted with appropriate sculpture and a backdrop of shrub plantings. Level differences in open space should be addressed with sloping lawns or sloping planting beds, with ground covers arranged in a pattern. The plant composition of colourful shrubs should be used for aesthetic appeal.

c) Spaces between the building and the internal road

These spaces are placed over the basement slab. The landscape here should be developed for patients, visitors, and workers as breakout and overflow spaces. These areas should include seating areas, connecting pathways, a maintenance pathway, and vegetative patches.

When over the basement slab, appropriate waterproofing and drainage technologies should be used to create planting areas above the slab.

Minimum 1X1X1 m tree wells to be created to plant trees. Being close to the building, it is suggested to plant medium-height trees or Palm trees in the tree wells.

To plant shrubs, edges, and ground covers, min. 45-60 cm deep planters to be created. Ground covers and edgings should be used to create a colourful plant arrangement.

Appropriate waterproofing should be done over the basement slab, followed by a drainage layer of screed for slopes, and plastic 35-60 mm drain cells & pipes, and a filtration layer of geotextile to prevent wash of planting soil. The last layer of planting medium should be well-prepared planting soil.

d) Open to sky courtyards, inside the building.

Courtyards inside the buildings should be treated as multipurpose spaces, largely used as extensions of waiting areas to cater to large numbers of people. These areas should also be used for education and information purposes, with talks, small seminars, and exhibitions to be held for patients and workers.

Courtyards are proposed to be landscaped with potted plants, prefabricated benches, and interesting paving patterns to create an organised space for a variety of purposes.

e) Parking areas

Parking areas are large paved areas; hence, they are proposed to have pervious surfaces, such as grass pavers, to avoid heat accumulation. This will also allow water to percolate into the subsoil.

4. HARDSCAPES:

Landscape in this site includes the following types of hardscape:

- Pathways along the main roads-

These areas cater to large public movement on the campus; hence, durable, strong, and easy-to-maintain paving with concrete paver blocks and precast PCC curbs is proposed. Alternative material can be stamped concrete with pigment and suitable patterns.

- Pathways and paved areas inside the site along the internal roads cater to patient and visitor movement; hence, pavement with green crate tiles and interlocking tiles are proposed.
- Maintenance pathways can be finished with low-cost, easy-to-maintain materials like Kota stone.
- Tree wells, planters, and seats should be finished with a material that is aesthetically appealing, easy to clean, and that does not develop moss due to water, with colour choices to create a pleasing outdoor space. Polished granite coping with designer cement tiles for cladding is proposed.
- The courtyard is proposed to have a flamed granite finish for its strength, durability, and anti-skid properties, with a minimum of two colours for the paving pattern. A raised platform, separated for display, etc., is proposed to have grass-joint paving with polished red sandstone.

5. IRRIGATION, SURFACE DRAINAGE and OUTDOOR LIGHTING

- Appropriate provisions for mechanical irrigation to be done.
- Appropriate provisions for surface drainage in landscape areas through catch basins, grassed swales or drain channels for collection, storage/ discharge of water to be done.
- Appropriate and efficient outdoor lighting design for roads & walkways, green areas, Entry & exits, parking areas and other suitable locations, to be done as per approving authority. Suitable pole-mount garden lights, bollards, and uplighter lights for focus should be used.
- Suitable signage to be used at appropriate locations in the landscape areas.

6. VEGETATION

Plant material should be selected based on its suitability to the climate, purpose, and design theme. Following is the guideline and suggestive list:

Trees:

- Roadside trees should be native species, with a combination of flowering plants in different seasons, and evergreen and deciduous medium-height trees.
- Trees in the tree wells are suggested to include palm trees or small-canopy flowering trees.
- Tree-planting areas should have trees suitable for creating urban forestry, bird-friendly, and shade-giving.

Shrubs:

- Hardy, drought-resistant, easy-to-maintain, perennial, flowering, with different textural qualities and suitable for different light conditions, shrubs should be used in outdoor planting.
- Potted plants for the courtyard should have shrubs that can tolerate low light levels.
- Different foliage colours, sizes and flowering shrubs should be used to create plant compositions.
- Plants that are toxic should be avoided to create a clean, safe environment for patients.

Hedges and Borders:

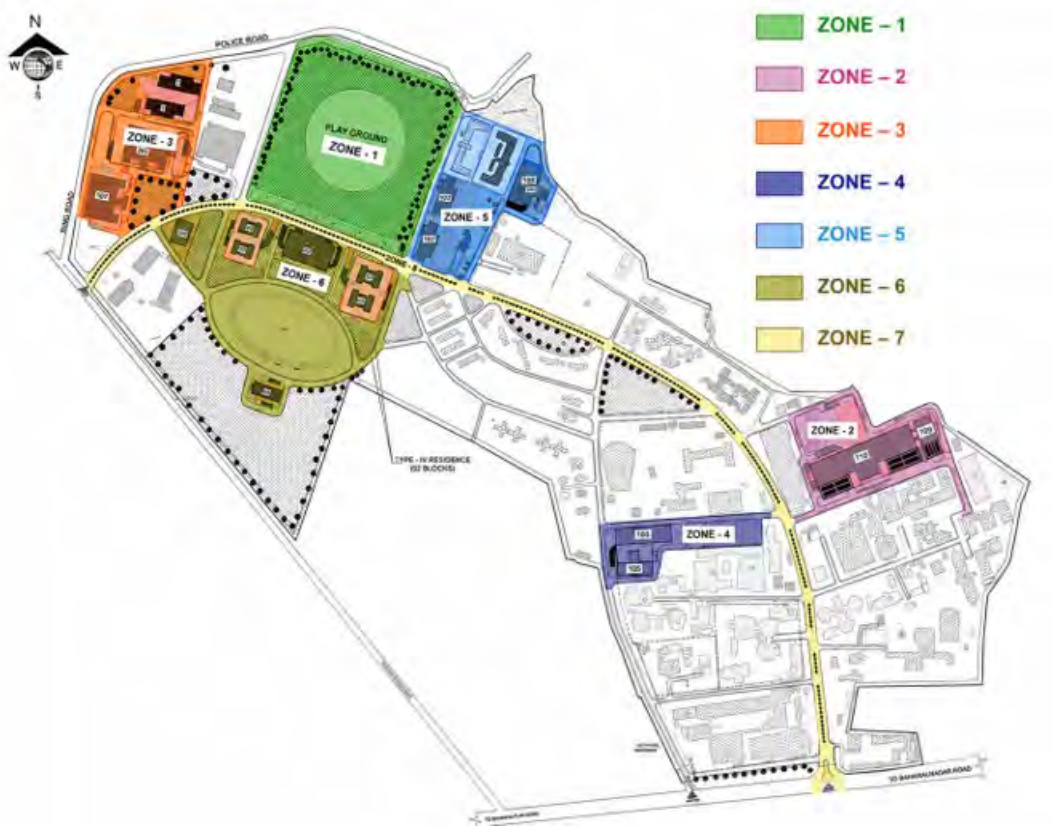
- Hedges of drought-resistant, strong, sturdy, flowering, and perennial shrubs should be created. Thorny shrubs should be avoided for hedges and borders. Edging and borders should be composed of small herbaceous or woody plants, adding colour and flowers to the landscape.

Lawns and Ground Covers

- Hardy, low-maintenance grasses such as American blue selection 1, Saint Augustine, and Korean carpet should be used to create lawns.
- Perennial ground covers with controlled growth and flowering, easy to maintain, should be used in the planters for a green, colourful cover.

*Note: only native trees which are low on maintenance will be provided.

13.7 LANDSCAPE ZONES



13.7.1 ZONE DETAIL

ZONE 1 – PLAYGROUND ZONE

The Playground Zone is conceived as the primary recreational and sports landscape of the Medical College Campus. The landscape is designed to accommodate active sports, outdoor events, physical training, and student interaction while ensuring thermal comfort through strategic peripheral plantings. The design philosophy is to retain a large uninterrupted playfield while developing a shaded recreational edge around the sports infrastructure.

Given Odisha's hot, humid climate, tree planting is concentrated along the perimeter to create

microclimatic cooling without obstructing sports activities. The landscape also acts as a visual buffer between the playground and adjoining institutional buildings.

The central portion of the zone is retained as an open multipurpose sports field capable of accommodating cricket, football, athletics, and ceremonial events with the spectator stands.

Two spectator stands, each with a capacity of 150 persons, are proposed to support sporting events and institutional gatherings.

Large canopy trees such as Neem, Kadamba, Peltophorum, and Amaltas are proposed along the outer edge of the playground to provide shade and reduce heat gain. Flowering species such as Tabebuia Rosea and Lagerstroemia Speciosa introduce seasonal colour and strengthen the campus's visual identity.

Table 1: Soft Landscape

Category	**Landscape Element**	**Quantity**
Trees	Neem (Azadirachta indica)	12 Nos.
Trees	Kadamba (Anthocephalus cadamba)	10 Nos.
Trees	Amaltas (Cassia fistula)	8 Nos.
Trees	Peltophorum	8 Nos.
Trees	Tabebuia Rosea	8 Nos.
Trees	Lagerstroemia speciosa	4 Nos.
Palm	Royal Palm	6 Nos.
Shrubs	Duranta Gold	50 Nos.
Shrubs	Chandani	40 Nos.
Shrubs	Hibiscus Rosa Sinensis	40 Nos.
Shrubs	Areca Palm	40 Nos.
Shrubs	Tecoma Stans	30 Nos.
Ground Cover	Wedelia Trilobata	As per site plan
Ground Cover	Dianella Variegata	As site plan
Lawn	Broad leaf lawn grass	As site plan

Table 2: Hard Landscape

Category	Landscape Element	Material	Quantity	Remarks
Hardscape	Multipurpose Sports Ground	Synthetic/Natural Turf	1 No.	
Hardscape	Spectator Stand (150 Capacity)	RCC + Precast Seating	2 Nos.	
Hardscape	Jogging Track	EPDM Rubber	As per site plan	
Street Furniture	Seating Benches	Cast Iron + WPC	20 Nos.	
Street Furniture	Drinking Water Stations	SS304	2 Nos.	
Street Furniture	Waste Bins	SS304	12 Nos.	
Lighting	Sports Lighting Poles	GI High Mast + LED Floodlights	25 Nos.	

ZONE 2 – HOSPITAL ZONE

The Hospital area Landscape is designed as a healing environment that supports patient recovery, mental well-being, visitor comfort, and staff productivity. The landscape extends the healthcare experience beyond the building envelope by integrating nature into everyday user interaction.

The design adopts internationally accepted healing landscape principles while responding to local

climatic conditions and cultural context.
The landscape is organised into a hierarchy of outdoor spaces, including entrance forecourts, patient waiting gardens, therapeutic courtyards, healing gardens, shaded seating plazas, and reflection spaces.
The landscape is intentionally open and visually permeable to ensure safety, visibility, and ease of navigation.
Planting focuses on species with calming visual characteristics, fragrant flowers, seasonal flowering cycles, and low maintenance requirements. Plumeria, Bauhinia, Tabebuia, and Lagerstroemia create a soothing environment suitable for healthcare settings.
The planting design avoids excessive tree density and instead emphasises courtyards, lawn panels, and ornamental planting.

Table 1: Soft Landscape

Category	Landscape Element	Quantity
Trees	Plumeria Alba	8 Nos.
Trees	Plumeria Rubra	8 Nos.
Trees	Neem (Azadirachta indica)	8 Nos.
Trees	Tabebuia Rosea	6 Nos.
Trees	Cassia Fistula (Amaltas)	6 Nos.
Trees	Bauhinia Purpurea	6 Nos.
Trees	Lagerstroemia Speciosa	4 Nos.
Trees	Tabebuia Argentea	4 Nos.
Palm	Royal Palm	12 Nos.
Palm	Bismarck Palm	4 Nos.
Shrubs	Areca Palm	80 Nos.
Shrubs	Chandani	120 Nos.
Shrubs	Croton	100 Nos.
Shrubs	Cordyline	80 Nos.
Shrubs	Aglaonema	80 Nos.
Shrubs	Spathiphyllum	60 Nos.
Shrubs	Jasmine	40 Nos.
Ground Cover	Syngonium Butterfly	As site plan
Ground Cover	Dianella Variegata	As site plan
Ground Cover	Wedelia Trilobata	As site plan
Lawn	Broad leaf lawn grass	As site plan

Table 2: Hard Landscape

Category	Landscape Element	Material	Quantity	Remarks
Hardscape	Healing Garden	Natural Stone Paving + Seating	2 Nos.	
Hardscape	Sensory Garden	Textured Paving + Therapeutic Planting	1 No.	
Hardscape	Courtyard Gardens	Concrete Pavers + Granite Edging	4 Nos.	
Hardscape	Medicinal Garden	Natural Stone + Herbal	1 No.	

		Plantation		
Hardscape	Water Feature Court	Granite + RCC + Water Feature	1 No.	

ZONE 3 – ACADEMIC ZONE

The Academic Zone is envisioned as an outdoor extension of the educational environment. The landscape fosters interaction, collaboration, outdoor learning, and social engagement among students, faculty, and researchers. The landscape framework creates a network of shaded plazas and pedestrian corridors connecting the academic buildings.

The central academic plaza functions as the primary gathering space. Secondary courts and outdoor classrooms are distributed throughout the landscape to encourage informal learning.

The pedestrian environment is prioritised over vehicular movement.

Tree-lined walkways and flowering avenues create visual continuity across the academic precinct. Species are selected to provide seasonal variation, shade, and low maintenance.

Table 1: Soft Landscape

Category	Landscape Element	Quantity
Trees	Tabebuia Rosea	15 Nos.
Trees	Peltophorum	15 Nos.
Trees	Kadamba	10 Nos.
Trees	Silver Oak	8 Nos.
Trees	Amaltas	8 Nos.
Trees	Bauhinia Blakeana	4 Nos.
Palm	Royal Palm	10 Nos.
Shrubs	Areca Palm	70 Nos.
Shrubs	Croton	80 Nos.
Shrubs	Chandani	70 Nos.
Shrubs	Hibiscus Snowflake	60 Nos.
Shrubs	Tecoma Stans	70 Nos.
Ground Cover	Wedelia Trilobata	As site plan
Ground Cover	Dianella Variegata	As site plan
Ground Cover	Syngonium Butterfly	As site plan
Lawn	Broad leaf lawn grass	As site plan

Table 2: Hard Landscape

Category	Landscape Element	Material	Quantity	Remarks
Hardscape	Fountain Court	Granite + Water Feature	1 No.	
Hardscape	Student Interaction Plaza	Concrete Pavers + Seating	2 Nos.	
Structure	Pergola Seating Area	MS + WPC/Wood	3 Nos.	
Street Furniture	Seating Benches	Cast Iron + WPC	10 Nos.	
Street Furniture	Bicycle Parking	MS Powder Coated	3 Nos.	
Street Furniture	Waste Bins	SS304	15 Nos.	
Signage	Academic Wayfinding Signage	ACP + Aluminium	8 Nos.	
Lighting	Decorative Garden Lights	Powder-coated Aluminium	35 Nos.	

ZONE 4 – HOSTEL ZONE

Zone 4 is envisioned as an active student-centric landscape that supports recreation, social interaction, physical wellness, and informal outdoor activities. The landscape extends the hostel environment, offering students opportunities to relax, gather, exercise, and engage in community activities beyond academic hours.

The design focuses on creating comfortable, shaded outdoor spaces that remain functional year-round, despite Odisha's hot summers and heavy monsoon rains. Large canopy trees are strategically positioned around the periphery and along pedestrian pathways to create shaded movement corridors and reduce ambient temperatures.

The landscape is organised around a central open lawn that functions as a flexible activity space for hostel residents. Courtyard gardens are developed between hostel blocks to encourage interaction and provide visual relief from built structures. Semi-shaded seating areas and pavilions are incorporated to support informal gatherings and outdoor study sessions.

A dedicated recreational zone, comprising a volleyball court and an outdoor fitness corner, is integrated into the landscape to promote healthy lifestyles and active living among students.

Native and adaptive tree species including Neem, Kadamba, Karanj, Amla, and Sheesham are proposed to create a dense shade canopy and enhance biodiversity. Shrub plantations consisting of Chandani, Hibiscus, Croton, and Tecoma are used around courtyards and seating areas to provide colour and visual interest throughout the year.

Table 1: Soft Landscape

Category	Landscape Element	Quantity
Trees	Neem (Azadirachta indica)	10 Nos.
Trees	Karanj (Pongamia pinnata)	8 Nos.
Trees	Kadamba (Anthocephalus cadamba)	8 Nos.
Trees	Amla (Phyllanthus emblica)	7 Nos.
Trees	Sheesham (Dalbergia sissoo)	7 Nos.
Palm	Fish Tail Palm (Caryota urens)	8 Nos.
Shrubs	Chandani (Tabernaemontana)	60 Nos.
Shrubs	Hibiscus Rosa Sinensis	50 Nos.
Shrubs	Croton (Codiaeum variegatum)	50 Nos.
Shrubs	Tecoma Stans	40 Nos.
Shrubs	Areca Palm	50 Nos.
Lawn	Broad leaf lawn grass	As site plan

Table 2: Hard Landscape

Category	Landscape Element	Material	Quantity	Remarks
Hardscape	Courtyard Gardens	Concrete Pavers + Granite Edging	2 Nos.	
Hardscape	Volleyball Court	Synthetic Sports Flooring	1 No.	
Hardscape	Outdoor Fitness Corner	EPDM Rubber Flooring	1 No.	
Structure	Pavilion / Gazebo	MS Structure + WPC/Wood Finish	2 Nos.	

Street Furniture	Seating Benches	Cast Iron + WPC	20 Nos.	
Street Furniture	Waste Bins	SS304 / Powder-coated MS	8 Nos.	
Lighting	Garden Lights	Powder-coated Aluminium	20 Nos.	

ZONE 5 – HOSTEL ZONE

Zone 5 is designed as a quieter residential landscape supporting passive recreation, reading, relaxation, and mental well-being. The landscape provides students with a peaceful environment away from the active recreational spaces, allowing opportunities for individual study, contemplation, and informal social interaction.

The zone is structured around a central reading garden and meditation lawn surrounded by shaded seating courts. The landscape incorporates smaller gathering nodes that encourage interaction while maintaining a calm and comfortable atmosphere.

The overall character is softer and more contemplative than Zone 4, emphasizing greenery, shade, and visual comfort.

Shade trees such as Neem, Kadamba, Karanj, and Amla are arranged along circulation routes and around gathering spaces. Fragrant shrubs including Chandani and Jasmine are proposed near reading gardens and seating courts to enhance sensory experience.

Groundcovers and lawn areas create visually connected green spaces throughout the hostel precinct.

Table 1: Soft Landscape

Category	Landscape Element	Quantity
Trees	Neem (Azadirachta indica)	10 Nos.
Trees	Karanj (Pongamia pinnata)	8 Nos.
Trees	Kadamba (Anthocephalus cadamba)	8 Nos.
Trees	Amla (Phyllanthus emblica)	7 Nos.
Trees	Sheesham (Dalbergia sissoo)	7 Nos.
Palm	Fish Tail Palm (Caryota urens)	8 Nos.
Shrubs	Chandani (Tabernaemontana)	70 Nos.
Shrubs	Jasmine (Jasminum sambac)	50 Nos.
Shrubs	Croton (Codiaeum variegatum)	50 Nos.
Shrubs	Areca Palm	40 Nos.
Shrubs	Tecoma Stans	40 Nos.
Lawn	Broad leaf lawn grass	As site plan

Table 2: Hard Landscape

Category	Landscape Element	Material	Quantity	Remarks
Hardscape	Reading Garden	Concrete Pavers + Softscape	1 No.	
Hardscape	Meditation Lawn	Natural Lawn + Stone Paving	1 No.	
Structure	Pavilion / Gazebo	MS Structure + WPC/Wood Finish	2 Nos.	

Street Furniture	Seating Benches	Cast Iron + WPC	20 Nos.	
Street Furniture	Waste Bins	SS304 / Powder-Coated MS	8 Nos.	
Lighting	Garden Lights	Powder-Coated Aluminium	20 Nos.	

ZONE 6 – RESIDENTIAL ZONE

The Residential Zone is envisioned as a family-oriented landscape supporting faculty and staff housing. The landscape promotes social interaction, recreation, health, and community engagement while creating a comfortable, nature-integrated living environment.

The landscape framework aims to establish a neighbourhood character through parks, walking trails, play areas, and community gathering spaces.

A hierarchy of open spaces is proposed, consisting of community parks, children's play areas, senior citizen gardens, and passive recreation lawns. Pedestrian pathways connect residential clusters with common amenities while shaded green corridors enhance walkability and comfort.

The landscape encourages outdoor activity and community interaction while maintaining a safe and secure residential environment.

Large shade trees including Neem, Karanj, Kadamba, Amla, and Peltophorum provide canopy cover throughout the residential precinct. Flowering species such as Amaltas and Tabebuia are introduced at key locations to provide seasonal interest and strengthen the neighbourhood's visual identity.

Shrub planting and lawn areas are used extensively around parks and residential courtyards.

Table 1: Soft Landscape

Category	Landscape Element	Quantity
Trees	Neem (Azadirachta indica)	15 Nos.
Trees	Karanj (Pongamia pinnata)	12 Nos.
Trees	Kadamba (Anthocephalus cadamba)	10 Nos.
Trees	Amla (Phyllanthus emblica)	8 Nos.
Trees	Sheesham (Dalbergia sissoo)	8 Nos.
Trees	Peltophorum	7 Nos.
Palm	Royal Palm (Roystonea regia)	6 Nos.
Palm	Fish Tail Palm (Caryota urens)	4 Nos.
Shrubs	Chandani	120 Nos.
Shrubs	Hibiscus	80 Nos.
Shrubs	Croton	100 Nos.
Shrubs	Tecoma Stans	80 Nos.
Shrubs	Areca Palm	70 Nos.
Lawn	Broad leaf lawn grass	As site plan
Hedge	Duranta + Kamini Hedge	As site plan

Table 2: Hard Landscape

Category	Landscape Element	Material	Quantity	Remarks
Hardscape	Community Park	Concrete Pavers + Granite Kerb	2 Nos.	

Hardscape	Children's Play Area	EPDM Rubber Flooring	2 Nos.	multi-play stations, fiberglass slides, swing sets, seesaws, and climbing frames
Hardscape	Rain Garden	Natural Stone + Pebbles	2 Nos.	
Hardscape	Median Landscape	Concrete Kerb + Plantation	As site plan	
Street Furniture	Seating Nodes	Precast Concrete / Cast Iron + WPC	10 Nos.	
Street Furniture	Bollards	Powder-Coated MS / SS304	100 Nos.	
Signage	Directional Signage	ACP + Aluminium + Vinyl	20 Nos.	
Signage	Signage Towers	MS Frame + ACP Cladding	6 Nos.	
Lighting	Decorative Street Lights	GI Pole + LED Luminaire	80 Nos.	

ZONE 7 – CENTRAL ROAD

The Central Road Landscape Spine functions as the primary organising element of the campus landscape framework. It establishes the institution's visual identity and creates a strong sense of arrival through grand avenue plantings, landscaped medians, and ceremonial landscape features.
This corridor serves as the main connector between the hospital, academic, hostel, residential, and recreational precincts, while providing a coherent, unified landscape character throughout the campus.

The design adopts a boulevard character with double-row avenue plantation, landscaped medians, pedestrian walkways, and strategically placed focal elements. Continuous tree planting creates a shaded movement corridor and significantly improves pedestrian comfort.
Rain gardens and bioswales are incorporated along selected stretches to support sustainable stormwater management and groundwater recharge.
Neem, Tabebuia Rosea, Peltophorum, Kadamba, Amaltas, and Tabebuia Argentea are used as the primary avenue plantation species. Royal Palm and Bismarck Palm are introduced at major intersections, gateways, and roundabouts to create visual landmarks.
Duranta and Kamini hedges provide edge definition and visual continuity throughout the corridor.

Table 1: Soft Landscape

Category	Landscape Element	Quantity
Trees	Neem (Azadirachta indica)	25 Nos.
Trees	Tabebuia Rosea	20 Nos.
Trees	Peltophorum	20 Nos.
Trees	Amaltas	15 Nos.
Trees	Kadamba	10 Nos.

Trees	Tabebuia Argentea	10 Nos.
Palm	Royal Palm	20 Nos.
Palm	Bismarck Palm	10 Nos.
Shrubs	Duranta Gold	400 Nos.
Shrubs	Kamini	300 Nos.
Shrubs	Chandani	100 Nos.
Ground Cover	Wedelia Trilobata	As site plan
Ground Cover	Dianella Variegata	As site plan
Hedge	Duranta + Kamini Hedge	As site plan

Table 2: Hard Landscape

Category	**Landscape Element**	**Material**	**Quantity**	**Remarks**
Hardscape	Median Landscape	RCC Kerb + Topsoil + Plantation	As site plan	Trees and plants as suggested above.
Street Furniture	Seating Nodes	Precast Concrete / Cast Iron + WPC	10 Nos.	
Street Furniture	Bollards	SS304 / Powder-Coated MS	100 Nos.	
Signage	Directional Signage	ACP + Aluminium + Reflective Vinyl	20 Nos.	
Signage	Signage Towers	MS Frame + ACP Cladding	6 Nos.	
Lighting	Decorative Street Lights	GI Octagonal Pole + LED Luminaire	80 Nos.	

5.1. ROAD

The indicative master plan is enclosed in the drawing package. The width of the road and its length, including the footpath and stormwater drainage, are marked there.
The Turnkey contractor shall design accordingly to the minimum technical requirements as mentioned in the technical specification.

5.2. OUTDOOR SPORTS FIELD

The indicative master plan is enclosed in the drawing package. the sports activities like cricket ground & pitch, spectator stand – 2nos., basket ball court, volleyball court, football court.

The Turnkey contractor shall design accordingly to the minimum technical requirements as mentioned in the technical specification.

5.3. Contractor's Scope of Work

1.1. Tender Design Document

Tender Design is a document of design guidelines that outlines the site master planning concepts and landscape design intent across the site.

Gui delines for landscape design are covered under the Tender Design Document. It is supported

by plans, details, and schedules that provide design details for all landscape components, including hardscape, softscape, site furniture, signage, and lighting. The detailed design to be developed by the Turnkey contractor shall consider and comply with all sections of the Tender Design Document, including Planting Overview, Plant Selection, Setting up a Nursery, Soil Mix, and Irrigation.
The Tender Design Document characterises the site into 'Character Zones', each defined by a unique character, thereby creating a sense of place and establishing an inherent system of wayfinding within the development. The Tender Design Document provides design information, including location, size, colour, texture, material, etc. Refer to Tender Design Document for the design requirements for all landscape components outlined in the following sections.

Additional documents (outlining landscape design criteria and requirements) to be read in conjunction with the Tender Design Document include:

(a) Concept Landscape Plans
(b) Schedule of Finishes
(c) Tender Drawing Package
(d) Landscape Details Design

Applying the design principles outlined in the above documents and illustrated through Landscape Concept Drawings provided in the Employer's Requirements, the Turnkey contractor must develop the Detailed Design Drawings which, on approval, shall be followed by Good for Construction Drawings which, on approval, may then be executed on site. While developing the complete and final designs and specifications, the Turnkey contractor shall review the concept design and planning to identify improvements that may be incorporated to achieve the Employer's goals and objectives better. These betterments, if any, shall be submitted by the Turnkey contractor to the Engineer for review and approval, only upon which the same shall be deemed fit for execution. Key deliverables by the Turnkey contractor will include the following stages:

- Detailed Design Stage: General Arrangement Plans (including Layout, Materials, Site Furniture, Play equipment, etc.
- Levels and Grading Plan
- Site Sections
- Material/Lighting/Furniture Schedules
- Hardscape Details (including feature structures)
- Lighting Plan and Details
- Tree and Shrub Plan including species names and numbers
- Planting Schedule
- Planting and Soil Details
- Irrigation Layouts and Details
- Hard Landscape Specification; Softscape Specifications Good for Construction Stage

(d) Execution

The on-site execution scope of work comprises full, final and entire installation and completion of landscape works (inclusive of hardscape, softscape, site furniture, exterior signage and lighting) and associated landscape services (levelling, drainage, irrigation, etc.) based on the detailed design developed by the Turnkey Contractor and handing over of the same in full accordance with the Employer's requirements. The base-wide landscape works common across all building typologies within the site include the following, but are not limited to:

(e) Hardscape

- Road (with footpath and stormwater drain, road marking, kerb stone)

- Kerbs (Road drain kerbs, drop kerbs, pin kerbs, flush kerbs)

- Paving

- Decks / Hardstands

- Gravel courts

- Drainage

- Outdoor structure i.e. gazebos, pergolas etc.
- Sports Court

- Parking

- Softscape

o Tree planting
o Shrub / Groundcover planting
o Lawns/mounds
o Drainage
o Irrigation system

Site Furniture (Minimum numbers to be provided as per Tender Drawing)

- Seating

- Rubbish bins

- Bollards

- Shade structures (pergolas, tensile fabric structures, etc.)

- Railings, Screens, Fences

- Tree guards & Tree grates

(a) Pergolas
(a) Gateway Markers
(b) Directional Signage
(c) Pedestrian Map point
(d) Information Panels
(e) Building Markers
(f) Pathway Markers

- Exterior Lighting

(a) High Mast poles

(b) Street Light poles (single arm / double arm)

(c) Pedestrian Light poles

(d) Parking Light poles

(e) Outdoor sports lights

(f) Landscape Lights (bollards, spike lights, step lights etc.)

The design criteria for these items have been described and detailed in the Tender Design Document, Design Intent, Landscape Schedule of Finishes, and the provisions of the Contract. All items under this section, together with the overall scope of work for the Residential package, must be covered to complete the project successfully.

7. FAÇADE LIGHTING- SCOPE OF WORK

1. Introduction & Scope

This establishes the design basis for the architectural facade lighting installation to the Hospital Block, Pharmacy College Block and Dental College Block of the MKCG Medical College & Hospital campus, Brahmapur, Odisha.

The intent of the facade lighting scheme is twofold:
(a) to accentuate the architectural composition of all three buildings after dark — the central glazed entrance spine, the perforated GRC/aluminium jali screens, the red-oxide masonry bands and the roof-level cornice / canopy line — using a warm, static architectural wash for everyday operation;
(b) to provide the facility with a colour-changing RGBW DMX lighting capability so that each building envelope can be illuminated in the tricolour of the National Flag (saffron–white–green) on days of national importance such as Republic Day, Independence Day and other Government-notified occasions.
This document should be read together with the architectural elevation and floor plan drawings and the lighting & lighting-automation DBR, from which all products referenced herein are drawn.

1.1 Buildings Covered

- Hospital Block (“MKCG HOSPITAL”) — Basement + Ground + 10 upper floors, terrace level +48,500mm; central full-height glazed entrance portal flanked by symmetrical wings finished in red-oxide and beige bands with aluminium perforated jali screens; ground floor OPD entrance canopy.
- Pharmacy College Block — Ground + 5 upper floors with a projecting central entrance bay (glazed atrium with vertical fins), flanking wings clad in GRC jali screen panels, and a colonnaded entrance canopy signed “PHARMACY COLLEGE”.
- Dental College Block — Ground + multiple upper floors, with a central projecting entrance block rising above two flanking wings; the central bay carries a full-height glazed vertical spine capped by a white cantilevered roof canopy with raking struts, the flanking wings are clad in diamond-pattern perforated jali screens, and the ground floor entrance carries a columned canopy signed “DENTAL COLLEGE”.

1.2 Objectives

- Reinforce the architectural identity and civic presence of the hospital, pharmacy college and dental college at night.
- Provide uniform, glare-controlled general facade illumination for way-finding, security and campus ambience.

- Provide an RGBW, DMX-512/Ethernet-addressable lighting layer capable of full-building tricolour display for national days, synchronised across all three blocks.
- Ensure all fixtures meet outdoor durability requirements — minimum IP65, appropriate impact (IK) rating, CE and BIS certified, LM-79/LM-80 tested.

2. Architectural Facade Analysis

- All three buildings share a common architectural vocabulary developed by DDF Consultants, which conveniently divides the facade into five lighting zones. This zoning is used consistently across the Hospital, Pharmacy College and Dental College blocks and forms the basis of the fixture selection in Section 3.



Fig. 1 — MKCG Hospital Block



Fig. 2 — Pharmacy College Block



Fig. 3 — Dental College Block

- The Dental College Block follows the same three-part composition as the Hospital and Pharmacy College blocks — a taller, projecting central entrance bay flanked by two lower wings — but with two variations relevant to the lighting design: the flanking wings carry a diamond-pattern (rather than linear) perforated jali screen, and the central bay is capped by a white cantilevered roof canopy with exposed raking struts in place of a zinc-panel cornice. Both variations are treated identically to the Hospital/Pharmacy blocks in the zoning below (Zone C and Zone E respectively), since the lighting technique — grazing texture-light and linear roofline graze — applies equally to either finish.

2.1 Facade Lighting Zones

Zone	Architectural Element	Description
A	Entrance portal & signage	Full-height red-oxide portal frame, building name signage panel and canopy at main OPD / college entrance
B	Central glazed spine / atrium fins	Full-height curtain glazing with vertical structural fins rising through the central bay
C	Jali screen wings	Perforated aluminium / GRC jali cladding panels on the flanking wings — linear pattern at Hospital & Pharmacy College, diamond pattern at Dental College
D	Podium, base & landscape	Ground-floor red-oxide podium band, colonnade, entrance plaza, palm avenue and planters
E	Parapet / cornice / roof canopy line	Projecting terrace cornice finished in zinc panel (Hospital & Pharmacy College) or a white cantilevered canopy with raking struts (Dental College); in both cases forming the building's roof-line silhouette

- Reference elevation (Hospital Block) is reproduced below, spanning zones E (top, cornice) through D (base, podium).



Fig. 4 — Hospital front elevation, Drg. No. MKCGB-DDF-B01-ARC-ELE-1110

3. Lighting Concept & Zone-wise Product Application

- All colour-changing fixtures are drawn from the RGBW, DMX/Ethernet-controllable items in the supplied BOQ (Item Nos. 37, 38, 39 & 40), each capable of 16-million colour mixing so that a consistent saffron / white / green tricolour — as well as a warm-white daily architectural scene — can be produced from the same fixture population. The zone-wise application below is common to the Hospital, Pharmacy College and Dental College blocks; only fixture quantities and spacing vary per building footprint. Static-white fixtures from the BOQ are retained for landscape, security and general amenity lighting outside the tricolour envelope (paths, bollards, tree up-lights, canopy soffits).

Zone	Lighting Technique	Product (BOQ Item)	Mounting
A	Narrow-beam column wash + signage outline highlight	Item 38 — 36–150W RGBW DMX floodlight (narrow beam) + Item 40 — 20W/m RGBW LED flex to signage border	Ground-recessed / concealed behind fascia
B	Wide flood wall-wash up the full-height glazed spine	Item 37 — 72–150W RGBW DMX floodlight (wide beam)	Ground-mounted at base of atrium, aimed upward
C	Grazing up-light across jali screen texture, medium beam	Item 37 / 38 — RGBW DMX floodlight, medium beam, spaced per bay	Podium ledge / recessed ground fixture at wing base
D	General amenity & landscape lighting (kept static white)	Item 1/12 post-top luminaires, Item 7/14 bollards, Item 27/29 in-ground up-lights (palm avenue)	Pole / bollard / in-ground
E	Continuous linear graze along cornice / zinc panel roofline	Item 39 — Linear 40–200W RGBW DMX luminaire	Recessed in terrace parapet upstand, continuous run

3.1 Design Notes

- Zones B, C and E form the primary “tricolour canvas” — glazed spine, jali wings and roofline — reading as one unbroken vertical composition and giving the strongest tricolour silhouette from the approach road.
- Zone A (entrance) is an accent to the building identity signage, kept slightly warmer / brighter than the wings in daily white mode.
- Beam angle (12°/25°/40°/60° options) to be confirmed at mock-up stage against actual throw distance, to avoid hot-spotting on upper floors of the 10-storey hospital block.
- Fixture spacing on Zones B & C to give at least 30% cone overlap, preventing visible banding across

the jali pattern.

- At Dental College, Zone A fixtures aimed up the entrance bay should be positioned clear of the white canopy's raking struts so the struts are not thrown into silhouette shadow across the glazed spine above.

Note — Other Elements: Any building element identified for illumination outside the five zones described above (e.g. a boundary wall, gate, signage totem, water tank, helipad edge or any other future facade feature) shall be lit using only a product selected from **Annexure A — Lighting & Lighting Automation Product Schedule**, which lists the complete range of BOQ-approved fixtures (RGBW DMX, static-white, pole-mounted, indoor and automation items). No fixture outside this schedule shall be introduced without a formal design addendum, to preserve product consistency, spares commonality and warranty compliance across the campus.

Lights should be selected based on their suitability to the climate, purpose, and design theme. Following is the guideline and suggestive list:

- Linear Wall Washer LED 3000K, 4000K, 6000K 24Vdc CRI >80 MacAdam step 3 Input power: 24W Dimension: 1000 x 35 x 78 mm Beam angle: 30° Electronic driver ON/ OFF, Surface Mounted luminaire. IP rating: IP65, Extruded aluminum alloy housing (grade 6063). Toughened clear glass diffuser. SS fasteners. Mechanical resistance IK06. Aluminium mounting bracket for surface mounting on ground. Toughened Clear glass diffuser and optics to control glare. This luminaire contains built-in LED modules. LED modules are engineered in accordance with the existing Lumen Maintenance (LM80) and Technical Memorandum (TM21) regulations, with a Lifespan of the luminaire > 60,000 hours at 40°C. The operating ambient temperature range is -15°C to +50°C. Driver efficiency >85%, power factor >0.90, Surge protection 3KV. CE and BIS.



- Static White 3000K 25W In-ground with built-in honeycomb louvre symmetrical luminaire. The front ring should be made of stainless steel grade 316, with a black silicone gasket and a toughened clear glass diffuser. CCT 3000K BEAM - 15°/25°/40. The ingress protection is IP67, and the impact resistance is IK09. The luminaire is integrated with a high-power CITIZEN COB with CRI≥80, SDCM≤3, L70/B10 @ 60000 Hrs. The integral constant-current driver features a power factor of 0.9

or greater, total harmonic distortion of less than 15%, an operating efficiency of greater than 80%, and surge protection of 2 kV. The driver input voltage is 240Vac at 50-60Hz, operating voltage of 100-277Vac and operating temperature of -20˚ ~ +40˚C.An adequate heat sink with proper thermal management shall be provided—operating Humidity: 10%-90%. THD should be less than 10%. The fixtures proposed must have passed LM 79 & LM-80. Reports from the NABL laboratory will be submitted post-issuance of the LOA to the successful bidder and before the supply of materials. CE & BIS Certified.



- Static White 3000K surface-mounted compact spotlight designed to provide directional light. Beam angle 15°/ 25°/ 40°. Luminaire made of pressure die-cast aluminium alloy of high corrosion resistance and non-corrosive A2 stainless steel fasteners. Clear toughened glass, 4mm thick. Hybrid optics with lens & mirror finish, pure aluminium reflector combination for higher efficiency, lower optical losses, and optimum glare suppression. Power consumption should be between 25W. A steady-state full-intensity luminaire should have a minimum luminous flux of 2225 lm. Colour rendering index CRI ≥ 80 and power factor of complete luminaire ≥ 0.90, at white colour. Swivel range of 0° - 90°. Single cable entrance M10 cable gland. Protection class IP65—mechanical resistance IK06. Pure polyester powder-coated graphite grey/ anthracite grey/ jet black. Available colour temperatures: 3000K/4000K. Colour rendering index (CRI):>80. SDCM-3 MacAdam. LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single-phase AC supply. Luminaire dimension: 101mm length x 64mm width x 93mm height. Adequate heat sink with proper thermal management shall be provided. Operating Temperature: -10°C to +50°C, Operating Humidity: 10%-90%. THD should be less than 10%. The fixtures proposed must have passed LM 79 & LM-80. Reports from the NABL laboratory will be submitted post-issuance of the LOA to the successful bidder and before the supply of materials. CE & BIS Certified.



- LED 3000K, 4000K, 5700K 230-240Vac CRI >80 MacAdam step 3 Input power : 6W

Dimension: 150 x 90 x 43mm. Facade. IP rating: IP65. MATERIAL CHARACTERISTICS: Die-cast aluminium housing (grade ADC12 with test certificate). SS fasteners. Pre-treated silicone gaskets. Die-cast aluminium mounting plate with pure polyester powder coating. Mechanical resistance IK08.Pure polyester powder-coated process: Acid treatment & pure polyester powder coating.LIGHTING PERFORMANCE: Optical grade clear polycarbonate lens. Lamp fixed position.**SILL**

This luminaire contains built-in LED modules. LED modules are engineered in accordance with the existing Lumen Maintenance (LM80) and Technical Memorandum (TM21) regulations, with a Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >70%, power factor >0.95, THD <10%, Surge protection 2.5KV. CE and BIS

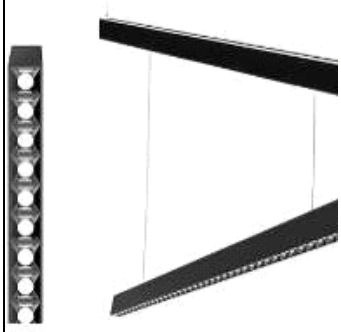
Note: Lighting design to be done by a specialised agency or firm (to be approved by the Employer), not by the OEM.

1. Summary of IGBC Green Healthcare Rating Feasibility:-

Requirement / Credit	Max Points Available	Notes
Minimum Fresh Air Ventilation	**Mandatory**	**Meet ASHRAE 170-2013 ventilation rates by space type**
Tobacco Smoke Control	**Mandatory**	**No-smoking policy + signage within 100m of entrance**
Healing Architecture — Day-lit Spaces	2	50-75% patient areas at 110 lux daylight
Healing Architecture — Connectivity to Nature	2	25% patient areas with vision glazing sightlines
Healing Architecture — Green Open Spaces	2	20-30% site area as native/adaptive green open space
Healing Architecture — Patient-centric Healing Spaces	2	Healing garden, min 250 sq.m, near in-patient wards
Healing Architecture — Colour Psychology	2	Evidence-based colour scheme in min 2 design elements
Acoustical Design	3	BNL & RT compliance per Indian Health Facility Guidelines
Ergonomics	2	Furniture dimensions + circulation % per space type
Stress Relieving Spaces	2	Physical fitness + mental relaxation spaces for staff
Low-Emitting Materials	4	Low-VOC paints/adhesives, certified carpets, urea-formaldehyde-free composite wood.
Building Flushout, During Construction & Before Occupancy	1	IAQ management plan during construction
Air Quality Monitoring & Testing, After Occupancy	1	Continuous IEQ monitoring with public display
Subtotal (credits only, excl. mandatory)	**23**	
Municipal Solid Waste Management, Post-occupancy	**Mandatory**	**Segregated dry/wet waste bins, floor + centralised level**
Bio-medical Waste Management, Floor & Centralised Level	**Mandatory**	**As per BMW (Management & Handling) Rules 2016**
Infection Control within the Spaces	5	Filtration (MERV), pressurisation, purification, antibacterial surfaces, entryway systems
Isolation Room Design	2	10% of IP beds as Class-S isolation + filtration/pressurisation
Sanitation Facilities	1	Washroom counts per NBC Part 9 / IPHS guidelines
Eco-friendly Cleaning Practices	2	Green Seal GS-37 chemicals + CDC cleaning protocol
Automated Solid Waste Management System	2	Optional — high capex, pneumatic waste collection
Organic Waste Management	2	On-site treatment of 50-75% kitchen/landscape waste
Subtotal (credits only, excl. mandatory)	**14**	
Ozone Depleting Substances	**Mandatory**	**CFC-free refrigerants + Halon-free fire suppression**
Minimum Energy Efficiency	**Mandatory**	**ECBC 2008 / ASHRAE 90.1-2013 compliance (simulation or prescriptive)**
Commissioning Plan for Building Equipment & Systems	**Mandatory**	**Third-party Commissioning Authority (min. 3 yrs experience)**
Eco-friendly Refrigerants	1	LCGWP+LCODPx10^5 < 13
Enhanced Energy Efficiency	12	Energy cost savings over ASHRAE 90.1-2013 base case (targeting ~22-24% savings)
On-site Renewable Energy	5	Solar PV — targeting 2% of annual consumption (rooftop area permitting)
Off-site Renewable Energy	2	Optional — PPA/RECs, cost & availability dependent
Commissioning, Post-installation of Equipment & Systems	1	CxA observations/report post-installation
Energy Metering & Management	2	Sub-metering + BMS-based energy management

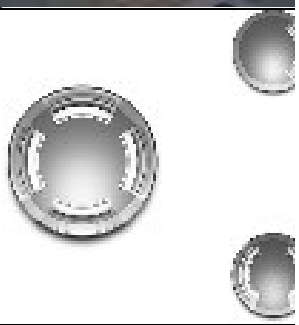
Subtotal (credits only, excl. mandatory)	**23**	
Rainwater Harvesting, Roof & Non-roof	**Mandatory**	**Recharge/storage system for roof & site runoff**
Water Efficient Plumbing Fixtures	**Mandatory**	**Low-flow fixtures baseline compliance**
Rainwater Harvesting, Roof & Non-roof	3	Enhanced capture/recharge above mandatory baseline
Water Efficient Plumbing Fixtures	5	Enhanced flow-rate reduction across all fixtures
Landscape Design	2	Native/adaptive, low-water-demand species
Management of Irrigation Systems	1	Drip/sprinkler with moisture sensors, treated water use
Waste Water Treatment and Reuse	3	On-site STP + reuse for flushing/HVAC/landscape
Water Metering	1	Sub-metering of major water uses
Subtotal (credits only, excl. mandatory)	**15**	
Handling of Waste Materials, During Construction	**Mandatory**	**C&D waste segregation & diversion from landfill**
Sustainable Building Materials	3	Recycled content, regional materials, rapidly renewable materials
Certified Green Building Materials, Products & Equipment	5	IGBC GreenPro / third-party certified products
Eco-friendly Furniture and Medical Furnishing	1	Low-emission, certified furniture & furnishings — relevant to the Non-Medical Furniture Matrix
Subtotal (credits only, excl. mandatory)	**9**	
Local Building Regulations and Safety Compliance	**Mandatory**	**Local development control regulations, fire NOC, etc.**
Soil Erosion Control	**Mandatory**	**Erosion & sedimentation control during construction**
Integrated Design Process	1	Multi-disciplinary charrettes at design stages
Passive Architecture	2	Building orientation, shading, massing strategies
Value Added Services	1	E.g. telemedicine, patient amenities per IGBC list
Proximity to Public Transport	1	Site-dependent — verify proximity to transit node
Low-emitting Vehicles	1	EV charging infrastructure / preferred parking
Heat Island Reduction, Non-roof	1	High-SRI paving / shaded hardscape
Heat Island Reduction, Roof	1	High-SRI roofing / green roof
Outdoor Light Pollution Reduction	1	Compliant fixture cutoff & lighting zones
Universal Design	1	Accessibility for differently-abled per Indian Health Facility Guidelines
Basic Facilities for Construction Workforce	1	Site welfare facilities during construction
Subtotal (credits only, excl. mandatory)	**11**	
Innovation in Design Process (up to 4 credits)	4	Exemplary performance / innovative strategies not otherwise covered
IGBC Accredited Professional (IGBC AP)	1	IGBC AP on project design team from design stage
Subtotal (credits only, excl. mandatory)	**5**	
TOTAL AVAILABLE CREDIT	**100**	
RECOMMENDED TARGET SCORE FOR GOLD RATING	**75**	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
1	Supply, installation, testing and commissioning of recessed type LED downlighter (DALI/On- Off) with pressure die-cast aluminium housing and polycarbonate diffuser, suitable for neutral white light (4000K). The luminaire shall have a minimum system lumen output of 2070 lumens with an efficacy of 115 lumens per watt or higher. The fixture shall have a rated life of L70 at 50,000 burning hours, UGR less than 16, IP40,inbuilt surge protection up to 2 kV, power factor greater than 0.95, THD less than 5%, and CRI greater than 80.	
2	Supply, installation, testing and commissioning of recessed-mounted (DALI/On-Off), office- compliant modular LED panel light of size 600mm x 600mm, constructed with CRCA housing and equipped with deep inset pyramid optics arranged in modules to ensure low glare performance. The luminaire shall have a minimum system efficacy of 125 lumens per watt (system level), minimum lumen output of 4000 lumens, and maximum wattage of 32W. The fixture shall provide uniform illumination with balanced vertical and horizontal brightness distribution. It shall have a rated life of 50,000 hours (L70B50), CCT of 4000K, CRI ≥80, power factor ≥0.95, and THD less than 10% at full load. The luminaire shall operate within a voltage range of 140–270V and include internal surge protection of 3 kV. The product shall have SDCM less than 5 and UGR less than 16, ensuring visual comfort and consistent color performance.	
3	Supply, installation, testing and commissioning of LED surface-mounted batten light with width >50mm conforming to IS:10322 with a replaceable driver. The luminaire shall operate on AC 140–270V, 50/60 Hz, with driver efficiency greater than 85% and operating temperature range of -15°C to 40°C. The fitting shall have internal surge protection of 2.5 kV along with short and open circuit protection. The system shall have THD less than 10%, power factor ≥0.95, CRI ≥80, and flicker less than 5%. The luminaire shall have a minimum life of 50,000 hours (L70), CCT of 4000K with SDCM less than 3, and comply with BIS standards. The housing shall be powder-coated die-cast or extruded aluminium with proper thermal management ensuring LED junction temperature does not exceed 90°C. The system efficacy shall be minimum 105 lumens per watt and less than 120 lumens per watt. LM79 and LM80 test reports shall be submitted, and the product shall be backed by a minimum 5-year OEM warranty.	
4	Supply of recess mounted circular downlighter (DALI/On-Off) Graphite grey powder coated aluminum die-cast aluminium housing with white power coated aluminium frame non- integral down lights for soft down lighting. PC diffuser for better light output. Mid power LEDs connected in series and parallel combination with better heat dissipation arrangement. Highly efficient driver provided with open and short circuit protection. SS spring loaded clips provided for easy installation.. fixture should have minimum system lumen of 1500lm & minimum efficacy at System level >=100lumens/ watt, Life of fixture : 50K Hrs. @ L70B50 Lumen maintenance, CCT up to 5700 CRI >80, THD <10%@ 240v ac. An operating Voltage Range of 140 - 270 V. Minimum Internal Surge Protection 3kv, IP 20. BIS certification is required for LED Driver & Luminaire, Luminaire manufacture shall provide LM79 report from in house NABL accredited lab & LM80 report issued by LED manufacturer.	
5	Supply of Surface mounted circular downlighter (DALI/On-Off) White powder coated pressure die-cast aluminium housing fixed in spun aluminium housing, suitable for surface mounting. Specially designed imported opal acrylic diffuser.High power LED chips mounted on MCPCB, pasted on housing. LED Driver installed on housing and prewired upto the terminal block. fixture should have minimum system lumen of 1200lm & minimum efficacy at System level >=100lumens/ watt, Life of fixture : 50K Hrs. @ L70B50 Lumen maintenance, CCT up to 4000 CRI >80, THD <10%@ 240v ac. An operating Voltage Range of 140 - 270 V. Minimum Internal Surge Protection 3kv, IP 40. BIS certification is required for LED Driver & Luminaire, Luminaire manufacture shall provide LM79 report from in house NABL accredited lab & LM80 report issued by LED manufacturer.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
6	Supply of LED bulkhead sufrace and wall mounted with Graphite grey (RAL7024) powder coated pressure die-cast aluminium alloy. Diffused polycarbonate held with a silicon gasket. PCB mounted LEDs are fixed on pressure Die-cast aluminium housing. Inbuilt constant current non-isolated driver. The luminaire is complete with all accessories wired up-to a terminal block. PG7 Cable entry provided to ensure better ingress protection. fixture should have minimum system lumen of 800lm & minimum efficacy at System level >=80lumens/ watt, Life of fixture : 50K Hrs. @ L70B50 Lumen maintenance, CCT up to 5700 CRI >80, THD <10%@ 240v ac. An operating Voltage Range of 140 - 270 V. Minimum Internal Surge Protection 3kv, IP 65. BIS certification is required for LED Driver & Luminaire, Luminaire manufacture shall provide LM79 report from in house NABL accredited lab & LM80 report issued by LED manufacturer.	
7	Supply of On/off or DALI Linear Suspended/Surface line n dot LED luminaire with system power [30-40W], should be available in 3000K/4000K/6000K color temperature, should be made up of High-Grade Aluminium with Die-cast Endcaps, Diffuser/Lens Material : Polycarbonate, Secondary : Hexa-Cell (Matt Black), UGR<16, dali dimmable driver operational voltage range of 90-265V, power factor > 0.9, THD < 10%, Inbuilt surge protection of 3 KV, Luminaire has Ingress protection of IP44. The luminaire should have minimum lumen output of 78lm/W, CRI of >80 . The LEDs used have a life of 50000 burning hrs Lumen maintenance as per L70B10 with SDCM<=3 binning Luminaire performance & Safety :IEC 60598, IS 10322-5, IS 161-03/05/06/07, Surge : IEC 61000-4-5, IES, LM 79, LM 80, & TTC certificates will be provided from NABL accredited lab. Certification: CE Certified, Design Patented/Registered, ROHS compliant, BIS Certification for Luminaires & Drivers .	
8	Round 60W Post top luminaire LED 3000K, 4000K, 5700K 230-240Vac CRI >80 MacAdam step 3 Dimension: Ø600 x 443 mm, Light Distribution 360° Electronic driver ON/ OFF IP rating IP65. Should be made from Spun aluminum top cover Ø600 x 1.6mm thickness & LED fixing bottom cover. Mild steel rectangle hot dip galvanized supporting arm integrated with Mild steel hot dip pipe Ø102 x 240mm height. Diffuser placed into the provision formed on the pheriphery of the bottom cover. Base should be made from Pressure die cast aluminum (grade ADC12 with test certificate) suitable for Ø60mm OD pipe. SS fasteners. Pure polyester powder coated process: Acid treatment & pure polyester powder coating. Translucent acrylic diffuser of 1.8mm thickness with controlled downward light emission. Lamp fixed position. This luminaire should contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C, Minimum delivered luminous efficacy should be 85lm/w @ 4000K. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10% Surge protection 6kV. CE and BIS.	

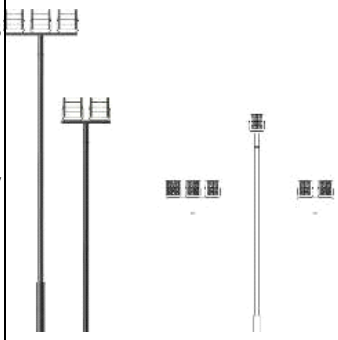
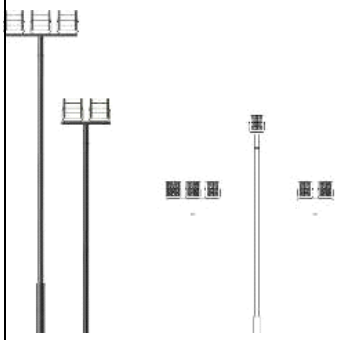
SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
9	3.6m decorative circular pole should be made up of circular mild steel pipe (grade YST 210) top to bottom 114mm dia. Wind speed considered in design 50 m/sec in compliance with IS 875 Part 3: 1987. Pole section welded by certified welders using high end MIG welding processes. PDC aluminum service door 348mm height x 80mm width shall be provided with the company logo embossed on the bottom of the door and safety rope with IP protection rating. The control gear tray is prewired with 2.5 Sq.mm cable, 6A MCB and 32A terminal connectors for loop-in/ loop-out arrangement. Any other internal cables and connections shall not be covered in the scope of supply. Mild steel mounting plate 200mm Sq x 12mm thick Steel of grade E250 to IS 2062: 2011 with 4 elongated holes 38 x 19 to suit M16 x 300mm bolts of grade 4.6. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation. All dimension and weight are within +/- 5% tolerance. The pole is coated with pure polyester powder coating or epoxy zinc phosphate primer and finished using environmentally stable polyurethane-based paint (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey/ Anthracite grey/ Black as standard colour options.(Note 1: Pole Foundation and pole drawing must be got approved from Engineer-in-Charge before making the foundation) (Note 2: All the cartage, loading and unloading of the poles parts is included in the item nothing shall be paid extra).	
10	Supply of 10W minimum recessed mounted down light dimension Ø100 x 75mm LED 3000K, 4000K, 6500K 240Vac CRI >80 MacAdam step 3 C.O.D: Ø90, Beam angle: 45°. IP rating IP65, Die-cast aluminum housing with aluminum heat sink for better thermal management. Aluminum reflector, polycarbonate optical cover. Mechanical resistance IK07. Polycarbonate optical cover, This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, Power Factor >0.9, THD <10%, Surge protection 2.5KV.	
11	Static White 3000K surface mounted compact spot light designed to provide directional light. Beam angle 15°/ 25°/ 40°. Luminaire made of pressure die cast aluminum alloy of high corrosion resistance and non corrosive A2 stainless steel fasteners. Clear toughened glass of 4mm thickness. Hybrid optics with lens & mirror finish pure aluminum reflector combination for higher efficiency, lower optical losses with optimum glare suppression. Power consumption should be between 5W to 6W at steady state full intensity luminaire should have minimum luminous flux of 300 Lm. Color rendering index CRI ≥ 80 and power factor of complete luminaire ≥ 0.90, at white colour. Swivel range of 0° - 90°. Single cable entrance M10 cable gland. Protection class IP65. Mechanical resistance IK06. Pure polyester powder coated graphite grey/ anthracite grey/ jet black. Available colour temperature 3000K/ 4000K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Luminaire dimension: 101mm length x 64mm width x 93mm height. Adequate heat sink with proper thermal management shall be provided. Operating Temperature: -10°C to +50°C, Operating Humidity: 10%-90%. THD should be less than 10%. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
12	24W LED 3000K, 4000K, 6500K 230-240Vac CRI >85 MacAdam step 3 Input power: 24W, Minimum 100mm dia and Height 2640mm, Light Distribution 360° Light Column. IP rating IP65, Extruded aluminum bottom ribbed pipe (grade 6060 T6 with test certificate) Ø100 x 3mm thickness & die-cast aluminum top cover(grade ADC12 with test certificate). SS fasteners. Clear silicone gaskets. ADC12 aluminum service door 348mm height x 81mm width at 300mm height above the base plate shall be provided with the company logo embossed on the bottom of the door and safety rope. The control gear tray is prewired with 2.5 Sq.mm cable, 6A MCB and 32A terminal connectors for loop-in/ loop-out arrangement. MS mounting plate Sq. 200 x 12mm thick steel of grade E250 to IS 2062:2011 with 4 elongated holes 38 x 19 to suit M16 bolts at CC140. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation pole. Hot dip galvanised foundation bolt. Mechanical resistance IK10. Pure polyester powder coated process: Mild shot blast & pure polyester powder coating. Translucent polycarbonate diffuser of 2.5mm thickness with light emission. Lamp fixed position. This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 56,000 hours at 40°C. Operating ambient temperature range is from - 15°C to +50°C. Driver efficiency >85%, power factor >0.95, THD <10%, Surge protection 4KV.	
13	Square shaped UP-DOWN 2 x 6W/12W/18W. Dimension 150 x 100 x 210mm, Wall- mounted compact updown light, emission designed to use monochromatic Warm white (3000K) & Neutral white (4000K). Should be equipped with Hybrid optics with lens & mirror finish pure aluminum reflector combination for higher efficiency, lower optical losses with optimum glare suppression. Extruded aluminum section with inner grooves to fix the top and bottom frame (grade 6063) Sq100 x 3mm thickness, die-cast aluminum glass fixing top and bottom frame Sq100mm (ADC12) with clear toughened glass diffuser of 4mm thickness with ceramic black coated on outer corner siliconed to frame. Die-cast aluminum heat sink for excellent thermal management. Single cable entrance via black PG7 cable gland, Die cast aluminum base for surface mounting on wall (ADC12). All external screws are made of stainless steel. Clear silicone gasket. Protection class IP65. Mechanical resistance IK07. Acid treatment & pure polyester powder coated graphite grey/ anthracite grey/ jet black. The luminaire's built-in LED module are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21). Operating ambient temperature range is from -15°C to +50°C. Beam angle 15°/ 25°/ 40°, Colour rendering index (CRI)>80. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Driver efficiency >85%, Power factor >0.95, THD <10%, Surge protection 4KV. Luminaire dimension: 150 x 100 x 270mm. IES, LM 79, LM 80, & TTC certificates will be provided from NABL accredited lab. Certification: CE Certified, Design Patented/ Registered, ROHS compliant, BIS Certification for Luminaires & Drivers.	 

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
14	10W Square shaped bollard should be available in different color temperature LED 3000K, 4000K, 5700K 230-240Vac CRI >80 MacAdam step 3 Minimum Sq.150 Height 1000mm Light Distribution shall be 360°, minimum IP rating IP65 or higher. Should be made from Extruded aluminum bottom pipe (grade 6063 with test certificate) Sq. 150 x 3mm thickness & extruded aluminum stem with inner ribbed Sq.30 x 2mm thickness. SS fasteners. Pre treated silicone gaskets. Die-cast aluminum mounting plate Sq.150 x 4mm thick with 3 elongated holes 20 x 12 to suit M10 bolts at PCD 90 with pure polyester powder coating. This mounting plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foudation. Hot dip galvanised foundation bolt. Mechanical resistance IK08. The Pure polyester powder coated processed through Acid treatment & pure polyester powder coating. Optical grade clear toughened glass diffuser of 4mm thickness with controlled downward light emission. Lamp fixed position. The luminaire must contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.90, THD <10%, Surge protection 2.5KV. Luminaire can be aligned on the mounting base plate around 360°.	
15	1Way/2way/4way light distribution ground recessed LED round fixture with wattage not more than 9W, CCT-3000K, CRI>80. LEDs in fixture should be of Macadam step 3 or less, Minimum dimension Ø116 x 169mm. Fixture to be made of Die-Cast aluminum alloy housing (grade ADC12 with test certificate) and Hard chrome plated stainless steel 316 grade front ring. Silicone clear gasket. SS fasteners. Mechanical resistance IK09, IP 67 Translucent acrylic diffuser, This luminaire contains built- in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 70,000 hours (L70 B10) at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >80%, power factor >0.90, THD <15%.	
16	6m multi head pole with provision of 6X45W Led, bottom should be in two parts dia 139.7mm and top dia 88.9mm, Wind speed considered in design 50 m/sec in compliance with IS 875 Part 3: 1987. Pole section welded by certified welders using high end MIG welding processes. Two PDC aluminum service door 348mm height x 80mm width shall be provided with the company logo embossed on the bottom of the door and safety rope with IP protection rating. The control gear tray is prewired with 2.5 Sq.mm cable, 6A MCB and 32A terminal connectors for loop-in/ loop-out arrangement & Driver box. dee Mild steel mounting plate 250mm Sq x 12mm thick Steel of grade E250 to IS 2062: 2011 with 4 elongated holes 38 x 19 to suit M16 x 500mm bolts of grade 4.6. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation. All dimension and weight are within +/- 5% tolerance. The pole is coated with pure polyester powder coating or epoxy zinc phosphate primer and finished using environmentally stable polyurethane-based paint (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey/ Anthracite grey/ Black as standard colour options. Flood lights should be available with different led color temperature option 3000K, 4000K, 5700K 230-240Vac CRI >80 MacAdam step 3, Input power: 45W, Beam angle: 10°/ 28°/ 45°, Food Light. IP rating IP65, Extruded aluminum bottom pipe (grade 6063 with test certificate) Ø100 x 2.5mm thickness & extruded aluminum hood cover(grade 6063 with test certificate) Ø166 x 3mm thickness. Module fixing clamp made of galvanized CRCA sheet 3mm thickness. SS fasteners. Mechanical resistance IK07.Pure polyester powder coated process: Acid treatment & pure polyester powder coating. Clear polycarbonate optical cover with light emission at desired angle. Delivered lumens should more than 110lm/w Lamp fixed position. This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 6KV. (Note 1: Pole Foundation and pole drawing must be got approved from Engineer - in - Charge). (Note 2: All the cartage, loading and unloading of the poles parts is included in the item nothing shall be paid extra).	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
17	Square shaped UP-DOWN 2 x 6W. Dimension 150 x 100 x 270mm, Wall-mounted compact updown light, emission designed to use monochromatic Warm white (3000K) & Neutral white (4000K). Should be equipped with Hybrid optics with lens & mirror finish pure aluminum reflector combination for higher efficiency, lower optical losses with optimum glare suppression. Extruded aluminum section with inner grooves to fix the top and bottom frame (grade 6063) Sq100 x 3mm thickness, die-cast aluminum glass fixing top and bottom frame Sq100mm (ADC12) with clear toughened glass diffuser of 4mm thickness with ceramic black coated on outer corner siliconed to frame. Die-cast aluminum heat sink for excellent thermal management. Single cable entrance via black PG7 cable gland, Die cast aluminum base for surface mounting on wall (ADC12). All external screws are made of stainless steel. Clear silicone gasket. Protection class IP65. Mechanical resistance IK07. Acid treatment & pure polyester powder coated graphite grey/ anthracite grey/ jet black. The luminaire's built-in LED module are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21). Operating ambient temperature range is from -15°C to +50°C. Beam angle 15°/ 25°/ 40°, Colour rendering index (CRI)>80. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Driver efficiency >85%, Power factor >0.95, THD <10%, Surge protection 4KV. Luminaire dimension: 150 x 100 x 270mm.IES, LM 79, LM 80, & TTC certificates will be provided from NABL accredited lab. Certification: CE Certified, Design Patented/ Registered, ROHS compliant, BIS Certification for Luminaires & Drivers.	
18	Linear Wall Washer LED 3000K, 4000K, 6000K 24Vdc CRI >80 MacAdam step 3 Input power: 24-36W Dimension: 1000 x 35 x 78 mm Beam angle: 30°/ 15°x60°, Electronic driver ON/ OFF, Surface Mounted luminaire. IP rating IP65, Extruded aluminum alloy housing (grade 6063). Toughened clear glass diffuser. SS fasteners. Mechanical resistance IK06. Aluminum mounting bracket for surface mounting on ground. Toughened Clear glass diffuser and optical to reduce glare controlled. This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.90, Surge protection 3KV. CE and BIS.	
19	Supply of 45-50W Post top with LED 3000K, 4000K, 5700K 240Vac CRI >80 MacAdam step 3 Dimension not less than Ø400 x 807 mm, Light Distribution 360° Electronic driver ON/OFF, IP rating IP65, Spun aluminium top cover Ø400 mm of 1.6mm thickness, die cast aluminium decorative knob on top, Mild steel (Sand Blasting with zinc primer supporting arm integrated with die-cast aluminium base suitable for mounting Ø76mm OD pipe. SS fasteners. Pure polyester powder coated process : Acid treatment & pure polyester powder coating. Clear acrylic diffuser with controlled downward light emission. Lamp fixed position. Lumen efficacy should be minimum 120lm/W. This luminaire should contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire >56,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >88%, power factor >0.96, THD <10%, Surge protection 6KV.	
20	Supply of Post top Lighting Pole of 4.2M Height made out MS Pipe Ø76.1mm confirming to YSt 210 and facilitating the luminaire mounting at the top. The pole shall be surfacemounted on a pre-formed foundation. The base plate of the of the pole shall be E 250 grade MS 200 mm x 200mm, 12mm thick confirming to IS2062:2011 shall be facilitated with elongated slots to suit the 300mm, J- type, M16 bolts, Grade 4.6 that shall be provided with suitable nuts and plain washers. The structurally sound pole emerging out of the base plate shall be architecturally designed with a decorative cast aluminium base cover. The grade of pressure diecast material shall be ADC12. A GDC embellishment is provided at appropriate height enhancing the decorative outlook of the pole. The grade of gravity die cast material shall be LM6. The Pole welding shall be done with certified welders using a V groove technique with a high end MIG welding process. A base compartment with a die cast aluminium door contoured to the poles's shape housing the gear tray, prewired with 2 way connector The surface preparation of the pole & components shall be done by shot blasting which is environmentally safe eliminating the chemical and acid use and ensuring the thoroughremoval of impuritise like, rust, oxides and other unwanted particles from the suface for high standard coating.The surface finish of the pole shall be Zinch rich primer coat & pure polyester powder coating or epoxy zinc phosphate primer followed by the environmentally stable Polyurethane based paint. Any other wiring/electrical consumables shall be under the scope of purchaser.	

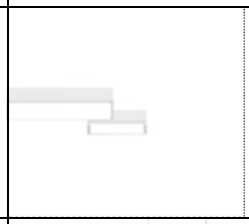
SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
21	Supply of 12W square decorative leser cut designer bollard LED 3000K, 4000K, 6500K 230-240Vac CRI >80 MacAdam step-3 Height 910mm Light Distribution Symmetrical, Electronic driver ON/OFF LUMINAIRE TYPE Bollard. IP rating IP66, Extruded square aluminium tube (grade 6063 with test certificate) Sq. 150 x 3mm thickness. Should have Bespoke laser cutting design options. SS fasteners. Must be equipped with Pre treated epdm black gaskets. Should have Die-cast aluminium mounting plate Sq.150 x 4mm thick with 3 elongated holes 20 x 12 to suit M10 bolts at PCD 90 with pure polyester powder coating. This mounting plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foudation. Hot dip galvanised foundation bolt. Mechanical resistance IK06. It should be Pure polyester powder coated process : Acid treatment & pure polyester powder coating. Optical grade clear toughened glass diffuser of 4mm thickness with controlled downward light emission. Lamp fixed position.This luminaire should contains built-in IP 65 LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 2.5KV. Manufacturer must have inhouse NABL certified lab equipped with photo goniometer, IP, IK test facilities .	
22	Supply of 2 x 18W & 50W LED square decorative leser cut designer column LED 3000K, 4000K, 6500K 230-240Vac CRI >80 MacAdam step-3 Height 4000mm Light Distribution Symmetrical, Electronic driver ON/OFF LUMINAIRE TYPE Bollard. IP rating IP65, Extruded square aluminium tube (grade 6063 with test certificate) Sq. 150 x 3mm thickness. Should have Bespoke laser cutting design options with 1400mm length. SS fasteners. Must be equipped with Pre treated epdm black gaskets. Should have Die-cast aluminium mounting plate Sq.300 x 16mm thick 4 Elongated holes 48 x 24 to suit M20 bolts at CC 215 with pure polyester powder coating. This mounting plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foudation. Hot dip galvanised foundation bolt. Mechanical resistance IK06. It should be Pure polyester powder coated process : Acid treatment & pure polyester powder coating. Optical grade clear toughened glass diffuser of 4mm thickness with controlled downward light emission. Lamp fixed position.This luminaire should contains built-in IP 65 LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 6KV.Manufacturer must have inhouse	
23	Supply of 6W surface mouted compact and robust wall surface luminaires for illuminating walls and stairs. Forward asymmetrical light distribution. Luminaire made of Die-Cast Aluminium cast aluminium alloy of high corrosion resistance and non corrosive A2 stainless steel fasteners. Protection class IP65. Mechanical resistance IK09. Pure polyester powder coated graphite grey / anthracite grey / jet black. Available colour temperature 3000K / 4000K / 5700K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. K-Lite LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Luminaire dimension : Sq.105 x 38mm. Manufacturer must have inhouse NABL certified lab equipped with photo goniometer, IP, IK test facilities. CE & BIS Certified.	
24	Supply of stand based IP 68 Input power : 6x3W surface mounted swimming pool luminaire for spot light. Beam angle 30°. Luminaire complete housing made of marine grade 316 stainless steel. PMMA diffuser of 8mm of thickness. Hard wired for single colour 2 x 1.0mm2 3metres water resistant cable. Protection class IP68. Mechanical resistance IK08. Available colour temperature 3000K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. K-Lite LED module with expected service life of at least 54,000 operating hours. Low Voltage at 12Vdc assures safety. Recommended installation depth upto 1meter below the water surface. Luminaire dimension : 127mm diameter x 120mm width x 193mm height. CE & BIS Certified.	
25	Supply of Static White 3000K surface mounted compact spot light designed to provide directional light. Beam angle 15° / 25° / 40°. Luminaire made of pressure die cast aluminium alloy of high corrosion resistance and non corrosive A2 stainless steel fasteners. Clear toughened glass of 4mm thickness. Hybrid optics with lens & mirror finish pure aluminium reflector combination for higher efficiency, lower optical losses with optimum glare suppression.Power consumption should be between 10W to 12W at steady state full intensity luminaire should have minimum luminous flux of 1087 Lm. Color rendering index CRI ≥ 80 and power factor of complete luminaire ≥ 0.90, at white colour. Swivel range of 0° - 90°. Single cable entrance M10 cable gland. Protection class IP65/66. Mechanical resistance IK06. Pure polyester powder coated graphite grey / anthracite grey / jet black. Available colour temperature 3000K / 4000K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Luminaire dimension : 113 x 100 x 451mm.Adequate heat sink with proper thermal management shall be provided. Operating Temperature : -10°C to +50°C, Operating Humidity : 10%-90%. THD should be less than 10%.. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
26	Supply installation testing & commisioning of Static White 3000K 25-27W In-ground with in built honey comb louvre symmetrical luminaire made up of die-casting with Ø173 x 220mm,the Ø173 front ring should be made up of stainless steel 316 grade front ring with silicone black gasket and toughened clear glass diffuser. The luminous flux of the luminaire is upto 2000-2500 lm for 3000K BEAM - 15°/25°/40. The ingress protection is IP67 and impact resistance of IK09 . The luminaire is integrated with high power CITIZEN COB with CRI≥80, SDCM≤3, L70/ B10 @ 60000 Hrs. The integral constant current driver comes with the power factor greater than or equal to 0.9, total harmonic distortion less than 15% with operating efficiency greater than 80% and a surge protection of 2KV. The driver input voltage 240Vac at 50-60Hz, operating voltage of 100-277Vac and operating temperature of -20˚ ~ +40˚C.Adequate heat sink with proper thermal management shall be provided. Operating Humidity : 10%-90%. THD should be less than 10%. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	
27	Supply of 3W Recessed Underwater mounted swimming pool/Water body luminaire for spot light. Beam angle 30°. Luminaire complete housing made of marine grade 316 stainless steel. ABS plastic installation housing for preparing the recess opening in wall / floor. Step tempered glass of 7mm thickness. Hard wired for single colour 2 x 1.0mm2 3metres water resistant cable. Protection class IP68. Mechanical resistance IK06. Available colour temperature 3000K, Colour rendering index (CRI)>80. SDCM-3 Macadam. K-Lite LED module with expected service life of at least 54,000 operating hours. Low Voltage at 12Vdc assures safety. Recommended installation depth upto 1meter below the water surface. Luminaire dimension : 68mm diameter x 76mm height. CE & BIS Certified.	
28	SITC of 9000mm micro mast pole made up of circular mild steel pipe (grade YST 210), Post made up of two section Bottom section 139.7mm Dia x 3.6mm thick with 2500mm Height & Top section 114.3mm Dia x 3.2mm thick with 4784mm Height.The micro mast bracket should be split constructed type, Bracket stem made up of MS Pipe 88.9mm Dia x 2.6mm thickness with 1000mm height. Mild steel Triangle structure welded to the bracket stem, The brackets are made in the form of "T" two brackets to mount 4 flood lights.Wind speed considered in design 50 m/sec in compliance with IS 875 Part 3 : 1987.Pole section welded by certified welders using high end MIG welding processes. Vandal proof PDC aluminium service door 348mm height x 110mm width shall be provided with the company logo embossed on the bottom of the door and safety rope with IP protection rating.The control gear tray is prewired with 2.5 Sq.mm cable,6A MCB and 32A terminal connectors for loop-in / loop-out arrangement. Any other internal cables and connections shall not be covered in the scope of supply.Mild steel mounting plate 300mm Square x 16mm thick Steel of grade E250 to IS 2062 : 2011 with 4 elongated holes 48 x 24 to suit M20 x 500mm bolts of grade 4.6 at CC215. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation.All dimension are within +/- 5% tolerance. The pole is coated with pure polyester powder coating or epoxy zinc phosphate primer and finished using environmentally stable polyurethane based paint (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey / Anthracite grey / Black as standard colour options.	
29	Supply installation testing & commisioning of Static White 3000K facade flood light luminaire made up Extruded aluminium housing and module with excellent thermal management heat sink & Mounting bracket made of CRCA sheet (3mm thickness) with polycarbonate optical cover should have minimum Dimension of 342 x 135 x 325mm, Must have option of antiglare visor. Power consumption should be between 180W at steady state full intensity luminaire, the luminous flux of the luminaire is upto 20234 lm for 3000K BEAM - 12°/25°/ 40/60. The ingress protection is IP67 and impact resistance of IK08. The luminaire is integrated with high power module with CRI≥70, SDCM≤3. The luminaire should contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire L70B10 >84,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >90%, Power factor >0.95, THD <7.8%, Surge protection 6KV. The driver input voltage 240Vac at 50-60Hz, operating voltage of 100-277Vac.Adequate heat sink with proper thermal management shall be provided. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	
30	Supply of 6000mm micro mast pole made up of circular mild steel pipe (grade YST 210), Post made up of two section Bottom section 114.3mm Dia x 3.2mm thick Top section 88.9mm Dia x 2.6mm thick.The micro mast bracket should be split constructed type, Bracket stem made up of MS Pipe 88.9mm Dia x 2.6mm thickness . The brackets are made in the form of "T"one brackets to mount 3 flood lights.Wind speed considered in design 50 m/sec in compliance with IS 875 Part 3 : 1987.Pole section welded by certified welders using high end MIG welding processes. Vandal proof PDC aluminium service door 348mm height x 110mm width shall be provided with the company logo embossed on the bottom of the door and safety rope with IP protection rating.The control gear tray is prewired with 2.5 Sq.mm cable,6A MCB and 32A terminal connectors for loop-in / loop-out arrangement. Any other internal cables and connections shall not be covered in the scope of supply.Mild steel mounting plate 250mm Square x 12mm thick Steel of grade E250 to IS 2062 : 2011 with 4 elongated holes 38 x 19 to suit M16 x 500mm bolts of grade 4.6 at CC180. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation.All dimension are within +/- 5% tolerance. The pole is coated with pure polyester powder coating or epoxy zinc phosphate primer and finished using environmentally stable polyurethane based paint (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey / Anthracite grey / Black as standard colour options.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
31	Supply installation testing & commisioning of Static White 3000K facade flood light luminaire made up Extruded aluminium housing and module with excellent thermal management heat sink & Mounting bracket made of CRCA sheet (3mm thickness) with polycarbonate optical cover should have minimum Dimension of 342 x 135 x 165mm, Must have option of antiglare visor. Power consumption should be between 60W to 70W at steady state full intensity luminaire, the luminous flux of the luminaire is upto 13976 lm for 3000K BEAM - 12°/25°/40/60. The ingress protection is IP67 and impact resistance of IK08. The luminaire is integrated with high power module with CRI≥70, SDCM≤3. The luminaire should contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire L70B10 >84,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >90%, Power factor >0.95, THD <7.8%, Surge protection 6KV. The driver input voltage 240Vac at 50-60Hz, operating voltage of 100-277Vac.Adequate heat sink with proper thermal management shall be provided. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	
32	Supply 10W/m encapsulated silcon flex, should be at least IP 67 3000K 24Vdc CRI >80 MacAdam step 3 Beam angle : 120°, Should be equipped with dot less homogenous lighting effect Electronic driver ON/OFF (External driver) MATERIAL CHARACTERISTICS Copper coated strip, Silicone moulded diffuser, End cap,Clip, This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 50,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >70%, Power factor >0.80, Surge protection 3KV.IES, LM 79, LM 80, & TTC certificates will be provided from NABL accredited lab. Certification: CE Certified, Design Patented/Registered, ROHS compliant, BIS Certification for Luminaires & Drivers.	
33	Supply of IP 67 Driver 150W suitable for led flex (Qty may vary at the time of actual installation	
34	Supply In-ground 3W 3000K asymmetrical luminaire made up of die-casting with Ø39 x 67mm stainless steel 316 grade front ring with silicone black gasket and toughened clear glass diffuser. The luminous flux of the luminaire is upto 172 lm for 3000K BA- 24°,8°,12°,40°,60°,40°x11°). The ingress protection is IP67 and impact resistance of IK07. The luminaire is integrated with high power CITIZEN COB with CRI≥80, SDCM≤3, L70/ B10 @ 60000 Hrs. The integral constant current driver comes with the power factor greater than or equal to 0.9, total harmonic distortion less than 15% with operating efficiency greater than 80% and a surge protection of 1KV. The driver input voltage 240Vac at 50-60Hz, operating voltage of 100-277Vac and operating temperature of -20˚ ~ +40˚C with CE confirmed BIS approved. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified	
35	Supply installation testing & commisioning of Static White 3000K, Should be rectangular compact and robust wall recessed luminaires for illuminating walls and stairs. Must be forward asymmetrical light distribution. Luminaire made of pressure die cast aluminium alloy of high corrosion resistance and non corrosive A2 stainless steel fasteners. ABS plastic installation housing for preparing the recess opening in wall / stairs. Clear acrylic diffuser. Single cable entrance via M10 cable gland. Protection class at least IP65 or higher. Mechanical resistance IK09. Pure polyester powder coated graphite grey / anthracite grey / jet black.Power consumption should be between 5W to 6W at steady state full intensity luminaire should have minimum luminous flux of 343Lm, should be available in different colour temperature 3000K / 4000K / 5700K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Luminaire dimension : 130mm length x 87mm width x 76mm height. Luminaire installation in a recessed opening cut-out dimension : 240mm length x 83mm width x 70mm height. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	
36	Supply In-ground 1W 3000K asymmetrical luminaire made up of die-casting with Ø32 x 62mm stainless steel 316 grade front ring with silicone black gasket and toughened clear glass diffuser. The luminous flux of the luminaire is upto 105 lm for 3000K BA- 40°. The ingress protection is IP67 and impact resistance of IK07. The luminaire is integrated with high power CITIZEN COB with CRI≥80, SDCM≤3, L70/ B10 @ 60000 Hrs. The External/ integral constant current driver comes with the power factor greater than or equal to 0.9, total harmonic distortion less than 15% with operating efficiency greater than 80% and a surge protection of 1KV. The driver input voltage 240Vac at 50-60Hz, operating voltage of 100-277Vac and operating temperature of -20˚ ~ +40˚C with CE confirmed BIS approved. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
37	Supply of 3.5m High, and 40W Square shaped Light Column.Minimum IP-65 must have LED color temperature options 3000K, 4000K, 5700K 230-240Vac CRI >80 MacAdam step 3, Should be made from Extruded aluminium bottom pipe (grade 6063 with test certificate) Sq. 150 x 3mm thickness, extruded aluminium stem with inner ribbed Sq.30 x 2mm thickness, extruded aluminium top pipe with inner ribbed. SS fasteners. Pre treated silicone gaskets. PDC aluminium service door 330mm height x 75mm width at 335mm height above the base plate shall be provided with the company logo embossed on the bottom of the door and safety rope. The control gear tray is prewired with 2.5 Sq.mm cable, 6A MCB and 32A terminal connectors for loop-in / loop-out arrangement.MS mounting plate Sq. 250 x 12mm thick steel of grade E250 to IS 2062:2011 with 4 elongated holes 38 x 19 to suit M16 bolts at CC180. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation pole. Hot dip galvanised foundation bolt. Mechanical resistance IK08. Pure polyester powder coated process : Mild shot blast & pure polyester powder coating. Should be equipped with Optical grade clear toughened glass diffuser of 4mm thickness with controlled downward light emission. Lamp fixed position. The minimum luminous flux of the luminaire should be 3800 lm for 3000K with 360° symetric distributionThis luminaire should contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >87%, power factor >0.95, THD <10%, Surge protection 5KV.CE and BIS	
38	Supply of adjustable street light luminaire Housing and front frame made of pressure die- cast aluminium featuring high strength and anti corrosion. The front frame of the luminaire should be hinged for easy open and ease of maintenance. Should have provision of NEMA socket on the top for future ILC upgradation . Suitable for mounting on to Ø60 pipe at -15° to +°15 lateral (side entry) and vertical (top mount). Led compartment should be covered with Clear tempered glass. High quality light transmittance lens must be used. should have minimum dimension of 645 x 257 x 147mm to 790 x 305 x 147mm. Power consumption should be between 120W to 180W at steady state full intensity luminaire, the delivered luminous flux of the luminaire should be minimum 140-150 lm/W for 4000K Distribution- Asymetrical Batwing street light optics T- III/T-IV. The ingress protection is IP65/66 or higher and impact resistance of IK08. This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire >60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 6KV.Driver operating voltage of 100-277Vac.Adequate heat sink with proper thermal management shall be provided. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material.	
39	Supply of Conical pole SA/DA with 6-8 mtr height, Continuously tampered circular pole made of Hot rolled steel flat (E250 to IS 2062 :2011) 130-160mm Bottom Dia x 76mm Top Dia x 3mm thick. All pole sections are welded using Submerged arc welding technique by certified welders by using automatic machine with precised welding.The base plate of the of the pole shall be E 250 grade MS 300 mm x 300mm, 16mm thick confirming to IS2062:2011 shall be facilitated with elongated slots to suit the 700mm J-type M20 bolts, Grade 4.6 that shall be provided with suitable nuts and plain washers.Built-in control box with cast aluminum service door and safety rope and vandal proof arrangement. Die cast aluminum door is contoured to the shape of the pole with silicone rubber gasket. The control gear tray is pre-wired with MCB, terminal connectors for loop-in / loop-out arrangement. The foundation bolt holes in the base plate are designed to be elongated for fine adjustments / alignment of the pole during installation. Base plate made of steel grade E250 & foundation bolt of grade 4.6 . Must carry out Shot Blasting process to remove surface impurities Like Rust, Dust, Oil and Chemical etc. The pole is coated with epoxy zinc phosphate primer and finished using environmentally stable powder coated (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey / Anthracite grey / Black as standard colour options. Must have inhouse manufacuturing facilities.	
40	Supply of 40W street light luminaire Housing and front frame made of die-cast aluminium featuring high strength and anti corrosion. Suitable for mounting on to Ø38 pipe. Led compartment should be covered with Clear tempered glass. High quality light transmittance lens must be used. should have minimum dimension of 378 x 120 x 72mm. Power consumption should be between 40W at steady state full intensity luminaire, the luminous flux of the luminaire is upto 4503 lm for 3000K Distribution- Asymetrical Batwing street light optics options Type II, Type III, Type IV. The ingress protection is IP66 and impact resistance of IK08.This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire >60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 4KV.Driver operating voltage of 100-277Vac.Adequate heat sink with proper thermal management shall be provided. The fixtures proposed must have passed LM 79 & LM-80, Reports from inhouse NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
41	Supply of Conical pole Single arm spigot bracket with 5 mtr height, Continuously tampered circular pole made of Hot rolled steel flat (E250 to IS 2062 :2011) 115-120mm Bottom Dia x 76mm Top Dia x 3mm thick. All pole sections are welded using Submerged arc welding technique by certified welders by using automatic machine with precised welding.The base plate of the of the pole shall be E 250 grade MS 250 mm x 250mm, 12mm thick confirming to IS2062:2011 shall be facilitated with elongated slots to suit the 500mm J- type M16 bolts, Grade 4.6 that shall be provided with suitable nuts and plain washers.Built-in control box with cast aluminum service door and safety rope and vandal proof arrangement. Die cast aluminum door is contoured to the shape of the pole with silicone rubber gasket. The control gear tray is pre-wired with MCB, terminal connectors for loop-in / loop-out arrangement. The foundation bolt holes in the base plate are designed to be elongated for fine adjustments / alignment of the pole during installation. Base plate made of steel grade E250 & foundation bolt of grade 4.6 . Must carry out Shot Blasting process to remove surface impurities Like Rust, Dust, Oil and Chemical etc. The pole is coated with epoxy zinc phosphate primer and finished using environmentally stable powder coated (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey / Anthracite grey / Black as standard colour options. Must have inhouse manufacuturing facilities.	
42	Supply of Specially designed spot light with glare cut visor 230-240Vac CRI >80 MacAdam step 3Input power : 30W-45W Dimension Ø166 x 153 x 423mm, Light Distribution Symmetrical along with inbuilt Electronic driver , IP rating must be IP65 or higher, Made out of Extruded aluminium bottom ribbed pipe (grade 6063 with test certificate) Ø166 x 3mm thickness & Die cast aluminium housing (grade ADC12 with test certificate). SS fasteners. Die-cast aluminium mounting plate Ø100.5 x 4mm thick with 2 elongated holes 15 x 10 to suit M8 bolts at PCD 55 with pure polyester powder coating. This mounting plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foudation. Hot dip galvanised foundation bolt. Mechanical resistance IK07. Pure polyester powder coated process : Acid treatment & pure polyester powder coating. Optical grade clear polycarbonate lens. Lamp fixed position. Should have minimum luminous flux of 90-100 lumens/Watt. This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 4KV. Manufacturer must have inhouse shot blasting machine and NABL certified lab equipped with photo goniometer, IP, IK test facilities Make of LEDs -LEDs of CREE / LUMINOUS / OSRAM / SEOUL / SAMSUNG/ LUMILED /NICHIA/CITIZEN, the fixtures proposed must have passed LM 79 & LM-80, latest Reports will be submitted post the issuance of LOA to the successful bidder and before the supply of material CE & BIS Certified. Make Ligman, K-Lite, Unilamp, Bega, Heper (Qty may vary at the time of actual installation as per architect/department direction)	
43	Supply of Static White 3000K surface mounted compact spot light designed to provide directional light. Beam angle 15° / 25° / 40°. Luminaire made of pressure die cast aluminium alloy of high corrosion resistance and non corrosive A2 stainless steel fasteners. Clear toughened glass of 4mm thickness. Hybrid optics with lens & mirror finish pure aluminium reflector combination for higher efficiency, lower optical losses with optimum glare suppression.Power consumption should be between 10W to 12W at steady state full intensity luminaire should have minimum luminous flux of 1054 Lm. Color rendering index CRI ≥ 80 and power factor of complete luminaire ≥ 0.90, at white colour. Swivel range of 0° - 90°. Single cable entrance M10 cable gland. Protection class IP65/66. Mechanical resistance IK06. Pure polyester powder coated graphite grey / anthracite grey / jet black. Available colour temperature 3000K / 4000K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Luminaire 113 x 84 x 117mm.Adequate heat sink with proper thermal management shall be provided. Operating Temperature : -10°C to +50°C, Operating Humidity : 10%-90%. THD should be less than 10%.Manufacturer must have inhouse shot blasting machine and NABL certified lab equipped with photo goniometer, IP, IK test facilities Make of LEDs -LEDs of CREE / LUMINOUS / OSRAM / SEOUL / SAMSUNG/LUMILED / NICHIA/CITIZEN, the fixtures proposed must have passed LM 79 & LM-80, latest Reports will be submitted post the issuance of LOA to the successful bidder and before the supply of material CE & BIS Certified.	
44	Supply of 72-150W LED RGBW, Integral control gear, Mounting: Surface ProductFinish: Grey IP: 65/66, should be made from die cast alumnium, Luminaire should be capable of producing dynamic colors changing lights with 16million color by DMX/Ethernet based control. Should have different options in beam angles, Luminaire should be complete with driver and capable of operating at line voltage of 100-270 Vac, 50Hz with PF of >0.9, Fixture should be capable to operate at ambient temperature range of -20-to +40°C and should be IP65 and IK06, LED life of L70B10 50,000 hrs.	
45	Supply of 36--150W LED RGBW, Integral control gear, Mounting: Surface ProductFinish: Grey IP: 65/66, should be made from die cast alumnium, Luminaire should be capable of producing dynamic colors changing lights with 16million color by DMX/Ethernet based control. Should have different options in beam angles, Luminaire should be complete with driver and capable of operating at line voltage of 100-270 Vac, 50Hz with PF of >0.9, Fixture should be capable to operate at ambient temperature range of -20-to +40°C and should be IP65 and IK06, LED life of L70B10 50,000 hrs.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
46	Supply of linear 40-200W LED RGBW, Integral control gear: Surface ProductFinish: Grey IP: 65/66, should be made from die cast alumnium, Luminaire should be capable of producing dynamic colors changing lights with 16million color by DMX/Ethernet based control. Should have different options in beam angles, Luminaire should be complete with driver and capable of operating at line voltage of 100-270 Vac, 50Hz with PF of >0.9, Fixture should be capable to operate at ambient temperature range of -20-to +40°C and should be IP65 and IK06, LED life of L70B10 50,000 hrs.	
47	Supply of 20W/m RGBW encapsulated silcon flex, should be at least IP 67/68 and must be available in RGB & WW/Amber/NW 24Vdc CRI >80 MacAdam step 3 Beam angle : 120°, Should be equipped with dot less homogenous lighting effect Electronic driver ON/OFF (External driver) Copper coated strip, Silicone moulded diffuser, End cap,Clip, This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Pf Lifespan of the luminaire > 50,000 hours at 40°C.Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >85%, power factor >0.9, THD <10%, Surge protection 2.5KV.IES, LM 79, LM 80 certificates will be provided from NABL accredited lab. Should be supplied with S.S channel and IP-connector.	
48	Static White 3000K surface mounted compact spot light designed to provide directional light. Beam angle 15°/ 25°/ 40°. Luminaire made of pressure die cast aluminum alloy of high corrosion resistance and non corrosive A2 stainless steel fasteners. Clear toughened glass of 4mm thickness. Hybrid optics with lens & mirror finish pure aluminum reflector combination for higher efficiency, lower optical losses with optimum glare suppression. Power consumption should be between 12W at steady state full intensity luminaire should have minimum luminous flux of 300 Lm. Color rendering index CRI ≥ 80 and power factor of complete luminaire ≥ 0.90, at white colour. Swivel range of 0° - 90°. Single cable entrance M10 cable gland. Protection class IP65. Mechanical resistance IK06. Pure polyester powder coated graphite grey/ anthracite grey/ jet black. Available colour temperature 3000K/ 4000K, Colour rendering index (CRI)>80. SDCM-3 MacAdam. LED module with expected service life of at least 60,000 operating hours. Prewired with LED driver and suitable for operating on 240V, 50Hz single phase ac supply. Luminaire dimension: 101mm length x 64mm width x 93mm height. Adequate heat sink with proper thermal management shall be provided. Operating Temperature: -10°C to +50°C, Operating Humidity: 10%-90%. THD should be less than 10%. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material. CE & BIS Certified.	
49	Supply of On/off or DALI 12-25W Adjustable track light with adapter for installation on track. The body of LED spot light should be made from die-cast aluminium for better thermal management. Clear polycarbonate optical cover which is with excellent optics effect and excellent spot light effect. It should be equipped with variable beam angle Twist & zoom : 15°-50°. CRI (Ra) : >80, SDCM≤ 3 to avoid color deviation Led life should be atleast L70 B10 60,000hrs, Luminaire provided with built-in-constant current driver with advanced circuit design achieves stable performances and long services span. Power Factor : >0.9 THD : <10% Surge Protection : 4KV Efficiency : >85%. CE,BIS	
50	1m Track +Connectors (Qty may vary as per site at the time of installation)	
51	Supply of On/off or DALI IP-40 rated 16W LED ceiling square surface mounted back-lit Indoor luminaire with soft uniform Light distribution. Luminaire should be made of die-cast aluminium for better thermal management. High efficiency diffuser for glare free, uniform light distribution. CRI (Ra) : >80, SDCM≤ 3 to avoid color deviation , Led life should be atleast L70B10 50,000hrs High lumen output (Delivered) of at least 90lm/w.High PF constant current LED driver with surge and thermal protection with follwoing ratings Power Supply : Integrated Power Factor : >0.90 THD : <10% Surge Protection : 2.5KV Efficiency : >83%.Suitable for operation on 240V, 50Hz single phase ac supply, Operating Voltage : 90-265Vac Operating Temperature : -15°~+50°C CE,BIS	
52	Supply of On/off or DALI specially designed Circular suspended ring type integral LED luminaire should have minimum dimension of Ø900 x 25 depth system power [36W ± 5%],should be available in 3000K/4000K/6000K color temperature, made of extruded aluminium alloy. Powder coated with Sliver / White / Black epoxy polyester powder coating., power factor > 0.95, THD < 10%, Inbuilt surge protection of 2.5 KV,Luminaire has Ingress protection of IP20 The luminaire should have minimum CRI of >80 . The LEDs used have a life of 50000 burning hrs Lumen maintenance as per L70B10 with SDCM<=3 binning Luminaire performance & Safety :IEC 60598, IS 10322-5, IS 161-03/05/06/07, Surge : IEC 61000-4-5, IES, LM 79, LM 80, & TTC certificates will be provided from NABL accredited lab. Certification: CE Certified, Design Patented/Registered, ROHS compliant, BIS Certification for Luminaires & Drivers.	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
53	SITC of 9000mm Trio mast pole made up of circular mild steel pipe (grade YST 210), Post made up of two section Bottom section 139.7mm Dia x 3.6mm thick with 2500mm Height & Top section 114.3mm Dia x 3.2mm thick with 4784mm Height.The trio mast bracket is a split constructed type, Bracket stem made up of MS Pipe 88.9mm Dia x 2.6mm thickness with 1000mm height. Mild steel Triangle structure welded to the bracket stem, This triangle structure made up of 40 x 6mm thickness L-Aangle. 3 Nos. Sq12 Twisted rod connected to bracket stem and triangle structure. 70mm Dia x 700mm height cone fitted to top of the bracket stem.Wind speed considered in design 50 m/sec in compliance with IS 875 Part 3 : 1987.Pole section welded by certified welders using high end MIG welding processes. Vandal proof PDC aluminium service door 348mm height x 110mm width shall be provided with the company logo embossed on the bottom of the door and safety rope with IP protection rating.The control gear tray is prewired with 2.5 Sq.mm cable,6A MCB and 32A terminal connectors for loop-in / loop-out arrangement. Any other internal cables and connections shall not be covered in the scope of supply.Mild steel mounting plate 300mm Square x 16mm thick Steel of grade E250 to IS 2062 : 2011 with 4 elongated holes 48 x 24 to suit M20 x 500mm bolts of grade 4.6 at CC215. This mounting steel plate along with foundation bolts of suitable size to be used for ensuring firm grouting into the specially designed foundation.All dimension are within +/- 5% tolerance. The pole is coated with pure polyester powder coating or epoxy zinc phosphate primer and finished using environmentally stable polyurethane based paint (coating thickness 60-80 microns). The Pole shall be provided with Graphite grey / Anthracite grey / Black as standard colour options.	
54	Supply installation testing & commisioning of Static White 3000K/4000K/6000Kfacade flood light luminaire made up Extruded aluminium housing and module with excellent thermal management heat sink & Mounting bracket made of CRCA sheet (3mm thickness) with polycarbonate optical cover should have minimum Dimension of 342 x 135 x 32mm, Must have option of antiglare visor. Power consumption should be between 180W to 200W at steady state full intensity luminaire, the luminous flux of the luminaire is upto 115 lm/W for 6000K BEAM - 12°/25°/40/60. The ingress protection is IP67 and impact resistance of IK08. The luminaire is integrated with high power module with CRI≥70, SDCM≤3. The luminaire should contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire L70B10 >84,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >90%, Power factor >0.95, THD <7.8%, Surge protection 6KV. The driver input voltage 240Vac at 50-60Hz, operating voltage of 100-277Vac.Adequate heat sink with proper thermal management shall be provided. The fixtures proposed must have passed LM 79 & LM-80, Reports from NABL laboratory will be submitted post the issuance of LOA to the successful bidder and before the supply of material.	
55	Supply of LED 3000K, 4000K, 5700K 230-240Vac CRI >80 MacAdam step 3 Input power : 6W Dimension 150 x 90 x 43mm Facade. IP rating IP65 MATERIAL CHARACTERISTICS Die cast aluminium housing (grade ADC12 with test certificate). SS fasteners. Pre treated silicone gaskets. Die-cast aluminium mounting plate with pure polyester powder coating. Mechanical resistance IK08. Pure polyester powder coated process : Acid treatment & pure polyester powder coating. LIGHTING PERFORMANCE Optical grade clear polycarbonate lens. Lamp fixed position. SILL This luminaire contains built-in LED modules. LED modules are engineered accordingly to the existing regulations of Lumen Maintenance (LM80) and Technical Memorandum (TM21), Lifespan of the luminaire > 60,000 hours at 40°C. Operating ambient temperature range is from -15°C to +50°C. Driver efficiency >70%, power factor >0.95, THD <10%, Surge protection 2.5KV. CE and BIS	
56	Supply of On/off or DALI specially designed Circular suspended/Surface type integral LED luminaire should have minimum dimension of Ø600,900,1200 x 78mm depth system power 60W,90W,120W respectively,should be available in 3000K/4000K/6000K color temperature, aluminium alloy : Extruded Aluminium Diffuser : Translucent Acrylic / Prismatic. Powder coated with Sliver / White / Black epoxy polyester powder coating., power factor > 0.95, THD < 10%, Inbuilt surge protection of 4KV,Luminaire has Ingress protection of IP20 The luminaire should have minimum CRI of >80 IP54 . The LEDs used have a life of 60,000 burning hrs Lumen maintenance as per L70B10 with SDCM<=3 binning Luminaire performance & Safety :IEC 60598, IS 10322-5, IS 161-03/05/06/07, Surge : IEC 61000-4-5, IES, LM 79, LM 80, & TTC certificates will be provided from ABL accredited lab. Certification: CE Certified, Design Patented/Registered, ROHS compliant, BIS Certification for Luminaires & Drivers	
57	CE Certified DALI certified sensor with ability to detect occupancy and must be programmable for constant light control for energy efficiency using daylight harvesting functionality. Should be able to detect area of 8m*6.2m at a max mounting height of 4mtrs. 10 mA DALI current consumption and must consume power via the DALI Application controller only. No separate BUS or PSU must be required. Must compy with DALI2 standard IEC62386, Parts 101, 103, 303 and 304.	
58	DALI2 certified application controller, with a built-in DALI PSU & a built-in Real time clock, capable of handling 1 DALI Loop. Suitable for each DALI line of up to 64 devices and with 1nos of 10 / 100 Ethernet gateway to connect to network. The controller must be capable to provide DALI-OUT current : 240mA Must comply with DALI STANDARD (IEC 62386) Parts : o 101 (System Components) o Part 103 (Control Devices) o Part 301 (Push Buttons) o Part 303 (Occupancy Sensor) o Part 332 (Feedback, LED only)	

SL.NO.	PRODUCT SPECIFICATIONS	IMAGE
59	7 Button Keypad - 4Scenes, Raiser+Lower, On/Off DALI certified,10 mA max Helvar DALI line current consumption, should be available in multiple finishes. Compliant to IEC 62386-301. 101 & 103. Should come with all accessories for 7 buttons per plate. Customisable labels available for specific projects. Must be powered by the DALI2 application controller.	
60	Hand-held unit fitted with 7 buttons that control basic system functions such as on/off, raising and lowering the general light level and the selection of four scenes. Basic programming functions can be performed with combinations of button presses. This includes address specific preset levels and scene settings.	
61	Corridor PIR Sensor providing energy saving functions for corridors, aisles, hallways and similar areas in a DALI system. Must have detection on three beams, covering a 100° sector with a 41- metre radius. Must have two detection modes, suited for different types of movements: • Low/ Office: used in areas where small movements occur, such as offices or hospitals. In this mode, the sensor's sensitivity is increased after the trigger. • High activity: used in areas where people walk, such as corridors in schools, hotels or warehouses. The Corridor PIR Sensor is compatible with Helvar's lighting systems and configuration software, Designer	
62	8 CH relay unit to allow control of non-DALI, nondimmable loads and Switching On/Off of HVAC system. The relay must be latching, volt-free contact, high-inrush type, with a contact rating of 16 A. The unit must be powered from the DALI network. It must form a DALI relay node with a typical current consumption of 2 mA. Must comply with DALI Standards IEC 62386-101 IEC 62386-102 IEC 62386-208	

N. Civil Scope (Structure Design Basis Report)

i. Structure DBR

ii. **Geotech Report is attached as Annexure-D**. Geotech report as stated earlier is for reference purposes. Bidders have to do their own due diligence before bidding. No Change of scope or Extension of time shall be allowed with reference to the report.

iii. **Other Civil Scope of Work**

i. **Road Work:** Road work as mentioned in the scope of work and drawings shall be in the scope of the turnkey Contractor. The work should be done in accordance with the Technical Specification Section-5.

ii. **Footpath/ Paver Block** work shall be as per the scope of work and drawings shall be in the scope of the turnkey Contractor.

DESIGN CRITERIA: CIVIL STRUCTURES

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1. INTRODUCTION

The report presents data related to the proposed project "CONSTRUCTION OF MAHARAJA KRISHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA. according to the Architectural plans, sections & elevations.

The purpose of this DBR is to establish the design basis for preparation of Construction Stage Design & Drawings. The Turnkey Agency, through its appointed structural consultant or Inhouse Design Team, shall be responsible for the final Good-for-Construction (GFC) design and drawings and for finalizing the structural system so that it meets the tender-document criteria and all applicable codal provisions as per latest addendums if any. The GFC stage structural drawings shall be submitted to the Engineer (Engineer-in-Charge) for review and approval after duly vetting by the appointed TPR (Third Party Consultant) in line with the RFP/ Contract.

All Civil Structures are to be designed for a life span of 50 years.

2. SIZES OF COLUMN BEAMS & SLABS

Member sizes (columns, beams, slabs and shear walls) as shown on the Structural General Arrangement (GA) drawings (Section-7) are indicative and are for reference purpose only. Contractor has to do their own Technical Due Diligence for the preparation of Design and Drawings for the project. Indicative sizes are summarised below; final sizes shall be as per the approved GFC drawings.

Element	Indicative size
Columns	As per GA drawings (rectangular / shear-wall type)
Beams	300×700 mm typical; deep/edge beams up to 300×1000 mm
Slabs	150–200 mm (two-way / flat as required)
Shear walls	230 / 240 / 300 mm thick

3. DESIGN DATA FOR MATERIAL

MATERIAL GRADES

Cement:

Ordinary Portland cement (OPC) of 43 grade and 53 grade conforming to IS 1489-2015 respectively shall be used. Portland Pozzolana cement (PPC) conforming to IS 1489-2015 of grades 43 & 53 may also be used. In all cases, the cement shall meet the 28-day strength requirement of IS 269-2015. In all cases the cement shall meet the 28-day strength requirement of

IS 8112-1989 or IS 12269-1987.

Fly ash (Grade 1) conforming to IS 3812 or granulated blast furnace slag conforming to IS 12089 as part replacement of ordinary Portland cement (having total alkali content as Na2O equivalent not more than 0.6 percent), provided fly ash content is at least 20 percent or slag content is at least 50 percent.

Reinforced Concrete Cement:

RCC grade of M35 as a minimum grade of concrete should be taken in consideration. Minimum cement content and water cement ratio of various structural elements shall be as per Table 5 of IS-456-2000.

Please refer to the respective structure drawings for grade of concrete of foundations, beams, slabs & columns.

Aggregates:

The sizes of coarse aggregates shall conform to IS 383-1970 (Reaffirmed 1997). Nominal maximum size of coarse aggregates would be 20 mm, suitably graded as per the requirement of mix design. The fine aggregates shall conform to the specifications of IS 383-1970(Reaffirmed 1997)

Water

Mixing water shall conform to IS 456:2000.

Reinforcement:

Reinforcement bars shall be Corrosion-Resistant Steel (CRS), Thermo-Mechanically Treated (TMT) of grade Fe550D (minimum) conforming to IS 1786, with minimum total elongation of 14.5% and the yield/ultimate-strength ratios required by IS 13920:2016 for ductile detailing. (Plain Fe500 is not permitted for ductile design.). Full reinforcing-steel specification, elongation and ductile-detailing compliance requirements are given in Section 21 (Reinforcing Steel Specification).

The total % of Corrosion Resistant Elements (CRE) in bars, which comprise of Copper (Cu), Phosphorus (P), and Chromium (Cr) shall not be less than 0.50%.

The reinforcement steel shall have the following properties: Unit Mass of Steel = 7850 kg/m3

• Modulus of Elasticity, E = 200x103 N/mm2

• Yield Strength- 500 N/mm2

• Ultimate Tensile Strength, Fu = As per IS 1786

• Coefficient of thermal expansion = Usually 12 x10-6 /ºC

• Shear Modulus, G = 76.9x103 N/mm2

CRS-TMT shall meet Cl. 5.3.1, 5.3.2 & 5.3.3 of IS 13920:2016 for members resisting earthquake forces (see also Section 3 – Reinforcement).

4. CLEAR COVER TO CONCRETE

All structures shall be designed for at least 'Severe' exposure as per IS 456:2000. Where the structure is in contact with aggressive sub-soil / groundwater or subject to sea-water spray, 'Very Severe' exposure shall be adopted. The applicable exposure shall be confirmed from the geotechnical report chemical analysis (sulphate SO_3 and chloride content, per IS 456 Table 4).

Concrete clear cover to the rebar as per (Clause No. 21.4 and 26.4.3 and Fig. 1) of IS – 456:

Fire rating:

The structure shall be designed for fire protection as specified by the National Building Code (NBC 2026), based on FAR provided by the Architect, which further defines the building Type. In all cases where there is significant fire risk, materials shall be self-extinguishing, low flammability, low smoke and low toxicity.

The Structural elements shall be designed for **2 hrs fire resistance as minimum**, in accordance with IS 1642, NBCS SP7:2016, unless a higher rating is stipulated by the relevant code which shall be further confirmed with the classification of building type per CFO/ Statutory approval.

If for any structure, depending on usage or classification, a higher period of fire resistance is stipulated as per the relevant Code/ Standards, it shall be so taken in design, after approval of the Engineer.

Concrete Cover:

Nominal Cover to Any R/F for Various Structural Members*

Structural Member	Description	Cover
Foundation		
Structural Member	**Description**	**Cover**
Raft	Bottom Sides Top	75mm 75mm 50mm

Plinth Beam/Ties Beam	All Sides	30mm
RCC Walls(i) Retaining Wall	Earth Side Inside Face	30mm 25mm
(ii) Water Tank Walls	Water Face Outer Face	45mm 30mm
(iii) STP Walls	Liquid Face Outer Face	45mm 30mm
Columns	-	40mm from face of ties
Shear Walls	-	40 mm from face of ties
Beams(i) Floor Beam (From Stirrup Face)	Bottom Top	30mm Fire rating 2 hrs. 30mm Fire rating 2 hrs.
(ii) Floor Beams on roof of Water tank having liquid of corrosive character	Top Bottom	30mm 45mm
(iii) Floor Beam over which filling is proposed	Top Bottom	30mm 30mm
Suspended Slabs/Staircase Waist Slab) Floor Slab/Staircase Slab	Top Bottom	25mm 25mm
Structural Member	**Description**	**Cover**
b) Roof Slab of water tank having liquid of corrosive character	Bottom Top	45mm 25mm
c) Slab having earth filling	Bottom Top	25mm 30mm

Modulus of Elasticity of Concrete, E_c = $5000\sqrt{f_{ck}}$ N/mm2

Concrete Poisson's ratio = 0.20

Coefficient of Thermal Expansion: To be determined based on aggregate type (Usually 12 x10-6 /ºC)

5. STRUCTURAL ARRANGEMENT

The buildings will be made with conventional ductile framed structures with R.C.C columns beams and R.C.C slabs to suit the architectural brief and space constraints. The walls of lifts and staircases in R.C.C shear walls wherever required.

All structures shall conform to the latest editions of the relevant IS codes, NBCS SP7:2016, CPWD specifications, local regulations and NDMA / OSDMA guidelines. In case of any conflict between the documents, drawings, codes or regulations, the most stringent provision shall govern.

6. FOUNDATION SYSTEM

Foundation needs to be as per soil report recommendations**.**

7. LIST OF CODES

List of primary Indian standards codes and publications used for analysis and design are given in Table below**:**

IS 875		Code of Practice for Design Loads for Buildings and Structures

Design Loads (Other Than Earthquake) for Buildings and Structures	Part I (1987)	Dead Loads
	Part II (1987)	Imposed Loads
	Part III (2015)	Wind Load
	Part V (1987)	Special Loads and Combinations
SP7: 2026		National Building Construction Standards 2026
IS 1893:2016 (Part 1 General Provisions and Building)		Criteria for Earthquake Resistant Design of Structures
IS 1893:2016 (Part 2Liquid retaining tanks)		Criteria for earthquake resistant design of structures
IS 4326:2013		Code of Practice for Earthquake Resistant Design and Construction of Buildings.
IS 13920:2016		Code of Practice for Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
IS 456:2000/2013 (amd.)		Plain and Reinforced Concrete - Code of Practice
IS 1786-2008		Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
IS:800:2007/2024(amd.)		Code of Practice for General Construction in Steel
SP 16:1980		Design Aids for Reinforced Concrete to IS 456
SP 34:1987		Handbook on concrete reinforcement and detailing
IS 3370 (Part 1):2021 General Requirements		Concrete Structure for Storage of Liquids- Code of Practice
IS 3370 (Part 2):2021 Reinforced Concrete Structure		Concrete Structure for Storage of Liquids- Code of Practice
IS 3370 (Part 4):2021; Design Tables		Concrete Structure for Storage of Liquids- Code of Practice

- Being an essential/critical facility (Hospital, Importance Factor 1.5 shall be considered), the structure is designed to remain functional after the design earthquake. Storey drift is limited per IS 1893 Cl. 7.11, and non-structural elements (infill walls, doors, glazing and utility-line fixtures) are detailed for the design drift with appropriate movement/separation joints per NDMA guidelines so that they remain serviceable post-event.

8. DESCRIPTION OF THE STRUCTURE AND STRUCTURAL SYSTEM

HOSPITAL BLOCK

The proposed building at BRAHMAPUR, ODISHA, consists of (B+G+10) Hospital Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

ELECTRICAL SUB STATION (ESS) – A

The proposed building at BRAHMAPUR, ODISHA, consists of (B+G+2) Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

INDOOR STADIUM BLOCK

The proposed building at BRAHMAPUR, ODISHA consists of (B+G+1) Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

SURGEON GENTS HOSTEL (150 UNITS) + GUEST HOUSE (25 UNITS)

The proposed building at BRAHMAPUR, ODISHA, consists of (B+S+8) Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

SURGEON LADIES HOSTEL (150 UNITS)

The proposed building at BRAHMAPUR, ODISHA, consists of (B+S+7) Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

UG GIRLS HOSTEL (300 CAPACITY)

The proposed building at BRAHMAPUR, ODISHA, consists of (B+S+12) Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

RESIDENCE - TYPE IVA (52 UNITS)

The proposed building at BRAHMAPUR, ODISHA, consists of (B+S+13) residence Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

RESIDENCE - TYPE IVB (52 UNITS)

The proposed building at BRAHMAPUR, ODISHA consists of (B+S+13) residence Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

RESIDENCE - TYPE II A (52 UNITS)

The proposed building at BRAHMAPUR, ODISHA consists of (B+S+13) residence Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

RESIDENCE - TYPE IIB (52 UNITS)

The proposed building at BRAHMAPUR, ODISHA, consists of (B+S+13) residence Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

CLUB HOUSE

The proposed building at BRAHMAPUR, ODISHA, consists of (B+G+3) residence Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

PHARMACY COLLEGE (180 ADMISSIONS ANNUALLY)

The proposed building at BRAHMAPUR, ODISHA, consists of B+G+5 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

BOYS HOSTEL PHARMACY (288 CAPACITY)

The proposed building at BRAHMAPUR, ODISHA, consists of B+G+13 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

GIRLS HOSTEL PHARMACY (192 CAPACITY)

The proposed building at BRAHMAPUR, ODISHA, consists of B+G+9 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

DENTAL COLLEGE (77 ADMISSIONS ANNUALLY)

The proposed building at BRAHMAPUR, ODISHA, consists of B+G+7 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

BOYS HOSTEL DENTAL (152 CAPACITY)

The proposed building at BRAHMAPUR, ODISHA, consists of B+G+11 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

GIRLS HOSTEL DENTAL (152 CAPACITY)

The proposed building at BRAHMAPUR, ODISHA, consists of B+G+11 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

ELECTRICAL SUB STATION (ESS) – B

The proposed building at BRAHMAPUR, ODISHA, consists of G+2 Building. Framing systems consists of columns, beams, slabs to resist both vertical & lateral loads. Brickwork of 250mm and 125mm have been used as wall element. The typical floor height is as per architectural drawings in building.

Combined Basement

Following are the buildings with combined basement:

- HOSPITAL BLOCK & ESS A
- RESIDENCE TYPE: IV A & TYPE: IV B
- RESIDENCE TYPE: II A & TYPE: II B

Apart from the above, please refer to the drawings provided in Section-8 for information regarding combined basement blocks.

9. METHOD OF ANALYSIS

a. Building should be modeled as a ductile RCC moment resistant framed structure. Dynamic analysis should be carried out as per IS 1893:2016. The framing arrangement and design of Beams & Shear walls shall be performed using ETABS.

b. All the RCC columns of the building should be supported on properly designed foundations as per the bearing capacity as per the soil investigation done by the Contractor. The foundation should typically designed for the reaction obtained from predominant load case, by using hand calculation & SAFE software.

c. Serviceability & strength checks of foundation & members have been carried out as per IS 456: 2000.

10.ALLOWABLE DRIFT AND DEFLECTIONS

10.1 Allowable Deflections (As per Clause No. 23.2 of IS456: 2000)

a. The final deflection due to dead loads and live loads (un-factored) including effect of temperature, creep & shrinkage measured as cast levels of supports shall not be more than Span/250.
b. The deflection including effects of temperature, creep & shrinkage after erection of partitions and the application of finishes shall not be more than span/350 or 20mm, whichever is less.

10.2 Lateral Frame Deflection (Story Drift) Under Seismic Load as per Clause 7.11.1.1 of 1893 (Part-1):2016.

Storey Drift in any storey shall not exceed 0.004 times the storey height, under the action of design base of shear V_B with no load factors.

10.3 Lateral Strength and Lateral Stiffness (As per Clause 7.10.3 of 1893(part-1):2016)

a. Lateral Stiffness in the open storey shall not be less than 80% of that in the storey above.
b. Lateral Strength in the open storey shall not be less than 90% of that in the storey above.

10.4 Modes of Oscillation in Two Principal Plan Directions (As per Clause 7.1 Table 6 (vii) of1893 (part- 1):2016)

It shall be ensured that the first three modes together contribute at least 65% of the Mass participation factor in each principal plan direction. This criterion shall be verified from the STAAD/ETABS modal-analysis output and satisfied for each seismic run in the final design.

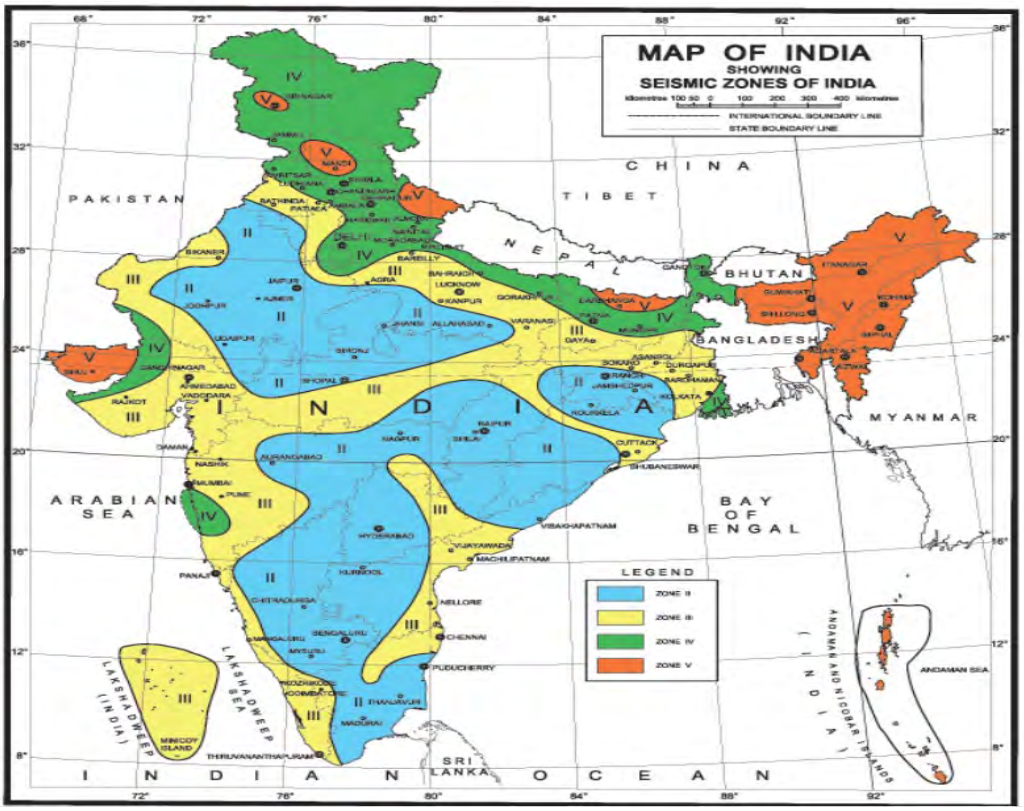
11.SOFTWARE TO BE USED (Optional)

ETABS & SAFE (latest edition), a Product of Computers and Structures Inc. & STAAD Pro(latest edition) a product of Bentley Engineers, along with hand calculations, have been used for the analysis & design of the structure.

12. SEISMIC AND WIND DESIGN CRITERIA SEISMIC DESIGN CRITERIA:

Seismic loads are calculated as per provisions of IS: 1893-2016.

Brahmapur is in seismic zone III as per IS 1893:2016 seismic zone map.



Seismic loads are calculated as per provisions of IS: 1893-2016. The parameters selected are given below:

Parameter	Value
Z - i.e. Zone Factor	0.16 (For zone III)
I - Importance Factor	1.5 (Hospital) / 1.2 (other buildings)
R - Response Reduction Factor	5 (SMRF)
Soil Type	Type-2
Analysis type	Dynamic analysis

Fundamental natural time period should be taken as T_a =0.09h/√d as per Clause 7.6.2 of IS: 1893-2016, for R.C.C Frame Building. h = Height of building in meter & d = base dimension of building at the plinth level along the considered direction of earthquake shaking in meter. Response Spectrum reduction factor should be taken as 5.0 from Table-9 of IS: 1893-2016 for Moment Resisting Frames. The time period of the structure shall be worked out using software.

The building shall be designed for base shear based on BIS code where time period is in accordance with clause 7.7.3 of IS: 1893-2016 using modification factor = $\bar{V}B/VB$ where $\bar{V}B$ is calculated base shear based on BIS code, the time period Ta =0.09h/√d and VB is calculated base shear based on time period generated by software. The horizontal earthquake force should be calculated for the full dead load & Reduce live load as per clause 7.3.1 Table-10 of IS: 1893-2016.

Importance Factor of 1.5/1.2 should be considered as per Clause 7.2.3(ii) of IS 1893:2016.

*** The stiffness modifier as per IS 1893:2016 shall be applied during designs and serviceability analysis.**

WIND DESIGN CRITERIA:

Wind loads should as per IS 875 (Part 3) – 2015

13.LOADS:

13.1 Density of Materials

Self-weights of materials are calculated using the unit weights in provided IS 875-Part1. As a guide the following unit weight allowances shall be used where appropriate:

MATERIAL	DENSITY
Reinforced Cement Concrete	25 kN/m^3
Plain Concrete	24 kN/m^3
Structural Steel	78.5 kN/m^3
Ceramic tiles	20 kN/m^3
Sand/Cement Screed	23 kN/m^3
Unit weight of dry soil	18kN/m^3
Unit weight of saturated soil	20 kN/m^3
Unit weight of water	10 kN/m^3
Brick Masonry (Walls)	19 kN/m^3
Floor Finishes / Plasters	20 kN/m^3
Solid Concrete Blocks	20 kN/m^3

The self-weight of structural elements will be calculated based on the member geometry and material densities mentioned above.

Vertical Loads shall include the Dead Loads due to weight of the structure itself, finishes, interior partition walls, interior infilled wall panels, stairways, shafts, etc., and appropriate Live Loads as per IS 875, Part 2.

An additional Dead Load of 0.5kN/m2 (min.) shall be considered for installation of Solar Panels on the roof slab or as per Manufacture details whichever is higher.

13.2 Live load

The Superimposed Dead and Live Loads shall be applied in the respective areas as per occupancy defined in Architectural intent, according to use loads given as per IS 875 (Part 2) should be considered for designing.

Open Terraces		
Load Component	**Thickness (mm)**	**UDL (kN/m^2)**
Water Proofing	150	3
Floor Finish	50	1
Live Loads	-	1.5

X-ray Room, Pharmacy Room, Library, Research Lab Staff room, Exam Room, Reception, Waiting Hall, Medication Room		
Load Component	**Thickness (mm)**	**UDL (kN/m2)**
Floor Finish	60	1.5
Services		1.5
Live Loads		4

CORRIDORS / LOBBY		
Load Component	Thickness (mm)	UDL (kN/m^2)
Floor Finish	60	1.5

Services	-	0.6
Live Loads	-	4

STAIRCASES		
Load Component	Thickness (mm)	UDL (kN/m^2)
Steps	Risers and Treads as per Arch	2.0
Finishes	-	1.0
Live Loads	-	4.0

Balconies		
Load Component	Thickness (mm)	UDL (kN/m^2)
Floor Finish	50	1.3
Filling (Light weight Material)	125	1.25
Live Loads	-	4.0

TOILETS		
Load Component	Thickness (mm)	UDL (kN/m^2)
Filling (Light weight Material)	150	1.5
False Ceiling & hung Services	-	0.6
Live Loads	-	2.0
Floor Finish	50	1.4

Description	Load

Car Parking (Live load)	Single stack-2.5kN/m^2 Double stack-5.0kN/m^2
Fire tender	For 60 Ton need to taken in consideration .

13.3 Heavy Floor or Ceiling Mounted Items

Following machine load considered on floors while designing of structure.

1) MRI – Machine weight of 10-12 tons.
2) CT – Machine weight 3 Tons
3) General Rad – 2 to 2.5 Ton approx. with combination of ceiling and floor mounted
4) Fluoro – 3 ton approx. with combination of ceiling and floor
5) Cath labs/ interventional labs – 2 to 2.5 Ton approx. with combination of ceiling and floor mounted
6) ORs– ceiling mounted booms and lights with maximum load of 400 kg on each boom and lights.
7) Trauma & Resuscitation rooms in Emergency dept -Ceiling mounted booms and lights with maximum load of 400 kg on each boom and lights.
8) Endo procedures – Endo procedure rooms may have ceiling mounted booms.
9) Intraoperative MRI – It would have MRI moving either on ceiling or on Floor depending on configuration decided later.

Manufacturer's manuals/specs/brochures of specialized medical equipment shall be referred to incorporate the loading and other vibration criteria while designing the localized member as well as its cascading effects on other structural members.

13.4 Vibration on floors:

Suitable provision in the design shall be made to cater dynamic effect of live loads, Impact loads, Vibrations on due to machinery operating loads. Floor shall be checked for vibration as per the ISO 10137.

The design provisions should take account of the nature and intended use of the structure, the potential number of people and their possible behavior. Structural design should be undertaken with the help of specialist advice and specialist guidance documents such as SCI Publication P354 and BS 6399 (there being no dedicated IS floor-vibration code), with acceptance limits appropriate to hospital environments. Specialist guidance documents referred include SCI P354, ISO 10137, AISC Design Guide 11, Eurocode EN 1990/1991 and equipment-manufacturer vibration criteria as required by the appropriate certifying authority.

The dynamic effects caused by the operation of medical equipment which depends on the type of equipment and the form of the building structure. Designers should seek specialist guidance and consider the dynamic loads and the potential resonant excitation of the occupied floor/structures. Vibration disturbance to patients, staff and equipment needs to be considered in the structural design to ensure that vibration is limited to an acceptable level. Relevant clauses of BS6399 (part1), SCI PUBLICATION P354, Eurocode EN:1990 and EN:1993 shall be referred from the latest versions.

13.5 Tower Crane Loads

During construction the contractor shall supply the design for tower-crane and any other crane-system loads. In addition, the structure should be checked for erection and temporary construction load cases (form work, material stacking, construction equipment and partial-structure stability). The Engineer will review these designs & drawings.

14. LOAD COMBINATIONS FOR CONCRETE DESIGN OF STRUCTURAL ELEMENTS

Basic load cases are as below.

DL: Dead Load

LL: Live Load

WL: Wind Load

EL: Earthquake Load

TL: Temperature Load TL+ & TL-

Considering X & Z as orthogonal directions in plan

WL are WLX+, WLX-, WLZ+ & WLZ-.

EL are ELX, ELY, ELZ.

Response spectrum 3D analysis to be done.

Where EL = +/- ELX +/- 0.3 ELY +/- 0.3 ELZ

+/- ELY +/- 0.3 ELX +/- 0.3 ELZ

+/- ELZ +/- 0.3 ELX +/- 0.3 ELY

Where Structural members are in orthogonal directions, addition of orthogonal horizontal seismic forces in plan is not required, however vertical seismic forces to be considered.

Any other basic load cases such as Crane load, Impact loads, Equipment loads, Friction loads etc applicable on structure to be considered as per applicable relevant codes.

Limit State of Serviceability Load Combinations:

Load Combination	LOAD FACTORS			
	DL	LL	WL/EL	TL
DL+LL+TL	1.0	1.0	-	1.0
DL+WL+TL	1.0	-	1.0	1.0
DL+EL+TL	1.0	-	1.0	1.0
DL+LL+WL+TL	1.0	0.8	0.8	1.0
DL+LL+EL+TL	1.0	0.8	0.8	1.0

Limit State of Collapse Load

Load Combination	DYNAMIC LOAD FACTORS			
	DL	LL	WL/EL	TL
DL+LL+TL	1.5	1.5	-	1.5
DL+WL+TL	1.5 OR0.9	-	1.5	1.5
DL+EL+TL	1.5 OR 0.9	-	1.5	1.5
DL+LL+WL+TL	1.2	1.2	1.2	1.2
DL+LL+EL+TL	1.2	1.2	1.2	1.2

Earthquake and wind loads are reversible.

If Slabs are modelled in 3D analysis software, slabs to be designed for forces and stresses from Software, & hand calculation, whichever critical.

15.**DETAILING OF STRUCTURE**

Detailing of all structural members shall be carried out as per the various clauses and provisions of the relevant IS codes. Ductile detailing shall be done in accordance with IS13920:2016. The Detailing ensures compliance with minimum R/F requirements, minimum and maximum spacing of bars.

For Beam - Longitudinal R/f- p min = $0.24\sqrt{f_{ck}}/f_y$ (Minimum R/F required in any face of beam) (maximum clear distance between bar shall be 150mm at tension face)

- Shear R/f - A_{sv}= 0.12% for Fe 415B
- S_v (Maximum spacing - 0.75d of or 300mm
- Side Face R/f - when web of beam (excluding slab) is more than 750mm, 0.1% of beam area shall be distributed equally on two faces.

- Spacing shall not exceed with width or 300mm.
- Side face R/f shall also be provided for beams of depth 450 mm, where beams are subjected to torsion as per clause 26.5.1.7.b of IS456:2000.

For Slab - Minimum R/f - 0.12% of total cross-sectional area. Spacing of bars - 3d or 300 mm c/c.

Columns -Minimum R/f - 0.8% of area of column section or boundary Element required to resist direct stress. At upper levels, due to symmetry column sizes are not reduced. But R/F requirement are minimum, thus 0.6% of total cross section area shall be provided.

Shear Wall - Minimum R/f - 0.4% of total cross-sectional area in both directions.

Isolated Footing - Minimum R/f - 0.12%/ 12φ 300 c/c at top when depth of footing is more than 900mm.

Raft - Minimum R/f - 0.12% of cross-sectional area for Top & Bottom mat.

Retaining Wall - Minimum R/f - 0.12% of cross-sectional area as vertical R/f. 0.2% of cross-sectional area of horizontal R/f equally divided on each face.

Retaining wall is designed for Earth, Surcharge load, water pressure and Fire tender load . All the limit state and serviceability criteria shall be met, keeping in view of high water.

Water Retaining Structures: All Water Retaining Structures shall be designed using the Limit State Method of design. The design shall meet the special requirements laid down in IS 3370 and IS 1893 (Part 2), besides the general provisions contained in IS 456, IS 4326 and IS 13920.

In all members of the Structure, the Design Surface Crack width shall be limited to 0.1 mm as per IS 3370 (Part 2):2009, under the worst combination of loads. This requirement should be met for both inside and outside faces.

Expansion/ Contraction Joints shall be provided in all Structures in accordance with relevant IS Codes, viz., IS 3370, IS 456, and IS 1893

16.STRUCTURAL DESIGN OF NON-FRAMING ELEMENTS

Design of non-framing elements shall be done as follows:

- Structural Glazing: Structural glazing shall be designed for all applicable loads including wind Earthquake Thermal etc.
- Architectural Features: All architectural features shall be designed & loading for same shall be applied on main building.

Miscellaneous point:

- The design life of structure is considered as 50 years.
- The limiting vertical deformation of all horizontal elements are as per IS 456-2000.
- The contractor needs to visit the site & go through available soil report for dewatering and should design & execute earth retention system (shoring piles, sheet piling, D wall, etc.) if required

17.**DESIGN & DETAILING OF RCC STRUCTURE**

The design of RCC Slab has to be done using IS: 456-2000 using limit state method of structure design. RC Ductile Structural walls and beams have been designed using ETABS software.

Ductile detailing has been done using IS 13920-2016. SP-34 and standard engineering practice has been used wherever necessary for detailing of structure.

18.**GENERAL NOTES**

General Notes for RCC work are written in each drawing and has been supplied along with working drawings. The following are included in the notes:

a. Notes on reinforcement.
b. Development length and lap length of reinforcement based on grade of steel and grade of concrete.
c. Cover to reinforcement.

19.**EXPANSION/SEPARATION JOINTS**

Keeping in view, the irregular shape in plan of structure, separation joints are proposed so as to maintain regularity in shape. Expansion gap / joints shall be provided around suitable areas and multi-storey buildings to avoid temperature stresses during construction.

Suitable Expansion joint shall be provided in concrete structures to safely enable the movement of structure mainly caused due to change in temperature, sway caused by wind, seismic events and static load deflections. All relevant latest codes shall be referred to calculate the gap required to fulfill the governing criteria, i.e., IS:1893, IS:16700, IS:456 etc.

The separation between two adjacent structures shall be as per Clause 7.11.3 of IS 1893:2016.

20.**DESIGN SUBMISSIONS**

The contractor shall be wholly responsible for the complete, thorough, and safe design of all structures, correctness of design and drawings, even after the approval of the same by the Approving Engineer or his representative.

Complete detailed design calculations of foundations (including piling where required) and superstructure together with general arrangement drawings and explanatory sketches (if required) shall be submitted to the Engineer for review and acceptance. The submitted design report shall contain the sound basis of every assumption considered in the design. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Engineer. All calculations to be produced in MS Excel sheet or equivalent calculation software. No handwritten documents are permitted.

Calculation documents must have following detailed information as minimum.

- Front page of calculation document to have Client name, project name, Document name, document no, Revision no, Prepared by Checked by and approved by Name and signature.

- Second page to have Table of Contents.

- All units to be in SI unit (kN, m, mm etc.).

- Introduction, Scope of work, Design specifications, all reference data such as approved Architectural drawings with document nos & Rev nos (to be added in annexture), Parts of soil report used for design, Codes used, Design deliverable list and Structural arrangement sections to be provided.

-All basic load cases matching software to be added. All applied load detail calculation to be provided with all code and clause references.

-All load combinations.

-Checklist of all clauses of seismic code IS1893 and other applicable codes and guidelines etc.

- Design results, structure total base reaction under each basic load case, Detail strength and serviceability checks as per codes.

- Detail foundation design from structure reaction table to foundation detailing information and design checks.

- Any reference used from code/agreement etc to be indicated with specific clause/page/table/figure etc.

Document Numbering shall be as below:

- All Structural design deliverables file shall have same name as document no.
- File naming shall be as below.
- OBCC-ABCD-NN-XYZ-NNNN_ANN

ABCD: Project Name/No.

NN: Structure name in numerical. 00 for general and 99 for miscellaneous drawings and documents.

XYZ: CAL for Calculation document, CIV for RCC drawings & STR for Steel structural drawings.

NNNN shall be document in numerical.

ANN shall be Revision no. (A00, A01 etc for Deliverables for approvals, R00,R01 etc for GFC, S01, S02 etc for as built.)

Document must be revised for next revision before sending. Revised drawing must have changed portion in clouds. Any portion under HOLD shall be marked HOLD with inverted cloud.

Vetted design deliverables shall be submitted to OBCC & PgMC for approval. OBCC & PgMC shall be marked while sending design deliverables to vetting authority. All deliverables (Design files, drawings, Calculation document) for any structure shall be submitted together for approvals.

All documents shall be uploaded on Employer approved PMIS with proper PDF document and all native files and design files (in .zip if more than one file) against each document no on approved documentation PMIS with proper transmittal.

No redesign/ optimization shall be allowed after submission of documents for review/approvals. Redesign requires rework by Client/PgMC and delays project schedule.

O. MEPF Scope (MEPF Design Basis Report)

i. Electrical DBR

ii. Plumbing DBR

iii. Fire DBR

iv. HVAC DBR

v. ELV DBR

vi. Medical Services

ELECTRICAL WORKS

1. Introduction

Electrical Power Supply and Distribution System are essential for the safe operation of the building during utility normal power, utility power failure and emergency operation periods.

The key design objectives of the electrical supply and distribution system for this project are listed below to achieve the following:

- Provide cost-effective, energy efficient and easily maintainable systems.
- Provide reliable and adequate power supply to maintain the development's operation at all times.
- Develop safe, reliable, maintainable, energy efficient, user-friendly controls, and economical electrical installation for the project.
- Maintain occupant's safety and comfort, client's personnel, and equipment in a safe operating environment.
- Ensure the design and installation is safe for operation and in compliance with the Codes of Practice at par with the National Building Code of India and all relevant Codes and Standards.
- Promote a consistent and uniform design approach and standardize the types and quality level of equipment to be specified.
- Establish a uniform basis for selection and specification of equipment and materials.
- Present uniform methods for identifying and maintaining material and equipment inventories required for preparation of drawings and specifications.
- Provide a means of interdisciplinary design interfacing through the use of standardized approaches.
- Provide a means of incorporating Client's input with respect to items of preference and operating requirement.
- Produce a design that will be easy to build and economical to construct and operate.

2. Scope of Work

The electrical services scope of works for the project includes the following:

a. Provision (civil work for concrete trenches is in the scope of the Turnkey Contractor) for Incoming 33/11KV as per availability of power supply of MKCG Dental Block, HT Cables from boundary wall to the substation located in service block. The incoming 33/11 KV HT cable along with 33/11 KV HT meter shall be provided by DISCOM in HT meter room.
b. Two substation blocks of 33/11 KV to be made for distribution of power for Hospital, Pharmacy & Dental blocks.
c. From Meter Room to respective ESS 33/11 KV supply shall be provided through 2 nos. HT cables connected to respective ESS RMU, from RMU to HT panel single HT cable.

    1) ESS-A for Hospital, Surgeon, UG Girls Hostel and external area including EV charging points, External lighting, landscape lighting, and any external features

as per site requirement, etc.

2) ESS-B for Dental College, Pharmacy, Residential Blocks, Hostel blocks, and external area including EV charging points, External lighting, landscape lighting, and any external features as per site requirement, etc.

d. From respective ESS HT panel to 33 /0.433 KV transformer/s located in substation and to respective Compact Sub Station for Girl's hostels & Surgeon Ladies Hostel (CSS 1) and Boy's hostel & Surgeon Male Hostel (CSS 2) as given in load sheet below in this document.
e. Copper conductor Sandwich type Bus-duct feed from 3150 KVA, 33 or 11/0.433 KV transformer & 2000 KVA DG sets to Main panel located in substation and XLPE cable feed from 33 or 11/0.433 KV CSS & DG sets to Main panel located in Near Building as per location in drawing Dental block, Girl's hostel, Boys hostel.
f. Substation equipment like HT Panels, Transformers, LT Panels, Hybrid capacitor Panels and all associated works for MKCG Hospital block and Residential Block.
g. DG sets for 100% power backup for College Block and 30% for Residential Common area / utilities and 50% for Service Blocks.
h. Main Power Distribution Network from Substation to MKCG Dental College block and Residential Blocks through RCC trench/ HDPE (DWC) pipes.
i. All residential unit shall be provided raw power through smart prepaid meter all as per norms of local State Electricity Board (DISCOM).
j. Inverter for emergency lighting.
k. UPS for Medical Equipment and fire safety equipment, ELV, 10%of Common Area lighting.
l. Lighting / Lighting automation as per Green Building requirement
m. General lighting for Basement, Common Areas
n. Lightning Protection System as per latest NBC
o. Earthing and T-N-S grounding system
p. External Lighting
q. Vertical Transport system (Lifts)
r. Fire alarm and detection system & PA System
s. CCTV system
t. Access Control System
u. Fire Suppression System
v. Asset Management System
w. Parking Management System
x. AV System
y. Data/ voice – Passive Networking
z. Command and control room

3. Incoming Supply Source

This concept report is based on the following assumptions.

33KV or 11KV as per availability of incoming supply will be received from State Electricity Board (DISCOM) with two nos. of independent source by putting RMU which shall further supply power to the MKCG Dental block and Boys & Girls Hostel.

S. No.	Description	Location
1.	a) ESS A - Minimum 4 Nos. 3150 KVA, 33 or 11/0.433 KV, (3W + 1S) Oil type transformers with on load tap changer with RTCC panel for Hospital, and external area including EV charging points, External lighting, landscape lighting, and any external features as per site requirement, etc. shall be provided	Ground floor of Service block
	b) For Surgeon Ladies Hostel & UG Girls Hostel minimum 2 Nos 1000 KVA, 33/0.433KV (1W+1S) Compact Substations shall be provided.	In respective Zone
2.	a) ESS B - Minimum 4 Nos. 2000 KVA, 33 or 11 /0.433 KV, (3W + 1S) Oil type transformers with on load tap changer with RTCC panel for Dental College, Pharmacy College, and external area including EV charging points, External lighting, landscape lighting, and any external features as per site requirement, etc. shall be provided.	Ground floor of Service block
	b) For Surgeon Male Hostel and Boys Hostels (Pharmacy & Dental) **minimum 3 no.s 1500 KVA** , 33/0.433KV (2W+1S) Compact Substations shall be provided	In respective Zone
	c) For Residential Blocks (Pharmacy & Dental) minimum 2000 KVA, 33 or 11 /0.433KV (1W+1S) Compact Substations shall be provided BY DISCOM AS PER SITE REQUIREMENT.	

All Panels shall be TTA Panels (tested Assembly) as per IEC 61439 as per technical specifications. All Tested Assemblies shall be smart type having switchgears (ACB, MCCB) communicating their release data over Ethernet.

Main LT Panel, DG Essential Panel, HVAC Panel shall be DESIGN VERIFIED (IEC-61439-1 & 2) panels of , Lauritz Knudsen (Ti), Schnider (Blockset), Siemens (Siepan 8pu), ABB(ArTu K) and shall have fire suppression system arrangement.

The Other LT Panel Manufacturer Enclosure plant shall be based in Odissa or shall have own maintenance facility in Odissa.

HT Panel shall have at least one spare breaker provision, the HT Panel OEM/ HT Panel Manufacturer shall have it's Plant in Odissa or shall have own maintenance facility at Odissa.

All Equipment shall be as per DISCOM make list & TDS shall be as per their Standards.

The switching of incoming & outgoing circuits up to 630 amps shall be moulded case circuit breakers and above 630 amps shall be air circuit breakers. Al bus bar shall be provided for all power distribution panels and for all motor control centers. All MCCB must be microprocessor based.

The Panels should be ethernet ready suitable for monitoring and control with BMS/ SCADA System. Suitable BMS Integration Cards shall be provided to achieve BMS compatibility of HT & LT Panels. Trenches with suitable width & depth shall be provided for below HT/LT/ Hybrid APFC Panels/DG Panels etc. for Laying of HT/LT Power & Control Cables. Substation shall comprise of all ancillary equipment like Battery Charger etc. Suitable size MS Checkered Plates, duly painted of minimum thickness 6 mm shall be provided for trenches inside the panel room as required. Hot Dip Galvanized Cable trays of suitable size shall be used as required.

All armored HT/LT power cables, control cables, telephone cables, signal cables etc. shall be laid underground, preferably along the roads & pathways at suitable depth as per CPWD specifications. Adequate no. of Hume pipes/ DWC HDPE Pipes having suitable diameter with spare shall be laid across the roads/pathways etc. with inspection chamber at suitable internal.

Maximum allowable transformer losses at 50% & 100% load shall comply with ECBC Super category. All Substation/HT/LT Panel Rooms/Floor panel Rooms shall be provided with safety equipment/items like suitable insulating mat (as per relevant IS codes), fire buckets, fire extinguishers, hand gloves, danger plates (HT/LT rating), safety charts, framed Schematic/SLD etc. Suitable civil foundation/ trenches etc. for all substation equipment shall be provided as per design load of respective equipment.

All LT Panels shall have 20% spare outgoing feeders for different ratings of feeders.

To prevent storm water entering the transformer and switch rooms, the floor level of the

substation/ switch room shall be at least 300 mm above the highest flood water level that may be anticipated in the locality or as directed by Engineer in charge.

There will be concrete trench for HT line to the substation building for laying the cable with adequate size with provision of 50 % extra space. And for LT cable running on the site plan, there will be concrete trenches with adequate space with provision of 50 % extra space.

4. Standby/ Emergency Power Supply

100% DG backup shall be provided for the complex.

The location of DG sets shall be at ground level of the service block. The rating of DG sets shall be as follows:

S. No.	Description	Location
1.	a) With ESS A - 4 Nos. (3W+1S) 2250 KVA, 415V DG set shall be provided for emergency power backup.	ESS A (Ground floor of Service block) outside
2.	b) With CSS 1 - 2 Nos. (1W+1S) 320 KVA, 415V DG set shall be provided for emergency power backup.	In respective Zone
	a) With ESS B - 3 Nos. (2W+1S) 1500 KVA, 415V DG set shall be provided for emergency power backup.	ESS B (Ground floor of Service block) outside
	b) With CSS 2 - 3 Nos. (2W+1S) 320 KVA, 415V DG set shall be provided for emergency power backup.	In respective Zone

All DG sets shall have an individual Day Oil tank of 990 liters. Diesel Buffer tank with at suitable height for gravity feeding of diesel supply to each DG Day oil tank (Float valve arrangement for controlling) to be provided. Automatic diesel feeding system from HSD Pumping system to diesel buffer tank shall be considered.

Emergency Power Back Up for Residential Blocks shall be provided from ESS-B.
Panels for Type-2 (A&B) and Type-4 (A&B) shall be provided with ATS and provision for connecting supply from DISCOM/SEB and catering to Common Area lighting, Lifts, UPS for (CCTV & Networking), Terrace Pump for Fire Fighting & Booster pump for water supply. For Playground Electrical works the power supply for the Electrical panel placed in the electrical room, shall be supplied from the ESS-B Essential panel.

DG set Exhaust Stack height shall be as per CPCB/ CPWD/ Local Bye-Laws standards. DG Set exhaust emission norms shall meet applicable norms at the time of installation. Exhaust pipes

shall cross the road on suitable steel structure with minimum 6-meter vertical clearance for fire tender movement at required location.

DG set Exhaust Stack shall run vertically along the MKCG Dental block building inside external shaft with louvers for heat dissipation.

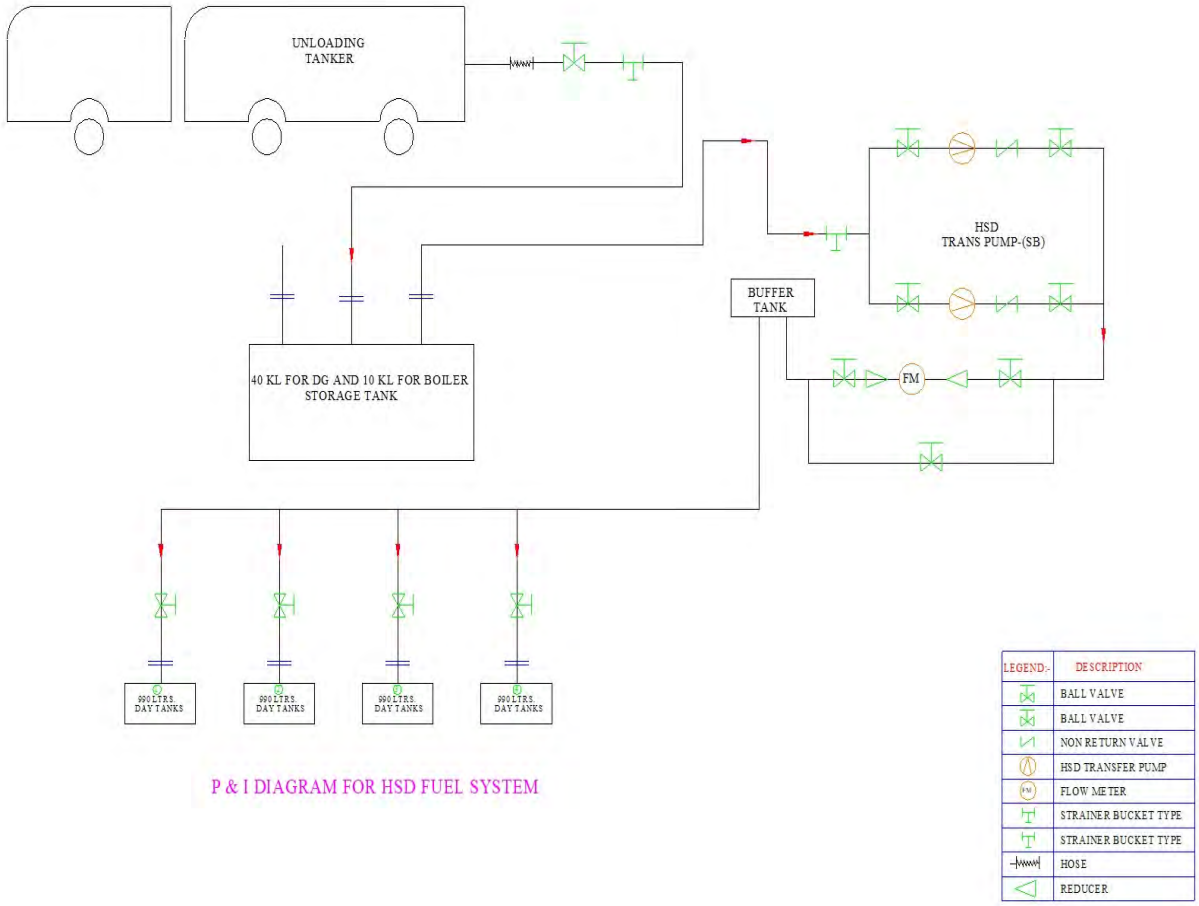
5. HSD Storage

Underground HSD oil storage tank of 50 KL +15 KL = 65 KL for DG sets installed at ESS A and CSS 1, planned for minimum 4 hours per day for 7 days storage and Underground HSD oil storage tank of 45+15= 60 KL for DG sets installed at ESS B and CSS 2 planned for minimum 4 hours per day for 7 days storage of High-Speed Diesel. The oil tank yards will be designed as per IS 10987 and Petroleum rule 2002.

HSD Storage Tank & Pumping System shall be provided by the Turnkey Contractor for continuous pumping of HSD to the DG Sets installed in service block. Underground HSD tanks shall be located as per CPCB/NFPA/CPWD/Local bylaws. Underground Diesel storage tank along with Auto fuel transfer system comprising of suitable number and capacity of fuel pumps (working & standby) with underground pipeline from underground diesel tank up to the buffer diesel tanks in DG room shall be provided. Fuel Transfer Pumps shall be flame proof, rotary gear, positive displacement type or as required for HSD pumping application. Underground tanks, buffer tanks, piping, fuel pumps, valves, cabling, control/ level switches, earthing etc. has to be provided as per CPCB/NFPA/CPWD/Local bylaws.

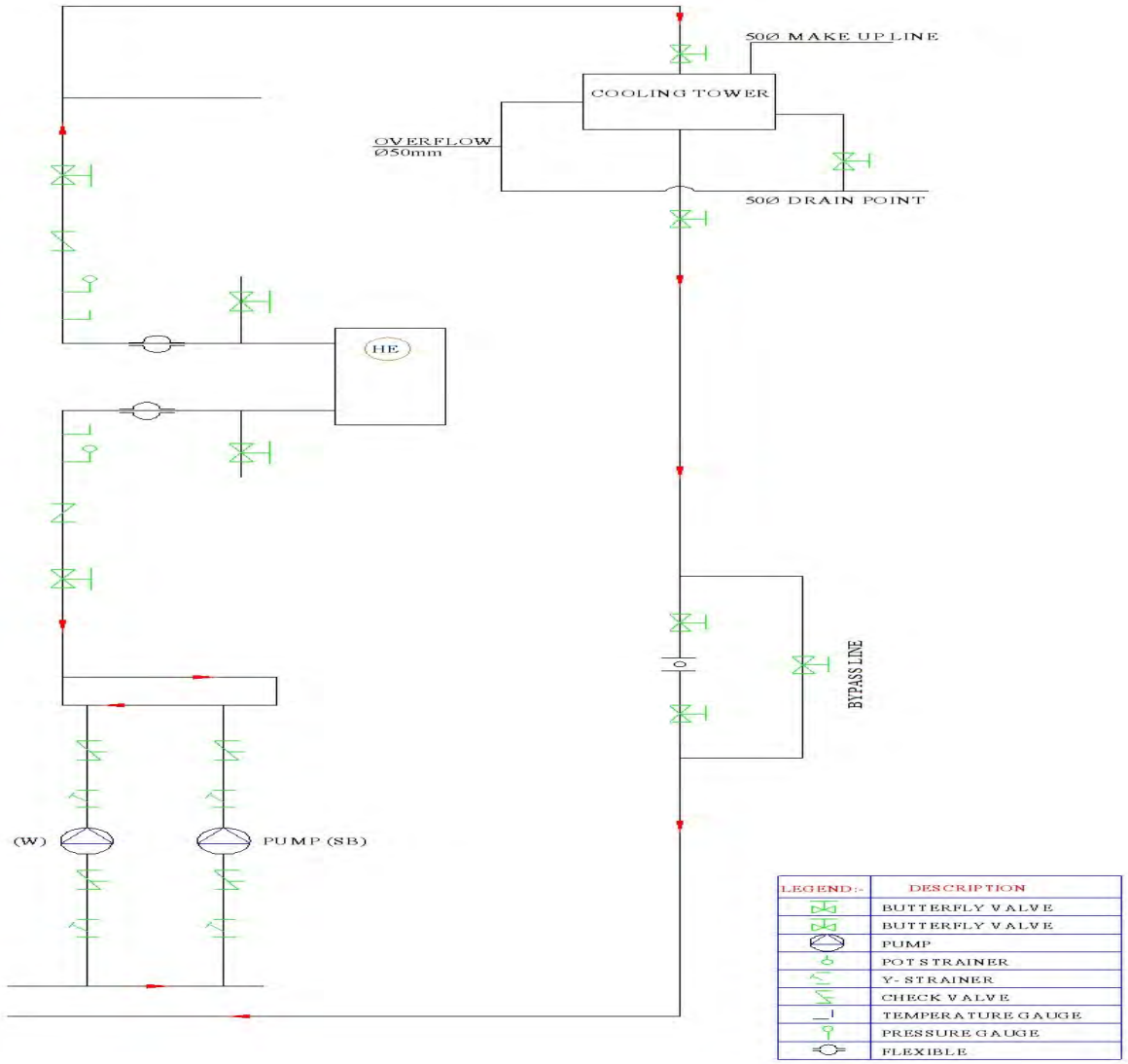
The supply of first fill of HSD Tanks, Buffer Diesel Tanks and DG Set fuel tanks shall be included in the scope of works. The first fill of HSD fuel shall be provided up to rated capacities of all diesel tanks. A suitable level Transmitter shall be fitted on top of each tank to give continuous level status to SCADA.

Necessary licenses or approvals for diesel storage shall be obtained before installation of UG diesel storage tank and pumping station from Local Administration and Chief Controller of Explosives, Petroleum & Explosives Safety Organization.



P & I DIAGRAM FOR HSD FUEL SYSTEM

ABOVE DIAGRAM IS INDICATIVE ONLY FOR REFERENCE



P & I DIAGRAM FOR DG SET COOLING WATER

ABOVE DIAGRAM IS INDICATIVE ONLY FOR REFERENCE

6. SCADA SYSTEM

The SCADA System comprising of complete Hardware, Software, wiring & cabling etc. alongwith facility to hook up/integrate through BMS communication cards shall be provided by the Turnkey Contractor in Substation This system shall be monitor & control various Electrical parameters of all Substations equipment like DG sets (Engine/Alternator Parameters, Synchronizing Relay/ PCCM parameters, Fuel Level etc.), Transformer (Temperature Parameters, RTCC panel etc.), HT/LT panels (VCB, ACB, MCCB, Energy Meters etc.) Capacitor Panels (APFC relay parameters, Harmonic filters monitor panel parameter etc.), HSD Storage & pumping system (Level of Storage tanks, Buffer tanks, Pumps etc.). It Should also have inbuilt Energy Management System complying to Align with energy efficiency, green building standards (e.g. ISO50001/2, SEP, LEED, NABERS), track energy performance indicators (EnPI) as per ISO50006, Verify utility/grid service and internal compliance to power, quality standards (e.g. EN50160, IEEE519, ITIC), Ensure regulatory compliance with backup power system testing (e.g. healthcare NFPA110 and others), comply with IT best-practices, align with cybersecurity best practices.

7. Power Factor Correction

Real time Hybrid Automatic power factor control panels with ultra-heavy-duty capacitors, IGBT/ switched, Hybrid/ harmonic filters (Active & Passive) are proposed to be provided in the substation to achieve overall power factor 0.99 (lagging) from existing Power Factor, as per ECBC with operation in both Auto and Manual mode. Power factor Correction Panel shall be BMS Compatible. The capacitor panels with Hybrid Harmonic filters shall be provided to achieve THD less than 3%. Connection from Main LT Panel to Capacitor Panel to be provided through Aluminium sandwich bus duct. Hybrid panel should be totally type tested as per IS 16636:2017, IEC 61921, IEC 61439.

8. Electrical Load Calculations

The total load demand is estimated based on area (watt per Sq. Ft); detail can be seen in load schedule however it may be noted that this is only for guidance and the contractor shall work out their own detailed loads, which may vary from the ones provided in this report and shall get the same approved by the consultants/ clients.

ELECTRICAL SUB STATION A														
S.NO.	**Description**	**UNIT**	**Basement/ Stilt (In sq.mt.)**	**Ground Coverage/ Stilt (In sq.mt.)**	**Total Area (In sq.mt.)**	**LOAD CALCULATION AS PER NBC AND CONSIDERING ECBC (KW)**		**DEMAND FACTOR CONSIDERING NBC & ECBC**		**LOAD CALCULATION AS PER NBC AND CONSIDERING ECBC (KW)**		**TOTAL ELECTRICAL LOAD (KW)**	**DG BACKUP CONSIDERED**	**DG BACKUP LOAD (KW)**
							0.055							
1	HOSPITAL BUILDING		15470	5896.11	71807.06	0.00	3949.39		0.35	0.00	1382.29	1382.29	100%	1382.29
2	ELECTRICAL SUBSTATION A			782.34	1982.34	0.00	109.03		0.35	0.00	38.16	38.16	50%	19.08
	Total				**73789.4**					**0.00 KW**	**1420.45 KW**	**1420.45 KW**		**1401.37 KW**
B														
2	Lift @ 18 KW/Lift		18	18			324.00		0.80			259.20	100%	259.20
3	**AIR CONDITIONING AREAS = (Total - Basement)*80%**			**Heat Load**	**Selection at Diversity**									
a	HOSPITAL BUILDING	56337.06	45069.64	3004.64	2700	1.20	3240.00		0.80		2592.00	2592.00	80%	2073.60
	Selection with diversity @ 90%				2700									
	Total Area for ventilation	60539.64												
4	Ventilation Load					0.002	90.81		0.80		72.65	72.65	50%	36.32
5	Water supply pump						180.00		0.80		144.00	144.00	50%	72.00
6	STP / ETP & Plumbing Load						150.00		0.80		120.00	120.00	50%	60.00
7	Fire fighting & Jockey pump						200.00		0.80		20.00	20.00		50.00
8	External Site lighting, fountains, High mast etc for load, only						60.00		0.80		48.00	48.00	30%	14.40
9	Medical Equipment & Lab						2600.00		0.60		1560.00	1560.00	80%	1248.00

	Equipment Load													
10	EV Charging points						400.00		0.80		320.00	320.00	0%	0.00
												5135.85		3813.52
	GRAND TOTAL-(A+B)						**11303.23 KW**					**6556.29 KW**		**5214.89 KW**
	Diversified load (diversity factor 80%)											5245.03		4171.91
	Maximum Load Demand in KVA (for transformer PF 0.80, DG PF 0.8)											6556 KVA		5215 KVA
	Transformer loading @ 80%, 98% efficiency, DG set @ 80% Loading											8363 KVA		6519 KVA
											SAY	**8500KVA**		**7000 KVA**

ESS A LOAD CALCULATION

SUB STATION A CSS ZONE 1													
S.NO.	**Description**	**UNIT**	**Total number of room in hostel**	**Common area**	**Basement/ Stilt (In sq.mt.)**	**Ground Coverage/ Stilt (In sq.mt.)**	**Total Area (In sq.mt.)**	**LOAD CALCULATION AS PER NBC AND CONSIDERING ECBC (KW)**	**TOTAL ELECTRICAL LOAD (KW)**	**DEMAND FACTOR As PER NBC & ECBC**	**TOTAL ELECTRICAL LOAD (KW)**	**DG BACKUP CONSIDERED**	**DG BACKUP LOAD (KW)**
1	SURGEON HOSTEL LADIES		150	3872	5132			438.53	438.53	0.35	153.49	0.10	15.35
2	UG GIRLS HOSTEL		300	10106	4652			950.08	950.08	0.35	332.53	0.10	33.25
	Ventilation												
a	SURGEON HOSTEL LADIES	5132							0.00	0.80	0.00	0	0
b	UG GIRLS HOSTEL	4652							0.00	0.80	0.00	0	0
	Total Area for ventilation	9784			14.68				14.68	0.80	11.74	0.5	7.338
	VRV/VRF Area =(As per calculation)					**TOTAL LOAD IN HP**	**UNIT FACTOR**						

	SURGEON HOSTEL LADIES					18	1		18.00	0.80	14.40	0	0
	UG GIRLS HOSTEL					58	1		58.00	0.80	46.40		
	Lift @ 18 KW/Lift				**10**	18			180.00	0.80	144.00	1.00	144.00
											702.56 KW		**199.94 KW**
	Diversified load (diversity factor 80%)										562.04		159.95
	Maximum Load Demand in KVA (for transformer PF 0.80, DG PF 0.8)										703 KVA		200 KVA
	Transformer loading @ 80%, 98% efficiency, DG set @ 80% Loading										896 KVA		250 KVA
											1000 KVA		**315 KVA**

ELECTRICAL SUB STATION B																
S.NO.	**Description**	**UNIT**	**TOTAL NO. OF ROOM**	**COMMON AREA**	**Basement / Stilt (In sq.mt.)**	**Ground Coverage (In sq.mt.)**	**Total Area (In sq.mt.)**	**LOAD CALCULATION AS PER NBC AND CONSIDERING ECBC (KW)**		**DEMAND FACTOR CONSIDERING NBC & ECBC**		**LOAD CALCULATION AS PER NBC AND CONSIDERING ECBC (KW)**		**TOTAL ELECTRICAL LOAD (KW)**	**DG BACKUP CONSIDERED**	**DG BACKUP LOAD (KW)**
								0	0.055							
1	DENTAL COLLEGE				6500	3067	28729	0	1547.595		0.35	0.00	541.66	541.66	60%	324.99
2	PHARMACY COLLEGE				4064	3067	20174	0	1089.25		0.35	0.00	381.24	381.24	60%	228.74
3	CLUB HOUSE				1423	789	4392	0	234.445		0.35	0.00	82.06	82.06	50%	41.03
4	INDOOR STADIUM				3612	2614	7516	0	395.32		0.35	0.00	138.36	138.36	25%	35.00
5	GIRLS HOSTEL (DENTAL)		152	6729.48	4790				591.29		0.35		206.95	206.95	10%	21.00
6	GIRLS HOSTEL (PHARMACY)		120	5494	2847				468.53		0.35		163.99	163.99	10%	16.00
7	ELECTRICAL SUBSTATION B					435.83	1284.83	0	70.6656		0.35	0.00	24.73	24.73	50%	12.37
8	SITE AREA															
	Total						**62095.83**					**0.00 KW**	**1538.98 KW**	**1538.98 KW**		**679.13 KW**
B																
9	Lift @ 18 KW/Lift				33	18			594.00		0.80			475.20	100%	475.20
10	**AIR CONDITIONING AREAS = (@ 70% of Total area - basement area)**					Heat Load	Selection at Diversity									
a	DENTAL COLLEGE	15560.3			10892.21	746.04	671.44	1.2	805.73		0.80		644.58	644.58	65%	418.98
b	PHARMACY COLLEGE	11277			7893.9	540.68	486.61	1.2	583.93		0.80		467.15	467.15	65%	303.64
	Selection with diversity @ 90%						1158.05									
11																
a	INDOOR STADIUM						220	1	220.00		0.80		176.00	176.00	50%	88.00
b	GIRLS HOSTEL						88	1	88.00		0.80		70.40	70.40		0.00

	(DENTAL)															
c	GIRLS HOSTEL (PHARMACY)						88	1	88.00		0.80		70.40	70.40		0.00
	Total Area for ventilation	**50073.3**														
12	Ventilation Load							0.0015	75.11		0.80		60.09	60.09	50%	30.04
13	Water supply pump								200.00		0.80		160.00	160.00	50%	80.00
14	STP / ETP & Plumbing Load								160.00		0.80		128.00	128.00	50%	64.00
15	Fire fighting & Jockey pump								150.00		0.80		120.00	120.00		50.00
16	External Site lighting, fountains, Highmast etc for load, only								50.00		0.80		40.00	40.00	30%	12.00
17	Medical Equipment & Lab Equipment Load (ASSUMED)								600.00		0.60		360.00	360.00	80%	288.00
18	EV Charging points								300.00		0.80		240.00	240.00		0.00
														3011.81		1809.87
	GRAND TOTAL-(A+B)								**7717.86 KW**					**4550.80 KW**		**2489.00 KW**
	Diversified load (diversity factor 80%)													3640.64		1991.20
	Maximum Load Demand in KVA (for transformer PF 0.80, DG PF 0.8)													4550.80		2489.00
	Transformer loading @ 80%, 98% efficiency, DG set @ 80% Loading													5805.00		3111.25
													SAY	**6000 KVA**		**3000 KVA**

SUB STATION A CSS ZONE 2												
S.NO.	**Description**	**UNIT**	**Total number of room in hostel**	**Common area**	**Basement/ Stilt (In sq.mt.)**	**Ground Coverage/ Stilt (In sq.mt.)**	**Total Area (In sq. mt.)**	**LOAD CALCULATION AS PER NBC AND CONSIDERING ECBC (KW)**	**DEMAND FACTOR As PER NBC & ECBC**	**TOTAL ELECTRICAL LOAD (KW)**	**DG BACKUP CONSIDERED**	**DG BACKUP LOAD (KW)**
1	SURGEON GENTS HOSTEL + GUEST HOUSE		175	4457	1143			460.82	0.35	161.2864855	10%	16.13
2	BOYS HOSTEL (PHARMACY)		180	7295	6579			676.70	0.35	236.844671	10%	23.68
3	BOYS HOSTEL (DENTAL)		152	6515.17	6580			598.97	0.35	209.6384952	10%	20.96
4	TYPE-II(A & B)											80.00
5	TYPE-IV (A & B)											100.00
	Lift @ 18 KW/Lift for hostel				**15**	18		270.00	0.80	216.00	100%	216.00
	Ventilation											
b	BOYS HOSTEL (DENTAL)	6580										
c	BOYS HOSTEL (PHARMACY)	6579										
f	SURGEON GENTS HOSTEL + GUEST HOUSE	1143										
	Total Area for ventilation	14302.00			214.53				0.8	171.624	50%	85.812
	VRV & VRF			**TOTAL LOAD IN HP**	**UNIT FACTOR**							
	SURGEON GENTS HOSTEL +			16	1			16.00	0.80	12.80	0%	0.00

	GUEST HOUSE											
	BOYS HOSTEL (DENTAL)			24	1			24.00	0.80	19.20	0%	0.00
	BOYS HOSTEL (PHARMACY)			24	1			24.00	0.80	19.20	0%	0.00
										1046.593652		542.59
	Diversified load (diversity factor 80%)									837.27		434.07
	Maximum Load Demand in KVA (for transformer PF 0.80, DG PF 0.8)									1047 KVA		543 KVA
	Transformer loading @ 80%, 98% efficiency, DG set @ 80% Loading									1335 KVA		678 KVA
										1500 KVA		**650 KVA**

9. Inverter

Localized inverter should be proposed for the emergency lighting with 90-minute backup. Inverter system shall be proposed a few locations to feed the emergency lighting load.

Areas to be covered shall be:

- 50% Stairways
- 20% lighting in circulation space
- ICU, critical areas
- Corridor
- lift lobby
- plant rooms
- 100% lighting in OT

10. Uninterruptible power supply

The total requirement of UPS system is considered of minimum 1585 KVA. UPS shall be considered in N+1 configuration except for OTs, Server rooms and very critical areas/ equipment where UPS shall be considered in N+N configuration.

All Medical equipment shall have individual UPS.

UPS shall be supplied on centralized basis to support all head end equipment's for FAS, PA, MATV, CCTV, Building automation system, Data networks, ICU's, Blood bank & Medical Equipment's. Major equipment's (like MRI, CT scan and X-ray) shall have their independent UPS and their loads have not been considered on the UPS capacities However, separate UPS shall be considered for OT's. UPS for emergency lights to be provided separately.

Actual requirement to be worked out as per actual medical equipment, IT equipment, A/V equipment and other LV equipment as required, whichever is higher shall be provided.

All UPS shall be of 3 phase input and 3 phase output configurations. All UPS shall be provided with built in Isolation transformer at output side. UPS systems in parallel redundant format shall be provided with 30 minutes battery backup for individual UPS with static bypass arrangement. Storage batteries shall be VRLA sealed maintenance free type. The system shall have an incoming and outgoing switchgear panel. The system shall include the interconnection of UPS Input/output power supply Panels & UPS units, UPS & Batteries through flexible copper cables of suitable size. UPS shall be equipped with a communication card for data monitoring on the BMS System.

Microprocessor Based True Online Dual conversion UPS with latest IGBT technology & inbuilt isolation transformer are to be provided for uninterrupted power supply for all Emergency requirements. UPS with separate Power distribution system (comprising of distribution panels, rising mains, distribution boards etc.) shall be provided for each

block. The ups system shall have minimum efficiency of 93.8 % as per ECBC.

All wires cables connecting to and from UPS, UPS panel or equipment shall be copper only.

Following are the building wise UPS.

MINIMUM CAPACITY TO BE PROVIDED AT SITE IN VARIOUS BUILDINGS (INDICATIVE)

S.N	BUILDING	UPS (KVA)
A	**HOSPITAL BUILDING**	
1	HOSPITAL BUILDING	1100
2	SURGEON HOSTEL LADIES	10
3	UG GIRLS HOSTEL	10
4	ELECTRICAL SUBSTATION	5
5	CLUB HOUSE	5
6	TYPE-II A (E TYPE QTER)-01 - 52 U (5KW/U)	5
7	TYPE-II B(E TYPE QTER)-02 - 52 U (5KW/U)	5
8	INDOOR STADIUM	30
9	SURGEON GENTS HOSTEL + GUEST HOUSE	10
10	TYPE-IV A (D TYPE QTER) HOSPITAL - 52 U (10KW/U)	5
11	ELECTRICAL SUBSTATION	5
	Total	1190 KVA
B	**DENTAL COLLEGE**	
1	DENTAL COLLEGE	200
2	GIRLS HOSTEL (DENTAL)	10
3	BOYS HOSTEL (DENTAL)	10
	Total	220 KVA
C	**PHARMACY COLLEGE**	
1	PHARMACY COLLEGE	150
2	BOYS HOSTEL (PHARMACY)	10
3	GIRLS HOSTEL (PHARMACY)	10
4	TYPE-IV A (D TYPE QTER) PHARMACY - 52 U (10KW/U)	5
	Total	175 KVA
	TOTAL KVA	1585 KVA

11. Electrical Power Distribution

Three phase LT Power from Transformers (33 or 11/ 0.433 KV) shall be brought to the Main LT Panel placed in the substation at ground floor through sandwich Type Copper Bus Duct.

Power from the main LT panel shall be fed to Main Distribution Boards (MDB), Motor Control Centers, Rising Mains, sub panels feed by XLPE insulated aluminium cables.

Dual source of power shall be considered up to Sub Panels. The size of both the incomer shall be in such a manner that if any one incomer fails, another shall take care of full load in Dental Block.

Copper cables shall be used for up-to size 16 sq.mm, and Aluminium cables will be used for cable sizes above 16 sq mm if not specified or mentioned otherwise in this tender.

All life safety equipment's cabling shall be fire survival category viz. Fire Lift, Fire Pumps, UPS cable for Fire Alarm system, Emergency Voice Evacuation system, Security System, Emergency Lighting distribution system, Pressurization fans, smoke exhaust system etc.

Al construction sandwich type rising main shall be provided for normal lighting & power load. As per required numbers of rising main shall be provided for MKCG Dental and Residential block. Both the rising mains shall be equally (50%) loaded during normal operation and power shall be tapped through tap-off boxes from both rising mains on each floor.

At least 20% spare feeders with switchgears shall be provided for each panel. Common area lighting including parking, walkways etc. and lifts shall be directly fed from the main electrical panel via XLPE cables of appropriate size. Cables shall be selected based on the maximum voltage drop in the system.

Floor Distribution board at each floor for Lighting and power load are interconnected through XLPE insulated Aluminium cables to cater to entire load in case of maintenance /failure of one rising main.

At least 20% spare capacity on sub mains and rising mains shall be provided.

The sub main protection shall be by circuit breakers, which shall discriminate with upstream protective devices.

All riser shafts/ openings at each floor shall be sealed and all floor wall penetration shall be sealed by using fire sealant as a fire protection measure.

Separate and dedicated distribution shall be planned for the UPS system which shall include MDBs fed from the UPS units through LT Panel, Sub Distribution Boards (SDB's) and Final Distribution Boards (FDB's) shall be located on area basis.

Distribution boards will be provided for lighting and power distribution. Distribution boards shall be in accessible positions to suit the area of each floor within the building.

Final distribution boards shall incorporate miniature circuit breakers of 10 KA minimum interrupting capacities (MCB) & residual current circuit breaker of 100 or 30 mA

(RCCB) as per requirements. Surge arrestor shall be provided in each final distribution board as per IEC-623.

12. Electrical Wiring

The system of wiring shall consist of insulated copper conductor stranded flexible FRLS wires of 1100 volts grade of insulation, in heavy duty FRLS PVC for concealed wiring and in metallic conduits for all exposed wiring.

FRLS PVC insulated copper wires will be used for all sub mains and final circuit wiring in conduit.

Minimum size of copper conductor shall be 1.5 sq. mm for lighting and 2.5 sq.mm for Circuit wiring for Lighting and 4.0/6 sq. mm for Light Plug and power socket.

Color code shall be maintained for the entire wiring installation, that is Red, Yellow and Blue for the three phases, Black for neutral and Green with Yellow band for earthing. Besides, ferruling shall be provided for number coding and easy identification for maintenance.

13. Voltage Drop

The maximum permissible voltage drop in the system at the consumer end shall be 5% from the source end. The limit of voltage drop shall also meet the IGBC Certification Requirement.

To check voltage level, supply a minimum number of independent sources.

14. Measurement

As part of measurement scheme for the project, separate metering arrangement through digital electronic energy meter shall be provided for remote data collection, along with bulk metering and maximum demand indicator. This shall be as per IGBC Certification Requirement

Mains supply Individual DG Power,

Interior & Common area lighting

UPS Power Consumption

Chillers, chilled water pumps, Air Handling Units

External Lighting Consumption

Water Supply System, Sewage Treatment Plant, Municipal water supply, borewell water consumption, waste & sewage treated water consumption, water consumption for landscape,

Utility grid,

Renewable energy generation (1000 KWP FOR HOSPITAL, 290 KWP FOR DENTAL & 275 KWP FOR PHARMACY)

Lift power consumption

Jockey Pump for Fire Fighting System Elevators

Elevators, Escalators, Travelators, etc.

Any other energy-consuming equipment and systems.

15. System Earthing (Electrical Grounding)

All non-current carrying metal parts forming part of the electrical system shall be connected to the grounding system. The requirement of Indian Electricity Rules and statutory requirement of local Electricity authority shall also be met fully.

The function of the earthing (grounding) system is to establish and provide:

- T-N-S grounding system for connection of all electronic/electrical equipment to the ground grid system.
- Protection of personnel and equipment from electrical shock hazard.
- Protection of personnel, structures, and equipment from lightning hazard.
- Return ground path for ground fault protective devices.

Earthing with Maintenance free Chemical earthing system/GI Earthing System/Copper Earthing system, as required, shall be provided by the EPC Bidder for earthing sub stations equipment, Electrical Panel boards, UPS and other Equipment /installations in each building. Earthing shall be in conformity with rule 32,61,61, 67 & 68 of Indian Electricity Rules 1956 & as per IS-3043 as amended up to date. Copper/GI earth strips shall be used for connecting the Electrical equipment and medical equipment with Earth pits as required. Earth Leakage circuit breakers shall be provided in the DBs for individual units

Earthing system shall be designed in accordance with BIS: 3043/ BS 7430 for earthing system. Dedicated earthing pits shall be provided for neutral earthing of major substation equipment like Transformers & DG sets.

Earthing pits shall be provided for body earthing of major substation equipment like HT Panel, transformers, MV panel, elevator etc.

DG sets neutral shall be earthed through neutral grounding resistance.

Distribution earthing shall be carried all along the MV distribution system and effectively bonding the equipment.

Earthing for light and power points shall be carried out with insulated copper earth wire running throughout the length of the circuit and shall be terminated at equipment, fixtures, etc.

All the earthing stations shall be connected to each other to make a common earthing electrode grid. If the resistivity of the soil is very high, then earthing calculations shall be done to ensure that the conductivity is maintained at less than 1 Ω. Type of Earthing shall be designed considering the soil resistivity.

Separate and distinct earth stations shall be provided for the following system.

a. HT Panels
b. Transformers - Neutral & Body
c. DG Sets – Body & Neutral through NGR
d. Main LT Panels & LT Distribution Panels
e. UPS System – Body & Neutral
f. Server

g. LV Equipment's

h. Elevator

i. Medical equipment's

j. OT's & ICU's

k. Laboratory

l. All types of Medical Equipment

m. Any other equipment as required.

All three phase electrical installations shall be provided with double Earth connection and single-phase electrical installations with one Earth connection as per CPWD specifications & NBC 2026.

16. Internal Lighting

General & Individual Lighting

Lighting is to be provided in accordance with the recommendations contained in Indian Standard Code of practice for Dental Block lighting i.e. lighting I.S. 4347/ 67, IS 3646 (Part 1): 1992 & amendments thereof, including amendments if issued subsequently.

Night Lighting

The elaborate arrangement recommended in the I.S. Code 4347/67 and amendments thereof is essential. For night lighting a satisfactory night lighting system is to be provided by a number of small fittings

Shadow less fittings (mountable type) with emergency lighting unit are to provide in following locations: -

S. No.	Space	Area
i.	Female ward Unit's delivery Suits	Operating delivery
ii.	Burn Centre	Operation Theatre
iii.	Operation Theatre department	Major Operation Theatre department

Emergency light units are to be provided in the following locations: -

Area	Requirement of Portable lights
Ward Units	One per ward unit of bed strength up to 15 beds
Special ward	Two per ward unit of bed strength of 16 beds and over
Neonatal care	One per unit
Delivery suite	One per delivery room
Out patients'	Two in emergency section of general out-

department	patient’s clinic

Red-green bulb indication system is to be provided to rooms restricting entry of unauthorized persons due to surgical operative procedure, greater radiation of deep penetration and radioactive processes. Such rooms are operation theatres, radiography room, radio-therapy room, radio isotope active zone etc.

Chambers of CO, Registrar, Consultants, Advisers, MI Room consulting chamber for administrative, functional purposes.

Lighting fixtures for internal areas shall be minimum 120 lumen/watt and external 100 lumen/watt and façade shall have 60 lumen/watt.

The general lighting of various spaces shall be planned to provide the following illumination levels recommended as per NBC 2026

S. No.	Space	Type of Lighting	Minimum Illumination (LUX) Level
i.	Corridor (General), Ward Corridors,Lobby	LED Lighting fixture	200
ii.	Offices	LED Lighting fixture	300
iii.	Consulting rooms-General	LED Lighting fixture	350
iv.	Labs -General	LED Lighting fixture	500
v.	Treatment General	LED Lighting fixture	1000
vi.	Nurse Station/Reception	LED Lighting fixture	300
vii.	Operation Theatre – General	LED Lighting fixture	500
viii.	Toilets	LED Lighting fixture	150
ix.	Ward Circulation Area	LED Lighting fixture	200
x.	Kitchen/ Pantry, Recovery Rooms, X- ray/ CT Scan Areas, ICU/ CCU, CSSD, Pharmacies	LED Lighting fixture	300

Day light, occupancy and motion sensors shall be provided in the following areas to optimize day light and operate based on presence of human.

- Faculty rooms
- Consultation rooms
- Offices
- Meeting & Conference rooms

- OPD Rooms

17. Ceiling fans

BLDC Ceiling fans are to be provided in all rooms at the following locations:

Area		Requirement of Celling fan
All Ward Units	Single bedded room	One 1200 mm dia. ceiling fan per room cubicle.
	Double bedded room	One 1400 mm dia. ceiling fan per room cubicle.
	Four bedded room/cubicle	Two 1400 mm dia. Ceiling fans.
	Six bedded room/cubicle	Four 1200 mm dia. Ceiling fans
	For other ward space room /cubicle not covered above	One 1400 mm dia. Placed centrally in space between two beds.
All departments	Room of an area up to 14 sq.m.	One 1200 mm dia. Ceilingfan.
	Room of an area of above 14sq.m up to 21 sq.m.	One (1400 mm dia ceiling fan)
	Room of an area above 21sq.m.	One 1200 mm dia. ceiling fan per 14 sq.m. space

Above shall be followed in line with CPWD guidelines.

18. Emergency Lighting Installation

Emergency lighting will be powered from a source independent of that supplying the normal lighting. Escape lighting will be capable of

a) Indicating clearly the escape routes,
b) Providing adequate illumination along such routes to allow safe movement of persons towards and through the exits,
c) Ensuring that fire alarm call points and firefighting equipment provided along the escape routes can be readily located.
d) All rooms shall have emergency lights minimum 25% rounded off and as per norms latest amended till date.
e) The horizontal luminance at floor level on the centerline of an escape route will be not less than 10 Lux. addition, for escape routes up to 2 m wide, 50 percent of the route width will be lit to a minimum of 5 Lux.
f) The emergency lighting shall lit at all times in case of failure of the normal lighting power supply.
g) Toilets & service rooms.
h) Escape lighting luminaries should be sited to cover the following locations:
i) Near each intersection of corridors and corridors also exit light to be provided.
j) At each exit door.

k) Near each change of direction in the escape route.
l) Near any other change of floor level.
m) Outside each final exit and close to it.
n) Near fire-fighting equipment.
o) To illuminate exit and safety signs as required by the enforcing authority.
p) None of the area shall be back up in case of supply failure hence entire Dental Block to be covered by emergency lighting with minimum 90-minute battery backup.

NOTE — For the purposes of this clause 'near' is normally considered to be within 2 meters measured horizontally.

Emergency lighting systems will be designed to ensure that a fault or failure in any one luminaire does not further reduce the effectiveness of the system.

The luminaries will be mounted as low as possible, but at least 2 meter above the floor level. Exit signs are required at all exits, emergency exits and escape routes, which should comply with the graphic requirements of the relevant Indian Standards.

It is essential that the wiring and installation of the emergency lighting systems and exit signages are of high quality so as to ensure their perfect serviceability at all times.

The emergency lighting system will be capable of continuous operation for a minimum duration of 90 minutes even for the smallest premises.

The emergency lighting system will be well maintained by periodical inspections and tests so as to ensure their perfect serviceability at all times.

19. System Description

Emergency exit signage will provide visual indication of egress paths in case of an emergency or power failure.

The emergency lighting will be designed to achieve an average illumination of not less than specified in NBC.

Emergency Luminaries will be provided, but not limited to, the following areas:

- Corridors and stairwells
- Security room/fire command room
- Telephone equipment rooms
- Electrical rooms & plant rooms
- Public toilets
- Main lobby

20. Lighting Control

Parking garage lighting control: Basement lights (Except Emergency Fixtures) shall be provided with control devices that can automatically reduce the lighting power of each luminaire by a minimum of 30% when no activity is detected for more than 30 minutes. This shall be done by using lighting fixtures with inbuilt PIR sensor for basement lighting control.

Control devices should be provided in all the Daylight transition zones. These zones are particularly the Entry & Exit ramp from Basement to Outside or vice versa. The control devices should ensure that lighting turns off automatically during daylight hours and on at sunset. This shall be done by using the day light sensor for controlling the light fixtures near Ramp Area

Lighting controls shall be provided for exterior lighting that can automatically turn off the lights when enough daylight is available. The timer shall be considered in the feeder pillar

All façade and landscape lighting should turn off between midnight and 6 A.M. Lighting except for façade and landscape should dim to 50% (alternate) from 12 P.M. to 6 A.M. This shall be done by using the daylight sensor with timer.

Internally illuminated exit signs shall not exceed 5 W per piece. The lighting control shall be as per IGBC Certification Requirement

21. Lightning Protection System

The Contractor shall design and construct Lightning protection systems in compliance with NBC and relevant code latest amended till date, which shall include air termination rods, down conductors, test links and earth terminations.

It is proposed to provide aluminum conductor air terminations, installed along the periphery at the terrace level. Air termination mesh shall be provided on the terrace and shall be connected to grounding pits through down conductors. The lightning protection system shall be of Faraday Cage system complying to BIS /IEC 62305. There shall be multiple down conductors around the periphery depending on the level 2 protection.

22. Emergency Lighting Units

50% Stairways and 20% lighting in circulation space, ICU, critical areas, corridor, lift lobby, plant room shall be provided through Inverter supply having 90 minutes battery backup 100% lighting in OT shall be provided through Inverter supply having 90 minutes battery backup Exit Signs shall be addressable with self-contained 3 hours duration maintenance free battery back-up power Matrix for Emergency Light.

23. External lighting (around building periphery)

All external lights along the building’s periphery shall have power supply from the building premises. The ON/OFF switching of these lights shall be controlled by Photo sensors/timers for energy conservation.

Exterior lighting shall be installed at an angle of 90 degree from nadir (straight down) with 30% reduction in Lighting Power Density over ASHRAE 90.1-2013. (Annexure 3)

24. Electric Vehicle Charging Stations

The scope includes Designing, Planning, Supplying, Installation, Testing & Commissioning of AC & DC Electrical Vehicle Charging Stations in the Parking areas of Hospital Building as per Local Area Norms/GOI norms whichever is stringent for 2 & 4 wheelers vehicle. Contractor shall do the detailed calculations in line with governing state and central guidelines for final selection, above given quantities are the minimum whichever is higher shall be provided without any additional cost.

	EV Charging Stations - at Basement Parking areas	UNIT	QTY
1	SITC of Type 2 AC EV Charger 7.4kW for 4 Wheelers. Mode 3, Level 2. Single phase 220V/50Hz 3 wire AC system, Protection IP54, Output connector type-2 with Cable length 5M.	Set	5
2	SITC of 10KW with 3 x 3.3kW Industrial Socket for 2/3 wheelers. Three Phase 415V 50Hz 5 wire AC System, Protection IP54, Output ports 3 numbers 3PIN Single Phase Industrial Socket with protective cover.	Set	10
3	SITC of DC Fast charger 30KW+30KW CCS2 Dual Gun, Mode 4, Level 3. Three Phase 415V 50Hz 5 wire AC System, Protection IP54, Output connector 2 Nos. 30KW 100A each CCS2 type with cable length 5M.	Set	5
4	DC CCS **Single Gun** (60kw) Fast EV Charger OCPP Based	Set	2
5	Electrical panel for EV Charger supply and cable for connection between charger and panels etc.	LS	1

Note: Above given quantities are indicative only. Successful bidder shall design the entire system as per actual site conditions & requirement and take approval from Engineer before procurement & execution. Additional Quantity if required any shall be provided by the Contractor without any additional Cost and Time.

Light fixture

Note:

All External light fixture shall be coated with marine based anti-corrosive coat (**Primer coating of 60–80 microns thickness, finished with environmentally stable pure polyester powder coating of selected colour with 30–40 microns thickness, Salt Spray Resistance the coating system must comply with a minimum 500 hour salt spray test as per relevant standards**), and the light pole shall be conical with cast iron (marine based anti-corrosive coating with minimum 150microns) base. All decorative poles must be provided with a cast iron base for enhanced strength, durability, and aesthetic appeal. The pole structure shall be designed to withstand wind speeds up to 200 km/hr or Wind load as calculated as per site condition.

Above given items are indicative only. Successful bidder shall design the entire system as per actual site conditions & requirement and take approval from engineer before procurement & execution. Additional quantity if any shall be provided by the contractor without any additional cost and time.

PLUMBING DBR

PLUMBINGSYSTEM

Introduction

Following shall be focusing area of design for the Hospital, Hostel, Residence & College.

Requirement of adequate and equal pressure of cold and hot water in OPD, Emergency and ward, toilets, kitchen and other designated areas of Hospital block, College and residential block.

Water treatment plant (WTP) to ensure that the chemical and bacteriological parameters of water supply in the Hospital block, Residence, Hostel & College is in accordance with Local standards or as per local water department or as per client requirements. Since, quality of water from Local Authority is assumed to be within acceptable limits. However, WTP (Water Treatment Plant) should have very basic, comprising of filters/ACF and hypo dosing units and should be verified for suitability prior to installation in accordance with latest water analysis report.

The water storage tank capacity shall be adequate to ensure availability of water for approximately two days' requirements of project.

Recycling of treated wastewater (from Sewage treatment plant (STP) for HVAC Cooling Water make up, Flushing & for Horticulture water use.

Capacity of STP treated water will be minimum for 1 day storage of Capacity of Treated water from STP or STP treated water demand whichever is greater. (HVAC + Irrigation +Road wash etc.)

Implementation of requirements of MOEF relating to rainwater harvesting, water conservation, etc.

Suitable capacity softener plant shall be provided to achieve required parameter of HVAC.

Sewage and Sullage collection & conveyance system based on ASPE standard and applicable guidelines by latest NBC and collection and treatment of other hazardous wastewater from the hospital.

Storm / rainwater drainage system from the roof terrace to be collected into the dedicated rainwater storage tank along with separate route and same shall be connected with STP/ETP tanks or separate tanks of adequate design size after required filtration and use for flushing, irrigation and for cooling towers and its overflow will be connected in to surface water line and basement drainage system shall include the drain pipe , drain channel, required no. of chambers sumps, sump pumps with risers and other accessories.

All AHUs and other machinal units drain shall be provided and connected to main waste line in Basement and Domestic cold-water supply will also be provided for all AHUs and other mechanical unis as required.

The surface water shall be discharged directly into the harvesting rainwater and its overflow to be connected into existing storm water municipal line with adequate pumping arrangement as per the site condition. Contractor must study the site condition and provide the suitable outfall for rainwater including pumping (if required) with piping and required accessories including stand by pump. Contractor to ensure through design and construction that No waterlogging in the project site.

Water conservation using low flow fixtures as per the IGBC/ GRIHA guideline latest amendment till date.

Levels of roads/pavements and other services in the area.

Required No. of standby equipment to be provided as per standard requirements like standby pumps etc.

Scope of PHE Works

The scope of work covered under this report includes the following major heads:

- Internal Plumbing Works — sanitary fixtures, CP brass fittings, soil, waste and rainwater piping, internal cold and hot water supply systems
- External Water Supply System — borewell/municipal source, water treatment, campus distribution network, storage and distribution
- Sewerage System — internal sanitary drainage, external sewers, manholes, and connection to sewage treatment plant
- Storm Water Drainage & Rainwater Harvesting — roof and surface drainage, storage, and recharge pits
- Irrigation System — garden hydrant and sprinkler irrigation for all landscaped areas
- Pumps & Water Treatment Equipment — all pump types, WTP, RO plant, STP, ETP

Design Philosophy, Objectives & Codes of Reference

Water Management Strategy

The project adopts a Reduce, Re-use, Recycle (3R) model for water management. Key elements include

- Discipline use of water through metering and monitoring at all supply points
- Installation of water-saving toilet fixtures, faucets, and flow regulators
- Water-saving landscape techniques — selection of plants and adoption of efficient irrigation
- Recycling of STP-treated wastewater for HVAC cooling tower make-up, flushing, and horticulture
- Rainwater harvesting & Recharge Pit, water conservation and solar water heating in compliance with MOEF guidelines
- Online monitoring devices to transfer outlet parameters to authority.

Basic Objectives

The fundamental objectives governing the design of all sanitary engineering services are:

- High standards of materials and workmanship throughout all systems
- Leak-proof plumbing and reliable, dependable engineering systems
- Minimization of energy requirements through system zoning and efficient equipment selection
- Provision of adequate safety and means of egress in the event of fire
- Minimum nuisance and disturbance to the environment during construction and operation

Codes, Standards & Manuals of Reference

The following codes of practice, standards, and design manuals are to be referenced for design of all plumbing systems:

- National Building Construction Standard of India latest revision 2026
- Handbook on Water Supply & Drainage — Bureau of Indian Standards SP-35
- Manual on Water Supply & Treatment — Ministry of Urban Development
- Manual on Sewerage & Sewage Treatment — Ministry of Urban Development
- CPWD Specifications and CPWD General Specifications for Electrical Works (Part V: Wet Riser & Sprinkler System, 2019)
- Bureau of Indian Standards (BIS): IS 2189, 15908, 15105, 12469, 3844, 1239, 3589, 10221, 8329, 15778, 15905 and all other referenced IS codes as per latest revision
- UL Listed and FM Approved specifications for pumps, valves and accessories

Water Supply System

Sources of Water

The water supply for the project is drawn from the following sources:

- Municipal / State Water Supply Network — water received from the local authority is stored in underground raw water tanks after verification of quality.
- Tube Wells / Bore Wells — constructed and tested as per IS 2800-1979 (Parts 1 & 2); to serve as suplementary source. At least one borewell to be proposed for each building.
- STP Treated Water — used exclusively for flushing, HVAC cooling tower make-up, and horticulture.

Water quality from the local authority is assumed to be within acceptable limits; however, the Water Treatment Plant (WTP) shall incorporate primary treatment comprising multimedia filters, activated carbon filters, hypo-dosing units, and softeners with UV treatment, verified in accordance with the latest water analysis report and the effluent treated water parameters shall be complied with the latest OSPCB.

Distribution Scheme

The campus water supply is categorized as follows:

- Potable (Domestic) Cold Water — Distributed via dedicated pump sets from underground tanks to individual OHT filling and then distributing through gravity zoning system for lower floors and pressure boosting system for top 3-4 floors.
- Non-Potable (Flushing) Water — STP treated water transferred to overhead tanks via transfer pumps and distributed by gravity. If the hydraulic calculation shows insufficient pressure at the upper 2-3 floors, provide a **booster pump set** (typically duty + standby with VFD and pressure vessel) for those floors. The water supply system shall provide **adequate pressure and flow** at every plumbing fixture as per NBC.
- Hot Water Supply — distributed through a hydropneumatics system.
- HVAC Make-up Water — softened water supplied from underground tanks of STP to cooling towers.

Cold water service pipes will be routed through pipe risers and building shafts. Colour coding direction marking shall be strictly maintained for flushing, domestic, and hot water supply pipelines for clear identification. Water meters shall be installed at all domestic and flushing inlets and outlets to monitor consumption of individual blocks and other buildings. Where pipes pass through fire compartments, all penetrations shall be fire sleeved.

For storage 1.5 days of water storage capacity shall be provided in UGR and 0.5 days in OHT based on ultimate demand.

Water Supply to Buildings

The potential water supply source for the project can be mainly classified as: Municipal Water Supply. But provision of suitable No. of borewells to be provided to cater water demand 100%.

Provision to fill UGT by water tankers also to be taken.

STP treated water which shall be used for flushing purposes, HVAC & Irrigation.

Bore Well

Construction and testing of tube wells shall be as per IS 2800-1979 (Parts 1 & 2). The tube well shall be developed by surging, over-pumping, back-washing with air lift, or high-velocity jetting until stabilization of sand and gravel particles is achieved. Development shall continue until gravel stops sinking, discharge depression ceases to improve, and sand content is not more than 20 parts per million. Grouting and sealing shall be carried out as required by site conditions.

Adequate number of borewells to be provided in all sites subjected to sufficient yield for filling UGR. However, each building should be assisted with at least one borewell provision in case of exigencies. 200mmX150mm dia borewell shall be provided/installed with cleaning and developing the tubewell using compressor, sanitary sealing and construction of brick masonry chamber with RCC cover slab and encasing the annular area of casing pipe with cement concrete.

Supply and installation of required size submersible pump set (1W+1S) with all accessories like MS Supporting clamp with nut bolt,200mm dia tube well cover and cap suitable for above pump set, necessary cable, control panel and earthing etc. all complete.

Irrigation System

Garden Hydrant System

A separate and independent captive garden hydrant system shall be provided to supply water for all horticultural operations across the landscaped areas of the campus. Key features are as follows:

- The distribution grid shall consist of HDPE pressure pipes for the main distribution and branch distribution, connected to a dedicated pumping set drawing from the STP treated water tank and raw water tank
- Garden hydrant outlets shall be 25 mm diameter, spaced approximately 45–50 m apart

Sprinkler Irrigation System

Sprinkler irrigation shall supplement the garden hydrant system for efficient, uniform water distribution across in playground areas where domestic water to be used. The system shall be designed for maximum water saving, combining high-quality, affordable components with ease of installation. All components shall be of high-strength engineering plastics with chemical resistance. Key design principles include:

- Water distribution through a network of pipes (usually pump-fed), sprayed into the air and broken into droplets for ground coverage.
- All products subjected to extensive quality and performance testing to ensure uniform water distribution and high efficiency.

Water Requirements

TABLE - SUMMARY OF DAILY WATER DEMAND

GROUP 1 BUILDINGS

S.No.	Description	Total Occupancy	Total Water Demand	Water Requirement				Total
				Domestic Use		Flushing Use		
				LPCD	in LPD	LPCD	in LPD	LPD
1	PHARMACY COLLEGE							
1.1	STUDENT	540	45	25	13500	20	10800	24300
1.2	TEACHER +STAFF	162	45	25	4050	20	3240	7290
1.3	VISITORS 25%	180	15	5	900	10	1800	2700
2	GIRLS HOSTEL	192	135	90	17280	45	8640	25920
2.1	WARDEN	10	135	90	900	45	450	1350
2.2	VISITORS 20%	38	15	5	192	10	384	576
3	DENTAL COLLEGE							
3.1	STUDENT	304	45	25	7600	20	6080	13680
3.2	TEACHER +STAFF	90	45	25	2250	20	1800	4050
3.3	VISITORS 25%	100	15	5	500	10	1000	1500
4	GIRLS HOSTEL	136	135	90	12240	45	6120	18360
4.1	WARDEN	10	135	90	900	45	450	1350
4.2	VISITORS 20%	27	15	5	136	10	272	408
5	RESIDENCE TYPE-II A	260	135	90	23400	45	11700	35100
6	RESIDENCE TYPE-II B	260	135	90	23400	45	11700	35100
7	INDOOR STADIUM	300	10	4	1200	6	1800	3000
8	CLUB HOUSE							
	CLUB HOUSE TOTAL REQ				12061		9740	21801
9	ELECTRICAL SUBSTATION/ SERVICE BLOCK	10	45	25	250	20	200	450
10	BOYS HOSTEL	288	135	90	25920	45	92	26012
10.1	WARDEN	10	135	90	900	45	450	1350
10.2	VISITORS 20%	58	15	5	288	10	576	864
11	TYPE-IV-A	312	135	90	28080	45	14040	42120
12	TYPE-IV-B	312	135	90	28080	45	14040	42120
13	BOYS HOSTEL	136	135	90	12240	45	6120	18360
13.1	WARDEN	10	135	90	900	45	450	1350
13.2	VISITORS 20%	27	15	5	136	10	272	408
14	SURGEON HOSTEL GENTS	150	135	90	13500	45	6750	20250
15	GUEST HOUSE	50	135	90	4500	45	2250	6750

	Grand Total				**235303**		**121216**	**356519**
	Filter Back Wash @ 5%				**11765**			11765
	Grand Total				**247068**		**121216**	**368284**
	HVAC Makeup water Pharmacy **(700TR X 8 HOUR WORKING X 10 LITER PER HOUR REQUIRMENT)**						56000	56000
	HVAC Makeup water dental **(900TR X 8 HOUR WORKING X 10 LITER PER HOUR REQUIRMENT)**						72000	72000
	IRRIGATION WATER REQ @ 2 LITER PER SQMT						215544	215544
	Grand Total				**247068**		**464760**	**496284**
		Calculation as per above	Proposed					
	UG Tank Capacity	**1**		**Remarks**				
					2 DAYS STORAGE -1.5 DAY UGT +0.5 DAY OHT			
1	Fire Water Tank	500	500	KL				
2	Raw Water Tank	230	230	KL	170 FOR RAW +54 FOR IRRIGATION			
3	Domestic Water Tank	185	185	KL				
4	Soft Water Tank	130	130	KL	FOR BACKUP OF HVAC			

					SYSTEM			
5	Flushing Use in STP 1	156	155	KL				
6	Flushing Use in STP 2	165	165	KL				
	Grand Total	1071	1070	KL				
	STP CAPACITY 1	**STP 1**	**Proposed**	**Remarks**				
1	Domestic Use @ 80 %	97		KL				
2	Flushing Use @ 100 %	76		KL				
3	TOTAL	173		KL				
4	Add g 20 % higher as per MOEF Requirement	35		KL				
5	**Total**	207		KL				
	Say	208	210	KL				
6	Treated Water Available @ 90%	156	155	KL				
7	**ETP**		10	KL				
	STP CAPACITY 2	**STP 2**	**Proposed**	**Remarks**				
1	Domestic Use @ 80 %	92		KL				
2	Flushing Use @ 100 %	45		KL				
3	TOTAL	137		KL				
4	Add g 20 % higher as per MOEF Requirement	27		KL				
5	**Total**	164		KL				
	Say	165		KL				
6	Treated Water Available @ 90%	123	125	KL				
	OVER HEAD TANK CAPACITY	**DOMESTIC**	**FLUSHING**	**FIRE FIGHTING (AS PER FIRE RECOMMENDATION)**	**HVAC MAKEUP WATER TANK**			
1	PHARMACY COLLEGE	15.0 KL	12.5 KL	10 KL(MIN)				

2	GIRLS HOSTEL	9 KL	5 KL	25 KL(MIN)				
3	DENTAL COLLEGE	5 KL	5 KL	20 KL(MIN)				
4	GIRLS HOSTEL	7 KL	3.5 KL	10 KL(MIN)				
5	RESIDENCE TYPE-II A	12 KL	6 KL	10 KL (MIN)				
6	RESIDENCE TYPE-II B	12 KL	6 KL	10 KL (MIN)				
7	INDOOR STADIUM	1 KL	1 KL	25 KL(MIN)				
8	CLUB HOUSE	7 KL	5 KL	5 KL (MIN)				
9	ELECTRICAL SUBSTATION/ SERVICE BLOCK	1 KL	1 KL	20 KL(MIN)	80 KL			
10	BOYS HOSTEL	13 KL	7 KL	10 KL(MIN)				
11	TYPE-IV-A	15 KL	7 KL	10 KL(MIN)				
12	TYPE-IV-B	15 KL	7 KL	10 KL(MIN)				
13	BOYS HOSTEL	7 KL	3.5 KL	10 KL(MIN)				
14	SURGEON HOSTEL GENTS	7 KL	3.5 KL	25 KL(MIN)				
15	GUEST HOUSE	2.5 KL	1.5 KL	25 KL(MIN)				

GROUP 2 BUILDINGS

S.No.	Description	Total Occupancy	Total Water Demand	Water Requirement				Total
				Domestic Use		Flushing Use		
				LPCD	in LPD	LPCD	in LPD	LPD
1	HOSPITAL							
1.1	TEACHING HOSPITAL (450 BEDS)	450	450	300	135000	150	67500	202500
1.2	OPD	1350	15	5	6750	10	13500	20250
1.3	Laundary	450	100	100	45000	0	0	45000
1.4	Kitchen	450	55	55	24750	0	0	24750
1.5	Lab Water	450	50	50	22500	0	0	22500
4	ELECTRICAL SUBSTATION/ SERVICE BLOCK	10	45	25	250	20	200	450
2	U.G. GIRLS HOSTEL	300	135	90	27000	45	13500	40500
3	SURGEON HOSTEL LADIES	150	135	90	13500	45	6750	20250
	Total				**274750**		**101450**	**376200**
	Filter Back Wash @ 5%				**13738**			0
	Grand Total				**288488**		**101450**	**376200**
	HVAC makeup water (2700TR X 13 HOUR WORKING X 10 LITER PER HOUR REQUIRMENT)					351000	351000	351000
	IRRIGATION WATER REQ @ 2 LITER PER SQMT						4888	4888
	Grand Total				**288488**		**457338**	**732088**
		Calculation as per above	Proposed					

	UG Tank Capacity	**2**		**Remarks**				
1	Fire Water Tank(As per fire recommendation)	500	500	KL				
2	Raw Water Tank	433	430	KL				
3	Domestic Water Tank	433	430	KL				
4	Flushing Use	242	290	KL				
5	Soft Water Tank	195	195					
	Grand Total	**1607**	**1650**	KL				
	STP CAPACITY 1	**STP 3**		**Remarks**			**STP**	**ETP**
1	Domestic Use @ 80 %	187		KL			**325**	**45**
2	Flushing Use @ 100 %	81		KL				
3	Total STP Volume without MOEF Requirement including 50 KLD ETP Volume	**269**		KL				
4	Add g 20 % higher as per MOEF Requirement	54		KL				
5	Total	322		KL				
	Say	**323**	**325**	KL				
5	**Treated Water Available @ 90%**	**242**	**245**	**KL**				

	STP CAPACITY 2	**STP 3**		**Remarks**			**STP**	**ETP**
1	Domestic Use @ 80 %	32		KL			**65**	
2	Flushing Use @ 100 %	20		KL				
3	Total STP Volume without MOEF Requirement including 50 KLD ETP Volume	**53**		KL				
4	Add g 20 % higher as per MOEF Requirement	11		KL				
5	Total	63		KL				
	Say	**64**	**65**	KL				
5	**Treated Water Available @ 90%**	**47**	**47**	**KL**				

	OVER HEAD TANK CAPACITY	**DOMESTIC**	**FLUSHING**	**FIRE FIGHTING (As per fire NOC)**	**HVAC MAKE UP WATE**			

					R TANK			
	HOSPITAL	110 KL	40 KL	20 KL(Min)				
	U.G. GIRLS HOSTEL	14 KL	7 KL	5 KL(Min)				
	SURGEON HOSTEL LADIES	7 KL	3.5 KL	25 KL(Min)				
	ESS	1 KL	1 KL	20 KL (Min)	175 KL			

Water Balance Chart

Group 1 Buildings:

S.NO	DESCRIPTION	REQUIRMENT
1	DOMESTIC	235 KLD
2	FLUSHING	121 KLD
3	HVAC	128 KLD

Group 2 Buildings:

S.NO	DESCRIPTION	REQUIRMENT
1	DOMESTIC	288 KLD
2	FLUSHING	101 KLD
3	HVAC	351 KLD

Note: All tank capacities shown above are indicative. During detailed design, if required and found necessary, the capacity/rating of any tank or equipment may be revised subject to the concurrence of the Engineer-in-Charge.

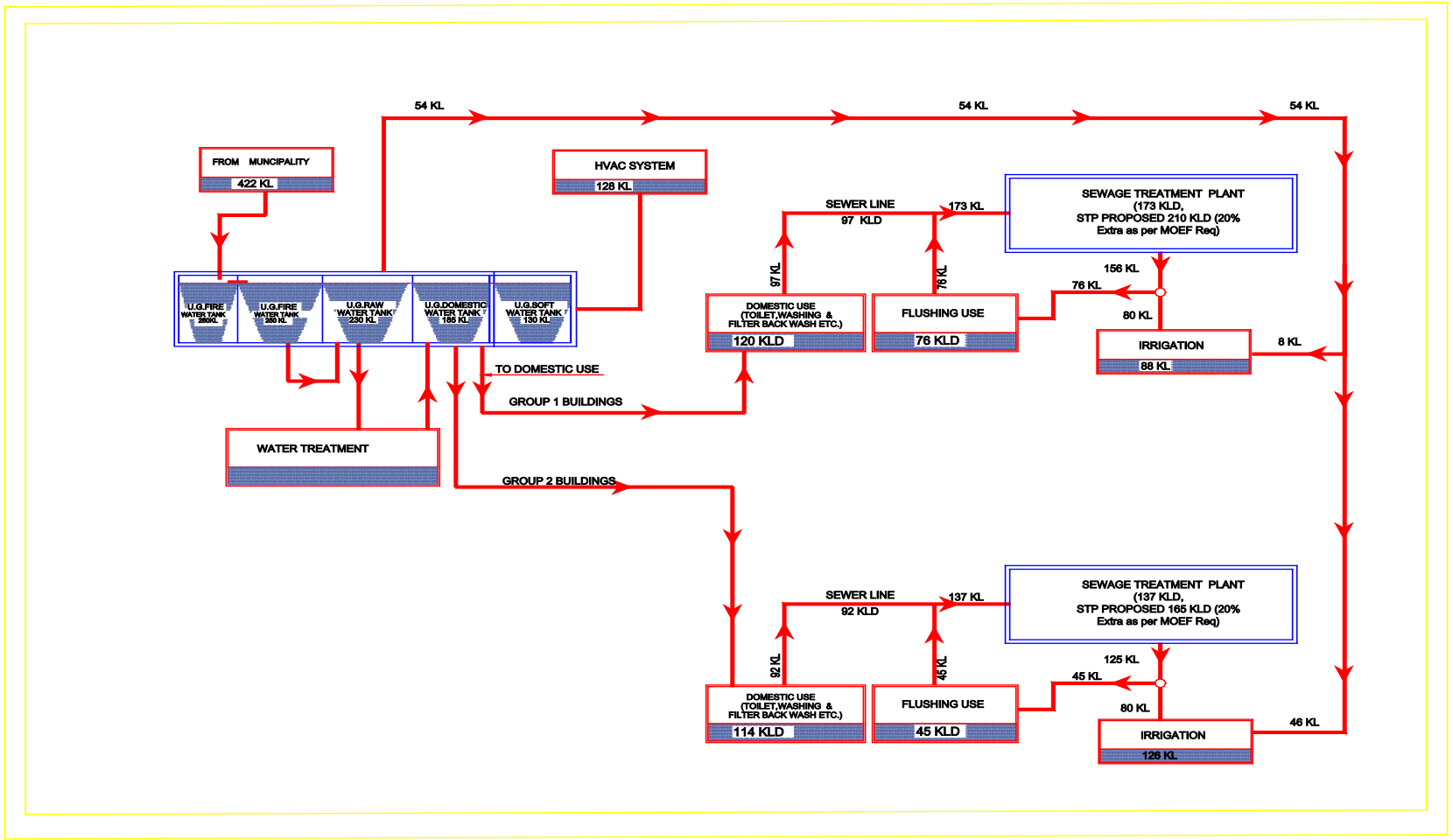
While calculating fire water tank capacities 90 min of pump running time for residential, hostel, Guest house to be taken for designing. And for hospital, college & club House with 120 min of pump running to be considered while calculating tank capacities.(Exact calculation will be based on Fire recommendation and as per NBC-2026)

The minimum required capacities of the Underground Reservoir (UGR) and Sewage Treatment Plant (STP) shall be indicated in the design submissions. However, the detailed sizing, hydraulic calculations, and final capacity determination shall be proposed and justified by the design agency based on applicable codes, occupancy loads, and project requirements.

Planning and design of RCC Underground Storage Tanks (UGR) for firefighting, raw, domestic, and flushing water shall be carried out in accordance with NBCS 2026. An adequately sized pump room with proper access, rolling shutter, and ventilation window shall be provided. Fire water storage and related provisions shall comply with Fire NOC requirements, NBCS 2026 guidelines.

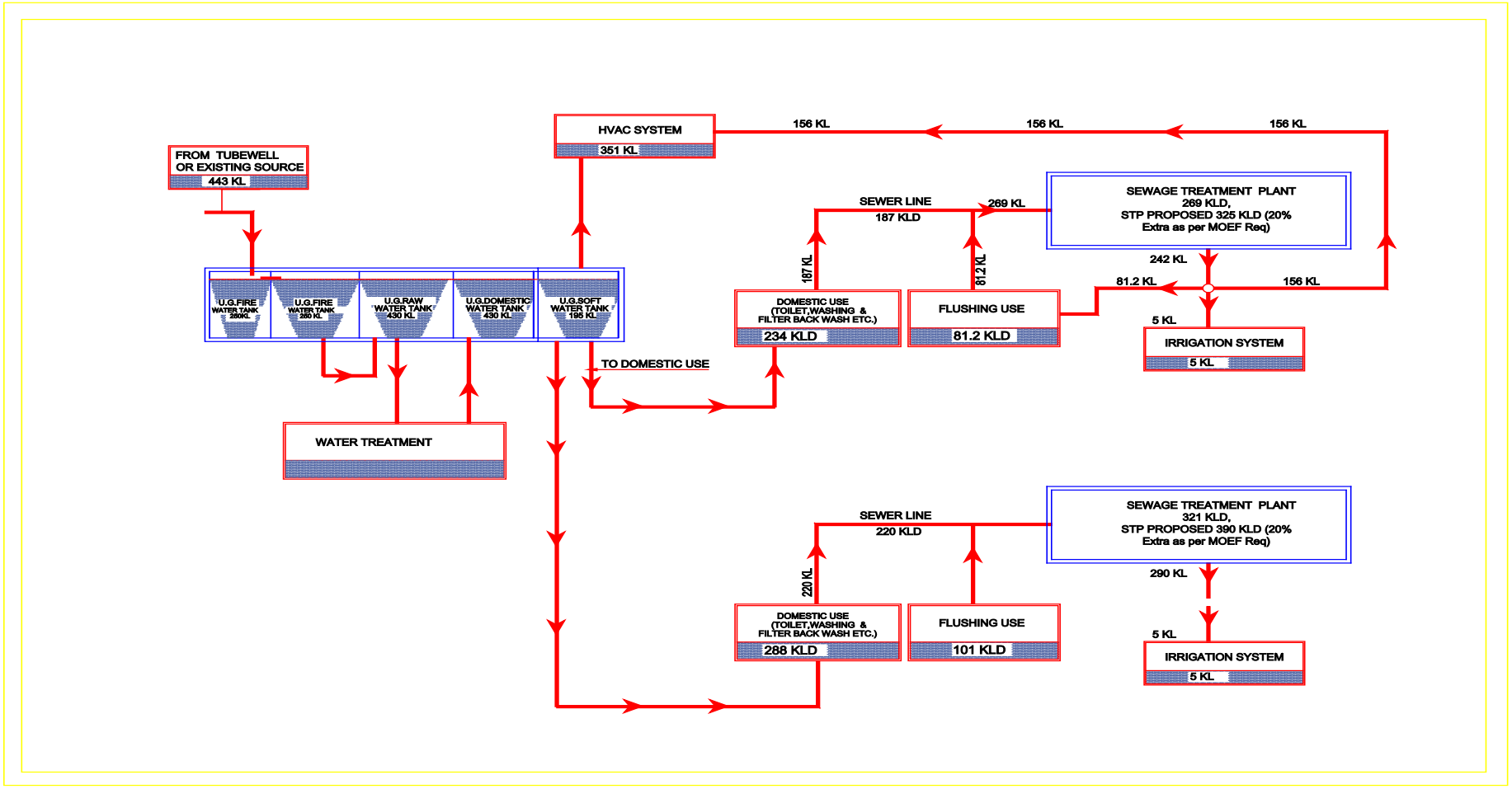
WATER FLOW DIAGRAM -1

UGT 1



WATER FLOW DIAGRAM 2

UGT 2



Water Distribution

Potable water supply: The cold-water supply will be supplied by the overhead domestic tank by gravity system except for top 3-4 Floors, Top 3-4 floor must be feed by Booster supply Pump(capacities to be finalized as per actual requirement as per actual calculation) in configuration of at least 1 stand by pump to achieve suitable pressure on fixtures, Separate pipe from OHT for top 3-4 floor shall be provided wherever height is more and cause excess pressure on lower Floor fixture, PRV also be provided where ever required and the overhead domestic water tank will fill through transfer pumps located in plumbing pump room.

The hot water system shall be distributed via a dedicated Hydro pneumatic pump. All pumps shall have 100% standby 2 Nos. (total pumps including standby) of pumps and N+1 standby required where the No. of pumps are more than 2 No. and all valves pressure ratings shall be selected with a minimum of 150% of working pressure.

Water distribution shall be regulated and maintained throughout the project to meet acceptable levels as recommended by IS Code Standards; minimum 150 kPa(Kilopascal) and maximum 350 kPa(Kilopascal) at water outlets (Plumbing fixtures) in the toilets and other area as required, cold and hot water supply with uniform and equal pressure should be provided up to the plumbing fixtures like shower , wash basin, sink or wherever its required including required plumbing CP fitting valves , piping and insulation etc. up to the plumbing fittings and fixtures.

Non-Potable water supply: The flushing water shall be transfer to overhead tanks through water transfer pumps and from there shall be supplied through gravity/ booster pump as required to the all cistern/ Flush valve with required plumbing fitting valves and piping etc.

Block wise plant room for PHE & FS including standby equipment is proposed as mentioned above. The domestic water supply shall be through hydro-pneumatics system from underground tanks to OHT .The flushing water supply will be supplied by the overhead flushing tank by gravity system and will fill the OH water tanks through transfer pump located in STP/ETP area and the soft water supply to OH tank on services block terrace also fill through the transfer pumps located in STP/ETP area and separate variable speed hydro-pneumatics system shall be provided for external garden hydrant and irrigation system with adequate flow rate and pressure including piping and other required accessories etc. The storage capacity of all water tanks at the underground level shall be in line with local authority and client requirements. Cold water service pipes will generally be routed up through the pipe work riser shafts / chases of the building.

The pipe sizing shall be based on fixture unit calculations as per NBC/ASPE standard. The pipe size of riser shall be restricted to nearest 4” size to optimize on capital cost, and for ease of installation and maintenance. However, the maximum velocity in the water supply piping shall not exceed 2.4 m/s. It is required to provide water meters in all domestic and flushing inlet and outlet to measure the water consumption and water meter shall be BMS compatible. Color coding for flushing, domestic and hot water supply piping needs to be ensured for clear identification of the piping.

It is required to provide water meters in all domestic and flushing inlet and outlet to measure the water consumption, and water meter shall be BMS compatible.

Color coding for flushing, domestic and hot water supply piping needs to be ensured for clear identification of the piping.

Access will be provided at major branch locations and adjacent services. Where water service pipes pass through fire compartments, all penetrations will be fire sleeved.

Potable Water pipe work will distribute in a ladder network around the site from its origin in the Water Treatment Centre. The pipe work will be sized for the requirements of the overall development, such that an upgrade of the service for later phases will not be required

It is proposed to provide approx. 1.5 days water underground storage capacity based on ultimate requirement and 0.5 day domestic/flushing water requirement of overhead tank.

Water Demand Projections & Storage Design

Water requirements have to be estimated on the basis of NBCS 2026 norms, local bye-laws, CPWD specifications, Public Health Manuals, and Ministry of Environment & Forests guidelines. Population and occupancy have to be determined on the basis of the maximum expected capacity of each building or facility. STP and ETP capacities are based on 90% recovery of sewage flow.

The storage calculations provided herein are indicative in nature and intended solely for preliminary estimation. The successful agency/contractor shall prepare detailed water demand calculations, storage tank sizing, and related design calculations based on the final approved drawings, applicable codes, and site requirements, and shall submit the same to the Client/Engineer-in-Charge for review and approval prior to execution.

In the event of any variation between the indicative capacities and the capacities derived from the approved detailed calculations, the higher capacity/value for each individual parameter shall be considered for design and execution purposes. The agency shall make all necessary provisions accordingly. No additional cost and time shall be provided for the same.

Any increase in quantities arising from such detailed calculations shall be deemed to have been accounted for in the quoted rates. No additional payment, claim, compensation, or cost implication shall be entertained.

Water balance chart for individual buildings or clusters to be prepared for monsoon and non-monsoon seasons and accordingly the water management plan should be decided. Additional requirement with storage facilities for makeup water for HVAC, landscaping, flushing to be calculated and if not fulfilled by treated water from STP, then necessary arrangement to store municipal supply or borewell supply arrangements to be done

The incoming main from municipality water supply line shall be led into raw reserve tanks, from where it shall be allowed to overflow in fire water tanks; thereafter the water shall be treated and stored in domestic water storage tanks. The water storage capacities of the tanks are as follows:

Note : Capacities given below are only indicative.

UNDER GROUND WATER TANK CAPACITY -LOCATION 1

S.NO.	DESCRIPTION	CAPACITY OF TANK
1	Fire Water Storage	As per NBC 2026 requirements
2	Raw Water Storage	1 X 230 KL
3	Domestic Water Storage	1 X 185 KL
4	Soft water Tank	1 X 130

UNDER GROUND WATER TANK CAPACITY -LOCATION 2

S.NO.	DESCRIPTION	CAPACITY OF TANK
1	Fire Water Storage	As per NBC 2026 requirements
2	Raw Water Storage	1 X 430 KL
3	Domestic Water Storage	1 X 430 KL
4	Soft water Tank	1 X 195

OVER HEAD WATER TANK CAPACITY

S.NO	OVER HEAD TANK CAPACITY	DOMESTIC	FLUSHING	FIRE FIGHTING	HVAC MAKEUP WATER TANK
1	PHARMACY COLLEGE	15.0 KL	12.5 KL	As per NBC 2026 requirements	
2	GIRLS HOSTEL	9 KL	5 KL	As per NBC 2026 requirements	
3	DENTAL COLLEGE	5 KL	5 KL	As per NBC 2026	

				requirements	
4	GIRLS HOSTEL	7 KL	3.5 KL	As per NBC 2026 requirements	
5	RESIDENCE TYPE-II A	12 KL	6 KL	As per NBC 2026 requirements	
6	RESIDENCE TYPE-II B	12 KL	6 KL	As per NBC 2026 requirements	
7	INDOOR STADIUM	1 KL	1 KL	As per NBC 2026 requirements	
8	CLUB HOUSE	7 KL	5 KL	As per NBC 2026 requirements	
9	ELECTRICAL SUBSTATION/ SERVICE BLOCK	1 KL	1 KL	As per NBC 2026 requirements	80 KL
				As per NBC 2026 requirements	
10	BOYS HOSTEL	13 KL	7 KL	As per NBC 2026 requirements	
11	TYPE-IV-A	15 KL	7 KL	As per NBC 2026 requirements	
12	TYPE-IV-B	15 KL	7 KL	As per NBC 2026 requirements	
13	BOYS HOSTEL	7 KL	3.5 KL	As per NBC 2026 requirements	
14	SURGEON HOSTEL GENTS	7 KL	3.5 KL	As per NBC 2026 requirements	
15	GUEST HOUSE	2.5 KL	1.5 KL	As per NBC 2026 requirements	
				As per NBC 2026 requirements	
16	HOSPITAL	110 KL	40 KL	As per NBC	

				2026 requirements	
17	U.G. GIRLS HOSTEL	14 KL	7 KL	As per NBC 2026 requirements	
18	SURGEON HOSTEL LADIES	7 KL	3.5 KL	As per NBC 2026 requirements	
19	ESS	1 KL	1 KL	As per NBC 2026 requirements	175 KL

Appurtenant

Following appurtenant shall be part of the design of water supply system for efficient functioning:

Flow Restrictors

Appropriate flow restrictors shall be provided at all fixtures to economize on water consumption. Typical flow rates shall follow latest NBCS guidelines with preference for 3-star water-efficient fixtures/fittings.

Automatic Air Vents

Automatic air vents shall be installed on all water risers to eliminate air locking and ensure efficient water flow and pressure availability at user outlets.

Ball Valves & Angle Stop Cocks

Full-bore forged brass ball valves shall be provided for isolation of water supply to different areas. Chrome-plated angle stop cocks shall be provided for cold water isolation to wash basin faucets and WC cistern connections.

Pressure Gauges & Pressure Reducing Valves

Pressure gauges shall be installed at strategic locations on the water supply piping for efficient system monitoring and better pressure management.

The maximum velocity in water supply piping shall not exceed 2.4 m/s. Pipe sizing shall be based on fixture unit calculations as per NBCS standards, optimized for capital cost and ease of installation.

Pipe Protection, Supports, Hangers & Clamps

All vertical pipes shall be fixed with galvanized clamps and angle brackets, truly vertical. Horizontal pipes along the ceiling shall be fixed on galvanized structural adjustable clamps, laid to uniform slope, with clamps adjusted to proper levels. Branch pipes shall connect to stacks at the same angle as the fittings. No collars shall be used on vertical stacks; each stack shall be terminated at top with a cowl (terminal guard). Factory-made prefabricated galvanized clamps shall be preferred. All sleeves, openings, hangers, and inserts shall be provided during construction.

Protection of Terrace Water Supply Lines

Adequate protective cladding, insulation, or architectural enclosures shall be proposed for exposed water supply pipelines located on terraces and roof areas to protect the pipelines from weathering, ultraviolet exposure, and mechanical damage.

Water Metering

A water meter shall be provided at the inlet of the Underground Reservoir (UGR) for monitoring and recording municipal water consumption. The meter location shall allow easy access for operation and maintenance. However, the meters installed to be tested and approved by WATCO authority.

Concealment of MEP Services

Exposed MEP services shall be avoided. All feasible efforts shall be made to conceal Public Health, Mechanical, Electrical, and Fire Fighting services within shafts, service corridors, false ceilings, trenches, or architectural enclosures while maintaining accessibility for maintenance.

Domestic Air Vents: Automatic air vent is to be provided on all water risers to eliminate possibility of air locking and to ensure efficient water flow / pressure availability at the user outlets.

Flow Restrictors: Appropriate flow restrictors are to be provided for economizing on water consumption. The flow resistors shall be typically sized for the low flow /discharge at design pressure 45 psi.

Wash Basin	:	4.0 LPM
Shower	:	4.0 LPM
Kitchen Sink	:	4.0 LPM
WC Flushing	:	4/2 LPF
Urinal Flushing	:	1 LPF

This is the minimum requirement final capacities will be as per IGBC/GRIHA guidelines latest amendments till date with approval of OBCC.

Ball Valve: Full bore gun – metal ball valve is to be provisioned for isolation of water supply for the different areas. Further chrome-plated angle valve shall be provided for cold water isolation to wash basin faucets and for WC cistern water supply.

Pressure Gauge: Pressure Gauge needs to be provided on water supply piping at strategic locations for efficient monitoring of the system.

Hot Water System (Solar/Heat pump/Geysers Hot Water Generation)

The site has daily hot water requirements for patient rooms, operation theatres, labs, CSSD, kitchen, residence etc.

The heat pump shall be used for centralized hot water system including standby.

The pumps in the Heat Pump shall pump the heated water through the Primary (heat pumps to Plate Heat Exchangers) of Plate Heat Exchangers with a required capacity with 20% safety factor for each zone of water supply. A Secondary Pump shall circulate the Water from the Hot Water Storage Tanks through the same Plate Heat Exchangers in order to heat up the water in the Storage Tanks. Hot water and cold water will be fed through the same Hydro-pneumatic system for each zone to ensure equal Hot and Cold-Water working pressures at the user points. And required capacity of hot water mixing tanks for each zone.

General

The Contractor shall carry out Design, Engineering, Supply, Installation, Testing, and Commissioning of the centralized solar, heat pump and individual geyser Hot Water generation System.

For Hostel and clinical areas, the requirement shall be fulfilled by solar (20%) and the balance (80%) by electrical heat pump (including SS storage tank) with hot water return line and pump provision.

Energy-efficient individual electric geysers (minimum BEE 3-star rated) shall be provided wherever centralized heating is not provided with a minimum 15 lit storage type geyser.

Solar Hot Water Heating System

A thermosyphon-type solar water heating system shall be provided with: copper-copper flat plate collectors with stainless steel 304 (food-grade) insulated hot water storage tanks; 100 mm glass wool insulation with 24 SWG aluminium sheet cladding on storage tanks; heat exchanger made of SS pipes installed inside the solar tank; solar collectors arranged on the building roof to avoid shading.

Heat pump Hot Water Heating System:

The domestic hot water requirement for the building shall be met through a high-efficiency Air Source Heat Pump (ASHP) system. The heat pump shall extract heat energy from the ambient air and transfer it to water through a refrigeration cycle, thereby generating hot water in an energy-efficient and environmentally sustainable manner. The system shall be designed to maintain the required hot water temperature of 55°C to 60°C and shall be capable of meeting the peak hot water demand of the facility. Hot water generated by the heat pump shall be stored in insulated hot water SS storage tanks and distributed through a dedicated hot water piping network.

The heat pump system shall comprise outdoor heat pump units, insulated SS hot water storage tanks, circulation pumps, temperature sensors, controls, safety devices, and all associated piping and accessories required for a complete installation. The units shall be suitable for continuous operation under the prevailing climatic conditions. The system shall incorporate automatic temperature control, anti-legionella protection, freeze protection, and intelligent operation to optimize energy consumption while ensuring uninterrupted hot water availability.

The heat pump water heating system shall be designed as an environmentally friendly alternative to conventional electric geysers or fossil-fuel-based water heating systems. The equipment shall use eco-friendly refrigerants with low Global Warming Potential (GWP) and shall comply with relevant applicable Indian Standards. The entire installation, including equipment foundations, piping, insulation, electrical works, testing, and commissioning, shall be carried out in accordance with the manufacturer's recommendations and approved engineering practices to ensure reliable, safe, and efficient operation throughout its service life.

For each Hospital & hostel building at least 1 days of hot water storage requirement in SS storage tank shall be stored in terrace areas and to be placed suitably and arrangements to be done to be protected from common people access.

Note:

1. The heat pump must not be installed in a closed room.

2. The contractor/agency shall submit Technical Data Sheets (TDS) for all sanitary fixtures and fittings for approval prior to installation in the project area. The submission shall clearly indicate the area of application and intended usage of each plumbing and sanitary (PH) item, along with the relevant design calculations and supporting technical details.

3. The Agency shall install two mock-up toilets (considering at least two brands) for approval by the Authority prior to proceeding with the full installation across all floors.

4. Any omission, discrepancy, ambiguity, or inadequacy in the Tender Documents, Drawings, Specifications, or any other contract document that may be required for the satisfactory completion, commissioning, testing, operation, and handing over of the project in all respects shall be deemed to be included within the scope of the Contractor. The Contractor shall carry out and provide all such items, materials, equipment, accessories, fittings, services, temporary works, labour, tools, tackles, and other necessary arrangements required for the successful execution and completion of the works, whether specifically mentioned in the Contract Documents or not, without any additional cost implication to the Employer. No claim for extra payment, extension of rates, or compensation on account of such omissions, discrepancies, or additional requirements essential for the intended functioning and completion of the project shall be entertained.

THE ASSUMED CAPACITY OF THE HEAT PUMP IS MENTIONED BELOW WHICH WILL BE FINALIZED BASED ON THE ACTUAL INPUT FROM THE RESPECTIVE VENDORS: -

Total Hot water Required for all buildings are as follows:

S.NO	BUILDING	HOT WATER REQ	REQUIRED FROM SOLAR	REQUIRED FROM HEAT PUMP	REMAK	NO. OF SOLAR PANEL REQ
1	PHARMACY COLLEGE	7200	1440	5760	50 KW (1W+1S)	14
2	BOYS HOSTEL	8640	1728	6912	50 KW (1W+1S)	17
3	GIRLS HOSTEL	5760	1152	4608	20 KW (2W+1S)	12
4	TYPE-IV-B	9360	1872	7488	50 KW (1W+1S)	19
5	DENTAL COLLEGE	4000	800	3200	30 KW (1W+1S)	8
6	BOYS HOSTEL	4080	816	3264	30 KW (1W+1S)	8
7	GIRLS HOSTEL	4080	816	3264	30 KW (1W+1S)	8
1	HOSPITAL	67500	13500	54000	250 KW (2W+1S)	135
2	U.G. GIRLS HOSTEL	9000	1800	7200	50 KW (1W+1S)	18
3	GUEST HOUSE	1500	300	1200	10 KW (2W+1S)	3
4	SURGEON HOSTEL LADIES	4500	900	3600	20 KW (2W+1S)	9
5	SURGEON HOSTEL GENTS	4500	900	3600	20 KW (2W+1S)	9
6	RESIDENCE TYPE-II A	7800	1560	6240	50 KW (1W+1S)	16
7	RESIDENCE TYPE-II B	7800	1560	6240	50 KW (1W+1S)	16
8	CLUB HOUSE	1500	300	1200	10 KW (2W+1S)	3

Note:
Capacity proposed is only indicative, Contractor will share final calculation.

Pump Sizing Criteria:

The flow rate of all pumps shall be suitably selected to meet building water demand with sufficient head to account for building height, pipe friction losses, bends, and site conditions. One standby pump shall be provided for every pump type. Pumps shall be sized to ensure maximum 2 hours of operation to fill the overhead tanks.

Sanitary Works

Sanitary Fixtures & CP Brass Fittings

All sanitary wares shall be of white vitreous china conforming to the relevant IS standards. The general specifications are as follows:

- Water Closets (WCs) — Wall-hung, European pattern, provided with concealed dual-flush type cisterns (3/6 LPF) as per IS 2556 or floor mounted EWC with dual flushing cistern in case of non-possibility of wall hung ECs.
- Wash Basins — White vitreous China undercounter oval in common toilet areas and flat back type with pedestal in attached araes; fitted with CP angle stop cocks, waste coupling, and CP bottle trap; half turn lever operated pillar tap as per IS 2256 (Part 7) 1995 in common areas and basin mixer in admin, doctors attached toilet and executive areas.
- Urinals — Flat back long body back inlet type urinal to be provided with pressmatic flushing arrangement as per IS 2556
- Showers — Shower mixer with cold and hot water arrangement in designated areas with adjustable rose and arm
- Kitchen Sinks — stainless steel 304 grade with single drain board and sink cock fittings
- Accessories — soap dispensers, toilet paper holders, towel rings & rails, hand dryers (in common areas), and soap dishes of stainless steel
- CP Fittings in clinical & other areas — Two-way bib cock, long body bib cock, short body bib cock, button type health faucet, angle valve, stop cock, special hospital fittings such as elbow operated pillar tap to be provided wherever required.
- Concealed urinal traps shall be adopted. Waste connections from urinals shall also be concealed within walls or service ducts to achieve improved aesthetics and ease of maintenance.
- At least 50% percentage of toilet facilities shall incorporate Indian-type water closets for common toilet areas in accordance with project requirements, user profile, and applicable accessibility provisions.
- Solid rigid PVC piping shall be used for wash basin waste connections. Suitable P-traps or bottle traps shall be provided as per fixture requirements and architectural considerations.
- For executive areas such as doctors chamber and higher-level officials, admin areas a premium range of sanitary fixture and fittings to be selected and to be approved as per direction of engineer in charge.

Soil, Waste & Vent Pipe System

The above-ground drainage system shall be designed on a two-pipe system as recommended in the code of practice. The following configuration applies:

- Soil pipes shall carry waste from WCs, urinals, and similar fixtures, connecting directly to the first manhole outside the building.
- Waste pipes shall carry discharge from lavatory basins, kitchen sinks, and similar appliances, connecting to gully traps and thence to external manholes.
- All internal sanitary disposal shall be under the RCC slab (by core cutting where required) and in residential buildings.
- Ventilation pipes shall be provided at all stacks to prevent loss of water seal in traps.
- All vertical stacks shall be installed in dedicated pipe shafts and shall terminate as vent pipes at terrace level.
- Cleanout doors and plugs shall be provided at all branches and changes of direction for rodding and maintenance.
- Velocity breakers shall be provided in all soil and waste stacks wherever required to control excessive flow velocity, reduce hydraulic shock, and minimize noise generation within the drainage system.
- Separate and independent vent pipes shall be provided for soil stacks and waste stacks to ensure proper ventilation of the drainage network and to maintain trap seals under all operating conditions.
- Sound-proof/low-noise drainage piping systems shall be adopted for soil, waste, and rainwater drainage networks, particularly in occupied areas, to minimize transmission of flow noise through building structures.

Materials for Soil, Waste & Vent Piping

All soil, waste, and vent pipes shall be independent low noise PP pipes and fittings.

Design Parameters — Soil & Waste Piping

Piping design shall be in accordance with the Code of Practice for Installation of Soil & Waste Pipes. Pipe diameters and slopes shall be as per the connected fixture load.

Other materials to be used:

Providing all materials, labour, T&P for fitting and fixing of standard size HPL Toilet Cubicle of approved make in all toilets of common areas.

Urinal partition (HPL) of size of 12 mm thick compact laminate, total height 1200 mm, Depth 550 mm, Gap from ground 400 mm to 550 mm shall be provided in common toilets areas.

Sewerage System

System Overview

- All sewage generated within the buildings shall be collected and conveyed by gravity to the Sewage Treatment Plant. The external sewerage system shall comprise a network of HDPE pipes with manholes, and associated appurtenances from the first building manhole to the STP inlet chamber.
- The scope includes planning, designing and construction of providing and laying external sewer lines with pipes of spigot and socket ends including Manholes of required size, shape, and depth complete and as per direction of Engineer-in-charge. The agency must plan, design, prepare the drawings for Sewerage system and get the same approved from concerned Engineer before execution by the competent authority. The sewerage lines of individual building shall be considered in buildings up to and including first manhole.
- The first inspection chamber shall be provided with a vent pipe for proper ventilation.
- The last manhole chamber shall be provided with a vent pipe for proper ventilation.
- Clean Out Plug (COP) – Clean-out plugs shall be provided at the base of soil, waste, and vent stacks and at required locations along drainage pipelines to facilitate inspection, cleaning, and maintenance of the system.
- Floor Trap with Channel Grating – Stainless steel floor drains with removable grating for efficient drainage of wastewater and easy cleaning.
- Pipes shall be supported with clips at prescribed spacing as per NBC-2026 measured along the centreline including fittings, and hydraulically pressure-tested prior to commissioning to ensure leak-free performance.

Design Parameters

All the design parameters to be followed as per latest NBCS 2026, SP 35, latest CPHEEO manual and updated IS codes.

Type of Distribution

Sewer flow shall be by gravity up to the final disposal point. The external sewer shall be connected to the centralized STP for clinical area and to individual STP for respective building areas. A backup connection to the city sewer system shall be provided for contingency if the connection is near to the proposed building.

Kitchen Effluent

All kitchen waste shall pass through a grease trap/oil separator prior to discharge into the external sewer network.

Manholes

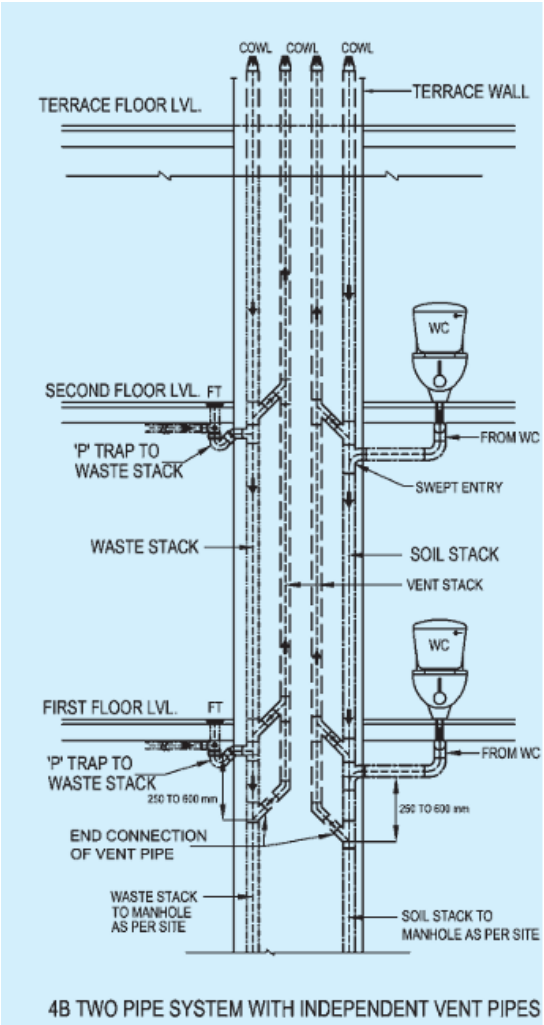
Manholes shall be constructed with brick/fly ash masonry/RCC as per NBCS latest standard specifications, provided at all junctions, changes of direction, changes in pipe diameter, and at a maximum spacing of 20 metres on the main sewer line. Medium duty SFRC covers shall be used on service roads; heavy duty SFRC covers on main roads.

Adequate provision shall be made for Grease Traps (GT), Inspection Chambers (IC), and Manholes throughout the external sewerage and drainage network to facilitate operation, maintenance, and inspection.

Sewage and Sullage Waste Drainage

The soil and waste drainage system will be designed as a dual pipe fully ventilated installation in accordance with all applicable local Indian Codes as a minimum Soil waste and vent pipe stacks and internal piping from sanitary fittings including required traps etc., will be provided to drain all sanitary fittings located in toilet areas, kitchens and cleaner's and other wet areas as required. Outlets at roof levels will be raised above the finish level to differentiate these from rainwater outlets.

Ventilation pipes will be provided to prevent the loss of water traps throughout the system. In all areas drainage pipe work will be accessible. Soil and waste pipes from upper floors will connect into the infrastructure drainage system at basement Level. Ventilation shall be 2-pipe system with independent vent pipe as per figure below:



4B TWO PIPE SYSTEM WITH INDEPENDENT VENT PIPES

LEGEND

SH	SHOWER
WC	WATER CLOSET
WB	WASH BASIN
FT	FLOOR TRAP
BT	BOTTLE TRAP
GT	GULLY TRAP

NOTES

1 Presentation of type of fixtures/drains, and pipe route/layout is typical in nature.

2 Kitchen waste/vent piping shall also be planned in a similar manner as for other waste appliances.

FIG. 4 TWO PIPE SYSTEM

Access will be provided at all branches, changes of direction and above connection to the drainage system. The soil stacks will be housed within purpose-built service shafts with branch connections at each floor level receiving the discharge from the various sanitary appliances. Where pipes pass through fire compartments all penetrations will be fire sleeved.

To meet the sustainable design expectations, a sewage treatment plant (STP) shall be provided to treat the onsite sewage generation. STP will provide recycled water to the flushing, irrigation water and cooling tower make-up tanks.

Sewage Treatment Plant shall be based on MBR technology Parameters for design of sewage treatment plant.

Parameters	**Value**	
	Before Treatment	**Aftertreatment**
pH	7.5-8.5	6.0-8.5
BOD	250-450Mg/L	Less than 5Mg/L
Suspended Solids	250-400Mg/L	Lessthan5Mg/L
COD	600-800Mg/L	Lessthan50Mg/L
Oil Grease	50-100Mg/L	Lessthan5Mg/L
Detergents	50-100Mg/L	Lessthan0Mg/L

The sewage treatment plant shall be designed for a capacity to handle soil and wastewater from the building and shall be able to withstand shock load situations. Soil & Wastewater from the building shall flow into a grit chamber to remove settling grit. Overflow from the grit chamber shall come to a sump chamber constructed as an integral part of the sewage treatment plant.

A connection will also be provided to the city sewer system for backup, or for periods when STP is not in operation.

STP Capacity shall be designed as per the above calculation.

The capacity of STP and ETP are as follows:

STP 1-210 KLD

STP 2-165 KLD

STP 3-325 KLD

STP 4-65 KLD

ETP 1-10 KLD

ETP 2 -45 KLD

Note:

All tank capacities of ETP/STP shown above are indicative. However, the capacities will have to properly estimated/observed and in the event of any variation between the indicative capacities and the capacities derived from the approved detailed calculations, the higher capacity/value for each individual parameter shall be considered for design and execution purposes. The agency shall make all necessary provisions accordingly.

Any increase in quantities arising from such detailed calculations shall be deemed to have been accounted for in the quoted rates. The rates for the corresponding items shall be suitably adopted, and no additional payment, claim, compensation, or cost implication shall be entertained by the Client at a later stage on this account.

All outlet parameters must match the required State Pollution Board parameters or CPCB (whichever is more stringent). STP recycled water shall meet minimum standards of SPCB, for use in HVAC cooling towers, flushing, and horticulture.

Effluent Treatment Plant for Hospital & Dental.

100%segregation of infected waste and wastewater is proposed. Effluent from labs, Operation theatres and blood banks and other infected area shall be carried through a separate network of waste line and manholes up to neutralization chamber of ETP cum STP.

All the waste collected in the neutralization chamber shall first be neutralized with the help of chemical depending on the composition of the waste and then transferred to the main equalization tank of STP and mixed with sullage and gets diluted. The mixed liquor then gets treated with the help of chemical, biological and tertiary treatment units.

Grease trap waste will be collected in sump, and each sump will have 2 No. submersible.

Pumps (1 working + 1 standby) shall be provided for disposal of collected run-off. Pumps

Shall be installed in identified pumps and shall be operated by Hi-Lo level Switches with automatic changeover between both pumps.

Storm Water and Basement Drainage system.

In order to achieve zero liquid discharge (Approximately) The roof top storm water will be stored in underground modular storage tanks and shall be used for non-potable demand using primary treatment and required filtration

The surface stormwater shall be through a separate drainage network and shall be used to augment the ground water table through rainwater harvesting pits with desilting chamber. Overflow from roof top storage tanks shall be connected to the surface storm water, in turn Overflow from surface stormwater network shall be connected to the municipal storm water through dedicated pumping station and which will connect to near existing municipal pumping station or outfall.

Comprehensive drainage plan and mitigation measures are in the scope of turnkey contractor. For outfall the bidder to assess the ground reality. Runoff can only be discharged into the existing drains as per site condition and in the direction of site In Charge and PMC.

Drain channel shall be provided in the basement level car parking and plant room areas within the floor fill above the raft. Drain channels shall be provided with adequate slope to affect self-cleaning velocity and shall terminate in sumps. For each sump, 2 No. submersible pumps (1 working + 1 standby) shall be provided for disposal of collected run-off. Pumps shall be installed in identified sumps and shall be operated by Hi-Lo level switches with automatic changeover between both pumps and high-level alarm including all valves and risers. The pump capacity shall be considered based on peak flow condition in case of fire, based on the fire pumps flow rate in basement considering there should not be water flooding in basement in any condition. And adequate capacity of sumps and pumping arrangement shall be provided in all plant rooms.

System Concept

The storm water drainage system has to be designed with a near-zero liquid discharge objective. Roof-top storm water & Surface storm water is to be collected to rainwater harvesting pits (with desilting chambers) to augment the groundwater table. Maximum efforts to be given to recharge 100% of the rain water collected from different areas, however, the provision are to be made for at least 70% of the rainwater collected from terrace, road, paved areas, landscape areas to be recharged for ground water recharging.

Overflow from rain water harvesting pits shall connect to the surface storm water network. Overflow from the surface network shall discharge to the municipal storm water system through gravity or a dedicated pumping station connected to the nearest existing municipal drain if invert level does not align.

Sand trap chambers shall be provided at appropriate locations in internal storm water drainage networks and basement drainage systems to arrest silt, grit, and suspended particulate matter before discharge into the downstream drainage system.

The external storm water drainage system shall be designed to discharge into the nearest available existing storm water drain, subject to hydraulic adequacy and approval from the concerned local authority. If not, necessary pumping arrangements to be done suitably for storm water management including chambers and pumping stations.

External periphery drains with perforated or slotted medium or heavy duty RCC cover slab (as per required) to be planned and final disposal point to be planned wherever suitable level matches with the existing drain with proper filtration like sand trap/catch basin/ desilting chamber etc.

Basement Drainage

Drain channels shall be provided in all basement car parking areas and plant rooms, designed with adequate slope to achieve self-cleaning velocity and terminating in sumps. Each sump shall be equipped with two submersible pumps (1 working + 1 standby) operated by Hi-Lo level switches with automatic changeover.

Design Parameters

Storm Water Design Parameters

All the design parameters to be followed as per latest NBCS 2026, SP 35, latest CPHEEO manual and updated IS codes.

Piping & Network

The storm water network shall comprise RCC covered drain with RCC perforated covers with NP-2 and NP-3 pipes with brick masonry collection chambers and catch basins. All paved, road, and green areas shall drain directly into the main storm water drains. Minimum pipe diameter for main storm water drains shall be 200 mm in line with local authority requirements.

Water Treatment Plant

The water treatment plant will be located adjacent to storage tanks. The area will incorporate primary treatment plant comprising of Activated Carbon Filter (ACF))and Multimedia Filter (MMF), the filtration velocity of the filters shall not exceed 16 m3/hr./sqm or as per the Hospital standard and requirements and operation period shall be maximum 16hr/day, softener if required as per latest water test report and Chlorination and UV treatment in accordance with the Hospital standard and requirements at ground level. Also, centralized RO system will be provided for hospital and service block with Storage tank and dedicated pumps shall also be located within same premises with a storage area capable of providing minimum 2.0 days storage specified and to allow for positive suction and flooded suction for all the pumps. And the filtration system shall be design for total freshwater requirement.

Location & Capacity

The Water Treatment Plant shall be located adjacent to the underground storage tanks. The WTP shall incorporate primary treatment comprising Multimedia Filters (MMF), Activated Carbon Filters (ACF), softeners (if required as per the latest water test report), chlorination, and UV treatment, in accordance with hospital-grade standards and requirements. A centralized RO system shall also be provided for individual hospital block with a dedicated SS storage tank and pumps. The WTP shall provide a minimum of 1 days of treated water storage.

The operation of getting required quantity of water must not exceed 10 hours of operation.

WTP System Components

The WTP shall comprise the following components, as a minimum:

- Water supply / lifting pumps, filter feed pumps, and non-clogging submersible sump pumps — SS 304/CI casing, SS 304/Brass/Bronze impeller, SS shaft; 400/440 V, 3 phase, 50 Hz, 2900 rpm TEFC motor (IE-3 preferred); complete with flexible rubber bellows, strainers, valves, and pressure gauges; mounted on PCC/RCC foundation with anti-vibration cushy foot mountings
- MS/FRP Filters — dual media, activated carbon, pressurized sand / multi-grade; and softeners sized for optimum working pressure with necessary UV treatment.
- Panels, allied equipment and accessories — level controllers, probes, vibration eliminators, starters, valves, pressure gauges, and all interconnecting pipework
- All equipment shall be installed on suitable foundations true to level with sufficient clearance between units. Piping within the pump house shall not obstruct movement.
- One standby pump shall be provided for each type

Expected Treated Water Quality

Expected water quality after filtration shall comply with the latest CPCB/State Pollution Control Board standards, whichever is more stringent.

The design of the Water Treatment Plant shall be based on the latest water quality standards, requirements, and guidelines issued by the Odisha State Pollution Control Board (OPCB) and other applicable statutory authorities.

Concept Planning — WTP

Separate WTP, STP/ETP, pump rooms, water treatment systems, RO systems, and solar hot water systems, heat pump shall be provided for the Hospital, Residential components (only geyser) and hostel building respectively. All water distribution pipelines from the WTP/STP/ETP to various buildings shall be laid underground at a suitable depth as per CPWD specifications.

WTP/STP/ETP rooms shall be equipped with safety items including: elastomeric mats (as per IS codes) for panels, fire buckets, fire extinguishers, hand gloves, safety charts, and framed schematic/SLD drawings.

Design of both the Sewage Treatment Plant (STP) and Water Treatment Plant (WTP) shall incorporate adequate provisions for operation, maintenance, inspection, accessibility, sludge handling, equipment replacement, and future operational requirements.

RO Plant — Centralized & Portable

Centralized RO Plant

A centralized Reverse Osmosis Plant shall be provided at the hospital terrace to meet the requirements of laboratories, dialysis, OT scrubs, and other critical areas. The system shall include:

- RO high-pressure feed pumps and raw water pumps — vertical multistage centrifugal type, SS 316 casing and impeller, TEFC motor (IE-2/IE-3, 415V/3Ph/50Hz)
- Anti-scalant dosing system, micron cartridge filter, CIP (Cleaning in Place) system, and pH correction dosing system
- High-pressure piping — SS 316 with SS fittings and ball valves up to 50 mm; flanged globe/butterfly valves in SS above 50 mm
- SS 316 RO water storage tank (10,000 lit per building) with inlet/outlet water flow meters, valves, overflow/drain connection, and MH cover
- Centralized control panel in CRCA sheet (min. 2 mm) with main contactors, emergency stop, and double earthing
- One standby pump for each pump type

For hospital use, the proposed centralized RO plant capacity is 2 x 2000 LPH for each building of OBGY, Paediatric and OPD Block.

The agency must submit calculation for approval and whichever higher to be considered as final during finalization.

For water supply from central RO to individual unit, SS 316/316L pipes to be used.

Portable RO Units

Required numbers of Portable RO +UV units of 80 LPH cooling capacity with a minimum 120 litre storage tank with SS body (quantity as per NBCS standard) shall be installed as per architectural plan to meet drinking and cooking water needs. A minimum of two units shall be provided per floor or as per requirement. Each unit shall include UV disinfection, interconnecting pipework, valves, cartridge filters, diaphragm pumps, RO membranes, and drain pipe. Units shall operate at 240V AC / 50 Hz.

All building shall have Portable RO system as mentioned in Architectural Plan or as per requirements of Engineer in charge.

RO Plant Design Basis

Treated water quality after RO shall comply with IS 10500 (latest revision) for drinking water quality parameters.

Instruments List — Centralized RO Plant (Indicative)

Table 9.1 — Instruments List: Centralized RO Plant

Sr. No.	Instrument
1	Flow Indicator
2	Pressure Gauge
3	Pressure Switch (Low & High)
4	Conductivity Indicator
5	pH Meter

Automatic Grease Separator

An **automatic grease trap** (more accurately called an **automatic grease removal unit / AGRU**) is a device used in commercial kitchens to separate and remove fats, oils, and grease (FOG) from wastewater **without manual skimming**. It's a more advanced alternative to traditional passive grease traps.The Mix & Pump disposal system allows for easy cleaning and refilling with the touch of a button. The maintenance-free macerating pump (stainless steel blades) facilitates separator cleaning and disposal. The system includes a closure valve for easy pump removal, a pump floor mount with installation hardware, and an anti-vibration mat. Top-mounted water jets are included for grease layer breakup, and water spray nozzles are provided for interior wall cleaning during disposal.

The Control Unit features an LCD display with the ability to be set in English and includes a mains power safety on/off switch.

Piping Material

Following material are recommended to be used in the project:

1. GI heavy class for domestic, flushing and irrigation water supply in plant room, sump risers and Basement vertical drain pipes.
2. GI Medium class for irrigation system.
3. CPVC pipes SDR-11 concealed in wall / floor, shaft schedule 40 and terrace schedule 40 with insulation etc. after proper chases for Domestic cold-water supply.
4. CPVC pipes SDR-11 concealed in wall / floor, shaft schedule 40 and terrace schedule 40 with insulation etc. after proper chases for flushing water supply.
5. Copper pipe for Hot water supply and return system with insulation.
6. SS-316L EN-10312 piping shall be for RO supply.

7. uPVC Class-B pipe for rain water down-takes 10 kg/cm2. And in basement ceiling uPVC pipe as per IS:13592 :1992 Amended till date.
8. uPVC Class-B Pipe for soil, waste & vent system up to first manhole as per IS:13592 :1992 Amended till date.
9. uPVC Class-A pipe for vent pipes down-takes 6 kg/cm2. And in basement ceiling uPVC pipe as per IS:13592 :1992 Amended till date.
10. SN-8 Double Wall Corrugated HDPE pipes rain water system above extended basement and basement periphery.
11. RCC NP-2 or NP-3 or NP-4 pipes as per loading for external storm water drainage system but for road crossing minimum NP-3 or NP-4 and RCC Box culvert as per design.
12. SN-8 Double Wall Corrugated HDPE pipes for external sewage water system

Piping Materials

The following piping materials are specified for use in this project:

- CPVC Pipes — IS 15778 SDR 11 upto 50mm dia and above 50mm dia Schedule 80; for all concealed domestic and flushing water supply pipelines in walls, floors, shafts, and terraces (with insulation); for hot and cold potable water distribution.
- Copper pipes— for hot water circuits
- Low noise 3-layer PP pipes (Noise level< 10db) — for soil and waste lines including basement ceiling runs
- UPVC Pipes (Type B) — for external rainwater downpipes on building fascia
- RCC drain (perforated cover slab) with RCC NP 2/3 pipes — for external storm water drainage (manhole to manhole)
- HDPE DWC Pipe — for external sewage (manhole to manhole)

Pipes, Hangers, Support sand Clamps

All vertical pipes shall be fixed by galvanized clamps and galvanized angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Horizontal pipes running along ceiling shall be fixed on galvanized structural adjustable clamps of special design. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them. The Contractor shall provide all sleeves, openings, hangers, inserts shall be provided during the construction by making such provisions in the structure as necessary.

All pipes clamps, supports and hangers shall be galvanized. Factory made prefabricated clamps shall be preferred. The Contractor may fabricate the clamps of special nature and galvanize them after fabrication but before installation. All nuts, bolts, washers and other fasteners shall be factory galvanized.

Building Demand Reduction and Re-use

Demand reduction is the simplest way of reducing water consumption across all sites and is the first step in any sustainability water strategy. The Contractor shall investigate all possible sustainability measures or betterments which may be incorporated and report the same to the Engineer. These will have at least three main benefits:

Lower levels of water consumption from any alternative source of supply, therefore lowering costs and increasing reliability.

Reduced impact on the surrounding environment and infrastructure. Pumps & equipment selected on “best” energy efficiency point.

Rainwater Harvesting Pit (Underground water Recharge pit).

The rainwater harvesting system has been designed to collect and recharge rooftop and surface runoff generated within the project premises. Rainwater collected through the storm water drainage network shall be conveyed to rainwater harvesting pits comprising graded filter media such as boulders, gravel, and coarse sand for removal of suspended impurities prior to recharge. A recharge borewell shall be provided within each harvesting pit to facilitate groundwater recharge, with bore diameter and depth finalized based on hydrogeological conditions and geotechnical recommendations. The rainwater harvesting pit shall be sized to accommodate runoff from the contributing catchment area and provide temporary storage during rainfall events. Overflow from the pit shall be connected to the storm water drainage system to prevent flooding during heavy rainfall. The system shall be designed in accordance with applicable local authority requirements, NBC provisions, and CGWA guidelines, with the objective of enhancing groundwater recharge, reducing surface runoff, and promoting sustainable water management.

GENERAL INSTRUCTIONS BEFORE EXECUTION OF WORK:

Execution: All works shall be executed strictly in accordance with the approved design drawings, and testing, commissioning, and inspection shall be carried out as per the specified design requirements.

All MEP services riser shafts shall be designed to provide adequate space for maintenance, inspection, testing, and commissioning of services. A minimum clear access opening of 900 mm × 600 mm shall be provided however, exact shaft opening size will be based on approved design drawing as recommended by engineer in chief.

Shop drawings shall initially be submitted at the General Arrangement (GA) level to freeze the overall indicative design and after incorporating the comments and coordinating with approved architectural, structural, and other MEP services, revised/complied drawings shall be submitted at Good for Construction (GFC) level prior to site execution. Upon completion of the work at the site, final As-Built drawings shall be submitted.

No MEP services shall remain exposed. All services shall be properly concealed within false ceilings /sunken slabs/shafts. The design shall ensure adequate slopes and drainage provisions for service lines to prevent water accumulation and ensure proper discharge.

Sunken slab shall be provided, or minimum 300 mm drop slab shall be provided in all toilet areas in dental clinic to conceal all the drain pipes.

NOTE:

- The contractor/agency shall submit Technical Data Sheets (TDS) for all sanitary fixtures and fittings for approval prior to installation in the project area. The submission shall clearly indicate the area of application and intended usage of each plumbing and sanitary (PH) item, along with the relevant design calculations and supporting technical details.
- The Agency shall install two mock-up toilets (considering at least two brands) for approval by the Authority prior to proceeding with the full installation across all floors.
- Any omission, discrepancy, ambiguity, or inadequacy in the Tender Documents, Drawings, Specifications, or any other contract document that may be required for the satisfactory completion, commissioning, testing, operation, and handing over of the project in all respects shall be deemed to be included within the scope of the Contractor. The Contractor shall carry out and provide all such items, materials, equipment, accessories, fittings, services, temporary works, labour, tools, tackles, and other necessary arrangements required for the successful execution and completion of the works, whether specifically mentioned in the Contract Documents or not, without any additional cost implication to the Employer. No claim for extra payment, extension of rates, or compensation on account of such omissions, discrepancies, or additional requirements essential for the intended functioning and completion of the project shall be entertained.

FIRE FIGHTING SYSTEM

8C408 Fire Fighting Systems

8C408.1 Building Classification as per NBC-2026

Hospital block, Service Block Hostel and Residential, as per clause NBC-2026, table No-7 of NBC-2026, to be provided minimum requirement.

8C408.2.1 Fire Protection System

Fire Pumps with all accessories including electrical panel and control with cable etc.

Automatic Sprinkler System.

Hydrant System (Internal and External).

Portable Fire Extinguishers.

Fire Compartmentation of basement as per NBSC 2026.

7B408.2.1.1 Fire Pump Room

The Fire Pump room is located at underground level and having direct access and thus complying the Local norms.

Sprinkler protection shall be provided within pump room keeping in view the day oil diesel tank for diesel engine driven fire pump.

Mechanical ventilation to be provided as per IS Code:3844 & NBCS 2026.

7B408.2.1.2 Fire Sealants

All the pipe works, conduits and cables etc. passing through fire Compartmentation (concrete/ brick /metal/ wood / plastic etc.) shall be covered with fire sealant to cover then cesarians in order to avoid spread of fire, smoke and toxic fumes. These fire sealants shall have fire rating comparable with fire Compartmentation. All work shall be done in compliance with relevant governing codes and standards amended till date.

7B408.2.1.3 Fire Water Reservoir

Fire reservoir capacity will be as per fire safety recommendations approved by the local fire authority & NBCS 2026.

7B408.2.1.4 Fire Pumps

The Fire Pump room location is as per drawing with direct access. electrical motor driven fire pumps with stand by pump shall be provided for Sprinkler and Hydrant System. The Head of

pumps shall be in compliance with NBC requirement of minimum pressure of 3.5 kg/cm2. This will also meet minimum pressure requirement of 3.5 Bars (0.50 Kg/cm2) at farthest and remotest sprinkler. The discharge density of both system pumps shall follow NBC Codes.

Jocky pump also required to overcome loss in pressure.

Following pumps shall be provided: -

Pump number and capacity will be as per fire safety recommendations approved by the local fire authority & NBCS 2026.

The Head of hydrant system pumps shall follow NBC requirement of minimum pressure of 3.5 kg/sq.cm at remote & Highest landing valve. This will also meet minimum pressure requirement of 3.5 Bars (3.5 Kg/cm2) at farthest and remotest sprinkler. And the electrical panel, cable, cable tray and other accessories to run all pumps as per the requirement of BIS to be considered.

If the building height exceeds 60 m the hydraulic calculations meeting recommended system architecture with multi-level pumping and storage with gravity redundant down comer may be considered. The pumps considered should not exceed 12 bar shutoff pressure.

The jockey pump operation (start-stop) shall be automatic whereas the main pumps of both systems and common engine pump shall have auto start but manual shut down.

OS&Y Gate Valves with supervisory switches shall be provided on main suction header from tank and on individual suction and delivery pipes of all pumps and all valves inside the pump room shall be OS&Y Gate Valves with supervisory switches.

Check valve shall be provided one ach delivery side of pumps and in main delivery header of

Pumps with both side OS&Y Gate Valves with supervisory switches.

Fire Pump test connection shall be provided by means of UL/FM approved flow measuring station and provides the piping to re-circulate the pump’s discharge to water supply tank or to the pump’s suction.

Fire Brigade inlet and collecting head shall be provided for taking water from tank and for filling of Underground Fire tank.

Air vessel / Air Cushion tank shall be provided for sprinkler, hydrant and water curtain system.

Each pump shall be provided with a 150 mm Dia pressure gauge, isolation cock and connecting

Piping, bleed and block valve.

The fuel tank capacity shall be as per requirement of fire code/local fire Authority.

7B408.2.1.5 FIRE HYDRANT SYSTEM (INTERNAL)

The main features of proposed internal hydrant system shall be as under:

The proposed hydrant system shall be designed as per Class III System (According to NFPA 14) with a Hydrant valve and First aid Hose Reel System

System shall be designed to provide water flow at minimum residual pressure of 3.5 Kg/cm2at outlet of most remote hydrant valve.

Hose connection and hose station shall be unobstructed and shall be located not less than 0.9 meters and not more than 1.5 meters from finished floor level.

2/4-way fire brigade inlets for pumping water in vertical risers shall be provided through ring-main. Fire brigade inlet shall be located and arranged so that hose lines can be readily and conveniently attached to the inlets without external interference.

The risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work along with necessary accessories.

Each internal hydrant station shall consist of single headed hydrant valve and hydrant box to equipped Firehoses (RRL) 2 nos. hose reel(1 no.),and branch nozzle(1no), fire man axe(1 no.).The wall mounted hose completes with shut off nozzle & clamps shall be provided as per appropriate location.

Butterfly valve(s) shall be provided with each hydrant valve for ease of maintenance and operational requirements. All isolation valves of internal hydrant system shall be OS&Y with supervisory switches. Internal fire hydrant internal fire hydrant shall be available within 30mtrs. from any point at each floor level and horizontal distance between any two adjacent risers must not exceed 45 mtr in sprinklered building and 30 mtr. In non-sprinklered building. Provision of wet riser shall be made conforming to BIS standards.

Note:- 1. All internal hydrants will be gunmetal.

2. Orifice Plate will be installed.

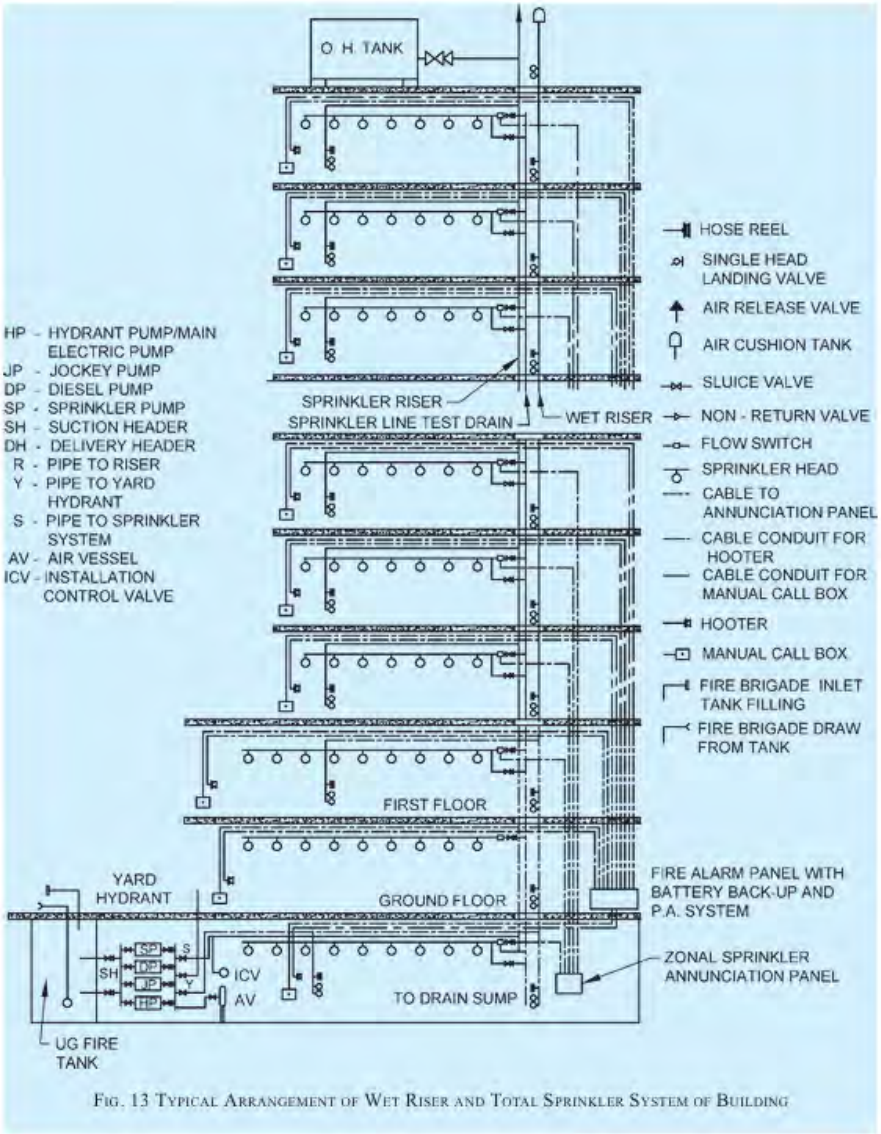


FIG. 13 TYPICAL ARRANGEMENT OF WET RISER AND TOTAL SPRINKLER SYSTEM OF BUILDING

3. Pressure gauge shall be provided at each hydrant and all sprinkler main header at each floor after flow switch in all buildings where wet riser and sprinkler system is provided

FIRE HYDRANT SYSTEM (EXTERNAL)

Underground external hydrant ring main shall be provided for providing external hydrants. The external hydrants shall be located at a minimum of 2.5 Mand maximum 15M away from building periphery to meet the NBC-2026 requirements.

The main features of proposed external hydrant system shall be:

Each external hydrant station shall consist of single headed hydrant valve (1no) and hydrant box to equipped Fire hoses (2no's) and branch nozzle (1 no).

The external hydrants shall be provided with butterfly valve for ease of maintenance and operational requirements.

Necessary isolation valves shall be provided in external ring-main to isolate the ring main in two or more parts for minimum impact on system in case of maintenance. As per industry practice one isolation valve is proposed after every three external hydrants but same can be discussed during detailed design for further submission.

External fire hydrant travel distance shall be 30 Meter to reach the nearest hydrant.

Note:- 1.All Extrenal hydrants will be gunmetal.

2. Orifice Plate will be installed.

3. External hydrants shall be provided with pressure gauge at the farthest point of the longest line.

7B408.2.1.7 Automatic Sprinkler System

AsperBIS:15105(2021), The systems Pressure in the sprinkler installation piping shall not exceed 12 bar and pressure at the most remote sprinkler at any level shall not be less than 3.5 bar and also not more than 5 bar. Density of application shall not be less than 5 lpm/m2.Software based hydraulic calculations are necessary to prove the pressures at all levels from the pumps. Where required, pressure-reducing arrangements shall be made.

The area / design density shall be in compliance of BIS: 15105 requirements of 5.0 L/m/m2 over 360m2 area.

The minimum residual pressure for remotest sprinkler shall not be less than 0.50 Bars (0.5 kg/cm2).

Ball valve of suitable size shall be provided for drain of sprinkler system at the farthest point and shall be taken to nearest drain outlet by means of piping.

Installation control valve shall be provided in the fire pumproom only for alarming in case of fire. Installation control valve shall comprise of main stop valve, alarm valve with accessories, strainer and water motor gong. The maximum floor area on any one floor to be protected by sprinkler supplied by any one sprinkler riser from an installation control valve shall be 4500 Sq. Meter.

The sprinkler piping network of each floor shall be provided with suitable size of butterfly valve within built supervisory switch, flows witch and test and drain assembly with test orifice K = 5.6 GPM / (PSI)1/2

Sprinklers shall be provided with coverage determined by BIS: 15015, 2021 latest Edition. Sprinklers under obstruction such as air ducts, cable trays and other services shall be provided in compliance with BIS:15105,2021latest Edition.

The risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work along with necessary accessories.

All sprinklers shall be quick response type.

For protection of Glass of atrium, window sprinkler will be provided in order to avoid the heating of glass & further fall of glass on occupants.

7B408.2.1.8 Portable Fire Extinguishers

Portable fire extinguishers shall be distributed all over the area as per BIS:2190. Additional extinguishers shall be provided as per requirements of Local fire Authority. The types of fire extinguishers installed throughout the hospital building shall include but not limited to:

6.0Kg, multi-purpose ABC Chemical type fire extinguishers. (ABC MAP 90 Fire Extinguisher)

9.0Kg, multi-purpose ABC Chemical type fire extinguishers. (ABC MAP 90 Fire Extinguisher)

9.0Litres, stored pressure water type fire extinguisher.

4.5Kg CO2fire extinguisher.

9.0 Kg CO2fire extinguisher.

9.0 Liters Aqueous film forming foam AFFF) stored pressure type fire extinguisher.

6.0LitresWetchemicalstoredpressuretypeextinguisher with liquid fire suppress an tangent.

5 Kg Clean Agent Extinguishers.

50KG Foam type
22.5 KG co2

7B408.2.2 Fire fighting piping and Valves.

All Internal Firefighting system piping shall be M.S. pipelines Minimum 150 mm dia (Actual size will be as per Hydraulic calculation) . shall be as per BIS: 1239, Part-I (heavy grade) while pipelines above 150 mm dia. shall be as per BIS. 3589 (heavy grade).

All valve in firefighting system shall be suitable for water works and shall be minimum rated for PN 16 pressure requirement or the rating of the valves shall be minimum 150% of the working pressure of the system.

FIRE FIGHTING TABLE AS PER NBC 2026

S.NO	BUILDING	NO. OF FLOOR	TYPE OF BUILDING	HEIGHT OF BUILDING IN (M)	HEIGHT OF BUILDING	SUB CATEGORY	FIRE EXTINGUISHER	FIRST AID HOSE REEL	DOWN COMER	WET RISER	YARD HYDRANT	AUTOMATIC SPRINKLER	AUTOMATIC DETECTION & ALARM	PUBLIC ADDRESS AND VOICE EVACUATION	CL
1	MKCG HOSPITAL	B+G+10	INSTITUTIONAL BUILDING	48.8	Above 45 m but not exceeding 60 m in height (CL-5) See Notes 4, 6, 7, 9 and 10	C-1	R	R	NR	R	R	R	R	NR	CL-5
2	ESS	B+G+2	INDUSTRIAL	14.1	BUILTUP AREA FROM 501 METER SQ TO 2000	G-2	R	R	NR	R	R	NR	R	NR	HL-3
3	INDOOR STADIUM & CLUB HOUSE	B+G+1	ASSEMBLY	9.6	1001 MTSQ AND ABOVE	D	R	R	NR	R	R	R	R	R	CL-4

4	**SURGEON GENTS HOSTEL + GUEST HOUSE**	**B+S+8**	**DORMITIORIES**	**30.5**	**1001 MTSQ AND ABOVE**	**A II**	**R**	**R**	**R**	**NR**	**NR**	**NR**	**R**	**NR**	**HL -2**
5	**SURGEON LADIES HOSTEL**	**B+S+7**	**DORMITIORIES**	**27.3**	**1001 MTSQ AND ABOVE**	**A II**	**R**	**R**	**R**	**NR**	**NR**	**NR**	**R**	**NR**	**HL -2**
6	**UG GIRLS HOSTEL**	**B+S+12**	**DORMITIORIES**	**43**	**1001 MTSQ AND ABOVE**	**A II**	**R**	**R**	**R**	**NR**	**NR**	**NR**	**R**	**NR**	**HL -2**
7	**RESIDENCE - TYPE IV-A**	**B+S+13**	**RESIDENTIAL**	**45.90**	**1 001 m2 and above (HL-3) See Notes 2, 3, 4, 5, 7, 9 and 10**	**AIII**	**R**	**R**	**NR**	**R**	**R**	**NR**	**R**	**R**	**HL-3**
8	**RESIDENCE - TYPE II-A**	**B+S+13**	**RESIDENTIAL**	**45.90**	**1 001 m2 and above (HL-3) See Notes 2, 3, 4, 5, 7, 9 and 10**	**AIII**	**R**	**R**	**NR**	**R**	**R**	**NR**	**R**	**R**	**HL-3**
9	**RESIDENCE - TYPE II-B**	**B+S+13**	**RESIDENTIAL**	**45.90**	**1 001 m2 and above (HL-3) See Notes 2, 3, 4, 5,**	**AIII**	**R**	**R**	**NR**	**R**	**R**	**NR**	**R**	**R**	**HL-3**

					7, 9 and 10									
10	CLUB HOUSE	B+G+3	ASSEMBLY	13.6	1 001 m2 and above (CL-4) See Notes 2, 5, 8 and 9	D	R	R	NR	R	R	R	R	NR	CL-4

S.NO	BUILDING	NO. OF FLOOR	TYPE OF BUILDING	HEIGHT OF BUILDING IN (M)	HEIGHT OF BUILDING	SUB CATEGORY	FIRE EXTINGUISHER	FIRST AID HOSE REEL	DOWN COMER	WET RISER	YARD HYDRANT	AUTOMATIC SPRINKLER	AUTOMATIC DETECTION & EVACUATION	AND VOICE	CL
1	BOYS HOSTEL	B+S+13	DORMITIORIES	47.5	1001 MTSQ AND ABOVE	A II	R	R	R	NR	NR	NR	R	NR	HL-2
2	GIRLS HOSTEL	B+S+9	DORMITIORIES	34.8	1001 MTSQ AND ABOVE	A II	R	R	R	NR	NR	NR	R	NR	HL-2
3	PHARMACY COLLEGE	B+G+5	EDUCATIONAL	26.4	1 001 m2 and above (CL-4)	B	R	R	NR	R	R	R	R	R	CL 4

					See Notes 3, 5, 7, 9 and 10										
4	**RESIDENCE-TYPE-IVB**	**B+S+13**	**RESIDENTIAL**	**45.9**	**Above 60 m height (CL-4) See Notes 3, 4, 5, 7, 8, 9, and 10**	**AIII**	**R**	**R**	**NR**	**R**	**R**	**R**	**R**	**R**	**CL 4**
5	**ELECTRICAL SUB STATION**	**G+2**	**INDUSTRIAL**	**14.75**	**BUILTUP AREA FROM 501 METER SQ TO 2000**	**G-2**	**R**	**R**	**NR**	**R**	**R**	**NR**	**R**	**NR**	**HL-3**
6	**DENTAL COLLEGE**	**B+G+7**	**EDUCATIONAL**	**35.6**	**1 001 m2 and above (CL-4) See Notes 3, 5, 7, 9 and 10**	**B**	**R**	**R**	**NR**	**R**	**R**	**R**	**R**	**R**	**CL 4**
7	**BOYS HOSTEL**	**B+S+11**	**DORMITIORIES**	**41.6**	**1001 MTSQ AND ABOVE**	**A II**	**R**	**R**	**R**	**NR**	**NR**	**NR**	**R**	**NR**	**HL -2**
8	**GIRLS HOSTEL**	**B+S+11**	**DORMITIORIES**	**41.6**	**1001 MTSQ AND ABOVE**	**A II**	**R**	**R**	**R**	**NR**	**NR**	**NR**	**R**	**NR**	**HL -2**

Note:

1. If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

2.Minimum 4 UGT will be proposed in campus. (if More UGT required contractors will propose to fulfill Local fire Authority requirements).

- UGT 1 -350000 Liters (Minimum)
- UGT 2-300000 Liters (Minimum)
- UGT 3-300000 Liters (Minimum)
- UGT 4-150000 Liters (Minimum)

3.Firefighting OHT Will be as per NBC 2026 /Recommended by local fire authorities.

4. Pre NOC shall be provided before submission of the firefighting Shop drawing and final NOC shall be provided at the completion of the project to the

Engineer in charge.

5.All the firefighting work, underground tank and overhead tank work should be as per FIRE SAFETY RECOMMENDATION provided by

Odisha Fire Service and NBCS 2026.

Note: -

1. Pre NOC shall be provided before submission of the firefighting Shop drawing and final NOC shall be provided at the completion of the project to the Engineer in charge.

2. In building with down comer shall be provided with terrace booster pump in extended mode(N+1).

3.Capacity & Quantity of fire Pumps will be as per NBC 2026 or as per fire safety recommendations approved by the local fire authority.

4.Contractor will calculate pump head and take approval from Client, PMC & local fire authority.

HVAC SYSTEM

8C402 HVAC SYSTEM

8C402.1 Reference Standards

The following standards and guidelines shall be adopted while designing the HVAC system, as amended to date of Execution.

a. NABH – 2015

b. National Building Code of India (NBC) 2026

c. Energy Conservation Building Code (ECSBC) 2024

d. ASHRAE Handbooks for HVAC Applications 2023, Refrigeration 2022, Fundamentals 2023 and HVAC Systems and Equipment 2020

e. ASHRAE 170-2021; Ventilation of Health Care Facilities

f. Duct construction standards as per relevant BIS Codes & SMACNA standards

g. Air filters as per ASHRAE 52.1-1992 and 52.2-2017

h. Indoor Air Quality as per ASHRAE 62.1-2022

i. Motors, cabling, wiring and accessories as per BIS Codes

j. National Fire Codes 2000

k. National Electric Codes (NEC)

l. ASHRAE Standard 90.1- 2022

8C402.2 Location

Site Location: Berhampur (Brahmapur), Ganjam District, Odisha

Geographic Location: 19° 18' 30.7116" N, 84° 48' 34.7292" E

Altitude: 90 M above mean sea level

8C402.3 Outdoor Design Conditions for Berhampur (Brahmapur) are considered based on Weather data:

	DBT °C	WBT °C
Summer	110 °F DB	78 °F WB
Monsoon	86 °F DB	82.0 °F WB

8C403 BASIS OF DESIGN

Recommended Master Hospital HVAC Design Criteria Schedule

Sl. No.	Area/Department	HVAC Type	Temp (°C)	RH (%)	Total ACH	Fresh Air ACH	Min. Outdoor Air (%)	Pressure Differential (Pa)	VAV Required	Type of VAV Control / Diffuser Strategy	100% Outdoor Air Required	Reason for 100% Outdoor Air Requirement	Filtration Level

Sl.	Area	HVAC Type	Temp	RH	ACH	FA ACH	OA %	ΔP	VAV	VAV Control Type	100% OA	Reason	Filtration
1	Main Lobby	Conventional	24–26	40–60	6	2	33	0	Yes	DCV using CO_2 sensors and PI-VAV terminals	No	Occupancy variation; recirculation acceptable	MERV-13
2	Waiting Area	Conventional	24–26	40–60	6	2	33	0	Yes	CO2 based PI-VAV	No	Energy optimisation through demand-controlled ventilation.	MERV-13
3	OPD Consultation	Conventional	22–26	40–60	6	2	33	0	Yes	TMP-VAV	No	Comfort conditioning	MERV-13
4	General Ward	Conventional	22–26	30–60	6	2	33	0	Conditional	Zone-based TMP-VAV	No	Normal patient occupancy	MERV-13
5	ICU	Precision	22–	40–	12	2	17	+5	Conditional	PRC-VAV	No	HEPA filtered	F9 +

			24	60				to +10		maintaining pressure offset		recirculation acceptable	HEPA optional
6	NICU	Precision	26–28	40–60	8–12	2	17–25	+5 to +10	Conditional	PRC-VAV	No	Stable environment required	F9
7	Major OT	Precision	20–24	40–60	20	4	20	+15	No	CAV with laminar flow ceiling	No	HEPA recirculation permitted	H14
8	Orthopaedic OT	Precision	18–22	40–60	25	4	16	+15 to +20	No	CAV	No	Ultra-clean environment maintained by HEPA filtration	H14
9	Isolation Room (AIIR)	Precision	22–24	30–60	12	2	100	−5 to −15	Yes	TVAV supply/exhaust tracking	YES	Prevention of recirculation of infectious aerosols	HEPA exhaust
10	Isolation ICU	Precision	22–24	30–60	12	2	100	−5 to −15	Yes	TVAV	YES	Airborne infection containment	HEPA exhaust
11	Bronchoscopy Room	Precision	21–24	40–60	12	2	100	−5	Yes	TVAV with exhaust dominance	YES	Aerosol generating procedure	HEPA exhaust
12	Sputum Collection Room	Ventilation	22–26	NC	12	2	100	−5	No	Exhaust tracking	YES	High risk aerosol source	HEPA exhaust
13	BSL-3 Laboratory	Precision	22–24	30–60	12	2	100	−15 to −30	Yes	Cascade TVAV	YES	Biosafety requirement	H14 supply and exhaust
14	Autopsy Room	Ventilation	18–24	30–60	12	2	100	−5 to	Yes	Exhaust tracking	YES	Bioaerosols and odour	Exhaust HEPA

								−10				control	
15	Embalming Room	Ventilation	18–24	30–60	12	2	100	−5 to −10	Yes	Exhaust tracking	YES	Formaldehyde vapours	Exhaust HEPA
16	CSSD Decontamination	Ventilation	22–26	30–60	10	2	100	−5	Yes	TVAV	YES	Steam and contaminated air removal	F9
17	Soiled Utility Room	Ventilation	22–26	NC	10	2	100	−5	No	Exhaust only	YES	Infection control	Exhaust filter
18	Biomedical Waste Room	Ventilation	22–28	NC	10	2	100	−5	No	Exhaust only	YES	Odour and contamination control	Exhaust filter
19	Hazardous Drug Mixing Room	Precision	20–24	40–60	12	2	100	−5	Yes	TVAV	YES	Cytotoxic drug containment	H14
20	Chemotherapy Preparation	Precision	20–24	40–60	12	2	100	−5	Yes	TVAV	YES	Hazardous pharmaceutical compounding	H14
21	Cath Lab	Precision	20–24	40–60	12	2	17	+5	Yes	PRC-VAV	No	Controlled environment; recirculation permitted	F9
22	IVF Laboratory	Precision	22–24	35–45	15	3	20	+10	No	CAV	No	Environmental stability preferred	H13
23	CSSD Sterile Area	Precision	20–22	40–60	10	2	20	+10	Yes	PRC-VAV	No	Sterility maintained by filtration and pressure	H13
24	Kitchen	Ventilation	≤30	NC	15–20	Make-up Air	80–90	−5	Yes	DCKV	No	Hood exhaust compensation	G4
25	Toilets	Exhaust	NC	NC	10	0	0	−5	Yes	Occupancy-	No	Exhaust-only	NA

										controlled exhaust		space	

Suggested Legend for the Report

Abbreviation	Meaning
PI-VAV	Pressure Independent Variable Air Volume Terminal
TMP-VAV	Temperature Modulating VAV
TVAV	Tracking Variable Air Volume (Supply–Exhaust Tracking)
PRC-VAV	Pressure Regulated Constant Offset VAV
DCV	Demand Controlled Ventilation using CO_2 sensors
DCKV	Demand Controlled Kitchen Ventilation
VGD	Variable Geometry Diffuser
CAV	Constant Air Volume System

VENTILATION REQUIRED IN AREAS AS PER NBCS 2026 ARE AS FOLLOWS:

Sl No.	*Application*	*Air Change per Hour*
(1)	(2)	(3)
i)	Assembly rooms	4 to 8
ii)	Bakeries	20 to 30
iii)	Banks/building societies	4 to 8
iv)	Bathrooms	6 to 10
v)	Bedrooms	2 to 4
vi)	Billiard rooms	6 to 8
vii)	Boiler rooms	*See* Note 2
viii)	Cafes and coffee bars	10 to 12
ix)	Canteens	8 to 12
x)	Cellars	3 to 10
xi)	Changing rooms	6 to 10
xii)	Churches	1 to 3
xiii)	Cinemas and theatres	10 to 15
xiv)	Club rooms	12, *Min*
xv)	Compressor rooms	10 to 12
xvi)	Conference rooms	8 to 12
xvii)	Corridors	5 to 10
xviii)	Dairies	8 to 12
xix)	Dance halls	12, *Min*
xx)	Dye works	20 to 30
xxi)	Electroplating shops	10 to 12
xxii)	Engine rooms/DG Rooms/GG Rooms	*See* Note 2
xxiii)	Entrance halls	3 to 5
xxiv)	Factories and work shops	8 to 10
xxv)	Foundries	15 to 30
xxvi)	Garages	6 to 8
xxvii)	Glass houses	25 to 60
xxviii)	Gymnasium	6, *Min*

Table (*Concluded*)

Sl No.	*Application*	*Air Change per Hour*
(1)	(2)	(3)
xxix)	Hair dressing saloon	10 to 15
xxx)	Hospitals sterilising	15 to 25
xxxi)	Hospital wards	6 to 8
xxxii)	Hospital domestic	15 to 20
xxxiii)	Laboratories	6 to 15
xxxiv)	Launderettes	10 to 15
xxxv)	Laundries	10 to 30
xxxvi)	Lavatories	6 to 15
xxxvii)	Lecture theatres	5 to 8
xxxviii)	Libraries	3 to 5
xxxix)	Lift cars	20, *Min*
xl)	Living rooms	3 to 6
xli)	Mushroom houses	6 to 10
xlii)	Offices	6 to 10
xliii)	Paint shops (not cellulose)	10 to 20
xliv)	Photo and X-ray dark room	10 to 15
xlv)	Public house bars	12, *Min*
xlvi)	Recording control rooms	15 to 25
xlvii)	Recording studios	10 to 12
xlviii)	Restaurants	8 to 12
xlix)	Schoolrooms	5 to 7
l)	Shops and supermarkets	8 to 15
li)	Shower baths	15 to 20
lii)	Stores and warehouses	3 to 6
liii)	STP rooms	30, *Min*
liv)	Squash courts	4, *Min*
lv)	Swimming baths	10 to 15
lvi)	Toilets	6 to 10
lvii)	Underground vehicle parking	6, *Min*
lviii)	Utility rooms	15 to 30
lix)	Welding shops	15 to 30

NOTES

1 The ventilation rates may be increased by 50 percent where heavy smoking occurs or if the room is below the ground.

2 The ventilation rate shall be as per **14.2.1** of Part D 'Building Services, Section 3 Air Conditioning, Heating and Mechanical Ventilation' of this NBCS.

Minimum Parameters for BEE 5 Star rating :

Parameter	Requirement
Energy Rating	BEE 5-Star certified as per current BEE Star Labelling Programme
Applicable Standard	IS 16590 (Water Chilling Packages), tested in accordance with AHRI 550/590
Chiller Type	Air-cooled Scroll/Screw or Water-cooled Screw/Centrifugal (as applicable)
Refrigerant	Low-GWP refrigerant such as R-134a, R-513A, R-1234ze, R-515B, or approved equivalent
Compressor	Screw or Centrifugal with VFD (preferred for large capacity)
Rated Cooling Capacity	As per project load calculations
Rated COP	Shall comply with or exceed BEE 5-Star minimum values
IPLV/NPLV	Shall comply with or exceed BEE 5-Star minimum values
Chilled Water Temperature	7°C supply / 12°C return (unless otherwise specified)
Condenser Water Temperature (Water-cooled)	30°C inlet / 35°C outlet
Power Supply	415 V ±10%, 3 Phase, 50 Hz
Controls	Microprocessor-based with BACnet/Modbus communication
Part Load Operation	Minimum 10–20% unloading (or as offered by OEM)
Noise Level	As per manufacturer and project requirements
Efficiency Certification	BEE Star Label, AHRI Certified (preferred)

TABLE 1 - INDOOR DESIGN CONDITIONS

8C403.2 Mechanical Ventilation System

Following standards shall be adopted for mechanical Ventilation of the specific areas in the table:

Car Parking	6 (Normal Mode) / 12 (Fire Mode) ACPH Exhaust 6 (Normal Mode) / 12 (Fire Mode) ACPH - fresh air make-up
Pump Room	25 ACPH
STP	30 ACPH exhaust with equivalent amount of supply air.
Toilets	**Patient Room** 70 CFM exhaust from the Toilet, with an equivalent draw of conditioned air from adjacent areas. A cut of 25 mm shall be provided in the main entrance door to the Toilet to achieve the desired result. **Public Toilets** 10ACPH exhaust. 70% of exhaust as make-up air through the fan, and 15% of exhaust air through the DTG (Door Transfer Grill), fixed on the main toilet door. Attached toilets shall be provided with an exhaust fan of appropriate size, in accordance with ASHRAE & NBC guidelines, as amended to date.
Electrical Rooms	8 ACPH exhaust with equivalent draw of air from adjacent areas or heat dissipation from the panels, whichever is higher to be considered.
Kitchen Ventilation	**Mess / Dining Kitchens** 40 ACPH exhaust using dry-type scrubber with 85% air supply through the AHU fan section + TFA unit. Final capacity shall be as per kitchen equipment requirements.
Stores/ Pantry	8 ACPH exhaust with equivalent amount of supply air.
Wet Garbage	Air-conditioning and exhaust

Garbage Chute	30 ACPH exhaust with equivalent draw of air from adjacent areas
Gas Stores	8 ACPH
Lift well pressurisation	To be mechanically pressurised to maintain 50 Pa.
Lift lobby pressurisation	Natural Ventilation / Mechanically pressurized for maintaining 30 Pa
Staircase pressurisation	Natural Ventilation / Mechanically to maintain 50 Pa
Smoke exhaust in all public areas above ground & typical patient corridor	12 ACPH Exhaust & 12 ACPH make-up air
Smoke exhaust in Atrium	6 ACPH
Laundry	Min 15 ACPH supply air, through treated fresh air AHU, and 20 ACPH mechanical exhaust arrangement through fan section.

TABLE 2 - MECHANICAL VENTILATION STANDARDS

8C403.3 Design Parameters

Water Chilling Machine for Hospital Building: Performance rating of the water chilling machine shall be based on the following design parameters:

Temperature of chilled water entering Chiller	(12.2° C) 54° F
Temperature of chilled water leaving Chiller	(6.7° C) 44° F
Fouling factor for Chiller in FPS unit	0.0005
Temperature of condenser water entering condenser	(32.22° C) 90° F
Temperature of condenser water leaving condenser	(37.78° C)100°F
Fouling factor for condenser in FPS unit	0.001
Chiller performance to meet the criteria	As per AHRI 550/590 condition /As per ECBC + and BEE conditions.

Water Chilling Machine for OTs: Performance rating of the water chilling machine shall be based on the following design parameters:

Temperature of chilled water entering Chiller	(12.2° C) 54° F
Temperature of chilled water leaving Chiller	(6.7° C) 44° F
Fouling factor for Chiller in FPS unit	0.0005
Temperature of condenser water entering condenser	(32.22° C) 90° F
Temperature of condenser water leaving condenser	(37.78° C)100°F
Fouling factor for condenser in FPS unit	0.001
Chiller performance to meet the criteria	As per AHRI 550/590 condition /As per ECBC + and BEE conditions.

Water Chilling Machine for Pharmacy & Dental college Building: Performance rating of the water chilling machine shall be based on the following design parameters:

Temperature of chilled water entering Chiller	(12.2° C) 54° F
Temperature of chilled water leaving Chiller	(6.7° C) 44° F
Fouling factor for Chiller in FPS unit	0.0005
Temperature of condenser water entering condenser	(32.22° C) 90° F
Temperature of condenser water leaving condenser	(37.78° C)100°F
Fouling factor for condenser in FPS unit	0.001
Chiller performance to meet the criteria (All water-cooled chillers factory visits and performance tests shall be mandatory before final procurement at site)	As per AHRI 550/590 condition /As per ECBC + and BEE conditions.

Air Handling Unit: Design parameters for selection of Air Handling Unit and its components shall be:

Maximum face velocity across pre-filters and filters	2.54 m/sec (500 fpm)
Maximum face velocity across cooling coil	2.54 m/sec (500 fpm)
Maximum fan outlet velocity	9.14 m/sec (1800 fpm)

Piping shall be sized for the following design parameters:

Maximum velocity	2.5 m/sec (8.2 fps) , 15 k Pa per 30M Run (5 ft per 100 ft Run)

Duct design: Design parameters for Duct design shall be:

Maximum flow velocity in duct for air conditioning	7.5 m / sec (1500 fpm)
Maximum flow velocity in duct for Ventilation in pump room, boiler room, toilet exhaust & kitchen exhaust	7.5 m / sec – 12.5 m/sec (1500-2500 fpm)
Maximum friction	0.65 Pa/M run (0.08 inch WG/100 ft run)

AHUs Filtration:
Three types of filtration efficiencies have been considered depending on the requirement, which is identified in Table 1 and are as follows:

Three stages of filtration consisting of MERV-8, MERV-14 and MERV- 16 filters up to 0.3-micron particle size.

Two stages of filtration consisting of combination of MERV-8 and MERV-14 filters up to 3 micron particle size.

One stage of filtration with MERV-8 filters, capable of removing particles up to 10 microns.

8C403.4 AIR CONDITIONING PLANT ROOM

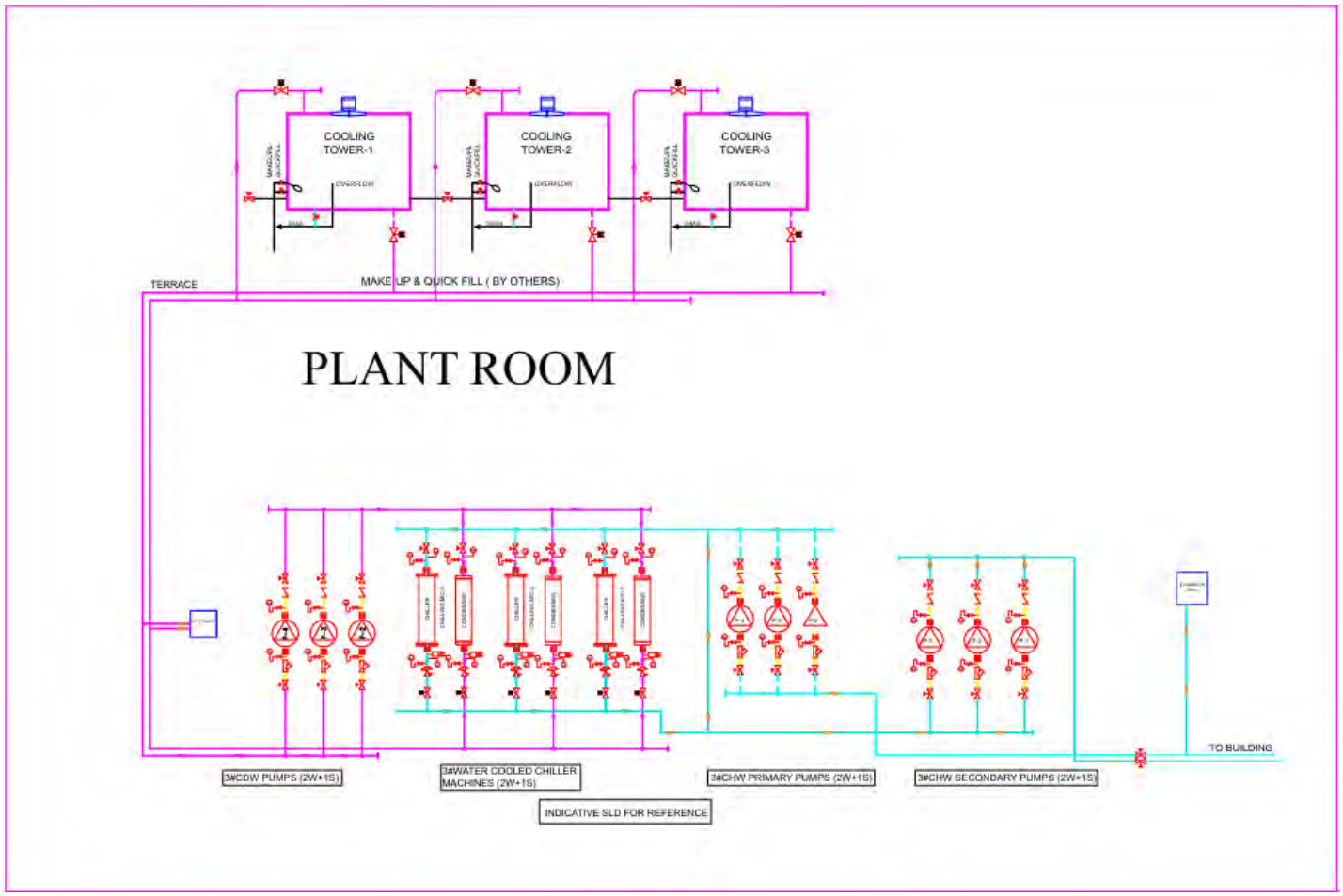
For Pharmacy College & Dental College

Considering diversity of 90%, a minimum total TR capacity of 1650 shall be provided by 2 Nos. 825 TR (Minimum Actual Capacity) (working) + 1 Nos. 825 TR Standby water-cooled centrifugal chillers.

The AC plant room has been proposed for location at Electrical Substation B Block.

Split Air-conditioning provision will be considered for Service block.

EQUIPMENT	NUMBER OF EQUIPMENT
Chillers Selection- For Pharmacy College & Dental College	3 x 825 TR (2W+1 S) water-cooled chillers with VFD BEE 5 Star rated.



FOR HOSPITAL BUILDING

MKCG building excluding OTs, and after considering a 90% diversity factor, a minimum total TR capacity of 2475 shall be provided by 3 Nos. 825 TR (Minimum Actual Capacity) (working) + 1 Nos. 825 TR Standby water-cooled centrifugal chillers.

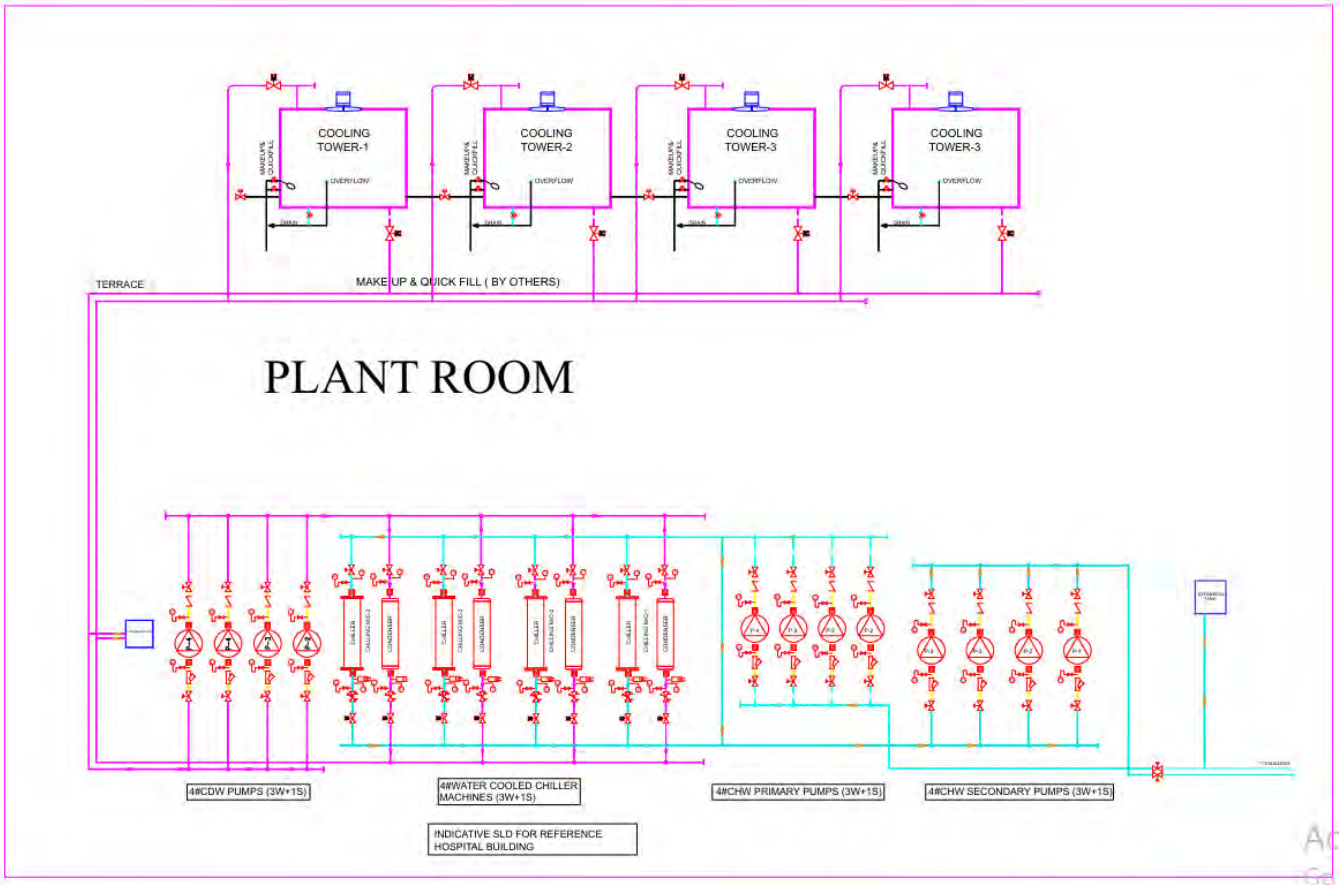
Air conditioning load for OTs is estimated as 180TR, 2 Nos. 180TR (Minimum Actual Capacity) of water-cooled screw chillers with VFDare proposed, including one standby (1W+1S), 415 V.

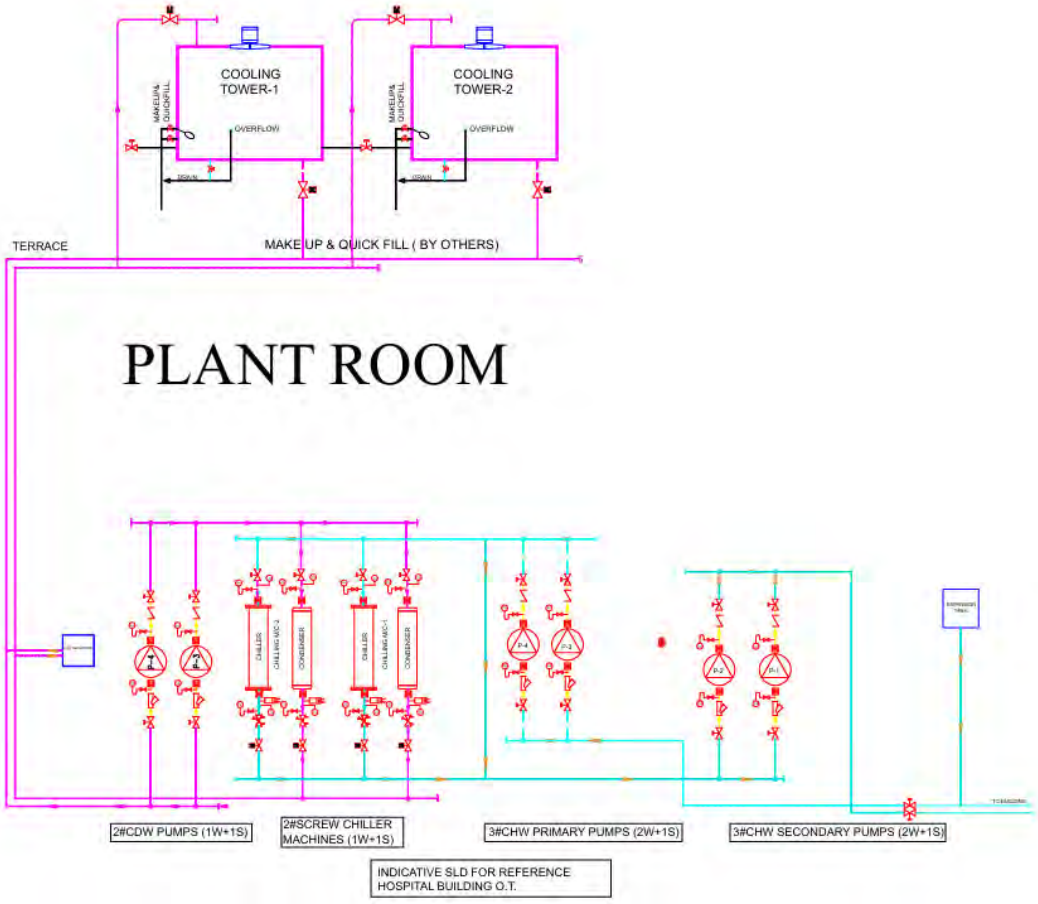
The AC plant room has been proposed for location in the Service Block, adjacent to the hospital building.
Split Air-conditioning provision will be considered for the Service Block.

1) Selection of Chillers

EQUIPMENT	NUMBER OF EQUIPMENT
Chillers Selection- For Hospital Building	For Hospital- 4 x 825 TR (3W+1S) water-cooled chillers with VFD BEE 5 Star rated. For OTs- 2x180 TR (1W+1 S) Water Cooled Screw chillers with VFD, BEE 5 Star rated

The above load is indicative only; actual load calculations to be done by the successful EPC bidder, whichever is higher, shall be provided.





8C403.5 System Description

8C403.5.1 CENTRAL AIR CONDITIONING SYSTEM - DENTAL COLLEGE & PHARMACY COLLEGE

The central air conditioning system shall consist of a minimum of 3 nos. 825TR (2W+1S) water cooled centrifugal chilling units with VFD, multiple primary chilled water pumps, secondary chilled water pumps with variable frequency drives, condensing water pumps, FRP induced draft cooling towers minimum 1000 TR for each Chiller or as per capacity calculated as per site actual condition whichever is higher, air handling units and fan coil units, chilled, and condensing water piping with accessories, air distribution system, insulation, overhead soft water make-up tank, electrical panels, wiring, control wiring and earthing. The Chiller shall be a minimum BEE 5-star-rated unit.

The system shall provide sufficient capacity to meet peak cooling loads but must be capable of operating efficiently at part load.

The central air conditioning for hospital system shall consist of minimum 4 nos. 825 TR (3W+1S) water cooled centrifugal chilling BEE 5 Star units with VFD, multiple primary chilled water pumps, secondary chilled water pumps with variable frequency drives, condensing water pumps, FRP induced draft cooling towers, minimum 1000 TR for each Chiller or as per capacity calculated as per site actual condition whichever is higher, Heat exchanger, Heat pump for monsoon reheating will be 3 Nos. 300 KW (3W+1S), hot water pumps for monsoon reheating, air handling units and fan coil units, chilled, hot and condensing water piping with accessories, air distribution system, insulation, overhead soft water make-up tank, electrical panels, wiring, control wiring and earthing. The Chiller shall be a minimum BEE 5-star-rated unit.

For OTs- 2 x 180 TR (1W+1 S) Water Cooled Screw chiller's with VFD, BEE 5 Star rated.

The system shall provide sufficient capacity to meet peak cooling loads but must be capable of operating efficiently at part load.

Reheat for OTs shall be provided as per the actual calculation, after obtaining approval from EIC.

To prevent condensation, Underdeck insulation with Aluminium sandwiched panel (PUF Panels) below OT floors shall be provided by the Turnkey Contractor.

pressurisation Expansion Tank Pressurisation Unit with Vacuum Degasser (ASME Stamped)

Pressurised Expansion Tank, Pressurisation unit with built-in Vacuum Degasser for handling Expansion, Contraction, degassing, and Top Up functions in the Chilled water loop, maintaining ± 0.2 bar pressure accuracy.

The Unit shall be in accordance to PED-97/23/EC, IEE, EMC-2004/108/EC, Machinery Directive 95/16/EC complete with Pumps, vacuum cylinder, Break tank, float valve, over flow connection, pressure sensor for system and for vacuum cylinder, solenoid valve, isolation Valve, NRV, Drain Valve, flood protection in the event of a serious leak, Pipe fittings, Controller & display, full Unit duly tested, all housed in a mild steel cabinet.

Cooling towers for air conditioning system shall be selected for minimum drift losses and minimum noise, and shall be installed on terrace away from the Hospitals and the adjoining Building.

Cooling tower motors shall be provided with a Variable Frequency Drive (VFD) to conserve energy during periods of low ambient wet-bulb temperature.

All mechanical equipment, such as pumps, AHUs, and larger ventilation fans, shall be provided with energy-efficient IE-4 motors to achieve energy savings.

AIR & DIRT SEPARATOR:

Air & Dirt Separator to be installed in the CHW return header on the Suction side of the Primary Pump to eliminate air bubbles and Dirt from the loop.

The Unit shall be manufactured and designed in accordance with European Pressure Equipment Directive PED 97/23/EC. The design unit shall incorporate a separating element to force water into tranquillity zones for air removal, with at least 15% of 70 µm micro bubbles per cycle and at least 35% of 150 µm dirt particles per cycle, and Dirt removal down to 4 µm.

AUTOMATIC TUBE CLEANING SYSTEM:

The water-cooled Chiller shall be provided with an online Automatic Tube Cleaning System (ATCS) employing recirculating sponge cleaning balls. The ATCS shall be supplied either directly by the chiller manufacturer or by a specialist manufacturer approved and integrated by the Chiller OEM. The chiller OEM shall retain single-point responsibility for design compatibility, performance, installation coordination, warranty, and post-commissioning support of the complete chiller package including the ATCS.

SIDE STREAM FILTRATION:

The condenser water system shall be provided with an automatic side-stream filtration system sized for not less than 5–10% of the condenser water circulation rate, or as recommended by the equipment manufacturer, to maintain the required water quality. The side stream filtration system shall be supplied, integrated, commissioned, and warranted by the **chiller OEM as part of the complete chiller plant package**. The chiller OEM shall assume full responsibility for system compatibility, hydraulic performance, water quality requirements, integration with the cooling tower and condenser water system, and overall chiller performance.

GROOVED PIPING SOLUTIONS:

All HVAC and fire-fighting piping of 50 NB and above shall utilise grooved mechanical piping systems employing rigid and flexible couplings, fittings, valves, and accessories from a single manufacturer. Grooved joints shall comply with AWWA C606 and be suitable for the system's operating pressure and temperature conditions. The complete grooved piping solution including couplings, fittings, valves, strainers, and accessories shall be supplied by a single grooved piping OEM. Mixing components from multiple grooved-piping manufacturers shall not be permitted.

The OEM shall provide compatibility certification and assume single-point responsibility for performance and warranty of the grooved piping system.

General Design Scheme:

8C403.6 Chilled Water Generation & Distribution

Central air conditioning shall be designed to maximise energy conservation provided by a Central Variable-flow Chilled Water Distribution System. Secondary chilled water pumps shall be provided with variable-speed drives to achieve variable water flow in each chilled water zone. Chilled water flow in load circuits shall be varied, but the same through chillers shall remain constant. By measuring the pressure differential between the chilled water supply and the return header, the speed of the secondary chilled water pumps shall be automatically varied, thus conserving pump brake horsepower. The main advantage of this system shall be that chilled water circulation throughout the Hospital shall be avoided, and chilled water shall be supplied to each zone according to air conditioning load demand. Class "O" closed cell Fire-resistant thermal XLPE Crosslinked Polyethylene insulation (-20 deg C to +105 deg C) with anti-microbial and anti-fungal properties along with multilayer aluminium foil composite lamination cladding (280 microns thickness) suitable for outdoor application and aluminium foil for indoor application shall be applied and provided along entire length of pipes to be laid inside the building, inside shafts and on the terraces etc.

8C403.7 Air Handling and Distribution System

Air-handling and distribution systems provide health care facilities with a comfortable environment, Ventilation to dilute and remove contaminants, and a supply of clean air for breathing, and they assist in controlling the transmission of airborne infection. To meet these requirements, HVAC systems must be properly designed to accommodate the applied loads and demands, as well as facility operational requirements.

In providing environmental comfort and Ventilation for a facility, an air-handling unit simultaneously performs several functions including the intake of outside air to meet ventilation air requirements, thermal mixing of this air with recirculated air from the occupied zones, thermal conditioning, moisture control, filtration to protect equipment and to remove contaminants, and attenuation of fan-generated noise to control ambient noise levels in occupied spaces.

A thermostat & humidistat shall be provided to control the room (system) temperature and humidity.

Heat Recovery Requirements

Heat recovery systems shall be provided in accordance with the infection control classification of the exhaust air stream. They shall comply with the latest editions of ANSI/ASHRAE/ASHE

Standard 170, ASHRAE Standard 62.1, FGI Guidelines, NABH requirements and applicable local regulations.

1. **Non-clinical and low-risk areas**, including administration offices, conference rooms, auditoriums, cafeterias, public waiting areas, and circulation spaces, shall be permitted to use rotary enthalpy wheels, sensible heat wheels, or plate heat exchangers with a minimum total effectiveness of 65%. Rotary wheels shall be provided with purge sections and seals to limit exhaust air carryover in accordance with ASHRAE and AHRI requirements.

2. **General clinical and patient care areas**, including wards, consultation rooms, treatment rooms, dialysis units, and diagnostic areas, shall utilise only heat recovery systems that provide complete physical separation between the supply and exhaust air streams, such as run-around glycol-coil systems, heat pipe heat exchangers, or wrap-around heat pipes. Rotary energy recovery wheels and regenerative exchangers shall not be permitted in these areas.

3. **Critical, sterile, infectious and hazardous areas** including operating theatres, hybrid OTs, transplant units, burn ICUs, AIIR rooms, protective environment rooms, microbiology laboratories, BSL laboratories, CSSD decontamination areas, mortuaries and similar spaces handling infectious or hazardous exhaust air shall not utilise rotary wheels, enthalpy wheels, plate heat exchangers or any heat recovery device with the potential for exhaust air carryover or cross-contamination. All heat recovery devices should comply with certified zero-carryover or cross-contamination standards.

4. Heat recovery systems shall not compromise prescribed room pressure relationships, airflow direction, ventilation rates, filtration requirements or infection prevention measures under any operating condition.

5. The Contractor shall submit detailed psychrometric calculations, an annual energy-savings analysis, and confirmation of compliance with healthcare ventilation standards for approval before the procurement and installation of heat recovery equipment.

8C403.8 Indoor Air Quality

8C403.8.1 UVGI: The quality of indoor air in critical areas, such as operating theatres and ICUs, is very important. The air should be free of any contamination or infection, including bacteria, Viruses, Fungi, or other microorganisms. If air is contaminated, the risk of cross-infection from patients to doctors increases significantly. This may adversely affect patients' rapid recovery. Hence, an AHU-coil-mounted UVGI system shall be provided to maintain indoor air quality and deep coil cleaning. The system must include UV modules with dish-antenna-shaped parabolic reflectors to ensure no stray UV-C radiation is leaked. The UVGI System shall be suitable for airborne microbe removal, with a minimum 80% killing rate for bacteria and viruses in a single pass.

8C403.8.2 Air Purification System (Plasma Ionisation) The Smart Comprehensive Air Purification System should include a combination of Smart Monitoring, Plasma ionisation (Active Air Purification), and EAC (Electronic Air Cleaner) Passive Air Purification.

8C403.8.3 Odour Control & Management System: Advanced Hybrid Odor-Control Solution for Sewage Treatment Plant Air Handling through Ion Oxygen Fusion System with bipolar ionisation system installed in the supply duct creating a continuous field of positive and negative ions that actively treat the air thus preventing odour accumulation and maintains superior indoor air quality throughout the treatment plant.

8C403.8.4 Fresh air shall be supplied to each area in Hospital, Pharmacy & Dental College, Indoor Sports building from fresh air units kept at terrace with energy recovery wheel having desiccant rotor through GI Ducts installed in shafts.

8C403.9 Air handling units for Operation Theatre

Each Operation Theatre shall be provided with an independent air handling unit with three (Pre-Filter + Micro vee + HEPA Filters) stages of air filtration, achieving particle size of up to 0.3 microns.

Air distribution within OTs shall be designed for laminar flow by supplying dehumidified air at a velocity of 90-110 feet per minute. A laminar airflow pattern shall be created by collecting the return air 300 mm above finished floor level. These AHUs shall be high-static units capable of overcoming pressure drop across various filtration stages and the energy recovery wheel. Fresh air shall be supplied from the terrace via fresh air units equipped with an energy recovery wheel featuring a desiccant rotor, through GI Ducts installed in shafts.

Return air shall be returned to the air handling unit room through the return air ducts. The return air fan shall be provided with an ON/OFF bypass damper for smoke exhaust and DE fumigation.

An air handling Unit will be provided with a humidifier to control humidity, Active Air Purification with a bipolar ionisation system downstream of the AHU near the fan, and coil-mounted UVGI.

Thermostat & humidistat shall be provided to control the room's (system) RH & temp.

8C403.10 Isolation Room

This is a patient room that demonstrates, through periodic or continuous testing, inward air flow through all six surfaces and sustained negative air pressure with respect to all adjoining interior rooms, which has specific ventilation design features, including 100% exhaust, well- mixed air distribution throughout the room, and a general flow of air from clean to less clean areas. An airborne infectious isolation room may or may not have an anteroom. It will have an electronic pressure-monitoring and control system and a mechanical means of measuring the pressure relationship. Differential pressure between the room and the adjacent space that is not an isolation room shall be -2.5 Pa or less. Exhaust Air from the isolation room shall be discharged

to the atmosphere through a dedicated exhaust duct to the terrace level after three stages of filtration. An electronic air cleaner after the pre-filter shall be provided.

8C403.11 Air handling units for Protective environment rooms (Pathology Labs, Hematology & ICUs etc.)

Shall be provided with an independent air handling unit with two stages of air filtration (Pre-Filter and Electronic Air Cleaner) and Active Air Purification with a Bipolar Ionisation System.

Return air shall be returned to the air handling unit room through the return air ducts. The return air fan shall be provided with an ON/OFF bypass damper for smoke exhaust and DE fumigation, if and where required.

Fresh air shall be supplied from fresh air units located on the terrace, with energy recovery wheels having desiccant rotors, through GI Ducts installed in the shafts.

Thermostat & humidistat shall be provided to control the room (system) temperature & humidity.

8C403.12 Lift and Staircase pressurisation

All Lift wells shall be provided with a Pressurisation arrangement consisting of supply air fans installed on the rooftop. The fans shall connect to the lift shaft and inject air into the Lift well to achieve effective pressurisation. Fans shall be sized to maintain a minimum positive pressure of 50 Pa across the door. Make-up air fans serving the Lift well shall be provided with motorised dampers at the fan discharge to prevent humid fresh air from entering the Lift well. These dampers shall be interlocked with the fan motor and shall open upon signal from the fire alarm system. Lift Lobbies and staircases shall be naturally ventilated/pressurised as per National Building Code of India.

8C403.13 Toilet Exhaust

Public and private toilets shall be provided with independent Toilet exhaust systems using Propeller or Inline fans discharging foul air to outside area. Equivalent air would be drawn from the adjacent areas through door undercuts/infiltration.

8C403.14 Kitchen Exhaust

Mess / Dining Kitchen shall be provided with an exhaust system. The exhaust shall be collected from kitchen hoods and connected to a dry-type air scrubber unit as per the requirements of the local pollution board. Greasy air shall pass through various sections of the scrubber and clean air shall be exhausted outdoors. Kitchen hoods over cooking area of main kitchens shall be compensating type. All kitchen hoods shall be provided with make-up air at 85%. Kitchens shall be maintained at slight negative pressure to prevent the spread of food smells into guest-occupied areas.

8C403.15 Pump room Exhaust

A plant room shall be provided with a mechanical ventilation system. The system shall consist of fans, an air distribution system with grilles, an electrical panel, power cabling, and control wiring. Fresh air shall be drawn from outside, and shall be supplied to these areas by means of fans, ducts and grilles. A ventilation fan & duct shall be provided to exhaust an equivalent amount of air.

8C403.16 Motors

All motors used in the ventilation system shall be suitable for a 415+10% Volts 3-phase 50 cycles/second incoming power supply, shall be high-efficiency (IE4), and shall meet the performance requirements of ASHRAE Standard 90.1–2022.

8C403.17 Duct Construction and fire safety

All ducts (except OTs) shall be fabricated from galvanised sheet steel (GSS) for long life, in accordance with NBC and Chief Fire Office (CFO) norms. All OTs shall be catered by aluminium duct. Kitchen exhaust circular type duct shall be of M.S construction

8C403.18 UPS / IP-PBAX Room air conditioning

Air-conditioning system for UPS/ EPABX with AHUs to be provided. There should be split AC units as standby.

8C403.19 Server Room Air Conditioning

Hi-wall DX as required, with a sequential controller for 24 hrs operation, to maintain an inside temperature of 23 ± 1 °C, will be provided for the air conditioning of the server room as per load requirements.

8C404 BASEMENT CAR PARKING VENTILATION

As defined in the latest revision of the 2026 National Building Code of India, mechanical Ventilation for Basement car parking shall be designed to permit 6 ACPH for normal Ventilation and 12 ACPH for fire Ventilation. The system shall comprise a ductless ventilation system, i.e. multiple ceiling-hung jet fans, keeping in view the following:

- Avoid low-level ducting to maximise car parking spaces and prevent damage to services by Vehicles.
- Prevent build-up of exhaust emissions from vehicles by providing adequate Ventilation.
- Good air movement to ensure a good environment.
- Smoke control in the event of a fire.

• Reduced operating costs by using CO-sensors so that fans are operated as and when required.

The mechanical ventilation system shall comprise make-up air fans to supply fresh air, and multiple ceiling-hung jet fans to assist in directing airflow and to propel air towards the main exhaust fans. Jet fans shall be operated at two speeds.

In normal mode, these fans will run at a lower speed. During high CO levels or fire conditions, fans shall run at higher speed. Both make-up & exhaust fans shall be axial-flow fans.

During normal Ventilation, main fans designed for 6 ACPH shall operate. To cater to an additional 6 ACPH (Total 12 ACPH in case of fire), an additional ceiling-hung axial flow fan shall be installed without a duct. In case of fire, these additional fans shall be actuated to draw air from the car park and discharge independently alongside the main fan. The shaft receiving the exhaust from both fans shall be sized for 12 ACPH. The fan shall be operated based on the signal through PLC panel. The Carbon Monoxide (CO) level shall be sensed by the Carbon Monoxide (CO) Sensor, which shall generate a suitable DC signal to provide feedback to the PLC panel, which in turn shall control the speed of the fan, thus conserving energy.

The entire basement parking area shall be compartmentalised into zones as per the latest amended NBC-2026, as amended till the date of Execution, with an internal Air Distribution System.

8C405 SMOKE EVACUATION SYSTEM FOR CORRIDORS:

In accordance with the National Building Code of India (NBC), all corridors are provided with a Smoke Evacuation system through exhaust grilles located on each floor, connected to a vertical duct riser in a dedicated shaft. Exhaust grilles shall be provided with a motorised damper which shall open upon sensing of smoke by any smoke detector in the corridor and actuate the fan on the terrace.

IPD corridors: The exhaust system shall be sized based on the corridor area at 12 air changes per hour, for three floor levels simultaneously. An equal amount of make-up air shall also be provided. Fresh air grilles located on each floor and connected to vertical duct riser in a dedicated shaft. Fresh air grilles shall be provided with motorised dampers and interlock with the exhaust grille.which shall open upon sensing of smoke by any smoke detector in the corridor and actuate the fan on the terrace. The sequence of operation in case of fire will be that fire & smoke damper of affected floor & one floor above & below will open for smoke exhaust, hence smoke fans at terrace will supply fresh air & take exhaust from these three floors only public areas corridors: The exhaust system shall be sized based on the area of corridor @ 12 air changes per hour, for each floor level. An equal amount of make-up air shall also be provided—fresh air grilles located on each floor. Fresh air grilles shall be provided with Motorised dampers

and interlock with the exhaust grille, which shall open upon sensing of smoke by any smoke detector in the corridor and actuate the fan. The sequence of operations in case of fire will be that the smoke damper on the affected floor will open for smoke exhaust; hence, the smoke fans will supply fresh air & take exhaust from the affected floor.

8C406 Indoor Air Quality Monitoring System shall be provided for Hospital and College Buildings -

IAQ Monitor to remotely measure PM 2.5, VOCs, CO2, Temperature, and Humidity in real time. The IAQ Monitor shall be capable of connecting to Wi-Fi.

The Monitor should be capable of sending indoor air quality information to the display screen, mobile device, or workstation, as per the Client's requirements.

The Monitor should indicate air quality by changing the display colours in accordance with NAAQS standards and should meet WELL building standards.

8C407 Air Cooled VRV / VRF System

VRV/VRF System shall have all inverter compressors with variable-speed compressors to meet actual demand requirements. Shall be BEE 5-star rated.

VARIOUS BUILDINGS MINIMUM VRV/ VRF CAPACITIES TO BE PROVIDED

a	SURGEON HOSTEL LADIES	18 HP
b	UG GIRLS HOSTEL	58 HP
C	INDOOR STADIUM	90 HP
d	BOYS HOSTEL (DENTAL)	24 HP
e	GIRLS HOSTEL (DENTAL)	24 HP
f	BOYS HOSTEL (PHARMACY)	24 HP
g	GIRLS HOSTEL (PHARMACY)	24 HP
h	SURGEON GENTS HOSTEL + GUEST HOUSE	16 HP

8C407.1 REFRIGERANT

Refrigerant used shall be eco-friendly Class A1 (ASHRAE Standard 34 - non-toxic (Class A) and non-flammable (Class 1)), such as R-134a for Chiller, R-410a for VRV/VRF, and R-32 for Split Units, or the latest in compliance with green building ratings.

8C407.2 COPPER PIPE INSULATION

Class "O" closed cell Fire-resistant thermal XLPE Crosslinked Polyethylene insulation (-20 deg C to +105 deg C) with anti-microbial and anti-fungal properties along with multilayer aluminium foil composite lamination cladding (280 microns thickness) suitable for outdoor application and aluminium foil for indoor application shall be applied and provided along entire length of pipes to be laid inside the building, inside shafts and on the terraces etc.

8C407.3 Design and Layout Considerations for VRV/ VRF

The Design and Layout Considerations for HVAC Systems in a Building must strictly conform to the provisions stated in the NBC, ECBC, and CPWD.

For DX Indoor Unit (Air Cooled VRV/VRF Unit or Air Cooled Hi CFM Packaged Unit & Hi-wall Unit, etc.), a standard filter shall be supplied by the manufacturer.

Filter frame shall be made of anodised aluminium.

Fresh air shall be supplied to each area of the building from fresh air units located on the terrace, with energy recovery wheels having desiccant rotors, through GI Ducts installed in shafts.

General Note:

- The contractor/agency shall submit Technical Data Sheets (TDS) for all long lead items for approval before installation in the project area. The submission shall clearly indicate the area of application and intended usage of each item, along with the relevant design calculations and supporting technical details.
- Any omission, discrepancy, ambiguity, or inadequacy in the Tender Documents, Drawings, Specifications, or any other contract document that may be required for the satisfactory completion, commissioning, testing, operation, and handing over of the project in all respects shall be deemed to be included within the scope of the Contractor. The Contractor shall carry out and provide all such items, materials, equipment, accessories, fittings, services, temporary works, labour, tools, tackles, and other necessary arrangements required for the successful Execution and completion of the works, whether specifically mentioned in the Contract Documents or not, without any additional cost implication to the Employer. No claim for extra payment, extension of rates, or compensation on account of such omissions, discrepancies, or additional requirements essential for the intended functioning and completion of the project shall be entertained.

DESIGN BASIS REPORT

ELV WORK

Note: - The components, equipment, accessories, and materials mentioned in the Design Basis Report (DBR) for all ELV systems shall not be construed as limiting the scope of work of the Contractor/Bidder. The Contractor/Bidder shall be responsible for providing, supplying, installing, testing, commissioning, integrating, and handing over all additional components, accessories, hardware, software, interfaces, licenses (perpetnual), cabling, connectors, mounting arrangements, and any other essential items, whether specifically mentioned in the DBR or not, as required for the complete, satisfactory, and end-to-end functionality, interoperability, reliability, and performance of the respective ELV systems in accordance with the project requirements, applicable standards, statutory regulations, and the intended operational objectives.

Minimum 5 years of Operation and Maintenance*, including workforce to run and maintain all services* for all ELV Systems to be provided. All ELV systems, including Fire alarm/Fire detection system licenses, should be perpetual. (This is limited to Hospital, Dental College and Pharmacy College – specifically for O&M)

The following services are covered under O&M.

ELV Services

1.CCTV System

2. Fire Alarm, Voice Evacuation and Public Address System.

3. Building Management System.

4. Queue Management System.

5. IT (Active and Passive System).

6. Audio & Video System

7. Access Control System

8.Fire Suppression System

9. Parking Management System.

10. ICCC & Datacenter.

11. IPTV

12. IP Telephony

13. MSI

OPERATION AND MAINTENANCE

The Contractor shall be responsible for the complete Operation and Maintenance (O&M) of all ELV systems installed under the contract and above mentioned medical systems ensuring reliable, safe, secure, and uninterrupted operation on a **24×7×365** basis for a minimum of 5 years starting from the completion/handover of the project.

The scope of O&M shall include operation, preventive and corrective maintenance, emergency breakdown support, software and firmware updates, cybersecurity patch management, system health monitoring, configuration backup, testing and calibration, replacement of defective components, maintenance of critical spares, documentation, reporting, and coordination with OEMs. All maintenance activities shall be carried out in accordance with OEM recommendations, applicable international standards, and hospital operational requirements, with minimum disruption to hospital services.

The Contractor shall deploy qualified and experienced personnel to operate and maintain all ELV systems and above mentioned medical systems. The recommended minimum dedicated O&M team shall comprise of manpower as per the indibidual O & M DBR to be submitted by the contractor for all ELV & Medical Services and to be approved by the employer.

The Contractor shall maintain the required inventory of critical spare parts and specialised test equipment to ensure prompt restoration of services in the event of failures. Breakdown response shall be available round-the-clock, with defined Service Level Agreements (SLAs) provided by the contractor at the beginning of the O & M period, and all critical faults shall be attended to immediately to minimise downtime.

The Contractor shall maintain comprehensive records of preventive maintenance, fault rectification, system configurations, software licenses, backups, asset inventory, and performance reports. Regular preventive maintenance, health checks, and periodic training for the Employer's personnel shall be carried out to ensure optimum system performance and long-term reliability.

The Contractor shall ensure that all ELV systems meet the specified performance, availability, and integration requirements throughout the contract period and shall be fully responsible for maintaining the operational integrity of the entire ELV infrastructure, including all hardware, software, networks, and integrated subsystems.

The Contractor's Operation & Maintenance (O&M) team shall coordinate daily with the Hospital's Engineering and Maintenance Department to review system status, address operational issues, plan maintenance activities, and ensure timely resolution of faults. Effective communication and close coordination shall be maintained at all times to minimise system downtime, avoid disruptions to hospital operations, and ensure the continuous, safe, and reliable functioning of all ELV systems.

Monthly reports for all ELV system uptime, performance, fault correction and maintenance work shall be submitted by the contractor during the 5-year operation and maintenance period, including staff attendance, to the Hospital's Engineering and Maintenance Department.

GENERAL:

The contractor shall design, supply, install, integrate, test, commission and maintain complete Enterprise Grade Extra Low Voltage (ELV) Systems for the Hospital in accordance with these specifications.

The systems shall comprise complete end-to-end solutions including all equipment, accessories, software, firmware, cables, connectors, mounting hardware, power supplies, licenses, programming, integration, testing and documentation necessary for satisfactory operation. Items not specifically mentioned but necessary for proper operation, interoperability, maintainability, reliability, and safety shall be deemed included within the Contractor's scope without additional cost.

All servers, controllers, workstations, network devices, and integrated ELV systems shall support synchronisation with a common Network Time Protocol (NTP) source to ensure consistent event logging, alarm correlation, and forensic analysis.

The ELV infrastructure shall be designed considering:

- Continuous 24×7 Hospital Operation
- Critical Healthcare Environment
- High Reliability
- Zero Single Point Failure
- Enterprise Grade Equipment
- Modular Expansion
- High Availability
- Cyber Security
- Ease of Maintenance
- Interoperability
- Long Product Life Cycle
- Energy Efficiency
- Scalability

All ELV Systems shall operate as an integrated intelligent building platform. Individual systems shall exchange information through open protocols to improve operational efficiency while maintaining cybersecurity and avoiding unnecessary dependence on proprietary interfaces.

Integration shall be achieved by the respective systems using industry-standard interfaces or equivalent open technologies.

All critical ELV systems shall be designed for continuous 24 hours per day, 365 days per year operation.

The proposed systems shall incorporate appropriate levels of redundancy, fault tolerance, diagnostics, and monitoring to minimise operational downtime.

The design objective shall be to eliminate single points of failure.

Power Redundancy

Equipment shall have dual power supplies, as provided by the OEM and appropriate to the application.

Power sources shall be derived from appropriately protected electrical systems. All ELV systems shall be provided with UPS-backed power sources.

Security/Cybersecurity

The ELV systems shall incorporate cybersecurity measures appropriate for deployment within a modern healthcare environment and shall support secure integration with the hospital ICT infrastructure.

The systems shall support:

- Role-based access control (RBAC)
- Strong password policies
- Secure authentication
- Secure communication protocols
- Encryption of sensitive communications
- Audit logging.
- User activity logging
- Secure firmware updates
- Secure remote maintenance
- Certificate-based authentication where supported
- Time synchronisation with enterprise NTP services

The Contractor shall ensure that all supplied firmware and software versions are manufacturer-supported at the time of handover.

SCALABILITY AND FUTURE EXPANSION

The hospital is expected to expand during its operational life. Accordingly, all ELV systems shall be designed to facilitate future expansion with minimum disruption to existing services.

Expansion of any system shall not require replacement of the complete installed infrastructure.

Additional devices, controllers, workstations, servers, storage, software licenses, and network capacity shall be capable of being incorporated through modular expansion supported by the OEM.

Unless otherwise specified, the following minimum spare capacities shall be provided:

Component	Minimum Spare Capacity
Fibre Backbone	25%
Rack Space	25%
Power Allocation/Demand (ELV)	25%
Switch Ports	25%
Controller Capacity	25%
Server Processing Capacity	50%
Storage Capacity (Planned capacity over and above 3yrs of usage)	50%

INTEROPERABILITY

All systems shall support interoperability with other project systems through recognised industry standards, APIs, or equivalent integration methods.

The Contractor shall ensure that system integration does not compromise system reliability, cybersecurity, or warranty.

Where multiple systems are integrated, the Contractor shall prepare and submit a comprehensive Integration Matrix identifying:

- Integrated systems.
- Interface method.
- Data exchanged.
- Event triggers.
- Alarm responses.
- Responsibilities of each subsystem.
- Testing procedures.

1. FIRE DETECTION AND ALARM SYSTEM

a. General

The objective of this report is to design a fire protection system that shall provide Life safety of occupants by means of providing early warning for complete evacuation.

b. Building Classification

A fire alarm system for each type of building in this project shall be classified as per clause 3.1.2 of the National Building Code (NBC, 2026) and provided accordingly.

c. Proposed Fire Detection Systems

In accordance with Table-7 of NBC-2026, BIS (ISO 7240), NFPA latest edition, EN 54 latest edition as guidelines, and good engineering practice, the following Fire alarm and detection systems are proposed for development.

The Fire Alarm System shall have an additional 20% spare capacity in each loop.

Addressable fire alarm and Detection system with communication, notification, and Interface capability; each detector and device shall have an inbuilt fault isolator or an isolator in the base, irrespective of UL/EN requirements.

d. System Description

The purpose of the Fire Alarm is to provide early notification to all building occupants of a fire and to inform occupants to evacuate the area accordingly. Hospital buildings are classified as critical infrastructure. Therefore, the fire alarm system shall be designed with adequate redundancy to ensure continuous, reliable operation 24/7 without failure.

The system shall provide a full read-write interface with third-party systems and perform monitoring/control/annunciating functions. It shall be modular and expandable, and shall include, but not be limited to, microprocessors, control panels, power supplies, amplifiers, batteries, battery chargers, detection devices, notification appliances, conduit, wire, fittings, and accessories required to provide a complete operating system.

The system shall be configured to automatically check and calibrate devices without the need to visit devices in the field.

e. System Architecture

The Initiating devices, Notification appliances, and Interface devices located at various floors of the building shall interface with the Fire Alarm Control Panel installed in the Fire Control room as per NBC and BIS requirements. If required, network repeater panels shall be located at alternate locations, as per the requirements of the engineering-in-charge

One-way and two-way communication systems shall be provided in the control room for safe and early evacuation of building occupants.

Two layers of detection shall be installed, with a false ceiling provided. Where false ceilings are provided, Response indicators for detectors above the false ceiling shall be provided. Where rooms are closed, Response indicators shall be provided.

Manual call points shall be provided at all floors of the staircase for manual activation of the system.

The hooters, speakers and visual strobes shall be provided at strategic locations to meet the code requirements.

Necessary interface devices shall be provided for the interface of the fire alarm system with other services required to operate life safety systems in buildings (E.g., elevators, pressurisation fans, etc.).

Also, the fire alarm and detection system is interfaced with the station's centralised fire control room via fibre-optic cables.

The entire Fire Alarm and PA system has been proposed in accordance with ISO 7240, EN 54, NFPA guidelines, and NBC 2026.

2C x 1.5 Sq.mm. Mineral Insulated copper clad cable fire survival 950-degree centigrade 3 hours C/W/Z category as minimum to maintain circuit integrity, LPCB/ UL approved, shall be used.

The main fire alarm panel shall be located in the fire control room on the ground floor of the Hospital & Residence Block. The main fire alarm panels shall be integrated with the integrated platform at the main ELV command and control centre.

Scope of Work

- The Contractor shall design, supply, install, test, and commission a complete addressable fire alarm and voice evacuation system for the hospital, including:
- Fire alarm control panels (FACP)
- Detection devices
- Notification appliances
- Cabling and accessories
- Integration with other systems
- The system shall be suitable for critical healthcare infrastructure with high reliability and fault tolerance.

1. Codes, Standards & Guidelines

- The fire alarm system shall be designed, supplied, installed, tested, and commissioned in accordance with the latest editions of:
- Underwriters Laboratories
- UL 864 (10th Edition) – Control Units
- UL 268 (7th Edition) – Smoke Detectors
- UL 1971 / UL 464 – Notification Appliances
- National Fire Protection Association
- NFPA 72
- VdS / EN 54 series
- Local statutory codes & Authority Having Jurisdiction (AHJ)

2. System Overview

The hospital being **critical infrastructure**, the fire alarm system shall be:

- Addressable, intelligent fire detection system
- Fully networked and redundant
- Designed for **defend-in-place strategy**
- Supporting **phased evacuation & voice alarm**

3. System Architecture

3.1 Fire Alarm Control Panel (FACP)

- UL 864 (10th Edition)
- Redundant architecture for Critical Infrastructure:
  - Dual CPU (hot standby)
  - Dual power supply
  - Dual loop card (hot standby)
  - Dual Network card (hot standby)
  - Networked panels in ring topology
- Fault-tolerant communication network

3.2 Network Topology

- High-speed fault-tolerant network (Class X equivalent)
- Fibre optic backbone (ring architecture)
- Loop isolation between panels

4. Loop Design (SLC – Signalling Line Circuit)
4.1 Loop Configuration

- All loops shall be designed as:
- NFPA Class A / Style X equivalent (fault-tolerant loop)
- System shall ensure:
- A single open/short circuit does not turn off the entire loop.
- Operation continues from both directions.
- Inbuilt isolator or isolator in the base in every addressable detector & devices

5. Detection System
5.1 Type of Detectors

- Multi-Sensor detectors (smoke + heat + ROR)
- Multi-Criterion, Beam and Heat Detector shall be used as per site requirement.
- UL 268 (Latest Edition)/ VdS approved as per latest EN54-5, EN54-7 & EN54-29 listed.

5.2 Detector Features

- Inbuilt isolator (isolator in the base)
- Drift compensation
- Addressable intelligence
- Remote test capability

6.1 Alarm Stages

1. Staff alert (silent / coded)
2. Local zone voice alert
3. Full evacuation (if required)

7. Power Supply & Redundancy

- Dual power supply (N+1 redundancy)

- Battery backup:
- 24 hrs standby + 15 min alarm
- UPS-backed control equipment (UL 864 compliant power systems)

8. Integration

System shall be integrated with:

- Firefighting systems (sprinkler, hydrant)
- HVAC shutdown & smoke control
- Elevator recall
- BMS system
- Nurse call system

9. Monitoring & Supervision

- All circuits shall be:
- Continuously monitored for:
  - Open circuit
  - Short circuit
  - Ground fault
- Point-level identification required (UL 864 10th capability/ EN54)

A talkback system shall be provided near the lift at each floor of the Assigned Fire Tower.

2. PUBLIC ADDRESS & VOICE ALARM SYSTEM & BGM SYSTEM

1. INTRODUCTION

Hospital buildings are classified as critical infrastructure, and therefore the PAVA system is designed to ensure reliable, intelligible, and fail-safe emergency communication for safe evacuation and fire response. It shall also be provided in Dental College, Pharmacy College, and Hostel Buildings, in line with NBC 2026, as amended to date.

The system shall be IP-based; each distributed rack shall have an IP-based amplifier, Network Audio Adaptor, Amplifier, Loudspeaker, Pre-Amplifier, etc. IT should be set up so it can operate in a stand-alone mode if the Master system fails.

The voice evacuation system should be separate from the public address system. The voice evacuation system should be integrated with the Fire alarm system. The public address system should only be used for announcements. The public address system should be divided into zones—the zones categorisation to be done during the detailed design and implementation stage.

The public address system is required for the Entire Hospital Block, except the Critical area and Wards.

The PA system should be integrated with the nurse call system.

3. AUDIO & VIDEO SYSTEM

Scope of Work

The scope of work shall include the supply, installation, testing, and commissioning of all Audio-Visual system services, equipment, components, accessories, and fittings required for the operation of the facility, to the extent specified and detailed in the Drawings and Specification.

Supply and installation of Audio/Visual and control equipment in Ceilings, Walls, and Floors, with all required cables, for proper system functioning.

Supply and installation of all cables, outlets, etc., associated with audiovisual systems. Anything that has been omitted in any item of works and materials usually furnished that are necessary for the completion of A/V works as outlined here before, then such items shall be and are hereby included in the section of work. The scope of work covers an Audio-Visual system in accordance with the specifications, drawings, and relevant tender documents, regardless of whether they are explicitly mentioned, for the proper functioning of the AV System.

All Modular OT and AV systems shall be integrated for viewing & presentation purposes.

AUDIO VIDEO AND AV CONFRENCING SYSTEMS

(I) AV SYSTEM FOR HOSPITAL BUILDING

Overall AV Concept

1. The AV system shall be designed as a fully integrated, network-based, software-driven ecosystem, ensuring seamless communication, collaboration, and content distribution as per the space requirements.

Recording & Streaming

- Designated areas shall support live streaming over an IP network
- Capability for simultaneous recording of audio, video, and presentation content
- Integration with centralised storage/server for archival and retrieval

Presentation System

- Interactive active LED-based solution
- Wired and wireless content sharing

User Experience

- Plug-and-play operation

- Minimal user intervention
- Standardised interface across all rooms

Scalability

- Modular and expandable architecture
- Future-ready system design

Audio Performance & Design Criteria

- The audio system in all areas shall be designed based on **SPL and coverage performance**, not on fixed speaker quantities
- Bidder shall submit **simulation** demonstrating compliance
- System shall ensure:
  - Minimum +**10 dB over noise Level**
  - Proper **gain structure and feedback stability**
- Speaker selection, placement, and quantity shall be **optimised for room acoustics**
- **Proper acoustic treatment to be provided for all halls and rooms where AV system is provided.**

Video Performance & Design Criteria

- The video system shall be designed based on:
  - Last Viewer distance vs screen size ratio
  - Content type (text, video, graphics)
- The system shall ensure:
  - Minimum Full HD display quality (4K preferred for Displays)
  - Uniform contrast ratio and brightness across the areas

PTZ CAMERA – DESIGN INTENT

2. The PTZ camera system shall be designed to enable high-quality video capture, live streaming, and recording of proceedings, ensuring clear visibility of participants, presenters, and presentation content across all functional spaces.
3. The system shall support hybrid collaboration, lecture capture, and event recording with seamless integration into the AV-over-IP and software-based conferencing environment.

Performance Requirements

- Cameras shall provide minimum Full HD (1080p) resolution (4K preferred)
- Support smooth PTZ operation with variable speed control.
- Optical zoom shall be sufficient to capture clearly:
  - Presenter
  - Participants
- The system shall ensure:
  - Proper framing of subjects across seating areas
  - Consistent image quality under varying lighting conditions

- Low latency for live streaming applications

Coverage & Functionality

- Camera placement and quantity shall be designed to cover:
- Presenter/faculty
- Audience/participants
- Wide room view
- The system shall support:
- Preset recall for quick switching between views
- Manual and/or automated camera switching (if integrated with DSP/control system)
- Simultaneous streaming and recording capability

Integration Requirements

- Cameras shall integrate with:
- Soft VC platforms (Teams/Zoom/WebRTC)
- AV-over-IP system for routing and switching
- Recording and streaming systems
- Control shall be via:
- Joystick controller and/or
- Touch panel/software interface

The AV-over-IP system shall support minimum 1G/10G network infrastructure, multicast/unicast streaming, and low-latency signal distribution suitable for real-time applications.

All equipment shall be of professional grade and suitable for continuous operation.

30-Seater Meeting Room

Closed-door collaboration space with soft VC, recording, streaming, projection + display, DSP audio, AV over IP, touch panel.

A. Audio System

- FOH wall-mounted column array speakers with minimum 12 x 2.25" LF designed for high speech intelligibility with controlled vertical dispersion and wide horizontal coverage, suitable for indoor applications, complete with mounting accessories
- Ceiling speakers with minimum 2.25" woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Table-embedded chairman/delegate gooseneck microphones with dedicated feedback suppressor integrated with DSP
- USB interface for soft VC

B. Video System

- Minimum 110” or higher Interactive display (final screen size to depend on the viewing distance and content requirement to ensure clear visibility and readability from the farthest seating position)
- Wired and wireless presentation system

C. Video Conferencing

- Software-based VC
- Minimum 1 PTZ camera with minimum 20x optical zoom

D. Control & Distribution

- AV-over-IP based signal distribution
- Minimum 10” touch panel for control
- Wire manager - pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications.

30-Seater Seminar Hall

Lecture/event space with interactive display of minimum 110” or better, Ceiling Speakers, DSP, digital podium.

A. Audio System

- Ceiling speakers with minimum 2.25” woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- DSP with minimum 8 inputs and 8 outputs.
- Wireless handheld (2 Nos.) and Lapel (1 Nos.)

B. Video System

- Interactive display of minimum 110” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. Podium & Presentation

- The digital podium (1 Nos) shall include connectivity for laptop input**, a built-in touch panel, a control interface, and a** microphone interface.
- Integration with AV system for seamless presentation

D. Control & Distribution

- Wall-mounted AV control keypad with programmable buttons and volume control, integrated with multi-input transmitter and HD Base T receiver featuring built-in amplifier, control interfaces, audio processing, and centralised web-based management capability.

50-Seater Seminar Hall

Lecture/event space with interactive display of minimum 110" or better, Ceiling Speakers, DSP, digital podium.

A. Audio System

- Ceiling speakers with minimum 2.25" woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- DSP with minimum 8 inputs and 8 outputs.
- Wireless handheld (2 Nos.) and Lapel (1 Nos.)

B. Video System

- Interactive display of minimum 110" or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. Podium & Presentation

- The digital podium (1 Nos)shall include connectivity for laptop input**, a built-in touch panel, a control interface, and a** microphone interface.
- Integration with AV system for seamless presentation

D. Control & Distribution

- Wall-mounted AV control keypad with programmable buttons and volume control, integrated with multi-input transmitter and HD Base T receiver featuring built-in amplifier, control interfaces, audio processing, and centralised web-based management capability.

60-Seater Classroom

Scalable lecture halls with Sound system, video system, digital podium, multi-camera recording, AV over IP and centralised control.

A. Audio System

- Ceiling speakers with minimum 2.25" woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories

- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker
-
- +system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Wireless handheld (2 Nos.), Lapel (1 Nos.) and gooseneck Microphone (1 Nos.)

B. Video System

- Interactive display of minimum 110” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. VC, Streaming & Recording

- Software-based VC integration
- Minimum 3 PTZ cameras with minimum 20x optical zoom for faculty and students both
- Live streaming over IP network
- Lecture recording (audio + video + presentation)
- Integration with centralised storage

D. Podium & Presentation

- The digital podium (2 Nos) shall include connectivity for laptop input**, a built-in touch panel, a control interface, and a** microphone interface.
- Integration with AV system for seamless presentation

E. Control & Distribution

- AV-over-IP-based system architecture
- Minimum 8” or better touch panel for control
- Camera control via joystick/software

Multipurpose Hall - 250-PAX

4. The multipurpose hall is designed with a comprehensive audio-visual solution to support a wide range of activities, including presentations, conferences, and events. The system comprises a high-quality speech reinforcement system**,** Active LED display**,** digital signal processing (DSP)-based audio system**,** AV over IP distribution, and an integrated video conferencing solution**.**

5. This integrated setup ensures seamless operation, superior audio clarity, high-resolution visual output, and flexible content-sharing capabilities, making the space adaptable to multiple use cases and user requirements.

A. Audio System

- Front-of-House loudspeakers shall comprise a minimum dual 8” LF driver configuration or better, optimised for high-quality speech reinforcement and cultural event applications. The system shall provide wide and uniform audience coverage with a nominal dispersion of **120° (H) x 60° (V)** or better, ensuring consistent sound pressure levels and intelligibility across the listening area.
- Subwoofers shall incorporate a minimum 15” LF driver or better, designed to deliver extended low-frequency performance for music and cultural event applications. The system shall ensure high output capability, low distortion, and seamless integration with the main FOH loudspeakers.
- Front fill loudspeakers shall consist of a minimum **8” LF driver or better**, intended to cover near-field audience zones. The system shall provide enhanced speech intelligibility and tonal consistency with the main system, featuring a nominal dispersion of **90°H x 60°V** or better.
- Delay loudspeakers shall comprise a minimum **8” LF driver or better**, designed to extend coverage to rear audience areas in larger venues. The system shall support time-aligned reproduction with the FOH system and maintain uniform coverage with a nominal dispersion of **120° (H) x 60° (V)** or better.
- The amplification system shall be based on **Digital Class-D multi-channel power amplifiers**, suitable for driving the FOH, subwoofer, front fill, and delay loudspeakers. The amplifiers shall deliver output power as per system design requirements, ensuring high efficiency, low distortion, and incorporating necessary protection features, such as thermal, overload, short-circuit, and clip limiting.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Wireless handheld (2 Nos.), Lapel (2 Nos.) Antenna system and gooseneck Microphone (1 Nos.)

B. Video System

- The display system shall consist of an **Active LED display with a minimum screen size of 163” or higher**, featuring a **pixel pitch of 1.8 mm or better**, selected in accordance with viewing distance and content requirements. The display shall deliver high-resolution visuals, optimal brightness, and clear readability from the farthest seating position, suitable for presentations, videos, and multipurpose applications**.**

C. Podium & Presentation

- The digital podium (2 Nos) shall include connectivity for laptop input**, built-in touch panel, control interface, connectivity, and** microphone interface
- Integration with AV system for seamless presentation

D. Control & Distribution

- AV-over-IP based system architecture
- Minimum 10” touch panel for control

(II) AV SYSTEM FOR DENTAL COLLEGE

Overall AV Concept

6. The AV system shall be designed as a fully integrated, network-based and software-driven ecosystem, ensuring seamless communication, collaboration, and content distribution as per space requirement.

Recording & Streaming

- Designated areas shall support live streaming over an IP network
- Capability for simultaneous recording of audio, video, and presentation content
- Integration with centralised storage/server for archival and retrieval

Presentation System

- Interactive active LED-based solution
- Wired and wireless content sharing

User Experience

- Plug-and-play operation
- Minimal user intervention
- Standardised interface across all rooms

Scalability

- Modular and expandable architecture
- Future-ready system design

Audio Performance & Design Criteria

- The audio system in all areas shall be designed based on **SPL and coverage performance**, not on fixed speaker quantities
- Bidder shall submit **simulation** demonstrating compliance
- System shall ensure:
  - Minimum +**10 dB over noise Level**
  - Proper **gain structure and feedback stability**
- Speaker selection, placement, and quantity shall be **optimised for room acoustics.**
- **Proper acoustic treatment to be provided for all halls and rooms where AV system is provided.**

Video Performance & Design Criteria

- The video system shall be designed based on:
  - Last Viewer distance vs screen size ratio
  - Content type (text, video, graphics)
- The system shall ensure:
  - Minimum Full HD display quality (4K preferred for Displays)
  - Uniform contrast ratio and brightness across the areas

PTZ CAMERA – DESIGN INTENT

7. The PTZ camera system shall be designed to enable high-quality video capture, live streaming, and recording of proceedings, ensuring clear visibility of participants, presenters, and presentation content across all functional spaces.
8. The system shall support hybrid collaboration, lecture capture, and event recording with seamless integration into the AV-over-IP and software-based conferencing environment.

Performance Requirements

- Cameras shall provide minimum Full HD (1080p) resolution (4K preferred)
- Support smooth PTZ operation with variable speed control
- Optical zoom shall be sufficient to capture clearly:
o Presenter
o Participants
- The system shall ensure:
o Proper framing of subjects across seating areas
o Consistent image quality under varying lighting conditions
o Low latency for live streaming applications

Coverage & Functionality

- Camera placement and quantity shall be designed to cover:
o Presenter/faculty
o Audience/participants
o Wide room view
- The system shall support:
o Preset recall for quick switching between views
o Manual and/or automated camera switching (if integrated with DSP/control system)
o Simultaneous streaming and recording capability

Integration Requirements

- Cameras shall integrate with:
o Soft VC platforms (Teams/Zoom/WebRTC)
o AV-over-IP system for routing and switching
o Recording and streaming systems
- Control shall be via:
o Joystick controller and/or
o Touch panel/software interface

The AV-over-IP system shall support minimum 1G/10G network infrastructure, multicast/unicast streaming, and low-latency signal distribution suitable for real-time applications.

All equipment shall be of professional grade and suitable for continuous operation.

30-Seater Meeting Room

Closed-door collaboration space with soft VC, recording, streaming, projection + display, DSP audio, AV over IP, touch panel.

A. Audio System

- FOH wall-mounted column array speakers with minimum 12 x 2.25” LF designed for high speech intelligibility with controlled vertical dispersion and wide horizontal coverage, suitable for indoor applications, complete with mounting accessories.
- Ceiling speakers with minimum 2.25” woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories.
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto-mixing, noise cancellation, and USB audio interface for soft VC integration.
- Table-embedded chairman/delegate gooseneck microphones with dedicated feedback suppressor integrated with DSP.
- USB interface for soft VC

B. Video System

- Minimum 110” or higher Interactive display
- Wired and wireless presentation system

C. Video Conferencing

- Software-based VC
- Minimum 1 PTZ cameras with minimum 20x optical zoom

D. Control & Distribution

- AV-over-IP based signal distribution
- Minimum 10” touch panel for control
- Wire manager - pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications.

48-Seater Seminar Hall

Lecture/event space with interactive display of minimum 110” or better, Ceiling Speakers, DSP, digital podium.

A. Audio System

- Ceiling speakers with minimum 2.25” woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories

- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- DSP with minimum 8 inputs and 8 outputs.
- Wireless handheld (2 Nos.) and Lapel (1 Nos.)

B. Video System

- Interactive display of minimum 110” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. Podium & Presentation

- The digital podium (1 Nos) shall include connectivity for laptop input**, a built-in touch panel, a control interface, and a** microphone interface.
- Integration with AV system for seamless presentation

D. Control & Distribution

- Wall-mounted AV control keypad with programmable buttons and volume control, integrated with multi-input transmitter and HD Base T receiver featuring built-in amplifier, control interfaces, audio processing, and centralised web-based management capability.

75-Seater Classroom

Scalable lecture halls with Sound system, projection system, digital podium, multi-camera recording, AV over IP and centralised control.

A. Audio System

- Ceiling speakers with minimum 2.25” woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Wireless handheld (2 Nos.), Lapel (1 Nos.) and gooseneck Microphone (1 Nos.)

B. Video System

- Interactive display of minimum 110” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. VC, Streaming & Recording

- Software-based VC integration
- Minimum 3 PTZ cameras with minimum 20x optical zoom for faculty and students both
- Live streaming over IP network
- Lecture recording (audio + video + presentation)
- Integration with centralised storage

D. Podium & Presentation

- The digital podium (2 Nos) shall include connectivity for laptop input**, built-in touch panel, control interface, connectivity, and** microphone interface
- Integration with AV system for seamless presentation

E. Control & Distribution

- AV-over-IP based system architecture
- Minimum 8” or better touch panel for control
- Camera control via joystick/software

125-Seater Examination Hall

Examination hall with Speech reinforcement system, projection, DSP audio, AV over IP.

A. Audio System

- Ceiling speakers with minimum 2.25” woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Wireless handheld (2 Nos.), Lapel (2 Nos.) Antenna system and gooseneck Microphone (1 Nos.)

B. Video System

- Display of minimum 115” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. Podium & Presentation

- The digital podium(1 Nos) shall include connectivity for laptop input**, built-in touch panel, control interface, connectivity, and** microphone interface
- Integration with AV system for seamless presentation

D. Control & Distribution

- AV-over-IP based system architecture
- Control System
- Minimum 8” touch panel for control

(III) AV SYSTEM FOR PHARMACY COLLEGE

Overall AV Concept

- The AV system shall be designed as a fully integrated, network-based and software-driven ecosystem, ensuring seamless communication, collaboration, and content distribution as per space requirement.

Recording & Streaming

- Designated areas shall support live streaming over IP network
- Capability for simultaneous recording of audio, video, and presentation content
- Integration with centralized storage/server for archival and retrieval

Presentation System

- Interactive Active LED based solution
- Wired and wireless content sharing

User Experience

- Plug-and-play operation
- Minimal user intervention
- Standardized interface across all rooms

Scalability

- Modular and expandable architecture
- Future-ready system design

Audio Performance & Design Criteria

- The audio system in all areas shall be designed based on **SPL, and coverage performance**, not on fixed speaker quantities
- Bidder shall submit **simulation** demonstrating compliance
- System shall ensure:
  - Minimum +**10 dB over noise Level**
  - Proper **gain structure and feedback stability**
- Speaker selection, placement, and quantity shall be **optimized for room acoustics.**
- **Proper acoustic treatment to be provided for all halls and rooms where AV system is provided.**

Video Performance & Design Criteria

- The video system shall be designed based on:
  - Last Viewer distance vs screen size ratio
  - Content type (text, video, graphics)
- The system shall ensure:
  - Minimum Full HD display quality (4K preferred for Displays)
  - Uniform contrast ratio and brightness across the areas

PTZ CAMERA – DESIGN INTENT

- The PTZ camera system shall be designed to enable high-quality video capture, live streaming, and recording of proceedings, ensuring clear visibility of participants, presenters, and presentation content across all functional spaces.
- The system shall support hybrid collaboration, lecture capture, and event recording with seamless integration into the AV-over-IP and software-based conferencing environment.

Performance Requirements

- Cameras shall provide minimum Full HD (1080p) resolution (4K preferred)
- Support smooth PTZ operation with variable speed control
- Optical zoom shall be sufficient to capture clearly:
  - Presenter
  - Participants
- The system shall ensure:
  - Proper framing of subjects across seating areas
  - Consistent image quality under varying lighting conditions
  - Low latency for live streaming applications

Coverage & Functionality

- Camera placement and quantity shall be designed to cover:
  - Presenter/faculty
  - Audience/participants
  - Wide room view
- The system shall support:
  - Preset recall for quick switching between views
  - Manual and/or automated camera switching (if integrated with DSP/control system)
  - Simultaneous streaming and recording capability

Integration Requirements

- Cameras shall integrate with:
  - Soft VC platforms (Teams/Zoom/WebRTC)
  - AV-over-IP system for routing and switching
  - Recording and streaming systems

- Control shall be via:
o Joystick controller and/or
o Touch panel/software interface

The AV-over-IP system shall support minimum 1G/10G network infrastructure, multicast/unicast streaming, and low-latency signal distribution suitable for real-time applications.

All equipment shall be of professional grade and suitable for continuous operation.

30-Seater Meeting Room

Closed-door collaboration space with soft VC, recording, streaming, projection + display, DSP audio, AV over IP, touch panel.

A. Audio System

- FOH wall-mounted column array speakers with minimum 12 x 2.25" LF designed for high speech intelligibility with controlled vertical dispersion and wide horizontal coverage, suitable for indoor applications, complete with mounting accessories
- Ceiling speakers with minimum 2.25" woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Table-embedded chairman/delegate gooseneck microphones with dedicated feedback suppressor integrated with DSP
- USB interface for soft VC

B. Video System

- Minimum 110" or higher Interactive display
- Wired and wireless presentation system

C. Video Conferencing

- Software-based VC
- Minimum 1 PTZ cameras with minimum 20x optical zoom

D. Control & Distribution

- AV-over-IP based signal distribution
- Minimum 10" touch panel for control
- Wire manager - pop-up mechanism, providing integrated connectivity including minimum 1× HDMI, 2× universal power sockets, and 1–2× LAN (RJ45) ports, suitable for conference table applications.

30-Seater Seminar Hall

Lecture/event space with interactive display of minimum 110" or better, Ceiling Speakers, DSP, digital podium.

B. Audio System

- Ceiling speakers with minimum 2.25" woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- DSP with minimum 8 inputs and 8 outputs.
- Wireless handheld (2 Nos.) and Lapel (1 Nos.)

B. Video System

- Interactive display of minimum 110" or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. Podium & Presentation

- The digital podium (1 Nos) shall include connectivity for laptop input**, built-in touch panel, control interface, connectivity, and** microphone interface.
- Integration with AV system for seamless presentation

D. Control & Distribution

- Wall-mounted AV control keypad with programmable buttons and volume control, integrated with multi-input transmitter and HD Base T receiver featuring built-in amplifier, control interfaces, audio processing, and centralised web-based management capability.

50-Seater Seminar Hall

Lecture/event space with interactive display of minimum 110" or better, Ceiling Speakers, DSP, digital podium.

A. Audio System

- Ceiling speakers with minimum 2.25" woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker system, with output power as per system design requirement.
- DSP with minimum 8 inputs and 8 outputs.
- Wireless handheld (2 Nos.) and Lapel (1 Nos.)

B. Video System

- Interactive display of minimum 110” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. Podium & Presentation

- The digital podium (1 Nos) shall include connectivity for laptop input**, a built-in touch panel, a control interface, and a** microphone interface.
- Integration with AV system for seamless presentation

D. Control & Distribution

- Wall-mounted AV control keypad with programmable buttons and volume control, integrated with multi-input transmitter and HD Base T receiver featuring built-in amplifier, control interfaces, audio processing, and centralized web-based management capability.

60-Seater Classroom

Scalable lecture halls with Sound system, video system, digital podium, multi-camera recording, AV over IP and centralized control.

A. Audio System

- Ceiling speakers with minimum 2.25” woofer driver or better, designed for speech applications with wide dispersion (≥100°) and uniform coverage, complete with back can and mounting accessories
- Digital Class-D multi-channel power amplifier suitable for driving the proposed loudspeaker
-
- +system, with output power as per system design requirement.
- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Wireless handheld (2 Nos.), Lapel (1 Nos.) and gooseneck Microphone (1 Nos.)

B. Video System

- Interactive display of minimum 110” or higher, with screen size selected based on viewing distance and content requirements to ensure clear visibility and readability from the farthest seating position.

C. VC, Streaming & Recording

- Software-based VC integration
- Minimum 3 PTZ cameras with minimum 20x optical zoom for faculty and students both
- Live streaming over IP network
- Lecture recording (audio + video + presentation)

- Integration with centralized storage

D. Podium & Presentation

- The digital podium (2 Nos) shall include connectivity for laptop input**, built-in touch panel, control interface, connectivity, and** microphone interface.
- Integration with AV system for seamless presentation

E. Control & Distribution

- AV-over-IP based system architecture
- Minimum 8” or better touch panel for control
- Camera control via joystick/software

Multipurpose Hall - 250-PAX

- The multipurpose hall is designed with a comprehensive audio-visual solution to support a wide range of activities, including presentations, conferences, and events. The system comprises a high-quality speech reinforcement system**,** Active LED display**,** digital signal processing (DSP)-based audio system**,** AV over IP distribution, and an integrated video conferencing solution**.**
- This integrated setup ensures seamless operation, superior audio clarity, high-resolution visual output, and flexible content sharing capabilities, making the space adaptable for multiple use cases and user requirements.

A. Audio System

- Front-of-House loudspeakers shall comprise a minimum dual 8” LF driver configuration or better, optimized for high-quality speech reinforcement and cultural event applications. The system shall provide wide and uniform audience coverage with a nominal dispersion of **120° (H) x 60° (V)** or better, ensuring consistent sound pressure levels and intelligibility across the listening area.
- Subwoofers shall incorporate a minimum 15” LF driver or better, designed to deliver extended low-frequency performance for music and cultural event applications. The system shall ensure high output capability, low distortion, and seamless integration with the main FOH loudspeakers.
- Front fill loudspeakers shall consist of a minimum **8” LF driver or better**, intended to cover near-field audience zones. The system shall provide enhanced speech intelligibility and tonal consistency with the main system, featuring a nominal dispersion of **90°H x 60°V** or better.
- Delay loudspeakers shall comprise a minimum **8” LF driver or better**, designed to extend coverage to rear audience areas in larger venues. The system shall support time-aligned reproduction with the FOH system and maintain uniform coverage with a nominal dispersion of **120° (H) x 60° (V)** or better.
- The amplification system shall be based on **Digital Class-D multi-channel power amplifiers**, suitable for driving the FOH, subwoofer, front fill, and delay loudspeakers. The amplifiers shall deliver output power as per system design requirements, ensuring high efficiency, low distortion, and incorporation of necessary protection features such as thermal, overload, short circuit, and clip limiting.

- AEC-enabled DSP with minimum 12 inputs and 8 outputs, supporting auto mixing, noise cancellation, and USB audio interface for soft VC integration
- Wireless handheld (2 Nos.), Lapel (2 Nos.) Antenna system and gooseneck Microphone (1 Nos.)

B. Video System

- The display system shall consist of an **Active LED display with a minimum screen size of 163" or higher**, featuring a **pixel pitch of 1.8 mm or better**, selected in accordance with viewing distance and content requirements. The display shall deliver high-resolution visuals, optimal brightness, and clear readability from the farthest seating position, suitable for presentations, videos, and multipurpose applications**.**

C. Podium & Presentation

- The digital podium(2 Nos) shall include connectivity for laptop input**, a built-in touch panel, a control interface, and a** microphone interface.
- Integration with AV system for seamless presentation

D. Control & Distribution

- AV-over-IP based system architecture
- Minimum 10" touch panel for control

CCTV SYSTEM

It is proposed to install an IP-based CCTV System.

In all buildings, CCTV Cameras shall be provided at all Entry & Exit points, Corridors, storerooms, patient waiting areas, pharmacies, parking areas, indoor & outdoor areas, inside all lift cars, all Service rooms like Electrical Room, AHU Room, UPS Room, Server Room, Hub Room, Pump Room, lift machine rooms, and HVAC plant room, etc.

IP Dome, Bullet Cameras, Panoramic, etc., with IR day/night vision, varifocal and fixed lenses, shall be provided inside the building. Bullet and dome cameras with PTZ capabilities shall be provided to monitor the building's external periphery and outside areas. All cameras shall be monitored on an appropriately sized 4K UHD display wall provided in the central control room. Provision for 90 days recording storage capacity shall be available.

4. ACCESS CONTROL SYSTEM

A touchless access control system will be provided for the controlled movement areas.

Like OTs, Service areas, IT areas, etc, the same shall be integrated with CCTV.
The system shall include:

- Facial recognition readers with 2d/3d IR and thermal cameras (for OTs and clinical areas)
- contactless secure smart card readers (for service areas like IT, Electrical, HVAC rooms, UPS rooms)
- Contactless RFID cards (provisions shall be there to integrate with asset management system for Staff movement requirements)
- UPS power and LAN cabling – Wi-Fi enabled readers can also be considered.
- Control panels and power supplies
- Racks, servers, storage, interfaces etc.
- Software shall be a part of the integrated security solution (CCTV, Access control, , parking management etc)

5. NETWORKING

All IT & ELV infrastructure backbone shall be connected via Fibre Optic Cables (in a ring-star topology with all buildings) and local distribution via CAT-6A cables. Seamless managed Wi-Fi shall be provided throughout the facility, with a minimum download speed of 200 Mbps or better to the farthest end user, with appropriate security firewall.

The system shall comprise:

- CAT 6A cabling system
- Patch panels, Jack Panel mounting racks, power supply units, patch cords
- RJ 45 jacks
- Surface/ recessed mounted face plates with outlets
- 2 per each workstations/ 3 per each workstation with printer
- 2 per each lab & diagnostic equipment
- 2 each Bedhead units, etc.
- Pure server-based VOIP telephone system along with end user telephone handsets type I & II
- POE Wi-Fi system (coverage of entire service block) with minimum download speed of 200 Mbps to the farthest end user of each wi-fi router/module
- The Wi-Fi system shall be MAC ID-based, along with the Firewall.
- Raceways, cable trays, conduiting for the network system
- UPS power supply with a minimum of 30 mins of power backup for the system in total.
- Electrical cabling, DBs, redundant power supply, automatic transfer switches, dual power outlets for racks, redundant networking equipment

All active networking components, including but not limited to Core switches, access switches, distribution switches, POE switches, SFP modules, etc., to be provided, including the firewall.

There should be two separate networks for non-medical and medical equipment. Medical equipment network to be fully redundant in nature with automatic failover switching (including a separate

redundant backbone)

Mobile Network for (All Service Provider) Signal Booster system shall be provided as per requirement.

6. FIRE SUPPRESSION SYSTEM

An inert gas (Nitrogen) based fire suppression flooding System shall be provided in Data Centre/server rooms, CCTV monitoring room, UPS Rooms, Hub Rooms, and Fire Alarm Control rooms.

An inert gas-based panel fire suppression system shall be provided for the Main LT panel, DG synchronising panel, Capacitor Panel in Substation and Buildings, HVAC Panel in Plant room, Main panel for Fire Fighting in UGT, and all LT panels etc. installed inside a room in each building, as per the latest amended governing norms.

7. Parking Management System

Parking management system shall be used to install a fully automated parking management system with RFID readers, boom barriers, , cameras, parking guidance displays, and ultrasonic parking sensors

Parking guidance and information (PGI) systems, or car park guidance systems, shall present drivers with dynamic information on parking within controlled areas. The systems combine traffic monitoring, communication, processing and variable message sign technologies to provide the service. This is to help motorists find unoccupied parking spaces, locate their car when returning to the vehicle, and improve their experience. This includes adaptive lighting sensors and parking space LED indicators (red for occupied, green for available, and blue for reserved for people with disabilities above every parking space), and an indoor positioning system (IPS).

The system shall consist of the following:

- Proximity card, RFID tag readers
- Boom barrier with loop sensor.
- Automatic Number Plate Image Capturing & Recognition System
-
- ANPR camera system (integrated with CCTV system)
- Parking Guidance system with lane-wise displays and parking space indicators
- Server with Central Management Software
- Accessories (Data & power cabling, UPS Systems etc.)

8. ICT SYSTEM

ICT: The Detailed design of the Main Operations & Command Centre and Security Command Centre

for ICT, with all details to be provided by the contractor. All BMS-related and other Electrical and Mechanical Equipment maintenance record systems, Fire and safety-related systems, into the Main Operations & Command Centre. The detailed network connecting all the Security command centres, ICT rooms, and fire control rooms to the Main Operations & Command Centre shall be provided for review and approval by the Engineer-in-charge. Only after taking the approval of the Engineer-in-charge, the designed system shall be provided in all respects. In Hospital Building, Data Centre/ Server Room of appropriate size with raised antistatic flooring having proper copper grounding, Passive IT infrastructure like network racks & Server Enclosure with Horizontal and Vertical PDUs with network power switches(Static Switch) for redundant UPS power supply, Jack panels, Patch Panels, raceways and Ladder/ basket Type cable tray, having dedicated UPS power with redundancy and Precision Air Conditioning with redundancy with CCTV 100% coverage, very early fire detection system, inert gas (100% Nitrogen) flooded fire Suppression System shall be provided to house all the IT Infrastructure active components to run the ICT system and Software for operation of the Hospital, its building and services Centre.

9. IPTV System

A Central Cable TV System shall be made to provide Cable TV signal to TV Outlet(s) through suitable Cat 6A cable by the Contractor, based on received inputs from the service provider, in the Hospitals, Dental College, and Pharmacy College.

Service provider to be decided by the End Users.

IPTV outlets shall be provided in the buildings as required, and they shall be connected to the service provider for various channels. No. of IPTV outlets to be decided after the approval from the Engineering in charge.

10. IP TELEPHONY

Scope of work shall include the detailed design, engineering, supply, installation, testing, commissioning, and integration of a complete enterprise-grade IP-Based Private Branch Exchange (IP PBX) system for the hospital. The system shall provide secure, reliable, and highly available voice communication services for all hospital departments, administrative offices, clinical areas, operation theatres, ICUs, emergency departments, laboratories, pharmacies, hostels, residential buildings and other associated facilities.

The Contractor shall provide all necessary hardware, software, licenses, IP telephones, communication gateways, Session Border Controllers (SBCs) where required, servers, call management software, voicemail, unified communication features, network interfaces, structured cabling interfaces, power supplies, racks, accessories, and all ancillary components necessary for complete end-to-end operation.

The IP PBX system shall support IP-based voice communication over the hospital's LAN/WAN infrastructure using open industry standards such as SIP and RTP, with seamless integration with PSTN/ISDN/SIP trunk services, emergency communication/response systems, nurse call systems, and public address systems.

The Contractor shall undertake detailed system design, preparation of shop drawings, equipment layouts, network architecture, numbering plans, dial plans, IP addressing schemes, redundancy architecture, and integration drawings for approval before execution. The system shall be designed for 24×7 uninterrupted hospital operation with appropriate redundancy, scalability, cybersecurity, and future expansion capability.

The Contractor shall also provide all essential components, accessories, interfaces, and services required for proper end-to-end functionality of the IP PBX system, irrespective of whether they are explicitly identified in the tender documents.

INTEGRATED BUILDING MANAGEMENT SYSTEM (IBMS) FOR ALL BUILDINGS

(HOSPITAL, PHARMACY & DENTAL COLLEGES, ALL RESIDENTIAL & HOSTEL BUILDINGS, INDOOR SPORTS, CLUB HOUSE, STP, UGT, SUBSTATIONS, HVAC PLANT ROOMS, AND EXTERNAL SERVICES)

GENERAL

i) An Integrated Building Management System is proposed from the perspective of smart buildings and energy conservation. The BMS System shall provide data on the cloud for monitoring and control purposes from a Remote location.
ii) The main IBMS server shall be set up in the control room or specified otherwise at a later stage by E-in-C, and the entire campus shall be monitored and controlled from there, as per the philosophy.
iii) Required number of DDC controllers shall be provided as per I/O summary and requirement (with keeping 15% extra in each DDC controller.
iv) The total number of I/O points as given in the I/O summary is an estimate and the minimum requirement. The exact nos. will be higher as per detailed design for monitoring and control of all Services in IBMS as below:
v) BMS shall work upon open protocols like BACnet IP, and it should be able to integrate 3rd party
vi) systems communicating on Modbus RTU/ Modbus TCPIP/ RS 485/ BACnet MSTP/OPC/ DA/ API/ MQTT/ IEC61850 etc.
vii) The main server shall be provided with redundancy.
viii) All Monitoring and Control equipment like temp. sensors, CO sensors, other sensors, transducers, flow meter, other switches, etc. are within the scope.
ix) Potential free contacts shall be provided with each device to be controlled through IBMS.
x) All energy meters shall be provided with an RS-485 port.

REQUIREMENT

i) Integrated Building Management System is proposed for the following:
- Monitoring and data logging from various services.
- Controls for various services.

ii) Monitoring, control and data logging is proposed for the following services:
- All high-side HVAC equipment shall be monitored and controlled by a dedicated chiller plant manager. This chiller plant manager shall be remotely connected to BMS for data logging.
- All low-side HVAC equipment like AHUs, ceiling suspended AHUs, Fan coil units, ventilation fans, etc.
- Water supply system, WTP, STP and SWM shall have their dedicated plant managers (panels with

PLC). These plant managers shall be remotely connected to BMS for data logging.

- Access control system to be linked with Fire alarm system. The data shall be provided from the FAS System via the open protocol Bacnet/IP to integrate with IBMS, so that in case of a fire, access control can be bypassed.
- All other services as per the table given for monitoring and control.

I/O SUMMARY FOR REFERENCE OF EPC BIDDER, ALL TO BE PROVIDED AS PER FINAL DESIGN FOR EACH ITEM

	I/O Summary								
S. No.	Description	Qty	AI	DI	AO	DO	S.I.	By IBMS Provider	By respective 3rd party contractors
A	**HVAC System**								
	PLANT ROOM								
1	**Water Cooled Chillers**								
1.1	Chillers On/Off Command							Relay output @ 2 amp, 230 V and Wiring & termination at Chiller	Microprocessor accepting (2 amp. NO contact) remote start/stop
1.2	Chiller Run Status							Wiring & termination	Termination detail of Potential Free NO contacts and AI/AO at the microprocessor panel
1.3	Chillers Trip Status							Wiring & termination	
1.4	Chillers Auto/Manual Status							Wiring & termination	
1.5	Chiller Main header Inlet & Outlet Temperature Feedback							Immersion temperature sensor with Matching	Welding of socket-in-line and installation, coordination, and pipe cleaning after welding.
1.6	Chiller Individual Outlet Temp. Feedback							Immersion temperature sensor with Matching	
1.7	Condenser Main header Inlet & Outlet Temperature Sensor Feedback							Immersion temperature sensor with Matching Thermowell	

1.8	Chiller Isolation Valves Open / Close Command							Relay output (1 SPDT for open and close) @ 2 amp, 230 V, Wiring &	Motorised butterfly valve at CHW supply line to accept 1 SPDT for opening and closing of valves.
1.9	Chiller Isolation Valves Open / Close Status							Wiring & termination	VFC to be provided in BF valve actuator for Feedback.
1.10	Condenser Isolation Valves Open / Close Command							Relay output (1 SPDT for open and close) @ 2 amp, 230 V, Wiring & termination on valve actuator	Motorised butterfly valve at CHW supply line to accept 1 SPDT for opening and closing of valves.
1.11	Condenser Out Valves Open / Close Status							Wiring & termination	VFC to be provided in the BF valve actuator for feedback.
1.12	Bypass Modulation valve command & Feedback							Wiring & termination	VFC to be provided in the BF valve actuator for feedback.
1.13	Combined Ambient Temperature & Humidity Sensor							Ambient T+RH Sensor with IP67 Shield	Installation Provision on Terrace
1.14	Chilled Water Flow Meter Feedback							Electromagnetic Type Water Flow	Installation Provision of Flow meter with suitable size of flanges
1.15	VFD Feedback & Modulation							Output signal 0-10 VDC from DDC Controller to VFD	VFD by HVAC, with acceptance of 0-10 V DC Signal
1.16	VFD Integration							Software Integration - BMS with VFD	VSPS Vendor shall provide port & mapping details to release information on BACnet MS/TP or on MODBUS-RTU
1.17	DP Transmitter across condenser Supply & Return							Differential Pressure	Installation Provision of DPT with suitable size Socket
1.18	Chiller microprocessor (software) integration for Chiller-intrinsic parameter monitoring (20 points per chiller)							Integration with Chiller Microprocessor Unit on BACnet/IP or MODbus RTU over RS-485.	BACnet/IP Open Protocol or MODBUS-RTU Protocol Mapping Details, network interface card for the above, and all wiring termination details for software and hardware integration. Snapshots of online parameters to be
1.19	Integration of ANTI FOULING CONDENSER SYSTEM (AFCS)							Software Connectivity/ Integrator shall be in BMS Vendor	PLC Vendor to Provide information on open Protocol (Modbus/BACnet)

	Sub Total for Chillers								
2	**Primary, Secondary, condenser Water**								
2.1	Primary Water Pump On / Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit
2.2	Primary Water Pump Run Status							DP Switch Water	Installation Provision of DP Switch Probes with suitable sizes
2.3	Primary Water Pump Trip Status							Wiring & termination	Termination details of auxiliary potential free contact of auto/manual switch
2.4	Primary Water Pump Auto/Manual Status							Wiring & termination	Termination details of auxiliary potential-free contact of auto/manual switch
2.5	Secondary Water Pump On / Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential free contact in auto mode in the control circuit
2.6	Secondary Water Pump Run Status							DP Switch Water	Installation Provision of DP Switch Probes with suitable sizes
2.7	Secondary Water Pump Trip Status							Wiring & termination	Termination details of auxiliary potential-free contact of auto/manual switch
2.8	Secondary Water Pump Auto/Manual Status							Wiring & termination	Termination details of auxiliary potential-free contact of auto/manual switch
2.9	Secondary VFD Integration (15 points per VFD)							Software Integration - BMS from VFD or VSPS in case of data being shared by VFD to VSPS first.	VFD /VSPS Vendor shall provide port & mapping details to release information on BACnet MS/TP or on MODBUS-RTU
2.10	Condenser Water Pump On / Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential free contact in auto mode in the control circuit
2.11	Condenser Water Pump Run Status							DP Switch Water	Installation Provision of DP Switch Probes with suitable sizes

2.12	Condenser Water Pump Trip Status							Wiring & termination	Termination details of auxiliary potential free contact of auto/manual switch
2.13	Condenser Water Pump Auto/Manual Status							Wiring & termination	Termination details of auxiliary potential-free contact of auto/manual switch
	Sub Total for Water Pumps								
3	**Cooling Tower (Fans with VFD)**								
3.1	Cooling Tower Fan On / Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit
3.2	Cooling Tower Fan Run Status							Current Relay	Suitable installation Provision provided by Contractor in CTs
3.3	Cooling Tower Fan Trip Status							Wiring & Termination	Terminal detail to be provided for Connection in starter panel
3.4	Cooling Tower Fan Auto/ Manual Status							Wiring & Termination	Terminal detail to be provided for Connection in the starter panel for Local-Remote Mode status.
3.5	Cooling Tower Sump Low Level Monitoring							VFC Signal from level switch	Suitable Installation Provision to be provided in Cooling Tower sump by HVAC Vendor.
3.6	Cooling Tower Inlet & Outlet Temp. Monitoring							Immersion temperature sensor with Matching Thermowell	Welding of socket in line and installation, Co-ordination and pipe cleaning after welding.
3.7	PH Analyzer							PH Analyzer	Suitable Installation Provision to be provided in Cooling Tower sump by HVAC Vendor.
3.8	TDS Analyzer							TDS Analyzer	Suitable Installation Provision to be provided in Cooling Tower sump by HVAC Vendor.
3.9	VFD Feedback & Modulation							Output signal 0-10 Vdc from DDC Controller to VFD	VFD by HVAC, with acceptance of 0-10 V DC Signal
3.10	VFD Integration							Software Integration - BMS with VFD	VSPS Vendor shall provide port & mapping details to release information on BACnet MS/TP or on

	Sub Total for Cooling Towers								
4	**Hot Water Generator**								
4.1	HWG On/Off Command							Relay output @ 2 amp, 230 V and Wiring & termination at	Microprocessor accepting (2 amp. NO contact) remote start/stop
4.2	HWG Run Status							Current Relay	Suitable installation Provision provided by Contractor in CTs
4.3	HWG Trip Status							Wiring & Termination	Terminal detail to be provided for Connection in starter panel
4.4	HWG Auto/Manual Status							Wiring & Termination	Terminal detail to be provided for Connection in starter panel for Local-Remote mode status.
4.5	HWG Main header Inlet & Outlet Temperature Feedback							Immersion temperature sensor with Matching Thermowell	Welding of socket-in-line and installation, coordination, and pipe cleaning after welding.
4.6	HWG Individual Outlet Temp. Feedback							Immersion temperature sensor with Matching Thermowell	
4.7	HWG Isolation Valves Open/Close Status & Command							Wiring & termination	Motorised butterfly valve at CHW supply line to accept 1 SPDT for valve opening and closing.
4.8	HWG VFD Feedback & Modulation							Output signal 0-10 Vdc from DDC Controller to VFD	VFD by HVAC, with acceptance of 0-10 V DC Signal
4.9	HWG VFD Integration							Software Integration - BMS with VFD	VFD Vendor shall provide port & mapping details to release information on MODBUS-RTU
	Sub Total								
5	**Hot Water Generator**								
5.1	Hot Water Pump On / Off Command					0		Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit
5.2	Hot Water Pump Run Status			0				DP Switch Water	Installation Provision of DP Switch Probes with suitable sizes

5.3	Hot Water Pump Auto / Manual			0				Wiring & termination	Termination details of auxiliary potential-free contact of auto/manual switch
5.4	Hot Water Pump Trip Status			0				Wiring & termination	Termination details of auxiliary potential-free contact of Trip Relay
5.5	VSPS Integration						0	Software Integration - BMS from VSPS	VSPS Vendor shall provide port & mapping details to release information on BACnet MS/TP or on MODBUS-RTU
	Sub Total								
6	**AHU's (Ceiling Mounted)**								
6.1	AHU On/Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control
6.2	AHU Run Status							Differential Pressure Switch (0-400 pascals)	Provision for Installation of DP switch tube in AHU body, across blower
6.3	AHU Auto/Manual Status							Wiring & Termination	Termination details at auxiliary potential free contact of auto/manual switch
6.4	AHU Pre Filter status							Differential Pressure Switch (0-200 pascals)	Provision for Installation of DP switch tube in AHU body, across Filter
6.5	Return Duct Air Temperature Monitoring							Duct mount Temp. Sensor in Return Duct	Suitable installation Provision provided by HVAC Contractor in return duct.
6.6	Motorised CHW Valve Modulation							Output signal 0-10 Vdc from DDC Controller to Motorised Valve	2 Way Control Valve by HVAC, with acceptance of 0-10 V DC Signal
	Total IO Points AHU								
7	**Floor Mounted AHU for Critical Rooms (ICU, Blood Bank, MRI, Citi Scan)**								
7.1	AHU On/Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit

7.2	AHU Run Status							Differential Pressure Switch (0-	Provision for Installation of DP switch tube in AHU body, across blower
7.3	AHU Auto/Manual Status							Wiring & Termination	Termination details at auxiliary potential-free contact of auto/manual switch
7.4	AHU Pre Filter Status							Differential Pressure Switch (0-	Provision for Installation of DP switch tube in AHU body, across Filter
7.5	AHU Fine Filter Status							Differential Pressure Switch (0- 200 pascals)	Provision for Installation of DP switch tube in AHU body, across Filter
7.6	AHU Duct Temp + RH Monitoring							Duct Temperature and Humidity Sensor	Provision for Installation of Sensor
7.7	Chilled & HOT Water Motorised Valve Modulation							Output signal 0-10 Vdc/4-20 mA from DDC Controller to Motorised Valve	2 Way Control Valve by HVAC, with acceptance of 0-10 V DC Signal
7.8	Fresh Air Damper Modulation and Feedback							Wiring & Termination	Termination details at auxiliary potential-free contact of auto/manual switch
7.9	Duct Type CO2 Sensor							Duct Temp Sensor	Suitable installation Provision provided by HVAC Contractor in return duct.
7.10	Fire Damper On/OFF Status							Wiring & Termination	Termination details at auxiliary potential-free contact of Damper. Vendor to provide the termination provision
7.11	AHU VFD Speed Control & Feedback							0-10 Vdc from BMS to VFD	Acceptance of 0-10 Vdc in VFD
7.12	Duct static Pressure sensor for VFD Modulation							Duct Static Pressure Sensor	Provision for Installation of Sensor tube in AHU body
7.13	AHU VFD Integration (7 points per VFD)							Software Integration - BMS from VFD	VFD Vendor shall provide port & mapping details to release information on BACnet MS/TP or on MODBUS-RTU
	Total IO Points AHU		**0**	**0**	**0**	**0**	**0**		
8	**OT ROOMS AHU**								

8.1	AHU On/Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit
8.2	AHU Run Status							Differential Pressure Switch (0-400 pascals)	Provision for Installation of DP switch tube in AHU body, across blower
8.3	AHU Auto/Manual Status							Wiring & Termination	Termination details at auxiliary potential free contact of auto/manual switch
8.4	AHU Pre Filter							Differential Pressure Switch (0-	Provision for Installation of DP switch tube in AHU body, across Filter
8.5	AHU Fine Filter Status							Differential Pressure Switch (0-	Provision for Installation of DP switch tube in AHU body, across Filter
8.6	AHU Hepa Filter							Differential Pressure Switch (0-	Provision for Installation of DP switch tube in AHU body, across Filter
8.7	AHU Inlet/Outlet Temp							Immersion Temp Sensor with Thermowell	Provision for Installation of Thermowell in Chilled Water and Hot Water Line
8.8	AHU Duct Temp + RH Monitoring in Return Duct							Duct Temperature and Humidity Sensor	Provision for Installation of Sensor
8.9	AHU Duct Temp Monitoring in Supply Duct							Duct Temperature Sensor	Provision for Installation of Sensor
8.10	Chilled & HOT Water Motorised Valve Modulation							Output signal 0-10 Vdc/4-20 mA from DDC Controller to Motorised Valve Actuator	2 Way Control Valve by HVAC, with acceptance of 0-10 V DC Signal
8.11	Duct static Pressure sensor for VFD Modulation							Duct Static Pressure Sensor	Provision for Installation of Sensor tube in AHU body
8.12	AHU VFD Speed Control							0-10 Vdc from BMS to VFD	Acceptance of 0-10 Vdc in VFD
8.13	AHU VFD Integration (7 points per VFD)							Software Integration - BMS from VFD	VFD Vendor shall provide port & mapping details to release information on BACnet MS/TP or on MODBUS-RTU

8.14	Humidifier Run Status							Wiring & Termination	Termination details at auxiliary potential free contact at PFC
8.15	Humidifier Trip Status							Wiring & Termination	Termination details at auxiliary potential free contact at PFC
	Total IO Points		**0**	**0**	**0**	**0**	**0**		
9	**HRW / TFA (VFD) (Max 1 DDC per HRW)**								
9.1	HRW On/Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control
9.2	HRW Run Status							Differential Pressure Switch (0-400 pascals)	Provision for Installation of DP switch tube in AHU body, across blower
9.3	HRW Auto/Manual Status							Wiring & Termination	Termination details at auxiliary potential free contact of auto/manual switch
9.4	HRW Pre Filter status							Differential Pressure Switch (0-200 pascals)	Provision for Installation of DP switch tube in AHU body, across Filter
9.5	HRW Fresh Air Damper Modulation & Feedback							Wiring & Termination	Termination details at Damper Actuator and 0-10V signal for Modulation
9.6	Supply Duct Air Temperature Monitoring							Duct mount Temp. Sensor	Suitable installation Provision provided by HVAC Contractor in duct
9.7	Motorised CHW Valve Modulation							Output signal 0-10 Vdc from DDC Controller to Motorised Valve	2 Way Control Valve by HVAC, with acceptance of 0-10 V DC Signal
9.8	HRW VFD Speed % Modulation Command & Feedback							Output signal 0-10 Vdc from DDC Controller to VFD	VFD by HVAC, with acceptance of 0-10 V DC Signal
9.9	HRW Supply Duct Static Pressure Monitoring							Duct mount DP Sensor in Duct	Suitable installation Provision provided by HVAC Contractor in supply duct.
9.10	IAQ Sensor - Integration of Air quality monitoring system (PM 2.5, Co2, HCHO, TVOC, temperature & humidity)							Software Connectivity/Integrator shall be within the BMS Vendor scope.	The SITC of Sensor is in scope of HVAC Vendor. The Vendor to Provide Sensor on open Protocol Bacnet/IP or Modbus RS485 and mapping details
9.11	HRW VFD Integration on Modbus Protocol							Software Integration - BMS with VFD	VFD Vendor shall provide port & mapping details to release information on MODBUS-RTU

	Total IO Points TFA								
10	**Smoke (Exhaust & Fresh) Air Axial Fans**								
10.1	Fan On/Off Command							Wiring & Termination	Termination detail to be provided by Fan starter panel supplier/HVAC Contractor.
10.2	Fan Run Status							Current Relay	Potential Free Contact to BMS from MCC Panel
10.3	Fan Auto/Manual Status							Wiring & Termination	Termination detail to be provided by Fan starter panel supplier/HVAC Contractor.
	Total IO Points Fans								
11	**Pressurisation Fans (Lift Well / Lift Lobby / Staircase)**								
11.1	Fan On/Off Command							Wiring & Termination	Termination detail to be provided by Fan starter panel supplier/HVAC Contractor.
11.2	Fan Run Status							Current Relay	Potential Free Contact to BMS from MCC Panel
11.3	Fan Auto/Manual Status							Wiring & Termination	Termination detail to be provided by Fan starter panel supplier/HVAC Contractor.
	Total IO Points in Basements								
12	**Air Washer**								
12.1	Air Washer Fan & Pump (1W+1S) On/Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit
12.2	Air Washer & Pump Run Status							Air DP Switch, Current Relay, Wiring & Termination	Provision for Installation provision
12.3	Air Washer Auto-Manual Operation Status							Wiring & Termination	Termination details at auxiliary potential-free contact of auto-manual switch
12.4	Low & High Water Level Status							Bi-Level Switch	Termination at level Switch

12.5	Air Washer Filter Status							Differential Pressure Switch (0-200 pascals)	Provision for Installation of DP switch tube in DOAS body, across Filter
	Total IO Points Air Washer								
13.0	**Scrubber**								
13.1	Scrubber On/Off Command							Relay output @ 2 amp, 230 V, wiring and termination	Termination details of potential-free contact in auto mode in the control circuit
13.2	Scrubber Run Status							Differential Pressure Switch (0-400 pascals)	Provision for Installation of DP switch tube in DOAS body, across blower
13.3	Scrubber Auto-Manual Operation Status							Wiring & Termination	Termination details at auxiliary potential free contact of auto-manual switch
13.4	Scrubber Trip Status							Wiring & Termination	Termination details at auxiliary potential-free contact of Trip Relay
13.5	Scrubber Filter Status							Differential Pressure Switch (0-200 pascals)	Provision for Installation of DP switch tube in DOAS body, across Filter
	Total IO Points Scrubber								
14	**Soft Integrations of HVAC Systems**								
14.1	Integration of FCU Thermostats							Software Connectivity/Integrator shall be within the BMS Vendor scope.	Vendor to provide information on open Protocol Bacnet/IP through PAC Card / Controller
14.2	Integration of (UVGI) Air Purifier System							Software Connectivity/ Integrator shall be in BMS Vendor scope	The SITC of the sensor is in scope of HVAC Vendor. The Vendor to Provide Sensor on open Protocol Bacnet/IP or Modbus RS-485 and mapping details
	Total IO Points								
	TOTAL IO FOR HVAC SYSTEM								
B	**Electrical System**								

1	**HT/LT**								
1.1	LT Incoming Breaker on/off status							Wiring & Termination	Volt-free contact from breaker to be provided by respective vendors
1.2	Bus Coupler on/off status							Wiring & Termination	Volt-free contact from breaker to be provided by respective vendors
1.3	Breaker on/off status							Wiring from MCC	Potential Free Contact
1.4	Breaker Trip status								
1.5	Transformer Winding High temperature Alarm Status							Wiring from DDC to Potential free contact available at Marshaling Panel	Provision of Potential Free Contact from Transformer Panel
1.6	Transformer Oil Pressure Alarm Status							Wiring & Termination	Volt-free contact from Transformer Panel to be provided by respective vendors
1.7	Transformer Oil Temp. Alarm Status							Wiring & Termination	Volt-free contact from Transformer Panel to be provided by respective vendors
1.8	Transformer HT Buchholz Relay status							Wiring & Termination	Volt Free Contact from Transformer Panel to be provided by respective vendors
	Total IO Points								
2	**DG SYSTEM**								
2.1	DG Run Status							Wiring & termination	Termination details of potential-free contact in RUN mode in the control circuit
2.2	DG Battery Voltage Status							DC Voltage Transducer (0-30V DC transducer)	Suitably space for installation of Voltage Transducer
2.3	DG Day Oil Tank level monitoring							Flameproof level transmitter for day tank	Suitable flange to be provided by DG Vendor for mounting level transmitter
2.4	DG Integration (20 Points per DG)							Transfer parameters to BMS from DG over Serial Communication on BACnet/MSTP or on MODBUS-RTU	DG Vendor shall provide a Network Interface card to release information on MODBUS-RTU and mapping details. Snapshots of online parameters to be shown to BMS Vendor

2.5	HSD Yard Oil Tank high / low level status							Flameproof level Switch HSD Yard tank	Suitable flange to be provided by DG Vendor for mounting level switch
2.6	HSD Supply Pump On/Off Command							Wiring & Termination	Termination detail to be provided by Pump starter panel supplier.
2.7	HSD Supply Pump Run Status							Wiring & Termination	Termination detail to be provided by the pump starter panel supplier.
2.8	HSD Supply Pump Auto/Manual Status							Wiring & Termination	Termination detail to be provided by Pump starter panel supplier.
2.9	HSD Supply Oil Meter Integration							Wiring & Termination	Vendor to provide the provision for installation and necessary probes
2.10	Buffer Oil Tank level monitoring							Flameproof level transmitter for Buffer oil tank	Suitable flange to be provided by DG Vendor for mounting level transmitter
2.11	Overflow Tank high level status							Flameproof level Switch Overflow tank	Suitable flange to be provided by DG Vendor for mounting level switch
2.12	DG Sync Panel Incoming Breakers on/off status							Wiring & Termination	Volt Free Contact from breaker to be provided by respective vendors
2.13	Bus Coupler on/off & Trip status							Wiring & Termination	Volt-free contact from breaker to be provided by respective vendors
2.14	DG outgoing Breaker on/off status							Wiring & Termination	Volt-free contact from breaker to be provided by respective vendors
	Total IO Points DG SYSTEM								
3	**LIFT System**								
3.1	Lift alarm connectivity							Wiring from Lift panel	Potential-free contact from lift panel
3.2	Lift trip status							Wiring from Lift panel	Potential-free contact from lift panel
3.3	Push Button Alarm Monitoring							Wiring from Lift panel	Potential free contact from lift panel
	TOTAL IO Points for LIFTS								
4	**Soft Integration of Electrical Systems**								

4.1	Integrations of Solar System - From Inverters							Software Connectivity/Integrator shall be within the BMS	A Solar System with a Modbus RS-485 port shall be available to provide data to the BMS.
4.2	Integration of Multifunctional Energy Meters							INTEGRATOR UNIT/Software connectivity	Microprocessor releasing information at one port on Open protocol [BACnet/Modbus) with built-in interface
4.3	Integration of HT Power Meter							INTEGRATOR UNIT/Software connectivity	Microprocessor releasing information at one port on Open Protocol [BACnet/Modbus] with built-in interface & communication cards
4.4	Integration of Lifts							INTEGRATOR UNIT / Software connectivity & Hardwired Connectivity	Lift Panel providing Output on Open Protocol BACnet / Modbus RTU
4.5	Integration of UPS System at 2 locations							Software Connectivity/ Integrator shall be in BMS Vendor scope	UPS System with Modbus SNMP / RS-485 port shall be available to provide data on BMS
	TOTAL IO Points								
	TOTAL IO FOR ELECTRICAL SYSTEM								
C	**Plumbing and Fire Fighting**								
1	**Fire Fighting System**								
1.1	Jockey / Sprinkler/hydrant Pump Run Status							Wiring from MCC	Wiring & termination at auxiliary potential-free contact for Run status of Pump Panel
1.2	Jockey / Sprinkler/hydrant Pump Trip Status							Wiring from MCC	Wiring & termination at auxiliary potential-free contact of auto-manual switch of Pump Panel
1.3	Hydrant / Sprinkler Line Main Header pressure monitoring							Pressure Transmitter	Wiring & termination from Pressure Switch of Pump Panel
1.4	Diesel Driven Pumps Run Status							Wiring from MCC	Wiring & termination at auxiliary potential-free contact for Run status of Pump Panel
	Total IO Points for Fire Fighting System								

2	**Water Pumps - Domestic/RAW water/Borewell**								
2.1	Pump on/off command							Relay output @ 2 amp, 230 V and wiring from MCC	Wiring and termination of potential-free contact in auto mode in the control circuit of Pump Panel
2.2	Pump run Status							Current relay & Wiring	Provision for Installation of current relay in the pump panel
2.3	Pump auto manual status							Wiring from MCC	Wiring & termination at auxiliary potential -free contact of auto-manual switch of Pump Panel
	Total IO Points for Plumbing Pumps								
3	**Sumps Pumps**								
3.1	Pump on/off command							Relay output @ 2 amp, 230 V and wiring from MCC	Wiring and termination of potential-free contact in auto mode in the control circuit of Pump Panel
3.2	Pump run Status							Current relay & Wiring	Provision for Installation of current relay in the pump panel
3.3	Pump auto manual status							Wiring from MCC	Wiring & termination at auxiliary potential -free contact of auto/manual switch of Pump Panel
3.4	Sump Water level monitoring Low & High							Level Switch & field Wiring	Provision of suitably sized socket for installation of level switch
	Total IO Points for Sump								
4	**UG/OG Tanks**								
4.1	Overhead Tank Water level monitoring low/High							Level Switch & field Wiring	Provision of suitably sized socket for installation of level switch
4.2	Underground Tank Water level monitoring low							Level Switch & field wiring	Provision of suitably sized socket for installation of level switch
	Total IO Points for								
5	**Soft Integration of Water & FF Pumps**								

5.1	Integrations of STP from PLC Panel							Software Connectivity/Integrator shall be within the BMS	A Solar System with a Modbus RS-485 port shall be available to provide data to the BMS.
5.2	Integration of WTP from PLC Panel							INTEGRATOR UNIT/Software connectivity	Networked DG microprocessor releasing information at one port on Open protocol [BACnet / Modbus) with built-in interface & communication cards
5.3	Integration of Fire Fighting PLC Panel							INTEGRATOR UNIT/Software connectivity	Microprocessor releasing information at one port on Open protocol [BACnet / Modbus) with built-in interface & communication cards
5.4	Integration of Hydro Pneumatics Transfer Pumps								
	Total IO Points for								
	TOTAL FOR PLUMBING & FF								
	GRAND TOTAL								
	Spare's @ 15%								

	Schedule of Material for Building Management System	
S. No.	**Description**	**Unit**
P.	**IBMS (INTEGRATED BUILDING MANAGEMENT SYSTEM)**	
1	Supply, installation, testing and commissioning of BMS ComputerSystem: i7 Processor, latest generation or Equivalent Server PC, Intel(R) Xeon(R) Processor, 2.93GHz, 4MB Cache with 16 GB RAM, & 1 TB SSD, 10/100 Mbps Ethernet card, USB connection & internal modem, Microsoft(R) Windows(R) 10 OS Professional Enterprise or latest, Web server software, DVD-ROM Drive (with RAM), 100/1000 Mbps NIC for Network connection and anti-virus software as per Tender Specifications. Accessories included: 32 Inch LED Screen, Optical Mouse & Key Pad, Windows Licensed software compatible with the above BMS System	Set
2	LaserJet A4 Black and White printer	Set
3	Supply, installation, testing, and commissioning of a 24-port Layer 2 managed Gigabit switch. The switch shall have ports to communicate with other switches to build a star topology network with redundancy, using S/FTP CAT 6A cable within the building, complete as per specifications and as required for BMS DDC Panel	Lot

4	Supply, installation, testing and commissioning of the following window-based graphical software for IBMS system with 1 No. Client for Operator workstation. The Software shall have 3D & HD vector dynamic graphics with AutoCAD import of plan with Zoom In & Zoom Out facility, Native 64 Bit System, Multi-Monitor Support-(Max 4 Nos), Multi-language support, BTL, UL, EN Certified System, BACnet Profile B- AWS (Advanced workstation) as per the BTL Listing, dot net platform, Certified OPC DA Server by OPC Foundation, Web-Based Server software shall permit use of Standard Web-Browsers such as Microsoft Internet Explorer, Netscape Navigator, etc. The Software shall comply with international standards and strive to deliver products that meet security standards such as ISA/IEC 62443, UL2900, ISO/IEC 27001, ISO/IEC 62443, and OWASP. Cyber security audit trail, 4-eye principle, Seamless integration of certificates within customer IT infrastructure, Microsoft's Active Directory-based authentication, Use of network infrastructure that supports physical network or VLAN segmentation, placing the web server in a "demilitarised zone" (DMZ), End-to-end encryption, from client to server, End-to-end encryption between servers, Certificate-based data exchange, encrypted backups. The Software shall be considered for 5000 IO Points and 2 Client Licenses. Special Note - The Software should have cloud connectivity and can be accessed remotely using User Name and Password from anywhere. For further compliance, the vendor to follow the Tender specifications	Set
5	Supply, installation, testing and commissioning of True IP Based DDC Standalone 32 Bit Intelligent, inbuilt web browser, peer to peer communication, interoperable DDC as per the specification. The controller shall have an inbuilt 2-port Ethernet switch. The DDC shall have a 300 MHz processor with 128 MB SDRAM (DDR3) and 512 MB NAND Flash. The DDC shall include IT security, including HTTPS and BACnet Secure Connect communication, and an Operating voltage of AC 24 V. The controller shall be freely programmable and shall include System functions (alarming, scheduling, trending, and access protection with individually definable user profiles and categories). Each DDC shall have a WLAN interface for local operations, engineering, and commissioning. It should have one built-in integration port and a port for POT on the local interface. For further compliance, the vendor must follow the Tender specifications.	
	The above shall be housed in vandal-proof, lockable & secure MS Cabinets to be supplied, along with all necessary switchgear protections as required. Each controller shall have spare capacity of 15% for future expansion.	
5.1	Controller for Chillers , CWP, SPW, Cooling Towers, condenser Pumps	
5.2	Controller for Hot Water Generator & Hot Water Pumps	
5.3	Controller for Ceiling Suspended AIR Handling Unit (Max 2 AHU per DDC)	
5.4	Controller for FM AIR Handling Unit for Critical Areas (Max 2 AHU per DDC)	
5.5	Controller for OT AHU's (Max 1 DDC per AHU)	
5.6	Controller for HRW / TFA (Max 2 HRW / TFA per DDC)	
5.7	Controller for Basement Ventilation Fans (Max 4 Fans per DDC)	
5.9	Controller for Terrace Pressurization Fans (Max 4 Fans per DDC)	
5.9	Controller for Axial Fans on Floors (Max 4 Fans per DDC)	
5.10	Controller for Air Washer & Dry Scrubber (Max 1 per DDC)	
5.11	Controller for Electrical System - DG/LT/HT/Transformer	
5.12	Controller for Lifts (2 lifts per DDC)	
5.13	Controller for Fire Fighting	

5.14	Controller for Plumbing (4 Pumps per DDC)	
5.15	Controller for Sump Pumps (2 Pumps per DDC)	
5.16	Controller for OH & OG Tanks	
6	Supply, installation, testing and commissioning of True IP Based BTL & UL Listed for third party integration. The controller shall include a 2-port Ethernet switch, a WLAN interface, and Cloud Connectivity. It should have a BTL label (BAC net communications passed the BTL test) and consist of a Dual microprocessor with a Storage capacity of 1 GByte RAM. It should support a Real-Time clock with up to 7 Days. It should support the major communication protocols: BACnet/IP, BACnet MS/TP, Modbus IP, and Modbus RTU, up to 500 points. (**Note -** Integrator shall be of same DDC make only.)	Lot
6.1	Integration of Chiller System on Modbus over RS-485 as per IO summary	
6.2	Integration of Pump VFD on Modbus over RS485 as per IO summary	
6.3	Integration on Combined Ambient Temperature & Humidity Sensor, CO2, TVOC, PM2.5, PM10, Light Level , Noise Level Sensor	
6.4	Integration of ANTI FOULING CONDENSER SYSTEM (AFCS) as per IO summary	
6.5	Integration of AHU & HRW VFD on Modbus over RS485 as per IO summary	
6.6	Integration of AHU Air Purification (UVGI) on Modbus over RS485 as per IO summary	
6.7	Integration of FCU Thermostat on Modbus over RS485 as per IO summary	
6.8	Integration of Solar Invertors on Modbus over RS485 as per IO summary	
6.9	Integration of DG Sets on Modbus over RS485 as per IO summary	
6.10	Integration of Energy Meters on Modbus over RS485 as per IO summary	
6.11	Integration of HT Meters on Modbus over RS485 as per IO summary	
6.12	Integration of Lift Sets on Modbus over RS485 as per IO summary	
6.13	Integration of UPS on Modbus over RS485 as per IO summary	
6.14	Integration of STP PLC on Modbus over RS485 as per IO summary	
6.15	Integration of WTP PLC on Modbus over RS485 as per IO summary	
6.16	Integration of FF PLC on Modbus over RS485 as per IO summary	
6.17	Integration of Hydro-pneumatic Pumps on Modbus over RS485 as per IO summary	
7	Supplying, installing, testing and commissioning of the following sensors / transducers/transmitters.	
7.1	Immersion Temperature Sensor along with Thermowell Measurement accuracy at -30...130 °C: ±0.95 K	Nos.
7.2	Ambient T+RH	Nos.
7.3	Electromagnetic type water flow meter	Nos
7.4	Differential Pressure Switch for Water	Nos
7.5	Differential Pressure Sensor Water	Nos
7.6	Bi-Level switch	Nos
7.7	Current relay	Nos
7.8	PH Analyzer	Nos
7.9	TDS Analyzer	Nos
7.10	Differential Pressure Switch for Air	Nos
7.11	IAQ Sensor	Nos
7.12	Duct temperature Sensor + RH Sensor	Nos
7.13	Duct Temperature Sensor	Nos
7.14	Duct Static Pressure Sensor	Nos

7.15	Room CO2 Sensor	Nos
7.16	Oil Flow Meter - 80 mm	Nos
7.17	Flameproof Level Switch	Nos
7.18	Flameproof Level Sensor	Nos
7.19	Voltage Transducer	Nos
7.2	Water Pressure Sensor	Nos
8	Supplying, laying, termination, testing and commissioning of Cables and Conduits	
8.1	Supplying, laying, termination, testing and commissioning of 2 Core x 1.0 sq mm PVC	Rmt
8.2	Supplying, laying, termination, testing and commissioning of 4 Core x 1.0 sq mm PVC	Rmt
8.3	Supplying, laying, termination, testing & commissioning of CAT 6 A S/FTP unarmoured	Rmt
8.4	Supplying and laying 25mm MS conduit on surface/recess, including cutting/filling chases, along with conduit accessories, etc., complete as required.	Rmt
8.5	GI Flexible conduit for termination in the DDC Panels	Rmt

ABOVE GIVEN ITEMS ARE MINIMUM INDICATIVE ONLY.

ANY ITEM REQUIRED FOR SUCCESSFUL BIDDER SHALL DESIGN THE ENTIRE SYSTEM AS PER ACTUAL SITE CONDITIONS &REQUIREMENT AND TAKE APPROVAL FROM ENGINEER IN CHARGE BEFORE PROCUREMENT & EXECUTION. I/O Summary is indicative only; the complete I/O summary will be provided by the contractor during the detailed design stage of the project, considering the site requirements, and will be approved by the engineer in charge. Any additional soft or hard integration will be added as per site requirements.

Master System Integration

Consolidation of a building's technical systems, subsystems and other available or required platforms into a cohesive and centralised platform with a single interface. This platform shall increase the utility and responsiveness of systems, improve asset monitoring, eliminate the need to track multiple interfaces, bolster control over resources, decrease energy demand, reduce staff training requirements, and cut costs.

The MSI shall be responsible for integrating and managing various complex systems or sub-systems into a single, cohesive, and functional system. The MSI shall integrate all critical systems in the facility, including building management systems, security systems, fire alarm and protection systems, HVAC, lighting control, NCS, IPBX, etc., to ensure centralised monitoring and control for the facility's automation. All MSI servers should be in (N+1) or (1+1) configuration—all the data and applications to be backed in local servers. The MSI shall also provide backup of all server data at an offsite location in case required for emergency conditions or disaster recovery for a minimum of 5 years.

The MSI shall work closely with the customer to understand their requirements and then develop a

detailed plan for integrating their various systems. This blueprint shall include selecting new hardware, validating existing hardware for compatibility and software components, designing the network infrastructure, and deploying the integrated systems. The MSI shall also provide ongoing support and maintenance services to ensure the continued performance and reliability of the integrated systems.

Prior to appointment the profile of the MSI has to be approved by the employer.

The following key aspects of the integrated system are listed below.

Reduce construction time and costs.

Improve patient outcomes and experience.

Centralised command centre for single window viewing and control.

Integrate all systems and sub-systems into one single platform.

Provide visualisations in the form of dashboards for various use cases and KPIs.

Optimise usage and consumption by applying the logic of custom KPIs, thereby controlling subsystems in an orderly manner.

Overview of entire portfolio and their performance monitoring and scheduled reports.

AI-based analytics for corrective, reactive, predictive, and preventive maintenance actions.

Optimise and sustainable operations for moving towards being energy-efficient and power-resilient through the following:

DE carbonization strategy

People centricity and societal impact

Resource-efficient operations

Energy-efficient operations

Power resiliency

Ensure healthcare cybersecurity and comply with standards.

Drive staff productivity and reduce operational costs.

Improve patient outcomes and experience.

Protect people and assets.

The MSI shall ensure the integration of technology, software, hardware, and other system components and shall be liable to deliver a complete comprehensive solution to the customer. The MSI shall therefore, to achieve the above, integrate with the following subsystems as a minimum:

- Building Digital Twin (3D) – BIM-based application)
- Building Management System (BMS), including all related systems integration, such as HVAC, HEPA Filters, IAQ, DG, Lift, UPS, Energy Meters, Chillers, MGPS, etc., as per approved I/O points.

- PHE and Water Management System
- Fire Detection and Alarm System (FDAS)
- Public Address System (PAS)
- Security Systems (CCTV & ACS)
- Lighting Management and Control System (LMS)
- Computerised maintenance management systems
- Nurse call system (NCS)
- Medical Gas Pipeline System (MGPS)
- IP-based telephony (IPBX)
- Solar Power Systems
- EV Charging System
- Parking Management System
- Queue Management System
- Integration of any Other system APIs as may be provided by the Hospital.

Some use case scenarios for the integration of various ELV systems by the MSI are

1. CASE 1- Integration of Access control door with elevators, and lighting and HVAC system of OTs in case of a Code Blue or emergency condition.

2. CASE 2- Fire Emergency - In case of any fire alarm detection, the floor plan popup with SOP shall be visible to the operator, which includes, but is not limited to affected floor's / locations detectors layout, nearby cameras live view on demand, AHU Running Status, fresh air damper status & hydrant line pressure status, nearby access control doors status with manual open and close command, on the same page of integrated BMS platform to minimize the emergency response time & quick decision making.

3. CASE 3- OT Environment Readiness - AQI Dashboard for OT and critical areas to ensure healthy indoor climates, CO2 measurement, VOC data to address offensive Odors, AHU Status, Fresh air damper status, positive pressure inside OT, Temperature & Humidity with emergency evacuation pre-defined path assigned cameras on a single dashboard for each OT. The operator shall check and confirm the complete scenario using individual login to ensure proper environmental conditions and safety clearance for operation.

Other required integrations will be provided by the MSI and decided by the engineer-in-charge during design approval.

The MSI coordinates the installation and commissioning of these systems, ensuring that they work together seamlessly to provide a secure and comfortable environment for the building's occupants. The solution shall be built on current technologies and shall comply with the latest cybersecurity laws and guidelines.

Resedential Blocks :-

ElV systems to be provided.

1. CCTV System.
2. Fire alarm and detection system (As per NBC 2026 and Fire recommendation)
3. Voice evacuation and Public address system. (As per NBC 2026 and fire recommendation)
4. IPTV
5. Data networking system (Including IT active and passive components)
6. IP Telephony

The technical specifications and general design philosophy of all ELV systems proposed for the Residential Blocks shall be consistent with those specified for the Medical Buildings. The Residential Blocks shall be equipped with the same standards of ELV infrastructure.

Each Residential Block shall be provided with an independent local control and monitoring facility for the respective ELV systems to enable day-to-day operation and management at the building level. In addition, all ELV systems installed within the Residential Blocks shall be integrated with the Integrated Command and Control Centre (ICCC)/Central Command Room through a centralized management platform. This integration shall facilitate centralized monitoring, control, alarm management, reporting, and system administration for all Residential Blocks from the ICCC.

The design, supply, installation, testing, commissioning, networking, software licensing, interfaces, communication infrastructure, and complete integration of all ELV systems with the ICCC/Central Command Room shall be deemed to be included within the Contractor's scope of work.

4.13. MEDICAL SERVICES:

THE EPC CONTRACTOR / SPECIALIZED AGENCY SHALL BE RESPONSIBLE FOR THE COMPLETE DESIGN, SUPPLY, INSTALLATION, TESTING, AND COMMISSIONING (SITC) OF THE FOLLOWING MEDICAL SERVICES:

GENERAL REQUIREMENTS — VALIDATION, SPARES, WARRANTY & CERTIFICATION Commissioning validation: all critical medical equipment (sterilisers, OGP, MGPS, OT air-handling, RO/water systems etc) shall be commissioned with documented Installation, Operational and Performance Qualification (IQ/OQ/PQ) protocols, executed jointly by the Contractor and the equipment OEM, and handed over as part of the O&M documentation.

Spares & consumables: the Contractor shall guarantee availability of spare parts and consumables for a minimum of 10 years from the date of handover, and shall furnish a recommended list of critical/insurance spares with pricing at the time of equipment submittals.

Warranty & maintenance: all equipment shall carry a minimum comprehensive warranty of **2 year from handover** (if not specified below); the Contractor shall separately provide a Comprehensive Annual Maintenance Plan (CAMP) for years 3–5 covering preventive maintenance, breakdown response, and consumables for consideration of the Engineer In Charge.

All quantities mentioned below are MINIMUM INDICATIVE and the final quantities will be derived as per the design and project requirements.

Certification Requirements: All patient-connected electrical and electronic medical equipment shall, as applicable, bear valid **CE Marking under the European Union Medical Devices Regulation (EU MDR 2017/745 or EU IVDR 2017/746)** issued through a **Notified Body designated by the European Commission**, and/or possess valid **US FDA clearance/approval** (510(k), De Novo, PMA or other applicable pathway). In addition, the Original Equipment Manufacturer (OEM) shall maintain a valid **ISO 13485:2016 (or latest revision)** Quality Management System certification issued by a **Certification Body accredited by a National Accreditation Body that is a signatory to the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA)** or an equivalent internationally recognized accreditation arrangement.

All certificates, approvals and declarations submitted shall be **current, valid and traceable** to the issuing authority through publicly accessible verification portals or official databases wherever such verification is available.

Only certifications issued by independent third-party conformity assessment bodies accredited by internationally recognized accreditation agencies shall be accepted. Certificates issued through self-certification, first-party declarations, certificates issued by the OEM or its subsidiaries, affiliates, distributors, dealers, or any entity having direct or indirect commercial interest with the OEM, or certificates issued by non-accredited or suspended certification bodies shall not be accepted.

Where an equivalent certification is proposed, the Contractor shall submit complete documentary evidence demonstrating that the proposed certification provides an equivalent or higher level of regulatory oversight, product safety, clinical evaluation and quality assurance. Acceptance of such equivalence shall be solely at the discretion of the Engineer-in-Charge, whose decision shall be final and binding.

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S.NO.	**SERVICES**	**Unit**
1.	**MAJOR OPERATION THEATER**	**5 NOS.**
2.	**MINOR OPERATION THEATER**	**3 NOS.**
3.	**OT INTEGRATION**	ALL OTs to be integrated with all demonstration rooms, lecture theatres, and conference rooms, etc. (Rooms likely to be used for demonstration purposes).
4.	**OXYGEN GENERATION PLANTS (OGP)**	
5.	**MEDICAL GAS PIPELINE SYSTEM (MGPS)**	
6.	**NURSE CALL SYSTEM**	**450 BEDS + 14 BEDS (PRE & POST OP)**
7.	**CURTAIN TRACK & I.V. HANGER SYSTEM**	**500 BEDS**
8.	**CENTRAL STERILE SUPPLY DEPARTMENT (CSSD)**	
9.	**THEATRE STERILE SUPPLY UNIT (TSSU)**	
10.	**LAUNDRY**	
11.	**KITCHEN**	
12.	**MORTUARY**	**36 BODIES**
13.	**PNEUMATIC WASTE & LAUNDRY COLLECTION SYSTEM**	
14.	**PTS**	
15.	**INTEGRATED STERILIZER WITH SHREDDER**	
16.	**QUEUE MANAGEMENT SYSTEM (QMS)**	
17.	**WALL GUARD & CORNER GUARD**	
18.	**BMW**	

DENTAL BLOCK		
S.NO.	**SERVICES**	**Unit**
1.	**MINOR OPERATION THEATER**	**2 NOS.**
2.	**MEDICAL GAS PIPELINE SYSTEM (MGPS)**	**190 CHAIRS**
3.	**CURTAIN TRACK & I.V. HANGER SYSTEM**	**190 CHAIRS**
4.	**CENTRAL STERILE SUPPLY DEPARTMENT (CSSD)**	
5.	**THEATRE STERILE SUPPLY UNIT (TSSU)**	
6.	**LAUNDRY**	
7.	**ISS (Integrated Sterilizer & Shredder)**	
8.	**QUEUE MANAGEMENT SYSTEM (QMS)**	
9.	**WALL GUARD & CORNER GUARD**	
10.	**BMW**	

MEDICAL HOSPITAL SERVICES (450 BEDS) BUILDING ARE MENTIONED BELOW:

Modular Operation Theatre (Major)			
s.no.	**Particulars**	**Qty**	**Unit**
	Supply & installation, Testing & Commissioning of Modular Operation Theatre – 5 Nos. as per following		
	MODULAR WALL SYSTEM		
1	**WALL PANEL**		
1.1	Supply, installation, testing and commissioning of a **flush-mounted Modular Operation Theatre wall panel system** fabricated from **minimum 12 mm thick homogeneous Solid Mineral Composite Sheet (SMS/SMC)**, factory finished with a non-porous, seamless, impact-resistant, scratch-resistant, stain-resistant and chemical-resistant surface suitable for hospital cleanroom applications. The panels shall be mounted on a corrosion-resistant aluminium/GI sub-frame using a **clamp-on, removable modular system** to permit maintenance of concealed services without damage to adjoining panels. All panel joints shall be **flush, airtight and sealed with hospital-grade antimicrobial silicone sealant** to prevent dust accumulation and microbial growth. The wall system shall be designed to accommodate and integrate all OT components including **hermetically sealed doors, vision panels, wall-integrated cabinets, X-ray viewing panel, writing board, medical gas terminal units, electrical outlets, data outlets, HVAC grilles, pressure relief dampers, medical equipment panels, control panels, pass boxes, pendants, utility panels and all concealed MEP services**. The complete wall system shall have smooth radiused junctions, concealed fixings, disinfectant-resistant finish, moisture resistance, dimensional stability, and shall not support fungal or bacterial growth. The wall panels shall be **Class B-s1,d0 or better** for reaction to fire in accordance with **EN 13501-1**, with low VOC emissions and suitable for repeated cleaning using hospital disinfectants. The complete wall panel system shall comply with **ISO 14644-4 & ISO 14644-5 (Cleanroom Design and Installation)**, **ASHRAE/ASHE Standard 170**, **NBCS 2026**, **EN 13501-1**, **ISO 22196** (where antimicrobial performance is claimed), **ISO 846** (Resistance to Microorganisms), and applicable **BIS standards**. The bidder shall provide all trims, corners, flashings, backing supports, sealants, cut-outs, reinforcements, fixing accessories, factory prefabrication, installation, testing and commissioning. Complete with testing, commissioning, O&M manuals and a **minimum 2-year comprehensive on-site warranty**, including replacement of defective panels, sealants, accessories and technical support during the warranty period.	As per design	Sq. Mtr.
1.2	Supply, installation, testing and commissioning of a **flush-mounted full-height Back-Lit Wall Panel** comprising a **fully customizable RGB LED backlighting system** integrated behind **one full-height Solid Mineral Composite (SMS/SMC) wall panel** of the Modular Operation Theatre, complete with high-efficiency dimmable LED modules, uniform light diffuser, aluminium housing, concealed drivers, control gear, power supply, wiring and all accessories. The	5	Nos.

Modular Operation Theatre (Major)			
	system shall provide **adjustable RGB colour selection, variable brightness (0–100%), programmable lighting scenes, colour temperature control (2700 K–6500 K), flicker-free illumination**, and shall be controllable through the **Surgeon Control Panel**, **Operating Room Integration (ORI) System**, and local touch controls. The panel shall be flush with the modular wall system, have **minimum IP54 protection**, low heat emission, energy-efficient LED modules with **minimum 50,000-hour service life (L70)**, and shall not affect the cleanroom integrity or laminar airflow. The system shall be fully compatible with the OT lighting controls, BMS (where specified) and hospital electrical system, with concealed wiring and maintenance access. The complete installation shall comply with **IEC 60598-1 & IEC 60598-2 (Luminaires)**, **IEC 62471 (Photobiological Safety of Lamps)**, **IEC 61347 (LED Control Gear)**, **IEC 60529 (IP Rating)**, **IEC 60601-1-2 (Electromagnetic Compatibility, where applicable)**, **EN 13501-1**, **ISO 14644-4 & ISO 14644-5**, **NBCS 2026**, and applicable **BIS standards**. Complete with factory commissioning, programming of lighting scenes, testing, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty** covering LED modules, drivers, controllers, software (where applicable), accessories, preventive maintenance, replacement of defective parts and technical support during the warranty period.		
1.3	Supply, installation, testing and commissioning of **flush-mounted Modular Graphic Glass Panel(s)** comprising **minimum 8 mm thick toughened safety glass** with high-resolution ceramic frit/digital printed graphics permanently fused onto the glass surface, integrated within the Modular Operation Theatre wall panel system. The glass shall be **non-porous, scratch-resistant, impact-resistant, stain-resistant, chemical-resistant and disinfectant-resistant**, with smooth polished edges and concealed fixing arrangement. The panel shall be flush with adjoining wall panels, sealed with **hospital-grade antimicrobial silicone sealant**, and shall not compromise the cleanroom integrity or pressure cascade. The graphics shall be fade-resistant, UV-stable, moisture-resistant and permanently bonded to withstand repeated hospital cleaning and disinfection without deterioration. The panel shall be compatible with the modular wall system and permit removal for maintenance of concealed services where required. The installation shall include all supports, fixing brackets, backing panels, trims and accessories. The system shall comply with **IS 2553 (Part 1) – Toughened Safety Glass**, **EN 12150-1 (Thermally Toughened Safety Glass)**, **ISO 14644-4 & ISO 14644-5 (Cleanroom Design and Installation)**, **ISO 22196** (where antimicrobial performance is claimed), **IEC 61340-5-1** (ESD control, where applicable), **NBCS 2026**, and applicable **BIS standards**. Complete with testing, commissioning, O&M manuals, and a **minimum 2-year comprehensive on-site warranty** covering the glass panel, graphics, sealants, fixing system, replacement of defective components and technical support during the warranty period.	As per design	Sq. Mtr.
2	**MODULAR CEILING PANELING SYSTEM**		
	Modular Stainless Steel Ceiling Panel System: Supply, installation, testing and commissioning of a **flush-mounted Modular Stainless Steel Ceiling Panel System** for the Modular Operation Theatre, comprising **minimum 1.0-1.2 mm thick**	As per design	Sq.Mtr.

Modular Operation Theatre (Major)			
	AISI 304 stainless steel panels with **No. 4 Scotch-Brite finish**, mounted on a corrosion-resistant aluminium/GI suspension framework with concealed fixing arrangement. The ceiling shall be fully modular, gasketed, and removable to facilitate maintenance of concealed services without disturbing adjoining panels. The system shall provide an **airtight, dust-free, non-porous, seamless, flush and disinfectant-resistant surface**, with all joints sealed using **hospital-grade antimicrobial silicone sealant** to maintain cleanroom integrity and pressure cascade. The ceiling system shall be designed and reinforced to accommodate and integrate **laminar airflow diffuser ceiling**, **HEPA filter housings**, **Double Dome Surgical Light**, **HD/4K Camera System**, **ceiling pendants**, **medical monitors**, **OT Integration equipment**, **LED general and peripheral lighting**, **access panels**, **fire detection devices**, **sprinklers (where applicable)**, **environmental sensors**, **pressure monitoring devices**, **HVAC terminals**, and all concealed MEP services. All necessary cut-outs, reinforcements, suspension members, brackets, load-bearing frames and supports shall be included within the scope. The ceiling shall be designed to support the suspended equipment loads as approved by the equipment manufacturers and structural consultant without vibration, deflection or loss of alignment, while maintaining the cleanroom envelope. The complete ceiling system shall comply with **ISO 14644-4 & ISO 14644-5 (Cleanroom Design and Installation)**, **ASHRAE/ASHE Standard 170**, **NBCS 2026**, **EN 13501-1** (Reaction to Fire), **IEC 60529** (where applicable), and applicable **BIS standards**. Complete with all suspension systems, access panels, trims, sealants, testing, commissioning, O&M manuals, and a **minimum 2-year comprehensive on-site warranty** covering ceiling panels, suspension system, sealants, supports, accessories, replacement of defective components and technical support during the warranty period		
3	**FLOORING WITH SELF-LEVELING**		
	Provide and lay minimum 4**.0 mm thick seamless, solvent-free, self-levelling, static-dissipative epoxy flooring system** comprising surface preparation, epoxy primer, conductive copper foil grounding grid, conductive epoxy intermediate coat and conductive epoxy wearing course, complete with **100 mm high integral coved skirting**, terminations, earthing and testing. The flooring shall be **non-porous, jointless, impervious, abrasion-resistant, chemical-resistant, stain-resistant, anti-microbial, low VOC, easy to clean and disinfect**, and resistant to blood, saline, iodine, alcohols, hydrogen peroxide, sodium hypochlorite and other hospital disinfectants. The finished floor shall have a **matt/satin slip-resistant surface (minimum R10)** suitable for movement of OT equipment. It shall achieve a **bond strength of not**	As per design	Sq.Mtr.

Modular Operation Theatre (Major)			
	less than 2.0 MPa, compressive strength of **not less than 70 MPa**, and **electrical resistance to ground and point-to-point resistance within 10^6–10^9 Ω** when tested in accordance with **IEC 61340-4-1**. The system shall comply with **IEC 61340-6-1 (Electrostatics – Healthcare Facilities), IEC 61340-5-1, ASTM F150, ASTM C722, ISO 14644 (where applicable), and NFPA 99** requirements for healthcare facilities. Installation shall be carried out by the flooring manufacturer's approved applicator strictly in accordance with the manufacturer's recommendations, and the contractor shall submit the manufacturer's product data, test certificates, electrical conductivity test reports, adhesion test results, and provide a minimum 10-year warranty against delamination, loss of conductivity, and material defects.		
4	**LAMINAR AIR FLOW SYSTEM**		
	Supply, installation, testing and commissioning of a **Plenum Laminar Airflow Ceiling System** comprising a factory-fabricated **2.0 mm thick extruded aluminium plenum** of minimum size **2400 × 2400 mm**, complete with **minimum six (06) H14 HEPA filters** having filtration efficiency **≥99.995% at MPPS**, individually tested as per **EN 1822**, and perforated aluminium diffuser panels to provide **uniform unidirectional (laminar) airflow** over the operating zone with an average face velocity of **0.25–0.35 m/s**, suitable for achieving **ISO Class 5** cleanliness. The system shall include airtight filter housings, gel-seal/knife-edge filter mounting, balancing arrangement, access panels, supports, suspension framework, sealing, and all accessories. The OT Contractor shall supply and install the complete laminar airflow ceiling assembly, while the AHU and external supply/return ducting shall be in the HVAC contractor's scope. The system shall be compatible with the modular ceiling, surgical lights, pendants, and other suspended equipment, and shall be validated through TAB, HEPA integrity (PAO/DOP) testing, air velocity measurement, airflow visualisation, particle count, recovery test, **and room pressure validation**. The system shall comply with **ISO 14644-1, 3, 4 & 5**, **EN 1822**, **ASHRAE/ASHE Standard 170**, **NABH OT Air Conditioning Guidelines (latest edition)**, **NBCS 2026** , and applicable **BIS standards**. Complete with testing, commissioning, validation reports, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	5	Nos.
5	**HERMETICALLY SEALED DOORS (two doors per OT)**		
5.1	Provide, install, test and commission a **single or telescopic hermetically sealed automatic sliding door** complete with door leaf, frame, drive unit, controller, safety sensors, vision panel, accessories and all associated hardware. The door shall be designed to maintain the positive/negative pressure differential of the operating theatre by providing **airtight sealing on all four sides** through continuous EPDM/silicone compression gaskets and an automatic bottom sealing mechanism, with **air leakage not exceeding Class 4 (highest class) as per EN 12207**. The door leaf shall comprise a minimum **50–60 mm thick insulated core** faced with **1.0 mm thick SS 304 stainless steel (No.4 satin finish), having smooth flush surfaces, radiused edges,** and concealed joints for infection control. The frame shall be heavy-duty anodised aluminium or SS 304 with flush installation. The door shall be operated by a **24 V DC brushless motor** with a microprocessor-based controller, capable of manual override during	4	Nos.

Modular Operation Theatre (Major)			
	power failure, and shall comply with **EN 16005** for power-operated pedestrian door safety. Operation shall be by **touchless sensor, elbow switch and foot switch**, with adjustable opening/closing speed, obstacle detection, automatic reversal, soft start/stop and self-closing functions. The system shall include a **double-glazed flush vision panel** of minimum **300 × 300 mm**, stainless steel recessed handles, emergency release, battery backup for a minimum 100 operations, and noise level not exceeding **60 dB(A)** during operation. The complete door assembly shall be easy to clean, corrosion-resistant, anti-bacterial, resistant to hospital disinfectants, and suitable for ISO 14644 cleanroom applications. Where required for Hybrid OT or imaging rooms, the door shall incorporate **lead lining of specified lead equivalent** without affecting hermetic performance. The complete system shall be supplied by the original manufacturer, installed by authorised personnel, tested for airtightness, smooth operation and safety, and shall carry a **minimum 2-year comprehensive warranty**. The system shall comply with **EN 16005, EN 12207, ISO 14644, IEC 60364 (or equivalent electrical installation requirements), and applicable NABH/NMC/HTM healthcare guidance**. (1800 X 2100) mm.		
5.2	Provide, install, test and commission a **single or telescopic hermetically sealed automatic sliding door** complete with door leaf, frame, drive unit, controller, safety sensors, vision panel, accessories and all associated hardware. The door shall be designed to maintain the positive/negative pressure differential of the operating theatre by providing **airtight sealing on all four sides** through continuous EPDM/silicone compression gaskets and an automatic bottom sealing mechanism, with **air leakage not exceeding Class 4 (highest class) as per EN 12207**. The door leaf shall comprise a minimum **50–60 mm thick insulated core** faced with **1.0 mm thick SS 304 stainless steel (No.4 satin finish), having smooth flush surfaces, radiused edges,** and concealed joints for infection control. The frame shall be heavy-duty anodised aluminium or SS 304 with flush installation. The door shall be operated by a **24 V DC brushless motor** with a microprocessor-based controller, capable of manual override during power failure, and shall comply with **EN 16005** for power-operated pedestrian door safety. Operation shall be by **touchless sensor, elbow switch and foot switch**, with adjustable opening/closing speed, obstacle detection, automatic reversal, soft start/stop and self-closing functions. The system shall include a **double-glazed flush vision panel** of minimum **300 × 300 mm**, stainless steel recessed handles, emergency release, battery backup for a minimum 100 operations, and noise level not exceeding **60 dB(A)** during operation. The complete door assembly shall be easy to clean, corrosion-resistant, anti-bacterial, resistant to hospital disinfectants, and suitable for ISO 14644 cleanroom applications. Where required for Hybrid OT or imaging rooms, the door shall incorporate **lead lining of specified lead equivalent** without affecting hermetic performance. The complete system shall be supplied by the original manufacturer, installed by authorised personnel, tested for airtightness, smooth operation and safety, and shall carry a **minimum 2-year comprehensive warranty**. The system shall comply with **EN 16005, EN 12207, ISO 14644, IEC 60364 (or equivalent electrical installation requirements), and**	6	Nos.

Modular Operation Theatre (Major)			
	applicable NABH/NMC/HTM healthcare guidance. (1500 X 2100) mm.		
6	**SURGEON CONTROL PANEL WITH TOUCH SCREEN 22 INCH or more**		
	Supply, installation, testing and commissioning of an industrial-grade, fanless, flush-mounted Digital Surgeon Control Panel (DSCP) for integrated Operating Theatres, complete with all hardware, software, communication interfaces, accessories, cabling and licences, suitable for continuous 24×7 operation in sterile environments. The panel shall provide centralized monitoring, control and integration of operating theatre environmental conditions, medical services, lighting, HVAC, medical gas alarms, electrical systems and hospital automation through a medical-grade capacitive multi-touch display, and shall be fully interoperable with the Modular OT, HVAC, Medical Gas Pipeline System (MGPS), Building Management System (BMS), Hospital Information System (HIS) and OT Integration System. **Minimum Technical Specifications:** • Industrial-grade fanless Panel PC with Intel x86-64 Quad-Core processor (Intel Celeron N5105/N6211, Intel Core i3 Industrial or higher), minimum 8 GB DDR4 RAM, 128 GB industrial SSD, TPM 2.0, watchdog timer and Gigabit Ethernet. • Minimum 22-inch Full HD (1920 × 1080) TFT LCD, LED backlit, projected capacitive multi-touch display operable with surgical gloves, anti-glare toughened glass, minimum IP65 front protection and flush-mounted hygienic construction. • Centralized control of OT ceiling lights including ON/OFF, intensity dimming, colour temperature adjustment (where applicable), endoscopy mode, ambient mode and preset scene selection. • Digital real-time clock with stopwatch, elapsed surgery timer, countdown timer and NTP synchronization. • Continuous monitoring and display of room temperature, relative humidity, room differential pressure, HVAC operating status, filter differential pressure, supply/return air parameters and alarm conditions. • Adjustment of HVAC temperature and humidity set points through BACnet/IP, BACnet MS/TP, Modbus TCP/RTU and/or 0–10 V analogue interface where integrated. • Compatible with HVAC systems designed to maintain ISO 14644-1 cleanliness classification, minimum 20 ACH, minimum +2.5 Pa positive pressure, temperature 21–24°C and relative humidity 40–60%, in accordance	5	Nos.

Modular Operation Theatre (Major)			
	with NABH OT Air Conditioning Guidelines and ASHRAE/ASHE 170. • Continuous monitoring of pre-filter, fine filter and HEPA filter differential pressure with programmable alarm limits. • Interface for room temperature, humidity, differential pressure and filter pressure sensors. • Integration with Medical Gas Alarm System for Oxygen, Medical Air, Surgical Air, Nitrous Oxide, Carbon Dioxide, Vacuum and AGSS, including High, Low, Fault and Communication alarms with audible and visual indication. • Integration with UPS/IPS and Line Isolation Monitor (LIM) for mains failure, battery operation, transformer overload, earth leakage and common alarm status. • Control of OT door locking/interlocking, electrochromic privacy glass or motorized blinds, and floor LED lighting including ON/OFF, dimming and RGB/RGBW colour control. • Integration with BMS, HIS, PACS, Nurse Call and OT Integration System through open communication protocols including BACnet/IP, Modbus TCP/IP, OPC UA and REST API (where supported). • User interface with password-protected access, role-based authentication, alarm acknowledgement, trend graphs, event history, audit trail and system diagnostics. • Secure communications with encrypted data transfer, secure boot, firmware protection and cybersecurity features compliant with IEC 62443 principles. • Complete with flush mounting box, industrial power supply, communication modules, software licences, mounting accessories, cables, configuration software, FAT, SAT, operator training and as-built documentation. • The system shall comply with IEC 60601-1, IEC 60601-1-2, IEC 60601-1-6, IEC 62366-1, IEC 62304 (where applicable), IEC 62443, ISO 14644-1, ISO 7396-1, ASHRAE/ASHE 170, NABH OT Air Conditioning Guidelines (latest edition) and NBCS 2026, as applicable.		
7	**X-RAY VIEW SCREEN**		

Modular Operation Theatre (Major)			
	Twin Plate X-Ray Viewing Screen: Supply, installation, testing and commissioning of a **wall-mounted Twin Plate LED X-ray Viewing Screen** suitable for viewing conventional radiographic films. The unit shall have a **uniform flicker-free LED backlight** with adjustable brightness, minimum **10,000 cd/m² luminance**, uniform illumination (≥90%), and **CRI ≥90**. The housing shall be fabricated from **powder-coated extruded aluminium** with an antimicrobial, disinfectant-resistant finish and shall be **flush-mounted** to prevent dust accumulation. The unit shall incorporate **scratch-free spring-loaded film retaining clips with rollers**, electronic dimming controls, energy-efficient LED light source with **minimum 50,000-hour service life**, and low power consumption. Overall size shall be approximately **880 × 500 × 30 mm** (or manufacturer's standard equivalent). The equipment shall comply with applicable **IEC 60601-1, IEC 60601-1-2**, relevant **BIS standards**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	5	Nos.
8	**WALL INTEGRATED WRITING WHITE BOARD**		
	Wall-Integrated Writing Board: Supply, installation, testing and commissioning of a **wall-integrated magnetic writing board** for modular operation theatres, flush-mounted with the modular wall panel to provide a seamless hygienic surface. The writing surface shall be **tempered safety glass (minimum 4–6 mm thick) or vitreous enamel steel (ceramic-coated steel)**, white in colour, non-porous, scratch-resistant, stain-resistant and suitable for use with dry-erase markers. The board shall have magnetic properties, be sealed with a continuous **medical-grade silicone gasket** to prevent dust ingress, and be resistant to routine hospital disinfectants. The board size shall be approximately **840 mm × 640 mm** (or manufacturer's nearest standard equivalent). The assembly shall comply with **NBCS 2026**, **ISO 14644-4 & ISO 14644-5**, **NABH Guidelines for Air Conditioning in Operation Theatres (latest edition)**, and **IS 2553 (Part 1)** or **EN 12150** for tempered safety glass, complete with all mounting accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	5	Nos.
9	**WALL INTEGRATED STORAGE UNIT**		
	Wall Integrated Storage Unit: Supply, installation, testing and commissioning of a **wall-integrated storage cabinet** for modular operation theatres, fully **flush-mounted** with the modular wall panel system to provide a seamless hygienic surface. The cabinet shall be fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with **Scotch-Brite internal finish**, and shall be provided with **minimum four adjustable SS304 shelves** capable of supporting **minimum 40 kg UDL per shelf**. Overall dimensions shall be approximately **1000 mm (W) × 2100 mm (H) × 450 mm (D)**. The cabinet shall be fitted with **toughened safety glass hinged doors** conforming to **IS 2553 (Part 1) or EN 12150**, mounted in **powder-coated stainless steel frames** matching the modular OT wall finish, with concealed hinges, flush handles, magnetic gasket and lockable hardware. The complete assembly shall be **airtight, dust-proof, easy to clean, resistant to hospital disinfectants**, and fully compatible with the modular OT wall and ceiling system to maintain the integrity of the cleanroom enclosure.	5	Nos.

Modular Operation Theatre (Major)			
	The unit shall comply with **ISO 14644-4 & ISO 14644-5**, **ASHRAE/ASHE Standard 170**, **NABH Guidelines for Air Conditioning in Operation Theatres (latest edition)**, **NBCS 2026** , and applicable **BIS standards**, complete with all accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.		
10	**PRESSURE RELIEF DAMPERS**		
	Pressure Relief Dampers (PRD) / Pressure Stabilization Dampers (PSD) / Overflow Ports: Supply, installation, testing and commissioning of factory-fabricated **Pressure Relief Dampers (PRD), Pressure Stabilization Dampers (PSD) and/or Overflow Ports**, complete with mounting frames, airtight seals, balancing provisions, supports and all accessories, for maintaining the specified room pressure differentials and pressure cascade in hospital cleanrooms and operation theatres. The units shall be gravity-operated, counterbalanced, or motorised as specified, fabricated from minimum SS304 or powder-coated galvanised steel (minimum 1.2 mm thick) with a corrosion-resistant finish, stainless steel fasteners, airtight gaskets, and field-adjustable opening pressure (typically **2.5–20 Pa**). The units shall provide **EN 1751 Class 3 or better** leakage performance, smooth low-noise operation, acoustic attenuation where applicable, compatibility with room pressure monitoring systems and BMS. They shall be complete with access panels, balancing devices and airtight installation. Performance shall be verified during **Testing, Adjusting & Balancing (TAB)** and room pressure validation. The system shall comply with **ISO 14644-1 & 3, ASHRAE/ASHE 170, NABH Guidelines (latest edition), NBCS 2026, EN 1751, SMACNA Standards, and ASHRAE 111 or AABC TAB Standards**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos.
11	**PERIPHERAL LIGHT**		
	Supply, installation, testing and commissioning of **recess-mounted, bottom-opening LED peripheral luminaires** for Modular Operation Theatres, providing uniform, shadow-free illumination and flush integration with the modular ceiling system. The luminaire shall have a **powder-coated CRCA or aluminium housing**, **tempered safety glass or high-impact opal diffuser**, **minimum IP65 from the room side (IP66 preferred)**, antimicrobial gasket, maintenance-friendly bottom-opening arrangement, **CRI ≥90**, **tunable correlated colour temperature (CCT) from 3500 K to 6500 K**, **luminaire efficacy ≥100 lm/W**, flicker-free electronic driver, and **LED life ≥50,000 hours (L70)**. The luminaire shall support **ON/OFF control, continuous dimming (0–100%) and tunable CCT control through the Surgeon Control Panel**, with provision for local override where specified. The luminaire shall comply with **IS 10322 (Part 5/Section 1), IS 16101, IS 16102 (Part 1 & Part 2), IEC 60598-1, IEC 60598-2-2, IEC 62031, IEC 61347 and IEC 62471**, complete with all accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	40	Nos.
12	**AMBIENT FLOOR LEVEL LED LIGHTING SYSTEM RGB**		

Modular Operation Theatre (Major)			
	Supply, installation, testing and commissioning of a **continuous recessed LED floor lighting system** integrated with the modular wall panel system at the wall-to-floor interface for **indirect ambient lighting, night-time orientation and walkway illumination** in each Modular Operation Theatre. The luminaire shall comprise a **recess-mounted extruded aluminium profile** with opal polycarbonate diffuser, **minimum IP65 protection**, **CRI ≥90**, **tunable CCT (3000 K–6500 K)**, **luminaire efficacy ≥100 lm/W**, flicker-free electronic driver, and **LED life ≥50,000 hours (L70)**. The system shall support **ON/OFF control, continuous dimming (0–100%) and tunable CCT control through the Surgeon Control Panel**, with provision for local override where specified. The lighting shall be mounted flush with the modular wall panel at the interface with the vinyl coved flooring, be resistant to routine hospital disinfectants, and provide uniform glare-free illumination without exposed fixings. The equipment shall comply with **IS 10322 (Part 5/Section 1), IS 16101, IS 16102 (Part 1 & Part 2), IEC 60598-1, IEC 60598-2-1, IEC 62031, IEC 61347, IEC 62471 and EN 12464-1**, and shall be designed in accordance with the recommendations of **HTM 03-01** for healthcare facilities, complete with all accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	sq.m
13	**PENDANTS FOR ANAESTHESIA AND SURGEON SIDE**		
13.1	**ANESTHETIST'S SINGLE ARM PENDANT**		
	Supply, installation, testing and commissioning of a **ceiling-mounted motorized single-arm anaesthesia pendant** comprising **double articulated arms** providing a **minimum horizontal reach of 1000 mm**, **minimum 330° rotation** at each arm joint with mechanical rotation stops, and **motorized vertical travel of not less than 500 mm** with programmable height adjustment and parking position. The pendant shall incorporate **electromagnetic braking**, anti-drift mechanism, anti-collision protection, concealed cable and medical gas routing, maintenance-free bearings and smooth vibration-free movement. The service head shall be manufactured from **anodized aluminium extrusion** with segregated compartments for medical gases, electrical services and communication cables, having smooth rounded edges and easy-to-clean surfaces. The pendant shall have a **minimum safe working load of 120 kg**, with **minimum two height-adjustable SS304 equipment shelves (minimum 80 kg load capacity per shelf)**, **one height-adjustable IV pole with four hooks (minimum 25 kg load capacity)**, **one monitor mounting arm/plate (VESA 75/100, minimum 15 kg capacity)**, **integrated equipment mounting rails conforming to DIN EN ISO 19054**, **minimum four medical gas terminal units**, **minimum eight 5/15 A switched hospital-grade electrical sockets**, **minimum two RJ45 Cat-6 data outlets**, **minimum one equipotential earthing terminal**, and provision for nurse call, telephone, video and additional communication outlets as specified. The pendant shall permit **360° equipment positioning without cable twisting**, include mechanical end stops, overload protection, service identification labels, concealed maintenance access panels, and shall be designed for future expansion without structural modification. Ceiling anchorage shall be designed and certified for the applied static and dynamic loads with manufacturer-approved structural calculations. The complete assembly	5	Nos.

Modular Operation Theatre (Major)			
	shall have **minimum IP20 protection**, comply with **ISO 11197 (Medical Supply Units), ISO 7396-1 (Medical Gas Pipeline Systems), DIN EN ISO 19054 (Accessory Rails), IEC 60601-1, IEC 60601-1-2, IEC 62366-1**, and applicable **BIS standards**. It shall be supplied complete with all medical gas terminal units, electrical outlets, accessories, testing, commissioning, load testing, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**.		
13.2	**SURGEON'S DOUBLE ARM PENDANT**		
	Supply, installation, testing and commissioning of a **ceiling-mounted motorised double-arm surgical pendant** comprising **double articulated arms** providing a **minimum horizontal reach of 1800 mm**, **minimum 330° rotation** at each arm joint with mechanical rotation stops, and **motorised vertical travel of not less than 500 mm** with programmable height adjustment and parking position. The pendant shall incorporate **electromagnetic braking**, an anti-drift mechanism, anti-collision protection, overload protection, maintenance-free bearings, concealed cabling and medical gas routing, and smooth, vibration-free movement. The service head shall be manufactured from **high-strength anodised aluminium extrusion with segregated compartments for medical gases, electrical power, and communication services; smooth hygienic surfaces with rounded corners; concealed maintenance access;** and colour-coded service identification. The pendant shall have a **minimum safe working load of 220 kg**, with **minimum four height-adjustable SS304 equipment shelves** (minimum **80 kg UDL per shelf**), **one height-adjustable SS304 IV pole with four hooks (minimum 25 kg capacity)**, **minimum two articulated monitor mounting arms/plates (VESA 75/100, minimum 15 kg capacity each)**, **integrated accessory rails conforming to DIN EN ISO 19054** on all sides, equipment mounting channels, cable management system, and provision for future accessories without structural modification. The service head shall be provided with a **minimum six medical gas terminal units**, **minimum twelve 5/15 A hospital-grade switched electrical sockets**, **minimum four RJ45 Cat-6 data outlets**, **minimum one fibre-optic/video outlet**, **minimum two equipotential earthing terminals**, and provisions for nurse call, USB, HDMI/video and additional communication outlets as specified. The pendant shall permit unrestricted positioning of equipment without cable twisting, maintain positional stability under full load without drift, and be designed for easy cleaning and infection control. Ceiling anchorage, suspension assembly and structural supports shall be designed, tested and certified for the applied static and dynamic loads with manufacturer-approved structural calculations. The complete assembly shall have **minimum IP20 protection**, comply with **ISO 11197 (Medical Supply Units), ISO 7396-1 (Medical Gas Pipeline Systems), DIN EN ISO 19054 (Accessory Rails), IEC 60601-1, IEC 60601-1-2, IEC 62366-1**, and applicable **BIS standards**, and shall be supplied complete with all accessories, ceiling mounting system, structural supports, load testing, testing, commissioning, operator training, O&M manuals, spare fuses/connectors and a **minimum 2-year comprehensive warranty**.	5	Nos.
14	**SURGICAL SCRUB STATION**		

Modular Operation Theatre (Major)			
	Two-Bay Surgical Scrub Sink: Supply, installation, testing and commissioning of a **wall-mounted, seamless two-bay surgical scrub sink** for Modular Operation Theatre, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with satin finish, radiused internal corners, coved edges and integral backsplash for infection control. Each bay shall be ergonomically designed for surgical hand scrubbing and provided with **a sensor-operated (touch-free) hot and cold water mixing faucet with a thermostatic mixing valve, adjustable temperature control (35–45°C), anti-scald protection, and a** laminar-flow outlet. The unit shall incorporate an **inbuilt point-of-use Reverse Osmosis (RO) water purification system** with **minimum 50 LPH capacity**, sediment and activated carbon pre-filters, RO membrane, UV or equivalent final disinfection, **minimum 10-litre SS304 storage tank**, low-pressure protection, auto-flush, auto cut-off, TDS indicator and filter replacement indication, supplying RO water to the scrub outlets. The scrub sink shall further include **a sensor-operated soap dispenser, sensor-operated antiseptic solution dispenser, sensor-operated hand sanitiser dispenser, programmable digital scrub timer (0–10 minutes), integrated LED procedure clock, removable SS drain strainers, concealed bottle trap, wall-mounted plumbing, and splash guards between users and at both ends**. The complete assembly shall have smooth crevice-free hygienic surfaces, be resistant to routine hospital disinfectants, and be supplied complete with all accessories, mounting hardware, plumbing and electrical connections, testing and commissioning. The complete system shall comply with **HTM 64 – Sanitary Assemblies, ISO 14644-4 & ISO 14644-5, NABH Guidelines for Air Conditioning in Operation Theatres (latest edition), IS 10500 (for treated water quality), IEC 60335-2-15/IEC 60335-1 (where applicable to the RO unit), and applicable BIS plumbing and electrical standards**, complete with a **minimum 2-year comprehensive warranty**.	5	Nos.
15	**HATCH BOX (One each for clean and dirty)**		
	Supply, installation, testing and commissioning of a **wall-integrated double-door interlocking hatch box (pass box)** for transfer of waste, used instruments and contaminated materials from the Operation Theatre to the dirty utility/linen area without compromising the cleanroom pressure cascade. The pass box shall be **flush-mounted** with the modular wall system and fabricated from **minimum 1.2 mm thick AISI SS304** with satin finish, radiused internal corners and crevice-free hygienic construction. The internal clear opening shall be **minimum 600 mm × 600 mm × 600 mm** (or as specified). The unit shall be provided with **double interlocked doors** fitted with **toughened safety glass viewing windows**, silicone gaskets, flush handles and electromagnetic/mechanical interlocking to prevent simultaneous opening of both doors. The chamber shall incorporate **UV-C germicidal irradiation (254 nm)** with automatic operation only when both doors are closed, automatic shut-off upon opening of either	10	Nos.

Modular Operation Theatre (Major)			
	door, door status indicators, operating cycle timer and safety interlocks. The unit shall have smooth disinfectant-resistant surfaces, removable SS304 base tray, concealed hinges, airtight sealing and provisions for cleaning and maintenance. The pass box shall maintain the integrity of the modular OT enclosure and pressure cascade and shall be supplied complete with all accessories, testing, commissioning and operator training. The equipment shall comply with **ISO 14644-4 & ISO 14644-5**, **ASHRAE/ASHE Standard 170**, **NABH Guidelines for Air Conditioning in Operation Theatres (latest edition)**, **IEC 61010-1** (where electrically powered), **IEC 62471** (photobiological safety of UV source), **IS 2553 (Part 1)** for toughened safety glass, and applicable **BIS standards**, complete with a **minimum 2-year comprehensive warranty**.		
16	**AUTOMATED DISINFECTION SYSTEM**		
	Automated Biomedical Waste Disinfection System: Provide, install, test and commission a **fully automatic, enclosed biomedical waste disinfection system** for installation within the Modular Operating Theatre (MOT) for on-site treatment of infectious biomedical waste by **integrated shredding and saturated steam sterilisation within the same pressure vessel**, without intermediate manual handling. The system shall have a **minimum effective chamber capacity of 25 litres**, to ensure operational continuity and redundancy. The equipment shall achieve a **validated Sterility Assurance Level (SAL) of 10^{-6}** and incorporate a PLC-based automatic control system with automatic recording of cycle parameters (time, temperature, and pressure), safety interlocks, batch data logging, and alarms. The treatment chamber shall be manufactured from **SS 304 or SS 316L stainless steel** and shall be suitable for continuous hospital operation. The system shall comply with the **Biomedical Waste Management Rules, 2016 (as amended), ISO 17665 (Steam Sterilisation), ISO 11138 (Biological Indicators), and ISO 14937 (General Requirements for Sterilisation Processes)**, and shall bear a **valid European CE Marking issued by a Notified Body** under the applicable EU legislation. The complete system shall be supplied, installed, tested, commissioned and warranted by the Original Equipment Manufacturer (OEM) or its authorised representative.	2	Nos.
17	**AIR RETURN GRIL SYSTEM**		
	Supply, installation, testing and commissioning of **flush-mounted return air grille(s)** for Modular Operation Theatre, complete with mounting frame, opposed blade volume control damper (OBD), airtight gaskets, supports and all accessories. The grille shall be fabricated from **minimum 1.2 mm thick extruded aluminium alloy** with **minimum 60–80 micron antimicrobial polyester powder-coated finish**, concealed fixing arrangement and **removable hinged or clip-in core** for easy cleaning and maintenance. The grille shall have **aerodynamically profiled fixed blades inclined at 35°–45°**, rounded edges, smooth crevice-free surfaces, and shall be provided with an **opposed blade balancing damper**, airtight perimeter sealing, and **G3/G4 washable pre-filter** where indicated in the approved HVAC design. The nominal face size shall be approximately **450 mm × 450 mm** (or as shown on approved drawings), with a **maximum face velocity of 2.0 m/s**, low pressure drop, and **noise level not exceeding NC-25** under design operating conditions. The grille shall be suitable	As per design	Nos.

Modular Operation Theatre (Major)			
	for disinfectant cleaning, corrosion resistant, compatible with the modular wall system, and shall maintain the integrity of the cleanroom enclosure and room pressure cascade. The complete assembly shall comply with **IS 655 (Metal Air Grilles, Registers and Diffusers), SMACNA HVAC Duct Construction Standards, ISO 14644-4 & ISO 14644-5, ASHRAE/ASHE Standard 170, ASHRAE Standard 111 (Testing, Adjusting & Balancing), NBCS 2026**, and applicable **BIS standards**, complete with testing, air balancing, commissioning and a **minimum 2-year comprehensive warranty**.		
17.1	**INTERNAL HVAC DUCTING & EXHAUST SYSTEM**		
	Supply, fabrication, installation, testing and commissioning of the **complete internal supply, return and exhaust air ducting system** within the Modular Operation Theatre, including ductwork, fittings, bends, reducers, turning vanes, plenums, flexible connectors, balancing dampers, access doors, supports, hangers, sealing, insulation and all accessories. All internal ductwork shall be fabricated from **Aluminium Alloy 3103-H14 or equivalent**, with sheet thickness conforming to **SMACNA HVAC Duct Construction Standards** based on duct dimensions and pressure class. Duct joints shall be airtight with sealed flanged connections achieving **minimum SMACNA Seal Class A** and leakage performance in accordance with the **SMACNA HVAC Air Duct Leakage Test Manual**. Supply air ducts shall be externally insulated with **minimum 25 mm thick closed-cell elastomeric insulation (Class O/Class 1 fire performance)** complete with vapour barrier. The ductwork shall incorporate airtight access doors, opposed blade balancing dampers, flexible connectors, vibration isolation at equipment connections, and terminal plenums as required. All internal surfaces shall be smooth, corrosion-resistant, non-shedding, easy to clean and suitable for hospital cleanroom applications. The complete ducting and exhaust system shall be designed to maintain the specified airflow pattern, air changes and pressure cascade within the operation theatre, and its performance shall be verified during **Testing, Adjusting & Balancing (TAB)** and cleanroom validation. The installation shall comply with **SMACNA HVAC Duct Construction Standards**, **SMACNA HVAC Air Duct Leakage Test Manual**, **ISO 14644-4 & ISO 14644-5**, **ASHRAE/ASHE Standard 170**, **ASHRAE Standard 111**, **NBCS 2026**, and applicable **BIS standards**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per Design	.
18	**MEDICAL GAS LINE INSTALLATION (MGPS WORK INSIDE OT)**		
	Supply, installation, testing and commissioning of the **complete Medical Gas Pipeline System (MGPS) within the Modular Operation Theatre**, including **seamless, degreased, deoxidized high-phosphorus (DHP) copper pipes conforming to EN 13348/ISO 7396-1 and IS 2501 or equivalent**, suitable for medical gas service, with wall thickness as per the applicable standard and operating pressure. All joints shall be **silver brazed (minimum 45% silver brazing alloy) under continuous nitrogen purging** by qualified personnel in accordance with **ASME Section IX**, ensuring oxide-free internal joints. The scope shall include gas-specific terminal units, zone valve box connections, pressure gauges, isolation valves, flexible hose assemblies to pendants, pipe supports, sleeves,	5	Nos.

Modular Operation Theatre (Major)			
	identification labels, colour coding, alarm interfaces and all accessories required for a complete installation. The system shall provide, as a minimum, **Oxygen (O_2) – 2 outlets, Medical Air (MA4) – 2 outlets, Surgical Air (SA7) – 1 outlet, Nitrous Oxide (N_2O) – 1 outlet, Vacuum (VAC) – 2 outlets and Anaesthetic Gas Scavenging System (AGSS) – 2 outlets** on the anaesthesia and surgical pendants or as indicated in the approved OT layout. Medical gas terminal units shall be **gas-specific, non-interchangeable, self-sealing and maintenance-friendly**. All concealed pipework shall be securely supported within the modular wall and ceiling system without compromising the cleanroom integrity or pressure cascade. The complete installation shall undergo **100% strength testing, leak testing, cross-connection testing, pipeline purity testing, flow testing and terminal functional testing** before commissioning. The MGPS installation shall comply with **ISO 7396-1, EN 13348, HTM 02-01, NFPA 99 (where applicable), IS 2501, ASME Section IX** and applicable **BIS standards**, complete with testing, validation, commissioning, as-built drawings, operator training and a **minimum 2-year comprehensive warranty**.		
19	**ELECTRICAL WORK + DISTRIBUTION BOX INSIDE OT**		
	Supply, installation, testing and commissioning of the **complete internal electrical installation** for the Modular Operation Theatre, including **two (02) flush-mounted IP54 minimum Distribution Boards (Normal Power and Essential/UPS Power)**, copper busbars, MCBs/MCCBs/RCBOs, Type II Surge Protection Devices (SPD), wiring, conduiting, junction boxes, modular switches, hospital-grade socket outlets, equipment isolators, earthing, equipotential bonding, lighting and power circuits, control wiring, cable trays, supports and all accessories required for a complete installation. The scope shall include all internal wiring from the OT Distribution Boards to lighting fixtures, surgical and anaesthesia pendants, surgeon control panel, medical equipment outlets, scrub station, HVAC controls, nurse call system, MGPS alarm panels, motorized doors and other OT equipment, complete with **1100 V grade FRLSH copper cables**, heavy-duty **FRLS LSZH conduits/trunking**, segregated routing for power and ELV services, and a **dedicated clean earth and supplementary equipotential bonding network** for all exposed conductive parts. The OT electrical installation shall be designed for **230/415 V, 50 Hz AC supply**, with provision for connection to the **Medical IT (IPS) System**, **line isolation monitor (LIM)**, insulation fault monitoring, **30 mA RCBO protection** for socket circuits, minimum **20% spare outgoing ways** in each Distribution Board, minimum **25% spare capacity** for future expansion, and clearly identified circuits and distribution schedules. All components shall be suitable for continuous operation in hospital cleanroom environments with corrosion-resistant finishes and shall comply with **IEC 60364-7-710 (Medical Locations), IEC 61557-8 (Insulation Monitoring Devices), IEC 61439-1 & IEC 61439-2 (Low-Voltage Switchgear and Controlgear Assemblies), IEC 60204-1 (Electrical Equipment of Machines), IEC 60601-1 (Medical Electrical Equipment – Safety), IEC 60601-1-2 (Electromagnetic Compatibility), IEC 61008/IEC 61009 (RCCB/RCBO), IEC 61643-11 (Surge Protective Devices), IEC 60529 (IP Ratings), IEC 62305 (Lightning Protection Interface), IS**	5	Sets.

Modular Operation Theatre (Major)			
	732, IS/IEC 60364, NBCS 2026, and applicable **BIS standards**. The complete installation shall include insulation resistance testing, earth continuity testing, earth resistance measurement, polarity testing, functional testing, protection coordination, commissioning, as-built drawings, O&M manuals, operator training and a **minimum 2-year comprehensive warranty**.		
20	**MEDICAL ISOLATION PANEL**		
	Supply, installation, testing and commissioning of a **Medical Isolation Panel (Medical IT System)** of **minimum 20 kVA** for each Operation Theatre, comprising a **medical-grade isolation transformer**, Line Isolation Monitor (LIM), insulation fault monitoring, transformer load monitor, transformer temperature monitor, audible and visual alarm indicators, test and mute functions, protective devices, copper busbars, MCBs/MCCBs, Type II Surge Protection Device (SPD), ventilation and all associated accessories. The system shall provide an **isolated power supply** for critical medical equipment with **continuous insulation monitoring**, automatic first-fault detection and alarm without interruption of power supply. The isolation transformer shall have **electrostatic shielding, Class H insulation, efficiency ≥98%, low leakage current, low noise, inrush current limitation, overload and over-temperature protection**, and shall be suitable for continuous duty. The Medical Isolation Panel shall be **wall-mounted or flush-mounted**, provided with a **digital display** indicating insulation resistance, transformer load (%), transformer temperature, supply voltage, system status and fault conditions, together with **volt-free contacts/BMS interface** for remote monitoring. The system shall permit periodic self-testing and calibration of the insulation monitoring device and shall include event logging for fault diagnosis. The complete system shall comply with **IEC 60364-7-710 (Medical Locations), IEC 60364-4-41, IEC 60364-5-54, IEC 61557-8 (Insulation Monitoring Devices), IEC 61557-9 (Fault Location System, where provided), IEC 61558-1, IEC 61558-2-15 (Medical Isolation Transformers), IEC 61439-1 & IEC 61439-2 (Low-Voltage Switchgear Assemblies), IEC 60601-1, IEC 60601-1-2, IEC 61643-11 (Surge Protection Devices), HTM 06-01, NFPA 99 (where applicable), IS/IEC 60364**, and applicable **BIS standards**, complete with factory acceptance testing (FAT), site acceptance testing (SAT), insulation monitoring calibration, functional testing, commissioning, as-built documentation, operator training and a **minimum 2-year comprehensive warranty**.	5	Nos.
21	**OT LIGHT**		
	Supply, installation, testing and commissioning of a **ceiling-mounted double dome LED Surgical Light System** complete with **third articulated monitor arm**, ceiling suspension, HD/4K camera interface, control electronics, integrated communication interfaces and all accessories for Modular Operation Theatre. The system shall comprise **two LED light heads** providing **minimum central illuminance of 160,000 lux (main dome) and 140,000 lux (secondary dome) at 1 m**, with **continuously adjustable illumination (10–100%)**, **tunable correlated colour temperature (CCT) from 3,500 K to 5,000 K**, **CRI ≥96**, **R9 ≥95**, **adjustable light field diameter**, **electronic shadow**	5	Nos.

Modular Operation Theatre (Major)			
	management, **adaptive illumination compensation**, **deep cavity illumination mode**, **endoscopic (ambient) lighting mode**, **multi-lens reflector technology**, **depth of illumination ≥1,200 mm**, **LED life ≥60,000 hours (L70)**, flicker-free operation, negligible UV/IR radiation and **individual LED redundancy** to maintain illumination in the event of LED failure. The light heads shall have an **aerodynamic laminar-flow compatible design**, **minimum IP54 protection**, removable autoclavable handles, smooth disinfectant-resistant sealed surfaces and unrestricted positioning with **minimum 360° horizontal rotation**. The **third articulated arm** shall support a **minimum 32-inch medical-grade Full HD/4K-ready monitor**, with **minimum 330° rotation**, concealed cable management, VESA 75/100 mounting, minimum **15 kg load capacity**, and provision for future monitor expansion. The surgical light system shall be supplied as an **OEM-integrated digital operating theatre solution** and shall be fully interoperable with the **Surgeon Control Panel**, **Operating Room Integration (ORI) System**, **Medical IT (IPS) System**, **Hospital UPS**, **Building Management System (BMS)**, **Nurse Call System**, **Medical Gas Alarm Panel**, **HVAC control and room pressure monitoring system**, **ambient/peripheral/general OT lighting**, **motorized OT doors**, and **hospital LAN**. The system shall provide centralized control of **light intensity, tunable CCT, focus, light field size, shadow management, endoscopic mode, deep cavity mode and user presets**, together with **monitor source selection, picture-in-picture (PiP), split-screen display, camera control, zoom, focus, white balance, image capture, video recording, live streaming and telemedicine capability**. The system shall support **HD/4K surgical camera integration**, **video routing and switching**, **PACS/RIS/HIS connectivity**, **DICOM image viewing**, **HL7 interoperability**, **Gigabit Ethernet connectivity**, **USB and HDMI interfaces**, **remote diagnostics**, **software and firmware upgrades**, **cybersecurity for network-connected medical devices**, **event logging**, **audit trail**, **user authentication**, **programmable workflow presets**, and **secure archival/export of images and videos**. The integration platform shall utilize **open communication protocols** including **BACnet/IP, Modbus TCP/IP or equivalent**, and shall permit future integration with **endoscopy systems, surgical navigation, robotic surgery, anaesthesia workstations and other digital OT equipment** without replacement of the core integration platform. The suspension system shall incorporate **maintenance-free bearings**, **anti-drift positioning**, **electromagnetic braking (where applicable)**, **anti-collision protection**, concealed cable		

Modular Operation Theatre (Major)			
	routing, certified ceiling anchorage and **125% proof load testing**. The system shall be supplied complete with all suspension hardware, HD/4K camera interface, monitor arm, integration software licences, network interfaces, Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), illumination verification, commissioning, operator training, O&M manuals, **and a minimum 2-year comprehensive on-site warranty covering the complete integrated system, including surgical lights, suspension arms, monitor arm, control electronics, camera interfaces, integration software, communication modules and all supplied accessories, with free software/firmware updates, replacement of defective parts, preventive maintenance and technical support during the warranty period.** The equipment shall comply with **IEC 60601-1**, **IEC 60601-1-2**, **IEC 60601-2-41**, **IEC 60529**, **IEC 62366-1**, **IEC 62471**, **IEC 80001-1 (Risk Management for IT Networks Incorporating Medical Devices)**, **DICOM (latest applicable version)**, **HL7 (latest applicable version)**, **ISO 13485 (OEM Quality Management System)**, **MDR (EU) 2017/745 and/or US FDA clearance**, and applicable **BIS standards**. The bidder shall demonstrate successful interoperability of all integrated subsystems during **Factory Acceptance Testing (FAT)** and **Site Acceptance Testing (SAT)** and shall provide complete integration documentation, cybersecurity documentation and system validation certificates.		
22	**HD CAMERA SYSTEM**		
	Supply, installation, testing and commissioning of an **integrated Full HD/4K-ready surgical camera system**, centrally mounted within one of the surgical light domes or on the dedicated third articulated arm, for real-time capture, recording and transmission of surgical procedures without obstructing the surgical field. The camera shall provide **minimum Full HD (1920 × 1080) resolution**, be **4K native or field-upgradable to 4K**, with **minimum 30× optical zoom**, autofocus, manual focus override, automatic/manual white balance, image stabilization, low-latency video output and **minimum 60 fps** video capture. The system shall support **HDMI, DVI, DisplayPort, SDI and Gigabit Ethernet/IP outputs**, image capture, video recording, live streaming, picture-in-picture (PiP), split-screen display and remote viewing. The camera system shall be **fully integrated** with the **Double Dome Surgical Light**, **Surgeon Control Panel**, **Operating Room Integration (ORI) System**, **medical monitor(s)**, **Operating Theatre Integration Software**, **PACS/RIS/HIS**, **DICOM image management**, **HL7 interoperability**, **hospital LAN**, **Medical IT (IPS) System**, **Building Management**	5	Nos.

Modular Operation Theatre (Major)			
	System (BMS) (where applicable), **Nurse Call System**, **telemedicine platform**, **video routing/switching system**, **digital documentation system**, **video conferencing system**, **recording and archival server**, and **hospital cybersecurity infrastructure**. The system shall permit centralized control of **camera pan, tilt (where applicable), zoom, focus, white balance, image capture, recording, playback, video routing, monitor source selection and live streaming** through the **Surgeon Control Panel** and/or **ORI workstation**. The system shall support **secure user authentication**, **role-based access control**, **event logging**, **audit trails**, **encrypted network communication**, **USB/network/NAS storage**, **remote diagnostics**, **software and firmware upgrades**, **cybersecurity patch management**, and future integration with **endoscopy systems, surgical navigation, robotic surgery platforms, anaesthesia workstations and AI-assisted surgical documentation systems** through open architecture. The suspension and mounting arrangement shall maintain the optical axis during movement of the light head without affecting illumination performance or laminar airflow. The complete system shall comply with **IEC 60601-1**, **IEC 60601-1-2**, **IEC 60601-2-41** (where integrated with surgical luminaires), **IEC 62366-1**, **IEC 62471**, **IEC 80001-1 (Risk Management for IT Networks Incorporating Medical Devices)**, **DICOM (latest applicable version)**, **HL7 (latest applicable version)**, **ISO/IEC 27001** (Information Security Management for network-connected systems), **ISO 13485 (Medical Device Quality Management System)**, **MDR (EU) 2017/745 and/or US FDA clearance**, and applicable **BIS standards**. The bidder shall demonstrate complete interoperability during **Factory Acceptance Testing (FAT)** and **Site Acceptance Testing (SAT)**, including verification of integration with all specified OT systems. Complete with testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty** covering the camera, optics, control electronics, software, integration interfaces, recording functions, accessories, free software/firmware updates, preventive maintenance, replacement of defective parts and technical support during the warranty period		
23	**OT TABLE**		
	Supply, installation, testing and commissioning of a **fully motorized electro-hydraulic universal operating table** suitable for general, laparoscopic, orthopaedic, neurosurgical, urology, gynaecology, vascular, cardiothoracic and minimally invasive procedures. The table shall have a **radiolucent carbon-fibre sectional tabletop**, powered floor-locking base,	5	Nos.

Modular Operation Theatre (Major)			
	rechargeable battery backup, wired and wireless hand controls, and interchangeable tabletop sections. It shall have a **minimum Safe Working Load (SWL) of 250 kg (dynamic) and 450 kg (static)**, height adjustment **600–1100 mm**, **motorized longitudinal slide ≥350 mm**, Trendelenburg/Reverse Trendelenburg **±30°**, lateral tilt **±20°**, back section **+80°/-40°**, leg section **+20°/-90°**, kidney bridge elevation **≥120 mm**, and unrestricted **360° C-arm/O-arm/intra-operative imaging compatibility**. The table shall provide **electro-hydraulic powered movements**, **powered floor locking**, **automatic zero position**, **minimum five programmable memory positions**, **one-touch home position**, **battery backup for minimum 50 operating cycles**, **battery health monitoring**, **self-diagnostics**, **anti-collision and overload protection**, **emergency manual override**, **IPX4 protection**, and a seamless **electrically conductive antistatic pressure-relieving mattress**. The table shall be supplied complete with **head, back and split leg sections**, **pair of arm boards**, **anaesthesia screen**, **DIN EN ISO 19054 accessory rails**, **shoulder, lateral and body supports**, **lithotomy stirrups**, **knee crutches**, **restraint straps**, **gel pads**, **IV pole**, **orthopaedic traction interface**, and all standard accessories required for universal surgical applications. The operating table shall be **fully integrated** with the **Operating Room Integration (ORI) System**, **Surgeon Control Panel**, **Double Dome Surgical Light**, **HD/4K Camera System**, **medical monitors**, **ceiling pendants**, **Medical IT (IPS) System**, **Medical Gas Alarm System**, **PACS/RIS/HIS**, **DICOM/HL7**, **Hospital LAN**, **UPS**, and **Building Management System (BMS)** where specified. The system shall support **remote table control**, **table position display**, **event logging**, **user authentication**, **remote diagnostics**, **software/firmware upgrades**, **Gigabit Ethernet connectivity**, and future integration with **robotic surgery, surgical navigation and intra-operative imaging systems**. The equipment shall comply with **IEC 60601-1**, **IEC 60601-1-2**, **IEC 60601-2-46**, **IEC 62366-1**, **IEC 60529**, **IEC 80001-1** (where network connected), **DIN EN ISO 19054**, **ISO 13485**, **MDR (EU) 2017/745 and/or US FDA clearance**, and applicable **BIS standards**. The bidder shall demonstrate interoperability during **Factory Acceptance Testing (FAT)** and **Site Acceptance Testing (SAT)**. Complete with testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site**		

Modular Operation Theatre (Major)			
	warranty covering the complete operating table, battery, controllers, accessories, software/firmware, preventive maintenance, calibration, replacement of defective parts and technical support during the warranty period.		
	Note: The Modular Operation Theatre (MOT) shall be delivered as a **complete, fully integrated, functional, validated and code-compliant facility**. The Contractor shall provide all materials, equipment, accessories, fittings, interfaces, software, **perpetual software licences**, hardware, cables, supports, structural fixings, consumables, testing instruments, validation services and incidental works, whether or not specifically indicated in the BOQ or technical specifications, but necessary for the satisfactory installation, integration, interoperability, testing, commissioning, statutory compliance and intended operation of the Modular Operation Theatre in accordance with the approved drawings, applicable national and international standards, OEM recommendations and the directions of the Engineer-in-Charge. The scope shall be deemed to include, wherever applicable, complete integration and interfacing of the **Modular OT wall and ceiling system, hermetically sealed doors, vision panels, lead shielding, HVAC system, laminar airflow ceiling, HEPA filters, pressure relief dampers/overflow ports, environmental monitoring system, lighting systems, surgical lights, HD/4K camera system, medical monitors, surgeon control panel, Operating Room Integration (ORI) system, operating table, ceiling pendants, Medical Gas Pipeline System (MGPS), AGSS, Medical IT (IPS) system, electrical distribution boards, UPS, nurse call system, fire alarm system, BMS, access control, hospital LAN, PACS/RIS/HIS, DICOM/HL7 connectivity, telemedicine, video routing, recording and documentation systems**, together with all communication interfaces, networking components, **perpetual software licences**, APIs, middleware and cybersecurity provisions necessary for seamless operation. The Contractor shall also be responsible for providing all mandatory **Factory Acceptance Tests (FAT), Site Acceptance Tests (SAT), Testing, Adjusting & Balancing (TAB), cleanroom validation, HEPA filter integrity testing, airflow visualization, particle count testing, room pressure cascade validation, illumination measurement, electrical safety testing, Medical IT (IPS) verification, MGPS validation, AGSS performance testing, calibration, interoperability testing and performance qualification**, statutory approvals (where applicable), as-built drawings, O&M manuals and training of hospital personnel. **All software, firmware, integration platforms, operating systems, middleware, APIs, drivers, DICOM/HL7 interfaces, database licences and application software required for complete operation and interoperability of the Modular Operation Theatre shall be supplied with perpetual, irrevocable, transferable and fully paid-up licences, with no recurring subscription, annual renewal or licence fee during the service life of the equipment.** The Contractor shall provide all licence certificates, activation keys and documentation at the time of handover. Software and firmware updates, security patches and bug fixes released by the OEM during the **2-year comprehensive warranty period** shall be provided without additional cost.		

Modular Operation Theatre (Major)	
	No claim for additional payment shall be entertained for any item, accessory, interface, software, licence, testing, validation or work reasonably required to achieve a complete and fully operational Modular Operation Theatre. The quoted rates shall be deemed to include all such requirements, whether specifically mentioned or not, including future-ready provisions for expansion and integration. All equipment and systems shall be supplied complete with testing, commissioning and a **minimum 2-year comprehensive on-site warranty**, including preventive maintenance, calibration (where applicable), software/firmware updates, replacement of defective parts and technical support during the warranty period.

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	MODULAR WALL SYSTEM		
1	**WALL PANEL**		
1.1	Supply, installation, testing and commissioning of a **flush-mounted Modular Operation Theatre wall panel system** fabricated from **minimum 6 mm thick homogeneous Solid Mineral Composite Sheet (SMS/SMC)** or equivalent **High-Pressure Laminate (HPL)-faced panel**, factory finished with a non-porous, seamless, scratch-resistant, stain-resistant and chemical-resistant surface suitable for hospital cleanroom applications. The panels shall be mounted on a corrosion-resistant aluminium/GI sub-frame using a **clamp-on, removable modular system** to permit maintenance of concealed services. All panel joints shall be flush, airtight and sealed with **hospital-grade antimicrobial silicone sealant**. The wall system shall be designed to integrate the hermetically sealed door, vision panel, wall-integrated cabinet, writing board, medical gas terminal units, electrical/data outlets, HVAC grilles, pressure relief dampers, control panel and all concealed MEP services. The wall panels shall be **Class B-s1,d0 or better** for reaction to fire as per **EN 13501-1**, with low VOC emissions. The complete system shall comply with **ISO 14644-4 & ISO 14644-5**, **ASHRAE/ASHE Standard 170**, **NBCS 2026** , **EN 13501-1** and applicable **BIS standards**, complete with all trims, sealants, testing, commissioning, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	As per design	Sq. Mtr.
	MODULAR CEILING PANELING SYSTEM		
2	**Modular Ceiling Panel System:** Supply, installation, testing and commissioning of a **flush-mounted Modular Ceiling Panel System** for the Minor Operation Theatre, comprising **minimum 0.8–1.0 mm thick AISI 304 stainless steel panels** (or powder-coated GI panels of equivalent hygienic finish as an economical alternative), **No. 4 Scotch-Brite finish**, mounted on a corrosion-resistant aluminium/GI suspension framework with concealed fixing. The ceiling shall be fully modular, gasketed and removable, providing an airtight, dust-free, seamless surface, with all joints sealed using **hospital-grade antimicrobial silicone sealant**. The ceiling shall be designed to accommodate the **HEPA terminal filtration module(s)**, single dome surgical light, general/peripheral LED lighting, access panels, fire detection devices and other concealed MEP services, without vibration, deflection or loss of alignment. The system shall comply with **ISO 14644-4 & ISO 14644-5**,	As per design	Sq. Mtr.

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	ASHRAE/ASHE Standard 170, **NBCS 2026** , **EN 13501-1** and applicable **BIS standards**, complete with testing, commissioning, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.		
	FLOORING WITH SELF-LEVELING		
3	Provide and lay **minimum 2.5–3.0 mm thick seamless, solvent-free, self-levelling, static-dissipative epoxy flooring system** comprising surface preparation, epoxy primer, conductive copper foil grounding grid, conductive epoxy intermediate coat and conductive epoxy wearing course, complete with **75 mm high integral coved skirting**, terminations, earthing and testing. The flooring shall be non-porous, jointless, abrasion-resistant, chemical-resistant, anti-microbial, low VOC, easy to clean and disinfect, with a **matt/satin slip-resistant surface (minimum R10)**. It shall achieve electrical resistance to ground and point-to-point resistance within **10^6–10^9 Ω** when tested in accordance with **IEC 61340-4-1**. The system shall comply with **IEC 61340-6-1, ASTM F150, ASTM C722, ISO 14644 (where applicable), and NFPA 99 requirements, complete with manufacturer's test certificates, conductivity/adhesion test reports, and a minimum 5-year warranty against delamination, loss of conductivity,** and material defects.	As per design	Sq. Mtr.
	HEPA TERMINAL FILTRATION SYSTEM (IN LIEU OF LAMINAR AIR FLOW PLENUM)		
4	Supply, installation, testing and commissioning of **ceiling-mounted HEPA Terminal Filtration Module(s)** (non-laminar diffusive type), factory-fabricated of minimum size **600 × 600 mm** (typically 2–4 modules per OT, as per design), fitted with **H13 HEPA filters** having filtration efficiency **≥99.97% at MPPS**, individually tested as per **EN 1822**, with a perforated diffuser face providing uniform, low-turbulence downward airflow over the procedure zone, suitable for achieving **ISO Class 7** (or better) cleanliness. The system shall include airtight filter housing, gasketed filter mounting, access panel, supports and all accessories. The OT Contractor shall supply and install the complete terminal filtration assembly, while the AHU and external ducting shall be in the HVAC contractor's scope. The system shall be validated through **TAB, HEPA integrity (PAO/DOP) testing, air velocity measurement, particle count and room pressure validation**. The system shall comply with **ISO 14644-1, 3, 4 & 5, EN 1822, ASHRAE/ASHE Standard 170, NABH OT Air Conditioning Guidelines (latest edition), NBCS 2026** and applicable **BIS standards**, complete with testing, commissioning, validation reports, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	As per design	Nos.
	HERMETICALLY SEALED DOOR (ONE DOOR PER MINOR OT)		
5	Provide, install, test and commission a **single hermetically sealed manual or semi-automatic sliding door**, complete with door leaf, frame, vision panel, accessories and all associated hardware. The door shall maintain the positive/negative pressure differential of the room by providing **airtight sealing on all four sides** through continuous EPDM/silicone compression gaskets and a bottom sealing mechanism, with **air leakage not exceeding Class 3 as per EN 12207**. The door leaf shall comprise a minimum **40–50**	3	Nos.

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	mm thick insulated core faced with **1.0 mm thick SS 304 stainless steel (No. 4 satin finish)**, with smooth flush surfaces and concealed joints for infection control. The frame shall be heavy-duty anodised aluminium or SS 304 with flush installation. Where motorised, the door shall be operated by a **24 V DC motor** with manual override during power failure and shall comply with **EN 16005**. The system shall include a **vision panel of minimum 300 × 300 mm**, stainless steel recessed handles and emergency release. The complete assembly shall be easy to clean, corrosion-resistant, anti-bacterial and suitable for ISO 14644 cleanroom applications, and shall carry a **minimum 2-year comprehensive warranty**. Approximate size: **(1200-1500) × 2100 mm**.		
	BASIC OT CONTROL PANEL		
6	Supply, installation, testing and commissioning of a flush-mounted **Basic OT Control Panel** with a **minimum 15-inch capacitive touch display**, providing local control of OT ceiling/peripheral lights (ON/OFF and dimming), a digital clock with elapsed-procedure timer, and display of room temperature, relative humidity and HVAC status. The panel shall be operable with surgical gloves and have **minimum IP54** front protection, interfaced with the local lighting circuit and HVAC monitoring sensors. Full integration with BMS/HIS/MGPS/Nurse Call. The system shall comply with **IEC 60601-1, IEC 60601-1-2 (where applicable) and NBCS 2026**, complete with cabling, mounting accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	3	Nos.
	X-RAY VIEW SCREEN		
7	**X-Ray Viewing Screen** *. A single-plate LED X-ray viewer of size (approx. 450 × 500 × 30 mm*	3	--
	WALL INTEGRATED WRITING WHITE BOARD		
8	**Wall-Integrated Writing Board:** Supply, installation, testing and commissioning of a wall-integrated magnetic writing board, flush-mounted with the modular wall panel. The writing surface shall be **tempered safety glass (minimum 4 mm thick)** or vitreous enamel steel, white in colour, non-porous and suitable for dry-erase markers, sealed with a continuous **medical-grade silicone gasket**. The board size shall be approximately **600 mm × 450 mm** (or manufacturer's nearest standard equivalent). The assembly shall comply with **NBCS 2026, ISO 14644-4 & 14644-5**, and **IS 2553 (Part 1)/EN 12150** for tempered safety glass, complete with mounting accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	3	Nos.
	WALL INTEGRATED STORAGE UNIT		
9	**Wall Integrated Storage Unit:** Supply, installation, testing and commissioning of a wall-integrated storage cabinet, fully flush-mounted with the modular wall panel system. The cabinet shall be fabricated from **minimum 1.0 mm thick AISI 304 stainless steel** with Scotch-Brite internal finish, provided with **minimum two adjustable SS304 shelves (minimum 30 kg UDL per shelf)**. Overall dimensions shall be approximately **600 mm (W) × 2100 mm (H) × 400 mm (D)**. The cabinet shall be fitted with	3	Nos.

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	toughened safety glass hinged door(s) conforming to **IS 2553 (Part 1)/EN 12150**, mounted in a powder-coated stainless steel frame matching the wall finish, with concealed hinges, flush handles and lockable hardware. The unit shall comply with **ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170, NBCS 2026** and applicable **BIS standards**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.		
	PRESSURE RELIEF DAMPERS		
10	**Pressure Relief Dampers (PRD)/Overflow Ports:** Supply, installation, testing and commissioning of factory-fabricated Pressure Relief Dampers and/or Overflow Ports, complete with mounting frames, airtight seals and accessories, for maintaining the specified room pressure differential in the Minor OT. The units shall be gravity-operated or counterbalanced, fabricated from minimum SS304 or powder-coated galvanised steel (**minimum 1.0 mm thick**), with field-adjustable opening pressure (typically **2.5–15 Pa**) and **EN 1751 Class 3 or better** leakage performance. Performance shall be verified during **Testing, Adjusting & Balancing (TAB)**. The system shall comply with **ISO 14644-1 & 3, ASHRAE/ASHE 170, NABH Guidelines, NBCS 2026 and EN 1751**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos.
	PERIPHERAL LIGHT		
11	Supply, installation, testing and commissioning of **recess-mounted, bottom-opening LED peripheral luminaires** providing uniform, shadow-free illumination flush with the modular ceiling system. The luminaire shall have a **powder-coated CRCA/aluminium housing**, tempered safety glass or high-impact opal diffuser, **minimum IP54 protection**, antimicrobial gasket, **CRI ≥80**, correlated colour temperature of **4000 K** (or as specified), **luminaire efficacy ≥90 lm/W**, flicker-free electronic driver and **LED life ≥50,000 hours (L70)**. The luminaire shall support ON/OFF and dimming control locally or through the OT Control Panel. The luminaire shall comply with **IS 10322, IS 16101, IS 16102, IEC 60598-1, IEC 60598-2-2, IEC 61347 and IEC 62471**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	24 (approx. 8 per OT, as per design)	Nos.
	CEILING SERVICE PENDANT / WALL-MOUNTED SERVICE PANEL		
12	Supply, installation, testing and commissioning of either **(a)** a ceiling-mounted **single-arm combined anaesthesia-cum-surgical services pendant** providing a **minimum horizontal reach of 800 mm**, **minimum 300° rotation**, gas-spring/manual-assisted vertical adjustment, **minimum safe working load of 60 kg**, **minimum one height-adjustable SS304 equipment shelf (minimum 40 kg capacity)**, **minimum two medical gas terminal units**, **minimum four 5/15 A switched hospital-grade electrical sockets** and **one RJ45 data outlet**; or **(b)**, as an economical alternative where a pendant is not specified, a **wall-mounted flush service panel/trunking** integrated with the modular wall system providing equivalent gas and electrical outlets at bed-head level. The system shall permit equipment positioning without cable/hose strain, include mechanical end stops and overload protection, and comply with **ISO 11197, ISO 7396-1, IEC 60601-1, IEC 60601-1-2** and applicable **BIS standards**, complete with testing, commissioning, operator	3	Nos.

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	training, O&M manuals and a **minimum 2-year comprehensive warranty**.		
	SURGICAL SCRUB STATION		
13	**Single-Bay Surgical Scrub Sink:** Supply, installation, testing and commissioning of a wall-mounted, seamless single-bay surgical scrub sink fabricated from **minimum 1.0 mm thick AISI 304 stainless steel** with satin finish, radiused internal corners and integral backsplash. The bay shall be provided with a **sensor-operated (touch-free) hot and cold water mixing faucet** with thermostatic mixing valve, adjustable temperature control (35–45°C) and anti-scald protection, together with a **sensor-operated soap dispenser, sensor-operated hand sanitiser dispenser, digital scrub timer** and removable SS drain strainer. Point-of-use RO water purification may be provided optionally where mains water quality requires treatment. The complete assembly shall comply with **HTM 64, ISO 14644-4 & 14644-5, NABH Guidelines, IS 10500 (where applicable)** and applicable **BIS plumbing/electrical standards**, complete with a **minimum 2-year comprehensive warranty**.	3	Nos.
	HATCH BOX		
14	Supply, installation, testing and commissioning of a wall-integrated **single or double-door interlocking hatch box (pass box)** for transfer of sterile supplies/instruments into the Minor OT, flush-mounted with the modular wall system and fabricated from **minimum 1.0 mm thick AISI SS304** with satin finish. The internal clear opening shall be **minimum 450 mm × 450 mm × 450 mm** (or as specified). Where double-door, the unit shall have interlocked doors, **toughened safety glass viewing windows** and silicone gaskets to prevent simultaneous opening; UV-C germicidal irradiation may be provided optionally. A **separate hatch box for dirty/contaminated waste transfer may be provided as an optional additional item** where the department workflow requires segregated clean/dirty transfer. The equipment shall comply with **ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170, NABH Guidelines, IS 2553 (Part 1)** and applicable **BIS standards**, complete with a **minimum 3-year comprehensive warranty**.	3 (clean transfer); dirty-utility hatch — Optional	Nos.
	AIR RETURN GRILLE SYSTEM		
15	Supply, installation, testing and commissioning of **flush-mounted return air grille(s)**, complete with mounting frame, opposed blade volume control damper (OBD), airtight gaskets and accessories. The grille shall be fabricated from **minimum 1.0 mm thick extruded aluminium alloy** with antimicrobial polyester powder-coated finish and a removable core for cleaning. The nominal face size shall be approximately **300 mm × 300 mm** (or as shown on approved drawings), with **maximum face velocity of 2.0 m/s** and noise level not exceeding **NC-30**. The complete assembly shall comply with **IS 655, SMACNA HVAC Duct Construction Standards, ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170** and **NBCS 2026**, complete with testing, air balancing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos.
15.1	**Internal HVAC Ducting & Exhaust System:** Supply, fabrication, installation, testing and commissioning of the complete internal supply, return	As per design	--

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	and exhaust air ducting system within the Minor OT, including ductwork, fittings, balancing dampers, access doors, supports, sealing, insulation and accessories, sized to achieve a **minimum of 15–20 air changes per hour (ACH)**, in line with NABH/ASHRAE guidance for minor/procedure rooms (as against 20–25 ACH for Major OT). All ductwork shall be fabricated from **Aluminium Alloy 3103-H14 or equivalent**, sheet thickness conforming to **SMACNA HVAC Duct Construction Standards**, with airtight sealed flanged joints and **minimum 25 mm thick closed-cell elastomeric insulation** on supply air ducts. Performance shall be verified during **Testing, Adjusting & Balancing (TAB)**. The installation shall comply with **SMACNA Standards, ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170, NBCS 2026** and applicable **BIS standards**, complete with a **minimum 2-year comprehensive warranty**.		
	MEDICAL GAS LINE INSTALLATION (MGPS WORK INSIDE MINOR OT)		
16	Supply, installation, testing and commissioning of the **Medical Gas Pipeline System (MGPS)** within the Minor OT, including seamless, degreased, deoxidized high-phosphorus (DHP) copper pipes conforming to **EN 13348/ISO 7396-1 and IS 2501** or equivalent. All joints shall be **silver brazed (minimum 45% silver brazing alloy) under continuous nitrogen purging** by qualified personnel in accordance with **ASME Section IX**. The system shall provide, as a minimum, **Oxygen (O_2) – 1 outlet, Medical Air (MA4) – 1 outlet, and Vacuum (VAC) – 1 outlet at the service pendant/panel, including Nitrous Oxide (N_2O) and Surgical Air** . Medical gas terminal units shall be gas-specific, non-interchangeable and self-sealing. The complete installation shall undergo **100% strength, leak, cross-connection, pipeline purity and terminal functional testing** prior to commissioning. The installation shall comply with **ISO 7396-1, EN 13348, HTM 02-01, IS 2501, ASME Section IX** and applicable **BIS standards**, complete with testing, validation, commissioning, as-built drawings and a **minimum 2-year comprehensive warranty**.	3	Sets
	ELECTRICAL WORK + DISTRIBUTION BOX INSIDE MINOR OT		
17	Supply, installation, testing and commissioning of the complete internal electrical installation for the Minor OT, including **one (01) flush-mounted IP54 minimum Essential/UPS Distribution Board** (combined normal and essential power, sized for the reduced connected load of a Minor OT), MCBs/RCBOs, **Type II Surge Protection Device (SPD)**, wiring, conduiting, modular switches, hospital-grade socket outlets, earthing and equipotential bonding. The scope shall include internal wiring from the Distribution Board to lighting fixtures, the service pendant/panel, OT control panel, HVAC controls and other Minor OT equipment, complete with **1100 V grade FRLSH copper cables** and **FRLS/LSZH conduits**, **30 mA RCBO protection** for socket circuits, and **minimum 20% spare outgoing ways**. Provision of a dedicated Medical IT (isolated power) system is covered under Item 20 where specified. All components shall comply with **IEC 60364-7-710, IEC 61439-1 & 2, IEC 60601-1, IEC 61008/61009, IEC 61643-11, IS 732, IS/IEC 60364, NBCS 2026** and applicable **BIS standards**, complete with testing, commissioning, as-built drawings and a **minimum 2-year comprehensive warranty**.	3	Sets

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	MEDICAL ISOLATION PANEL		
18	Supply, installation, testing and commissioning of a **Medical Isolation Panel (Medical IT System)** of **minimum 5–7.5 kVA** for each Minor OT (sized to the reduced connected load, as against minimum 20 kVA for Major OT), comprising a medical-grade isolation transformer, **Line Isolation Monitor (LIM)**, insulation fault monitoring, audible and visual alarm indicators, test/mute functions, protective devices and **Type II Surge Protection Device (SPD)**. The system shall provide an isolated power supply with continuous insulation monitoring and automatic first-fault alarm without interruption of supply, and shall be wall/flush-mounted with a display of insulation resistance and system status. **Provision of a Medical Isolation Panel may be omitted, as an optional deletion,** for Minor OTs used exclusively for procedures under local anaesthesia not involving line-powered critical life-support equipment, subject to the treating clinicians' and Engineer-in-Charge's approval. Where provided, the system shall comply with **IEC 60364-7-710, IEC 61557-8, IEC 61558-2-15, IEC 61439-1 & 2, IEC 60601-1, IEC 61643-11** and applicable **BIS standards**, complete with FAT/SAT, functional testing, commissioning and a **minimum 2-year comprehensive warranty**.	3	Nos.
	OT LIGHT		
19	Supply, installation, testing and commissioning of a ceiling-mounted **single dome LED Surgical Light System**, complete with ceiling suspension, control electronics and accessories, for the Minor Operation Theatre. The light head shall provide **minimum central illuminance of 100,000–120,000 lux at 1 m**, continuously adjustable illumination (10–100%), colour temperature of **4000 K–5000 K**, **CRI ≥90**, adjustable light field diameter, **LED life ≥50,000 hours (L70)**, flicker-free operation and negligible UV/IR radiation. The light head shall have an aerodynamic design, **minimum IP44 protection**, removable autoclavable handles, smooth disinfectant-resistant sealed surfaces and **minimum 360° horizontal rotation**. A third articulated monitor arm and HD camera integration are **not mandatory for Minor OT** and may be provided as optional items. The equipment shall comply with **IEC 60601-1, IEC 60601-1-2, IEC 60601-2-41, IEC 60529, IEC 62366-1, IEC 62471, ISO 13485** and applicable **BIS standards**, complete with testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
	OT TABLE		
20	Supply, installation, testing and commissioning of a **fully electro-hydraulic general-purpose operating table** suitable for minor surgical, gynaecological and endoscopic procedures. The table shall have a **radiolucent tabletop section** (minimum at the head/upper-body section for C-arm compatibility where required), powered or manual floor-locking base, and wired hand/foot control. It shall have a **minimum Safe Working Load (SWL) of 135 kg (dynamic) and 185 kg (static)**, height adjustment **700–950 mm** (or as per design), Trendelenburg/Reverse Trendelenburg **±15°**, back section **+70°/-25°**, and lateral tilt **±15°** (where electro-hydraulic). The table shall be supplied complete with head and leg sections, a pair of arm boards, anaesthesia screen, lithotomy stirrups (where applicable), restraint straps, gel pads and an electrically conductive antistatic mattress. The equipment shall comply with **IEC 60601-1, IEC 60601-1-2, IEC 60601-2-46, IEC 62366-1** and applicable	3	Nos.

	Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 3 Nos. as per following		
S.No.	**Particulars**	**Qty**	**Unit**
	BIS standards, complete with testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.		
	Note: The Modular Operation Theatre (Minor) shall be delivered as a complete, fully integrated, functional and code-compliant facility, specified in accordance with standard industry practice (**NABH, NBCS 2026, ASHRAE/ASHE Standard 170 and ISO 14644**) for minor/day-care surgical and procedure rooms, as distinct from Major Operation Theatres. The Contractor shall provide all materials, equipment, accessories, fittings, interfaces, cables, supports, structural fixings, consumables, testing instruments and incidental works, whether or not specifically indicated in the BOQ, but necessary for the satisfactory installation, testing, commissioning and intended operation of the Minor OT in accordance with the approved drawings, applicable standards and the directions of the Engineer-in-Charge. All equipment shall be supplied complete with testing, commissioning and warranty as indicated against each item, including preventive maintenance and technical support during the warranty period.		

Item	**OT INTEGRATION and controlling equipment (Only Major OT)**
Note	Unless otherwise specified, all equipment and systems shall be supplied, installed, tested and commissioned as **five (5) complete, independent and fully functional sets**, one for each OT, such that failure or maintenance of any system in one OT shall not affect the operation of the remaining OTs. Shared infrastructure, including **OR Integration servers, storage, recording/archiving servers, video-routing backbone, PACS/HIS gateways, and DICOM/HL7 interface servers, may be centralised only if provided with minimum N+1 redundancy, automatic failover,** and **perpetual software licences**. Each OT shall retain independent operation, including local control and essential functionality, in the event of failure of any central server or network. Compliance shall be demonstrated during **FAT** and **SAT**, and all associated hardware, software, networking, cybersecurity and integration components necessary for complete functionality shall be included in the Contractor's scope without additional cost
1	**OT INTEGRATION, AV MANAGEMENT AND COMMUNICATION SYSTEM**
	The AV management system should control the distribution of video data from integrated signal sources to signal targets within the operating room, with an integrated teleconference function. The AV management will be used in combination with the Documentation system and can be started from the start screen of the Documentation system or from the Workflow bar. Furthermore, “Picture in Picture” (PiP) as well as “Picture and Picture (PaP) displays should be possible. The system should allow Streaming of videos to be transmitted outside the OR within the Hospital network; audio comments should be sent bi-directionally, and videos to be commented visually with telestration bi-directionally. The Drawing image in the OR should only be displayed in the preview and should be routed to a monitor of choice in the OR. Drawings disappear automatically after approx 10 seconds. The streaming can be captured with the Documentation system. Videos can be recorded in the Documentation system with up to two channels in 4K, 3D and Full HD simultaneously. The AV System should be deployed on the surgical pendant or controlled from the sterile area.
1. a	**IMAGE, VIDEO AND DATA ACQUISITION & RECORDING SYSTEM**
	The Image, video, and data acquisition and recording system should be medical grade, USFDA/European CE certified. It should capture patient data, still images, video sequences, and audio files (annotation) during the surgical procedure. The system should be controlled

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	with the Control Screen, and it should be simple, user-friendly, secure, and upgradeable. The Image, video and data acquisition and recording system should have the following detailed data: - Should have user-friendly software designed specifically for medical purposes. - Should capture still images in 4K UHD and FULL HD, images from all integrated sources and audio files. - Should capture video sequences (optional with audio) in 4K UHD, FULL HD or 3D - Should have 2-channel recording for still images and videos. - Should provide visual and audible (external loudspeaker) feedback when capturing still images and videos. - Should have a watermark feature in printed reports. The same watermarking capability shall extend to exported and archived digital files. - Should have Resolution of still images: up to 3840x2160p, native resolution. - Should have video resolution up to 3840x2160p. - Should have an integrated, validated cybersecurity and data-protection module providing AES-256 encryption of data at rest, role-based access control and tamper-evident audit logging, compliant with IEC 62443 and IEC 80001-1. - Should be controllable via touchscreen. - Should be fully controllable from inside and outside the sterile field. - Should support network storage on file servers. - Should support FTP storage. Secure SFTP shall also be supported for protection of data in transit. - Should have a wireless connection via built-in Wi-Fi antenna. The wireless interface shall support IEEE 802.11 a/b/g/n/ac (or later) with WPA2/WPA3 encryption. - Should provide USB support for storage on USB drives. - Customisable printouts for documented information should be possible. - Should be able to print to any connected printer (local or network) - Should have a buffer system to ensure reliability. - Should comply with IEC 60601-1 (General requirements for basic safety and essential performance) and IEC 60601-1-2 (EMC), and shall be manufactured under an ISO 13485-certified quality management system. - Video input interfaces: minimum 1 x DisplayPort 1.2 (or higher) and 1 x HDMI 2.0 (or higher), expandable to accommodate additional integrated sources. - Should have an inbuilt hard disk: 2 TB or more. RAID-1 (mirrored) or higher configuration is recommended for data redundancy. The Image, video and data acquisition and recording system should have the following technical data: • Power supply: 100-240 VAC, 50-60 Hz. • Power consumption: Max. 500 watts. • CPU: Intel Core i7 (10th generation or later) or equivalent multi-core processor, minimum 3.0 GHz. • Internal storage: minimum 256 GB SSD (system drive) plus minimum 2 TB HDD/SSD (data storage), expandable and RAID-configurable. • Memory (RAM): minimum 16 GB, expandable.

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	• Connections: minimum 2 x Gigabit Ethernet (RJ-45) ports and minimum 4 x USB 3.0 ports (front and rear, combined). • Outputs: 2 x DP, 3 x RS232, Line I/O, DVI, remote power on, pilot light connection. • Image format: BMP, JPG, PNG. • Video format: MPEG-4, MPEG-2, MOV, MP4 (H.264/H.265). • Video signal inputs: 1 x DP 1.2a, 1 x HDMI 2.0. • Video signal outputs: 1 x DP 1.2a, 1 x HDMI 2.0. • Colour system: PAL, NTSC. • Operating System: Windows 10 IoT Enterprise (or later) or equivalent medical-grade embedded OS, with vendor-committed cybersecurity patch support for a minimum of 7 years. • Still image resolution: up to 3840x2160p, native resolution. • Video resolution: up to 3840x2160p@60Hz • RGB/YUV • Type approval: IEC 60601-1 (3rd Edition or later), IEC 60601-1-2 (EMC), IEC 60601-1-6 (Usability), and the applicable IEC 60601-2-xx particular standard for each integrated modality. • Classification: CE marking under EU MDR 2017/745 (or MDD 93/42/EEC under applicable transitional provisions), CSA certification, and USFDA 510(k) clearance / CDSCO registration as applicable in the country of installation. • Protection class: 1/B. • Medical device: Yes. • Communication (DICOM) functions: • Modality Worklist Information Model. • VL Endoscopic Image Storage. • Video Endoscopic Image Storage. • Secondary Capture Image Storage. • HL7 v2.x / FHIR interoperability with the Hospital Information System (HIS) / Electronic Medical Record (EMR) and PACS. • Recovery software on USB Stick • USB silicone keyboard with touch pad. The keyboard shall be medical-grade, washable, disinfectant-resistant, and rated minimum IP54.
1.b	**PATIENT SAFETY CHECKLIST**
	The Integrated Operating Room (IOR) Image, Video and Data Management System shall provide an integrated **electronic Surgical Safety Checklist** accessible through the sterile touch-screen interface before, during and after the surgical procedure. The checklist shall be configurable to comply with the **WHO Surgical Safety Checklist** and the hospital's approved clinical protocols, and shall align with NABH/JCI operating-theatre accreditation requirements where applicable, including the phases of **Sign In**, **Time Out**, and **Sign Out**. The system shall permit completion by authorized clinical personnel, record the date, time and user for each checklist stage, maintain an audit trail, allow customization of checklist items without software modification, and securely store checklist records as part of the patient's procedural documentation or integrate with the Hospital Information System (HIS)/Electronic Medical Record (EMR), where applicable.
1.c	**VIDEO Routing**
	The Integrated Communication System shall be able to manage 8 video sources and 8 destinations. These sources shall have different type of resolutions Full HD, 3D, 4K, 3D in 4K.
	The OR shall integrate at least the following Video Sources and Destinations, if available

<table>
<tr><th>Item</th><th>OT INTEGRATION and controlling equipment (Only Major OT)</th></tr>
<tr><td></td><td>inside the operating room:

<table>
<tr><th>Inputs</th><td>Outputs</td></tr>
<tr><td>Endoscopy camera</td><td>32” 3D 4K Medical grade monitor on Light arm</td></tr>
<tr><td>OT-Light camera</td><td>55” 4K Large screen Monitor on OT wall</td></tr>
<tr><td>Room camera</td><td>32” 3D 4K Medical grade monitor on Pendant</td></tr>
<tr><td>Patient Vital Sign</td><td>Streaming on Hospital LAN Network</td></tr>
<tr><td>C-Arm / Operating Microscope</td><td>Archiving System channel 1</td></tr>
<tr><td>Robotic System</td><td>Archiving System channel 2</td></tr>
<tr><td>Unified communication System</td><td>Unified communication System</td></tr>
<tr><td>Operative Ultrasound system</td><td>-</td></tr>
</table>
Note: The source/destination matrix above is indicative per Operating Theatre. Each of the 5 Major OTs shall have its own complete 8×8 (minimum) routing capability; central archiving channels may terminate on a shared, redundant central storage/PACS system common to all 5 OTs.</td></tr>
<tr><td></td><td>Video Routing and Integrated Communication System: Provide, install, test and commission a modular digital video routing and management system capable of routing a minimum of eight (8) simultaneous video sources to eight (8) independent destinations, with provision for future expansion. The system shall support Full HD, 3D Full HD, 4K UHD and 3D 4K video formats with real-time switching and negligible latency. The system shall integrate, wherever provided, endoscopy cameras, OT light cameras, room cameras, operating microscopes, C-arm, robotic systems, ultrasound systems, patient monitoring systems, medical displays, recording systems and unified communication systems. The router shall provide sufficient 12G-SDI, HDMI 2.0 (or higher), USB 3.0 and Gigabit Ethernet interfaces, or equivalent, to accommodate all connected equipment. The system shall support continuous 24×7 operation, centralised touch-screen control, Picture-in-Picture (PiP), Picture-by-Picture (PbP), side-by-side image composition, telestration with multi-user annotation, mouse pointer, colour-coded annotations, and simultaneous routing and streaming of annotated images. The communication system shall support secure IP-based streaming using H.264 and H.265/HEVC (or equivalent), bidirectional audio communication, multicast/unicast transmission, adaptive bandwidth management, and interoperability with hospital LAN, HIS, PACS and recording systems. The complete system shall permit simultaneous recording, live streaming, archiving, and routing of composed video to any connected display or destination, and shall be supplied complete with all encoders, decoders, interfaces, licences, cables, and accessories necessary for a fully functional integrated operating room. The router and communication system shall comply with IEC 60601-1 and IEC 60601-1-2 (EMC) and, where forming part of the hospital IT-network, IEC 80001-1 (risk management for IT-networks incorporating medical devices).</td></tr>
<tr><td>2</td><td>Wireless head-worn microphone.</td></tr>
<tr><td></td><td>The Suitable Integrated Communication System should be provided with one Wireless Head-microphone with the following technical information:

Base Unit and Bodypack
- Operating frequency: UHF band, within the licence-free / regulatory-approved ISM band applicable in the country of installation.
- Minimum operating range: 30 metres, line-of-sight.</td></tr>
</table>

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	- Minimum 20 selectable/auto-scanning frequency channels to avoid RF interference with other wireless OR equipment. - Body-pack transmitter battery life: minimum 6 hours continuous operation, with low-battery indication. - Automatic frequency scan/set function to select interference-free channels. - Receiver output: balanced XLR and/or unbalanced 1/4-inch analogue audio, with optional Dante/AES67 digital audio networking. - Shall comply with IEC 60601-1-2 (Electromagnetic Compatibility) for use within the clinical environment, and with applicable national wireless/spectrum-licensing regulations.
3	**Ceiling/Wall mounted Speaker**
	A suitable ceiling/wall-mounted speaker dedicated for communication, videoconferencing, and audio playback shall be installed in a selected place in the OR. - Power output: minimum 10 W RMS. - Frequency response: 80 Hz – 18 kHz (or better). - Mounting: suitable for ceiling or wall mounting as per approved OR layout. - Shall interface with the Unified Communication and AV Management System for two-way audio. - Housing/grille shall be cleanable and disinfectant-resistant, suitable for the OT environment.
4	**ON Air Lamp, set**
	Should include “ON Air” Signal Lamp. It should visually display video and audio signals activated from or to an external destination. ON Air lamp set should include: - 1 On Air lamp unit - 1 ON Air Lamp cable set - 1 mounting kit ON Air Signal Lamp specifications are as follows: - Power supply: 12 VDC - Colour: RGB - Shall comply with IEC 60601-1 electrical safety requirements and have a minimum IP54-rated enclosure suitable for the OT environment.
5	**Graphical User Interface**
	Graphical User Interface (GUI): Provide a **medical-grade capacitive multi-touch control panel** with a minimum 22-inch Full HD (1920 × 1080) TFT-LCD display, with an antimicrobial front surface, an IP54-rated (minimum; IPX5 preferred) front panel suitable for OT cleaning and disinfection, and fanless operation. The touch panel shall provide a centralised graphical user interface for monitoring and control of all integrated operating room functions, including surgical lighting, image and video management, medical displays, cameras, communication systems, recording, environmental controls and other integrated medical devices. The GUI shall communicate with the Integrated Operating Room System through **Gigabit Ethernet/IP**, with support for legacy RS-232 interfaces where required for third-party equipment. The display shall support **DisplayPort and/or HDMI** video input, USB touch interface, minimum 178° viewing angle, and continuous 24×7 operation. The panel shall be mounted on a wall, equipment column, ceiling pendant or equipment rack, as indicated in the approved layout. It shall permit user authentication, configurable graphical layouts, multilingual interface, alarm indication and seamless integration with HIS/PACS

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	where applicable. The GUI and associated control system shall comply with IEC 60601-1, IEC 62366-1 (Usability Engineering) and IEC 80001-1 (IT-network risk management for medical device integration), and shall support role-based user authentication in line with the hospital's IT security policy.
6	**Unified communication System**
	Unified Communication System: Provide, install, test, and commission a standards-based IP-enabled Unified Communication System integrated with the Integrated Operating Room (IOR) for secure real-time transmission of surgical video, audio, and clinical data for telemedicine, tele-proctoring, education, and multidisciplinary consultation. The system shall support **Full HD (1920 × 1080) resolution at 60 fps as a minimum**, with **4K UHD compatibility** for future expansion, and adaptive transmission over standard **Gigabit Ethernet/IP networks** using internationally accepted communication protocols such as **SIP, H.323 and/or WebRTC**, with H.264/H.265 video compression or equivalent. The system shall support secure encrypted communication (TLS/SRTP or equivalent), adaptive bandwidth management (minimum operating bandwidth **2–20 Mbps**), bidirectional audio, screen sharing, recording, remote collaboration, and interoperability with hospital network infrastructure and HIS/PACS where applicable. The contractor shall provide all required encoders, decoders, network interfaces, microphones, speakers, cameras, cables, connectors, software licences and accessories necessary for complete operation. The system shall comply with IEC 62304 (Medical Device Software Life-Cycle Processes) and applicable data-protection regulation (e.g., HIPAA/GDPR or the equivalent national data-protection law applicable in the country of installation) to safeguard patient confidentiality during tele-consultation.
7	**HD Room Camera**
	Full HD PTZ Room Camera • Resolution: 1920 x 1080p • Zoom: 10x or more • Minimum object distance: 10mm (wide end) – 1200 mm (tele end) • White Balance: Automatic • PAN Angel: 170 deg • Tilt Angel" +90/-20 deg • S/N Ratio: 50dB • Video Output: HDMI Shall comply with IEC 60601-1-2 (EMC) where installed within the patient environment (within 1.5 m of the patient), or IEC 62368-1 where installed outside the patient environment.
8	**Interactive Collaboration Platform -55"**
	Provide, install, test and commission a **minimum 55-inch 4K UHD (3840 × 2160) interactive collaboration display** with integrated computing platform and multi-touch capability for use within the Integrated Operating Room and associated consultation facilities. The display shall support **multi-user collaboration**, digital whiteboarding, annotation, multi-window workspace, Picture-in-Picture (PiP), Picture-by-Picture (PbP), simultaneous display of multiple live video sources, document sharing, remote device control, session recording and recall, and real-time collaboration with local and remote participants. The system shall support secure integration with **Microsoft Teams, Zoom and equivalent standards-based conferencing platforms**, web browsers, hospital network infrastructure, HIS/PACS where applicable, and Windows, macOS and Linux operating systems. Users shall be able to annotate live or recorded content, capture snapshots, exchange files, and securely share annotated content with connected participants. The display shall provide **minimum 20-point multi-touch**, LED backlighting, minimum **450 cd/m² brightness**, minimum **4000:1 contrast ratio**, 178° viewing angle, anti-glare protective glass, native **60 Hz refresh rate**, 10-bit colour

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	processing, and continuous **24×7 operation**. The system shall provide sufficient **HDMI 2.0/2.1, DisplayPort, USB 3.0 and Gigabit Ethernet interfaces**, with Wi-Fi connectivity where applicable, and shall include all hardware, software licences, mounting accessories and cables required for complete installation and operation. Where located within the patient environment (within 1.5 m of the patient), the display shall comply with IEC 60601-1; where located outside the patient environment (e.g., a consultation room), IEC 62368-1 (Safety of Audio/Video, IT and Communication Technology Equipment) shall apply.
9	**32" 4K/3D Monitor FLAT SCREEN (On the Third Arm of OT Light)**
	4K/3D 32inch, medical grade, 4K/3D display covering multimodality imaging. Suitable for integrated operating rooms based on 12G-SDI cabling for video management. Fanless design. Highly durable, scratch-resistant front glass.
	Medical Grade Surgical Display: Provide, install, test and commission **32-inch medical-grade LED surgical display(s)** suitable for installation on OT pendants or light arms, having a **minimum native 4K UHD resolution (3840 × 2160)** with **3D display capability**, where specified, and IPS or equivalent wide-view technology for accurate colour reproduction. The display shall provide **minimum 700 cd/m² brightness**, **minimum 1000:1 contrast ratio**, **178° horizontal and vertical viewing angles**, **minimum 100% BT.709 colour gamut**, **10-bit image processing**, and **HDR (HLG/PQ compatible) support** where applicable. The monitor shall incorporate **fanless cooling**, **optically bonded anti-glare front protective glass**, antimicrobial and chemically resistant front surface, **minimum IP45 front protection**, LED backlighting, automatic brightness and gamma stabilization, and shall be suitable for continuous **24×7 operation**. The display shall support **Picture-in-Picture (PiP), Picture-by-Picture (PbP), multi-image display**, latency of **not more than one frame**, and factory colour calibration with calibration certificate. The monitor shall provide **minimum one (1) 12G-SDI input with loop-through output, HDMI 2.0/2.1, DisplayPort 1.2 or higher, and DVI (or equivalent)** digital interfaces to support integration with endoscopy systems, operating microscopes, surgical cameras, C-arms, robotic systems and the Integrated Operating Room (IOR) system. Where intraoperative radiological images are displayed, the monitor shall include a **DICOM Part 14 preset display mode**. The equipment shall comply with **IEC 60601-1, IEC 60601-1-2, IEC 60601-1-6, IEC 62366, IEC 62471**, and other applicable international standards for medical electrical equipment, and shall be manufactured under an ISO 13485-certified quality management system, and shall be supplied complete with all mounting hardware, interface cables, software licences and accessories necessary for a complete installation, together with a **minimum two year comprehensive warranty and assured availability of spare parts for at least ten years**.
10	**CONSOLIDATED APPLICABLE CODES & STANDARDS**
	The following codes and standards are applicable, individually or in combination, across the OT Integration, AV Management and Communication System described in Items 1–9 above. Bidders shall submit valid, current certificates/test reports demonstrating compliance for each relevant item, along with the manufacturer's Declaration of Conformity, as part of the technical bid. - IEC 60601-1 – General requirements for basic safety and essential performance of medical electrical equipment. - IEC 60601-1-2 – Electromagnetic compatibility (EMC) requirements and tests. - IEC 60601-1-6 / IEC 62366-1 – Usability engineering applied to medical electrical equipment. - IEC 60601-2-18 – Particular requirements for the basic safety and essential performance of endoscopic equipment, where applicable. - IEC 62304 – Medical device software – software life-cycle processes. - IEC 62471 – Photobiological safety of lamps and lamp systems.

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	- IEC 62368-1 – Safety of audio/video, information and communication technology equipment (for displays/AV outside the patient environment). - IEC 80001-1 – Application of risk management for IT-networks incorporating medical devices. - IEC 62443 – Cybersecurity for industrial/network-connected automation and control systems, applied to the medical IT network. - ISO 14971 – Application of risk management to medical devices. - ISO 13485 – Medical devices – quality management systems. - DICOM PS3.x – Digital Imaging and Communications in Medicine conformance for image/video storage and worklist. - HL7 v2.x / FHIR – Healthcare data interoperability with HIS/EMR/PACS. - CE (EU MDR 2017/745) / USFDA 510(k) / CDSCO – Regulatory approval/registration, as applicable to the country of installation. - WHO Surgical Safety Checklist; NABH/JCI – Clinical safety-checklist content and operating-theatre accreditation alignment, where applicable.
11	**WARRANTY, SOFTWARE LICENSING & SPARES SUPPORT**
	The complete OT Integration, AV Management and Communication System, including all sub-systems and equipment described in Items 1–10 above, shall be supplied against the following minimum commercial and support terms, applicable uniformly across all 5 Major Operating Theatres: - Comprehensive onsite warranty: minimum 2 (two) years from the date of successful installation, testing, commissioning and joint acceptance, covering all parts, labour, software updates/patches and preventive and breakdown maintenance visits, at no additional cost to the purchaser during the warranty period. - All software supplied (operating system where OEM-licensed, AV management, video-routing, unified communication, DICOM/HL7 interface, and any other application software forming part of the system) shall be provided under perpetual (non-expiring, non-subscription) licences valid for the operational life of the equipment. Where a subscription or term-based licence is unavoidable (e.g., a specific cloud or cybersecurity service), this shall be explicitly identified and included by the bidder. - Assured availability of spare parts, consumables and software patches/updates for a minimum of 10 (ten) years from the date of supply, with a written OEM undertaking to this effect submitted as part of the technical bid.
12	**CYBERSECURITY SPECIFICATIONS**
	The complete OT Integration, AV Management and Communication System, and all constituent sub-systems/devices described in Items 1–11 above, shall meet the following minimum cybersecurity requirements, applicable uniformly across all 5 Major Operating Theatres: **A. Governance, Standards & Documentation** - Shall comply with IEC 62443-3-3 (system security requirements and security levels), IEC 62443-4-1 (secure product development lifecycle) and IEC 62443-4-2 (technical security requirements for components). - Shall comply with IEC 80001-1 (application of risk management for IT-networks incorporating medical devices) and provide a security-capability disclosure

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	equivalent to a Manufacturer Disclosure Statement for Medical Device Security (MDS2) for each networked device/sub-system. - The OEM's development and support organisation shall hold ISO/IEC 27001 (Information Security Management System) certification or equivalent. - Shall comply with applicable national cybersecurity and data-protection regulation in the country of installation (e.g., CERT-In directions and the Digital Personal Data Protection Act where installed in India, or the equivalent local regulation). - A Software Bill of Materials (SBOM) listing all third-party and open-source components and their versions shall be supplied and kept current. **B. Network Security** - The OT/medical-device network shall be logically and/or physically segmented (VLANs) from the general hospital IT and guest networks, with a dedicated OT-DMZ for any externally-facing service (e.g., streaming, tele-consultation). - A managed firewall/UTM shall be provided at the OT network boundary with a default-deny inbound policy; the OEM shall document all required ports, services and protocols. - Intrusion Detection/Prevention (IDS/IPS) capability shall monitor OT network traffic for anomalous behaviour. - No OR device shall have direct internet exposure; all external connectivity shall route through a hospital-approved secure gateway. - Wireless devices, including the wireless head-worn microphone, shall use WPA2/WPA3 (802.1X, where applicable) or an equivalent encrypted RF link. **C. Access Control & Authentication** - Role-based access control (RBAC) shall be provided on all system consoles/GUIs, following the principle of least privilege. - Unique credentials shall be issued to each user; shared or generic logins shall not be permitted. - Multi-factor authentication (MFA) shall be supported and enforced for remote access and all administrative accounts. - Automatic session timeout/lock shall be enforced after a configurable period of inactivity. - Integration with the hospital's Active Directory/LDAP for centralised identity management shall be supported, where required. **D. Data Protection** - Data at rest (patient data, images, video and audit logs) shall be encrypted using AES-256 or equivalent. - Data in transit shall be encrypted using TLS 1.2 or higher; real-time audio/video streams shall use SRTP or equivalent. - Secure cryptographic key-management practices shall be followed, including periodic key rotation. - De-identification/anonymisation options shall be available for data used for teaching or tele-education purposes, in line with hospital data-privacy policy. **E. Audit, Logging & Monitoring**

Item	OT INTEGRATION and controlling equipment (Only Major OT)
	- Tamper-evident audit logs shall record user access, data access/export and configuration changes, retained for a minimum period as per hospital policy or applicable regulation, whichever is longer. - All integrated devices shall be time-synchronised (NTP) for forensic log correlation. - Centralised log forwarding (e.g., syslog) to the hospital's Security Information and Event Management (SIEM) system shall be supported, where available. **F. Vulnerability & Patch Management** - The OEM shall provide a documented vulnerability-disclosure and patch-management process, with committed patch turnaround times for critical vulnerabilities (e.g., within 30 days of a CVSS-critical disclosure). - Security patches/updates shall be included under warranty/CMC at no additional cost for the supported lifecycle of the product (minimum 10 years, per Item 11). - End-of-life/end-of-support dates shall be disclosed in advance, with a defined migration path for continued security support. **G. Malware & Endpoint Protection** - Centrally-manageable endpoint protection/anti-malware shall be provided on all Windows-based or general-purpose computing components, with signature updates that do not require unauthorised internet access. - Application whitelisting shall be implemented on fixed-function devices, where feasible. - USB port control shall be provided to prevent unauthorised removable-media use.

Oxygen Generation Plants (OGP)			
S.no.	**Particulars**	**Qty**	**Unit**
	MEDICAL Oxygen Generation Plants (OGP) — PSA oxygen generator to conform to IS 16442:2017 (Pressure Swing Adsorption Oxygen Generator Systems for Medical Use) / ISO 10083, with continuous O_2 purity monitoring and a low-purity alarm and automatic isolation per CDSCO/MoHFW PSA plant guidance. The LMO bulk system shall be the primary oxygen source, the OGP the secondary source, and the emergency cylinder manifold bank the tertiary source, with automatic, alarmed changeover between all three per the priority sequence defined at detailed design stage, in line with ISO 7396-1 §5.2 multiple-source requirements.		
1	**Medical Oxygen Generation Plant (PSA):** Provide, install, test and commission a **fully automatic PSA Medical Oxygen Generation Plant** having a **minimum net oxygen generation capacity of 500 LPM (30 m^3/h)** delivering **medical oxygen at 93% ± 3% purity**, complete with **twin PSA adsorption vessels**, **N+1 redundant rotary screw air compressors** suitably sized by the OEM, refrigerated air dryer, pre- and after-filters, activated carbon filter, air and oxygen receivers, oxygen analyser, dew point monitor, pressure regulators, automatic condensate drains, automatic changeover manifold, PLC/microprocessor-based control system with HMI, local mimic panel, alarm system, main electrical control panel, safety valves, non-	1	Set

	return valves and all accessories for continuous **24×7 unattended operation**. The system shall provide continuous monitoring and recording of oxygen purity, pressure, flow, compressor status, operating hours and alarms, with Ethernet/Modbus TCP-IP connectivity for BMS integration and local/remote alarm indication. All oxygen-contact components shall be oxygen compatible and cleaned for oxygen service. The plant shall comply with **ISO 10083, ISO 7396-1, ISO 8573-1, European Pharmacopoeia (Oxygen 93%), IEC 60204-1, IEC 61439, HTM 02-01 (where applicable), NFPA 99 (where applicable), and the Indian Pharmacopoeia/Bureau of Indian Standards requirements**, and shall be supplied complete with FAT, SAT, commissioning, operator training, O&M manuals, calibration certificates, and a **minimum 2-year comprehensive warranty** with assured spare parts support for at least **10 years**.		

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Medical Gas Pipeline system (MGPS)		
1	**LIQUID OXYGEN TANK (LMO)**		
1.1	**Vacuum Insulated Liquid Medical Oxygen (LMO) Storage System:** Supply, installation, testing and commissioning of **one (1) × 10 KL Vacuum Insulated Evaporator (VIE) as the primary source and one (1) × 10 KL Vacuum Insulated Evaporator (VIE) as the automatic secondary (standby) source** for medical oxygen, complete with foundations, interconnecting piping, ambient vaporizers, pressure-building and economizer circuits, automatic changeover manifold, pressure regulators, safety relief valves, liquid level gauges, pressure gauges, pressure transmitters, fill and withdrawal connections, emergency shut-off valves, telemetry, control panel, earthing, lightning protection, fencing, crash barriers, safety signage and all accessories required for a complete operational installation. The storage vessels shall be **double-walled, vacuum-insulated (vacuum-perlite or super-insulated multilayer vacuum)** vertical cryogenic tanks with an **inner vessel of stainless steel and outer vessel of carbon steel**, designed for liquid oxygen service at **−196°C**. The vessels shall have a **maximum working pressure of 17 kg/cm²(g)**, hydrostatic test pressure not less than **1.5 times the design pressure**, and design temperature range of **−196°C to +50°C**. The complete system shall comply with **EN 13458**, **ISO 21009**, **ISO 7396-1**, **NFPA 99**, **PESO requirements**, **SMPV (U) Rules**, **Static and Mobile Pressure Vessels (Unfired) Rules**, **NBCS 2026**, and applicable **BIS standards**. Complete with testing, commissioning, statutory approvals, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty** covering the complete VIE system, instrumentation, controls, vaporizers, valves, accessories and technical support during the warranty period.	1	Set

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
1.2	Supply, installation, testing and commissioning of **two (2) ambient air vaporizers (one duty and one standby)** suitable for **1 × 10 KL primary and 1 × 10 KL secondary Vacuum Insulated Liquid Medical Oxygen (LMO) storage tanks**, complete with automatic duty/standby changeover arrangement, inlet/outlet isolation valves, pressure relief valves, stainless steel interconnecting piping, supports, foundations, instrumentation and all accessories required for continuous operation. Each vaporizer shall be of **natural draft, all-aluminium extruded fin construction** or equivalent corrosion-resistant design, designed for continuous outdoor operation without external power, capable of vaporizing liquid oxygen at the specified peak flow while maintaining the required outlet pressure, and shall be **cleaned and certified for oxygen service**. The vaporizer capacity shall be selected to meet the design oxygen demand with one unit in operation while the second remains on standby. The complete system shall comply with **ISO 7396-1 (Medical Gas Pipeline Systems)**, **EN 13458 (Static Vacuum Insulated Cryogenic Vessels, where applicable)**, **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, statutory approvals, O&M manuals, and a **minimum 2-year comprehensive on-site warranty** covering the complete vaporizer system, valves, instrumentation, accessories and technical support during the warranty period.	4	Nos
1.3	**Medical Oxygen Pressure Reducing Station (PRS):** Provide, install, test and commission **two (2) fully automatic Medical Oxygen Pressure Reducing Stations (one Duty and one Standby)** complete with automatic changeover, duplex pressure regulators, isolation valves, non-return valves, inlet filters, inlet and outlet pressure gauges, pressure transmitters, line pressure relief valves, bypass arrangement, alarm pressure switches, stainless steel manifold and supports, and all accessories for continuous operation. The station shall be designed for oxygen service, with all components oxygen-**cleaned and degreased**, and shall be sized to deliver a **minimum flow of 1200 Nm^3/h** (or as required by the system design). The PRS shall reduce the oxygen supply pressure from the Vacuum Insulated Evaporator (VIE)/bulk oxygen source to a **regulated pipeline pressure of approximately 4.2 bar (420 kPa)** in accordance with **ISO 7396-1**, with automatic duty–standby changeover and pressure relief protection. The complete assembly shall comply with **ISO 7396-1, ISO 15001, HTM 02-01, NFPA 99 (where applicable), and applicable BIS/PESO requirements**. It shall be supplied complete with testing, commissioning, calibration, documentation and a minimum **2-year comprehensive warranty**.	4	Nos
1.4	A **Remote Telemetry Unit (RTU)** shall be provided as an integral part of the LMO system for continuous remote monitoring of tank liquid level, pressure, product status, alarms and operational parameters, with GSM/GPRS/4G or Ethernet-based communication for remote diagnostics and inventory management. The complete system shall comply with **ISO 7396-1**, **EN 13458** (where applicable), **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, statutory approvals, O&M manuals, and a **minimum 2-year**	2	Nos

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	comprehensive on-site warranty covering the complete vaporizer system, telemetry unit, valves, instrumentation, accessories and technical support during the warranty period.		
2	**Oxygen Supply System**		
2.1	Supply, installation, testing and commissioning of a **(20 + 20) cylinder fully automatic duplex Medical Oxygen Manifold System**, comprising **20 cylinders as duty bank and 20 cylinders as standby bank**, complete with heavy-duty powder-coated steel manifold frame, cylinder restraining chains, high-pressure copper/stainless steel headers, non-return valves (NRVs), stainless steel flexible pigtail connections with cylinder-specific connectors, pressure regulators, automatic changeover unit, pressure gauges, line pressure regulator, pressure relief valves, isolation valves, local visual indication, manifold control panel, interconnecting piping, supports, testing and all accessories required for complete operation. The manifold shall be designed for uninterrupted oxygen supply with automatic changeover from duty to standby bank without interruption of gas flow and shall be compatible with the Medical Gas Alarm Monitoring System. **Medical oxygen cylinders shall be supplied by the Employer and are not included in the Contractor's scope.** The system shall comply with **ISO 7396-1**, **HTM 02-01**, applicable **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.	2	Set
2.2	**Fully Automatic Oxygen Manifold Control Panel:** Supply, installation, testing and commissioning of a **fully automatic, pneumatically operated duplex oxygen manifold control panel** suitable for a **(20+20) cylinder manifold**, with a **minimum continuous flow capacity of 2,000 LPM** at the specified line pressure. The control panel shall provide **automatic changeover** from the duty bank to the standby bank without interruption of gas supply, with automatic reset when the depleted bank is replenished. The panel shall incorporate **high-pressure pressure regulators, line pressure regulator, pressure gauges, digital pressure indication, reserve-in-use indication, bank status indicators, high/low pressure alarms, pressure relief valves, isolation valves, non-return valves, emergency bypass arrangement, local audible and visual alarm, and dry contacts/Modbus communication for integration with the Medical Gas Alarm Monitoring System (MGAMS) and Building Management System (BMS)**. The control panel shall be enclosed in a robust, powder-coated or SS304 enclosure suitable for hospital utility rooms and shall comply with **ISO 7396-1**, **HTM 02-01**, **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**	2	Set
2.5	**Oxygen Flowmeter with Humidifier:** Supply, installation, testing and commissioning of **medical oxygen flowmeter assemblies** complete with **polycarbonate humidifier bottle, flowmeter, probe/adaptor compatible with the specified medical gas outlet, flow control valve, pressure-compensated flow tube, bacterial filter, pressure relief**	510	Nos.

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	valve and all accessories. The flowmeter shall have an **adjustable flow range of 0–15 L/min** with clear graduated scale, minimum accuracy of **±10% of indicated flow**, and shall be suitable for use with **medical oxygen at 400 kPa nominal pipeline pressure**. The humidifier bottle shall be **autoclavable, shatter-resistant**, with a minimum **200–250 ml** capacity and reusable diffuser. The probe/adaptor shall be compatible with the installed terminal unit standard. The assembly shall comply with **ISO 9170-1 (Terminal Units for Medical Gas Pipeline Systems)**, **ISO 15002 (Flowmetering Devices for Connection to Terminal Units of Medical Gas Pipeline Systems)**, and **ISO 7396-1 (Medical Gas Pipeline Systems)**. Complete with testing, commissioning, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
2.6	**High-Pressure Oxygen Flexible Hose (Pigtail):** Supply, installation, testing and commissioning of **high-pressure flexible oxygen hose assemblies (pigtails)** complete with cylinder connection, manifold connection, stainless steel end fittings, non-return valve (where specified), sealing washers and all accessories. The hose shall be **white in colour** for oxygen service, manufactured from reinforced, non-kinking, oil-free, oxygen-compatible material suitable for continuous medical oxygen service, with a minimum working pressure of **200 bar** and a minimum burst pressure of **4 times the working pressure**. Each hose assembly shall be factory pressure-tested, cleaned for oxygen service and suitable for connection between oxygen cylinders and the manifold system. The assembly shall comply with **ISO 7396-1**, **ISO 21969 (High-pressure flexible connections for medical gas systems)**, and applicable **PESO requirements**. Complete with testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	As per design	Mtrs
2	**Nitrous Oxide System**		
2.1	**Primary Nitrous Oxide Cylinder Manifold:** Supply, installation, testing and commissioning of a **(10 + 10) cylinder fully automatic duplex Medical Nitrous Oxide (N_2O) manifold system**, comprising **10 cylinders as duty bank and 10 cylinders as standby bank**, complete with heavy-duty powder-coated steel manifold frame, cylinder restraining chains, high-pressure copper/stainless steel headers, stainless steel flexible pigtail connections with cylinder-specific connectors, non-return valves (NRVs), high-pressure regulators, automatic pneumatic changeover control panel, line pressure regulator, pressure gauges with digital pressure indication, pressure relief valves, isolation valves, emergency bypass arrangement, local audible and visual alarms, and dry contacts/Modbus communication for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. The manifold shall provide **automatic, uninterrupted changeover** from the duty bank to the standby bank without interruption of gas supply and shall automatically reset when the depleted bank is replenished. **Nitrous Oxide cylinders shall be supplied by the Employer and are not included in the Contractor's scope.** The system shall comply with **ISO 7396-1**, **HTM 02-01**, **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning,	1	Set

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.		
2.2	**Fully Automatic Nitrous Oxide Manifold Control Panel:** Supply, installation, testing and commissioning of a **fully automatic, pneumatically operated duplex Nitrous Oxide (N_2O) manifold control panel** suitable for a **(10+10) cylinder manifold**, with a **minimum continuous flow capacity of 1,000 LPM** at the specified line pressure. The control panel shall provide **automatic changeover** from the duty bank to the standby bank without interruption of gas supply and automatic reset when the depleted bank is replenished. The panel shall incorporate **high-pressure regulators, line pressure regulator, pressure gauges with digital pressure indication, duty/standby bank status indicators, high/low line pressure alarms, pressure relief valves, isolation valves, non-return valves, emergency bypass arrangement, local audible and visual alarms, and dry contacts/Modbus communication for integration with the Medical Gas Alarm Monitoring System (MGAMS) and Building Management System (BMS)**. The control panel shall be enclosed in a robust powder-coated steel or **SS304** enclosure suitable for hospital utility rooms. The system shall comply with **ISO 7396-1**, **HTM 02-01**, **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
2.3	**High-Pressure Nitrous Oxide Flexible Hose (Pigtail):** Supply, installation, testing and commissioning of **high-pressure flexible Nitrous Oxide (N_2O) hose assemblies (pigtails)** complete with cylinder connection, manifold connection, stainless steel end fittings, non-return valve (where specified), sealing washers and all accessories. The hose shall be **blue in colour** for Nitrous Oxide service, manufactured from reinforced, non-kinking, oil-free, Nitrous Oxide-compatible material suitable for continuous medical gas service, with a **minimum working pressure of 200 bar** and a **minimum burst pressure of four (4) times the working pressure**. Each hose assembly shall be factory pressure-tested, cleaned for medical gas service and suitable for connection between Nitrous Oxide cylinders and the manifold system. The assembly shall comply with **ISO 7396-1**, **ISO 21969 (High-pressure Flexible Connections for Medical Gas Systems)**, and applicable **PESO requirements**. Complete with testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	As per design	Mtrs
3	**CO2 CARBON DIOXIDE SYSTEM**		
3.1	**Primary Carbon Dioxide (CO_2) Cylinder Manifold:** Supply, installation, testing and commissioning of a **(6 + 6) cylinder fully automatic duplex Medical Carbon Dioxide (CO_2) manifold system**, comprising **6 cylinders as duty bank and 6 cylinders as standby bank**, complete with heavy-duty powder-coated steel manifold frame, cylinder restraining chains, high-pressure copper/stainless steel headers, stainless steel flexible pigtail connections with cylinder-specific connectors, non-return valves (NRVs), high-pressure regulators, automatic pneumatic changeover control panel, line pressure regulator, pressure gauges with digital pressure indication,	1	Set

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	pressure relief valves, isolation valves, emergency bypass arrangement, local audible and visual alarms, and dry contacts/Modbus communication for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. The manifold shall provide **automatic, uninterrupted changeover** from the duty bank to the standby bank without interruption of gas supply and shall automatically reset when the depleted bank is replenished. **Carbon Dioxide cylinders shall be supplied by the Employer and are not included in the Contractor's scope.** The system shall comply with **ISO 7396-1**, **HTM 02-01**, **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.		
3.2	**Fully Automatic Carbon Dioxide (CO_2) Manifold Control Panel:** Supply, installation, testing and commissioning of a **fully automatic, pneumatically operated duplex Carbon Dioxide (CO_2) manifold control panel** suitable for a **(6+6) cylinder manifold**, with a **minimum continuous flow capacity of 500 LPM** at the specified line pressure. The control panel shall provide **automatic changeover** from the duty bank to the standby bank without interruption of gas supply and automatic reset when the depleted bank is replenished. The panel shall incorporate **high-pressure regulators, double-stage line pressure regulator, pressure gauges with digital pressure indication, duty/standby bank status indicators, high/low line pressure alarms, pressure relief valves, isolation valves, non-return valves, emergency bypass arrangement, local audible and visual alarms, and dry contacts/Modbus communication for integration with the Medical Gas Alarm Monitoring System (MGAMS) and Building Management System (BMS)**. The control panel shall be enclosed in a robust powder-coated steel or **SS304** enclosure suitable for hospital utility rooms. The system shall comply with **ISO 7396-1**, **HTM 02-01**, **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
3.3	**High-Pressure Carbon Dioxide (CO_2) Flexible Hose (Pigtail):** Supply, installation, testing and commissioning of **high-pressure flexible Carbon Dioxide (CO_2) hose assemblies (pigtails)** complete with cylinder connection, manifold connection, stainless steel end fittings, non-return valve (where specified), sealing washers and all accessories. The hose shall be **grey in colour** for Carbon Dioxide service, manufactured from reinforced, non-kinking, oil-free, CO_2-compatible material suitable for continuous medical gas service, with a **minimum working pressure of 200 bar** and a **minimum burst pressure of four (4) times the working pressure**. Each hose assembly shall be factory pressure-tested, cleaned for medical gas service and suitable for connection between CO_2 cylinders and the manifold system. The assembly shall comply with **ISO 21969 (High-pressure Flexible Connections for Medical Gas Systems)**, **ISO 7396-1 (Medical Gas Pipeline Systems)** and applicable **PESO requirements**. Complete with testing, commissioning, and a **minimum 2-year**	As per design	Mtr.

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	comprehensive on-site warranty.		
4	**Supply, Installation, testing and commissioning of Gas outlet with fully metallic body and no plastic, including probe and adopter points for Oxygen, Nitrous Oxide, Air, & Vacuum system, etc.**		
4.1	Oxygen outlet with Probe/adopter	630	Nos.
4.2	Nitrous Oxide outlet with Probe/adopter	22	Nos.
4.3	Compressed Air (4 Bar) outlet with Probe/adopter	630	Nos.
4.4	Compressed Air (7 Bar) outlet with Probe/adopter	12	Nos.
4.5	Vacuum outlet with Probe/adopter	630	Nos.
4.6	AGSS Gas Outlets with Probe/adopter	11	Nos.
4.7	CO2 Gas Outlets with Probe/adopter	11	Nos.
5	**COMPRESSED AIR SYSTEM**		
5.1	Supply, installation, testing and commissioning of a **Triplex Medical Oil-Free Compressed Air System** comprising **three (3) stationary oil-free scroll compressors** configured as **2 Duty (automatic alternating) + 1 Standby (N+1 redundancy)** for supplying **Medical Air (4 bar)** and **Surgical Air (7 bar)**. The installed system shall have a **minimum duty capacity of 12,000 LPM (±5%)**, adequately sized to meet the diversified peak demand of the approved Medical Gas Outlet Schedule for the **450-bed hospital**, including **630 Medical Air outlets**, **5 Major Operation Theatres**, 3 **Minor Operation Theatres**, Emergency, ICU/HDU, Recovery, Procedure Rooms, all ward areas, and a minimum **20% provision for future expansion**, while maintaining one complete compressor package on standby at all times. The system shall comprise **100% standby duplex heatless desiccant air dryers**, pre-filters, coalescing filters, activated carbon filters, bacterial filters, **minimum two (2) vertical air receivers of 3000 litres each**, automatic condensate drains, pressure regulators, pressure relief valves, non-return valves, isolation valves, dew-point monitor, pressure, flow and air quality monitoring instruments, and a **PLC/HMI-based intelligent control panel** with automatic sequencing, duty rotation, load sharing, automatic standby changeover, fault diagnostics, event logging, runtime equalisation, and **Ethernet/Modbus TCP/IP communication** for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. Independent regulated distribution headers shall be provided for **Medical Air (4 bar)** and **Surgical Air (7 bar)**. The compressed medical air shall comply with **ISO 8573-1 Class 0 (Oil), Class 2 (Particles) and Class 2 (Moisture, Pressure Dew Point ≤ –40°C)**, with contaminant levels complying with **ISO 7396-1 Annex C** and the **Indian Pharmacopoeia**, verified during	1	Set

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	commissioning by a **NABL-accredited laboratory**. The complete system shall comply with **ISO 7396-1**, **ISO 8573-1**, **HTM 02-01**, **IEC 60204-1**, and **IEC 61439**. Complete with factory acceptance testing (FAT), site acceptance testing (SAT), performance validation, commissioning, operator training, O&M manuals, calibration certificates, recommended spare parts, and a **minimum 2-year comprehensive on-site warranty** covering the complete compressor plant, dryers, receivers, filters, controls, instrumentation, accessories and software.		
5.2	**Medical Air Receivers:** Supply, installation, testing and commissioning of **two (2) vertical Medical Air Receivers**, each of **minimum 5000 litres capacity**, complete with inlet and outlet isolation valves, safety relief valve, pressure gauge, pressure transmitter/switch, automatic condensate drain with drain trap, inspection opening/manhole (where applicable), supports, foundation bolts and all accessories required for complete installation. The receivers shall be fabricated from **IS 2062 Grade B carbon steel or equivalent**, internally coated with corrosion-resistant epoxy suitable for medical compressed air service and externally protected with epoxy/polyurethane anti-corrosive coating. Each receiver shall be designed for a **minimum working pressure of 10 bar(g)** and hydrostatically tested in accordance with applicable statutory requirements. The receivers shall be installed in parallel with individual isolation valves to permit maintenance without interruption of system operation and shall include suitable nozzles for future expansion, vibration-isolated supports and all interconnecting pipework. The total receiver capacity shall be adequate for the specified **12,000 LPM Medical Air Plant** serving the **450-bed hospital**, including **630 Medical Air outlets**, **630 Oxygen outlets**, **630 Vacuum outlets**, **5 Major Operation Theatres**, **3 Minor Operation Theatres**, ICU/HDU, Emergency and other critical care areas. The complete assembly shall comply with **ASME Section VIII Division 1** or **PD 5500**, applicable **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, statutory approvals, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
5.3	**Medical Air Bacterial Filtration System:** Supply, installation, testing and commissioning of a **duplex (100% Duty + 100% Standby) final bacterial filtration system** suitable for a **minimum continuous flow of 12,000 LPM**. The system shall comprise two identical sterile bacterial filter assemblies installed in parallel with individual isolation valves to permit filter replacement without interruption of medical air supply. Each assembly shall include **pre-filter (1 µm, minimum 99.99% particle removal efficiency), high-efficiency coalescing filter (0.01 µm, residual oil content ≤0.01 mg/m³), activated carbon filter (oil vapour removal to ≤0.003 mg/m³), and final sterile bacterial filter of absolute 0.01 µm rating** with **minimum bacterial retention efficiency of 99.9999% and viral retention efficiency of 99.99%**. Filter housings shall be fabricated from **316L stainless steel**, designed for a **minimum working pressure of 10 bar(g)** and provided with differential pressure gauges/transmitters, pressure gauges,	1	Set

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	integrity testing ports, automatic condensate drains (where applicable), isolation valves, non-return valves and all accessories required for complete installation. The bacterial filter element shall be hydrophobic, sterilizable, non-fibre shedding, and suitable for medical compressed air service. The complete filtration system shall ensure compressed air quality complying with **ISO 8573-1 Class 0 (Oil), Class 2 (Particles) and Class 2 (Moisture)** and **ISO 7396-1 Annex C**, with performance verified during commissioning by a **NABL-accredited laboratory**. Complete with testing, commissioning, integrity testing, O&M manuals, one complete set of replacement filter elements for each filter stage, and a **minimum 2-year comprehensive on-site warranty**.		
5.4	**Medical Air Pressure Reducing System:** Supply, installation, testing and commissioning of a **fully redundant duplex Medical Air Pressure Reducing System** suitable for the **12,000 LPM Medical Compressed Air Plant**, comprising **100% Duty + 100% Standby pressure reducing assemblies** with automatic duty/standby operation and manual bypass arrangement to ensure uninterrupted supply during maintenance or failure. The system shall provide **independent regulated distribution headers for Medical Air (4 bar)** and **Surgical Air (7 bar)**, each comprising duplex pressure regulators, pressure relief valves, inlet and outlet isolation valves, non-return valves, particulate filters, pressure gauges, digital pressure transmitters, high/low pressure switches, pressure monitoring ports and all associated interconnecting pipework and fittings. The pressure regulators shall maintain outlet pressure within **±5% of the set pressure** under all operating conditions and shall be sized for the **full plant duty of 12,000 LPM** without excessive pressure drop. The complete assembly shall be mounted on a rigid stainless steel manifold frame, factory assembled and tested, and provided with local visual indication, alarm contacts, and **Ethernet/Modbus TCP/IP communication** for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. The pressure reducing system shall comply with **ISO 7396-1** and **HTM 02-01**. Complete with testing, commissioning, pressure stability validation, O&M manuals, calibration certificates, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
5.4	**High-Pressure Medical Compressed Air Flexible Hose (Pigtail):** Supply, installation, testing and commissioning of **high-pressure flexible Medical Compressed Air hose assemblies (pigtails)** complete with cylinder/compressor connection, manifold connection, stainless steel end fittings, non-return valve (where specified), sealing washers and all accessories. The hose shall be **black in colour** for compressed air service, manufactured from reinforced, non-kinking, oil-resistant and moisture-resistant material compatible with medical compressed air, with a **minimum working pressure of 16 bar(g)** and a **minimum burst pressure of four (4) times the working pressure**.	As per design	Mtrs

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	Each hose assembly shall be factory pressure-tested, suitable for continuous compressed air service, and compatible with the medical air compressor and pressure reducing system. The hose assembly shall comply with **ISO 7396-1** and **ISO 21969 (High-pressure Flexible Connections for Medical Gas Systems)**. Complete with testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
6	**VACUUM SYSTEM**		
6.1	**Medical Vacuum Plant:** Supply, installation, testing and commissioning of a **Triplex Medical Vacuum Plant** comprising **three (3) oil-free rotary vane vacuum pumps** configured as **2 Duty (automatic alternating) + 1 Standby (N+1 redundancy)**. The installed system shall have a **minimum duty capacity of 12,000 LPM (±5%)**, adequately sized to meet the diversified peak demand of the approved Medical Gas Outlet Schedule and a minimum **20% provision for future expansion**, while maintaining one complete pump on standby at all times. The system shall comprise **duplex (100% Duty + 100% Standby) hydrophobic bacterial/viral filtration assemblies** at the plant inlet with **minimum 99.9999% bacterial retention efficiency and 99.99% viral retention efficiency**, **minimum two (2) vertical vacuum receivers of 3000 litres each**, automatic condensate drains (where applicable), inlet isolation valves, non-return valves, vacuum regulators, vacuum gauges, digital vacuum transmitters, vacuum switches, pressure monitoring ports and all accessories required for complete installation. The plant shall be provided with a **PLC/HMI-based intelligent control panel** incorporating automatic duty rotation, load sharing, automatic standby changeover, cyclic alternation, fault diagnostics, event logging, runtime equalisation, automatic restart after power restoration, local audible and visual alarms, and **Ethernet/Modbus TCP/IP communication** for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. Additional bacterial/viral filters at terminal units shall be provided only where required by the approved Infection Control Risk Assessment (ICRA) and clinical application. The complete system shall comply with **ISO 7396-1**, **ISO 10079-3**, **ISO 8573** (where applicable), **HTM 02-01**, **IEC 60204-1**, and **IEC 61439**. Complete with factory acceptance testing (FAT), site acceptance testing (SAT), performance validation, commissioning, operator training, O&M manuals, calibration certificates, recommended spare parts, and a **minimum 2-year comprehensive on-site warranty** covering the complete	1	Set

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	vacuum plant, receivers, filtration system, controls, instrumentation, accessories and software		
6.2	**Medical Vacuum Receivers:** Supply, installation, testing and commissioning of **two (2) vertical Medical Vacuum Receivers**, each of **minimum 5000 litres capacity**, complete with inlet and outlet isolation valves, vacuum gauges, digital vacuum transmitters, vacuum switches, automatic condensate drain arrangement (where applicable), inspection opening/manhole, supports, foundation bolts and all accessories required for complete installation. The receivers shall be fabricated from **IS 2062 Grade B carbon steel or equivalent**, internally protected with corrosion-resistant epoxy coating suitable for medical vacuum service and externally finished with anti-corrosive epoxy/polyurethane coating. Each receiver shall be designed for full vacuum service and tested in accordance with applicable statutory requirements. The receivers shall be installed in parallel with individual isolation valves to permit inspection and maintenance without interruption of system operation. The complete assembly shall comply with **ASME Section VIII Division 1** or **PD 5500**, applicable **PESO requirements**, and the **Static and Mobile Pressure Vessels (Unfired) Rules [SMPV(U) Rules]**. Complete with testing, commissioning, statutory approvals, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**	2	Nos.
6.3	**Medical Vacuum Bacterial Filtration System:** Supply, installation, testing and commissioning of a **duplex (100% Duty + 100% Standby) Medical Vacuum Bacterial/Viral Filtration System** suitable for a **minimum continuous flow of 12,000 LPM**, comprising **two identical high-efficiency filtration assemblies** installed in parallel with individual isolation valves to permit filter replacement without interruption of vacuum service. Each filtration assembly shall comprise a **coarse particulate pre-filter (5 µm nominal)** for removal of gross particulates, a **fine particulate pre-filter (1 µm nominal, minimum 99.9% particle removal efficiency)**, and a **final hydrophobic sterile bacterial/viral filter of absolute 0.01 µm rating** with **minimum bacterial retention efficiency of 99.9999% and viral retention efficiency of 99.99%**. The filter housings shall be fabricated from **316L stainless steel**, designed for full vacuum service and provided with differential pressure gauges/transmitters across each filter stage, vacuum gauges, integrity testing ports, isolation valves, non-return valves, drain connections and all accessories required for complete installation. The filter elements shall be **hydrophobic, moisture-resistant, sterilizable, non-fibre shedding, high dust-holding capacity, and replaceable without contamination of the downstream system**. The complete filtration system shall be designed for the **12,000 LPM Medical Vacuum Plant** serving the **450-bed hospital**, including **630 Vacuum outlets**, **5 Major Operation Theatres**, **5 Minor Operation Theatres**, ICU/HDU, Emergency, Recovery and other critical care areas. The complete assembly shall comply with **ISO 7396-1**, **ISO 10079-3**, and **HTM 02-01**. Complete with testing, commissioning, integrity testing, O&M manuals, one complete set of replacement filter elements for each filter stage, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
6.4	**Ward Vacuum Unit:** Supply, installation, testing and commissioning	630	Nos.

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	of a **Ward Vacuum Unit** comprising **one (1) continuously variable suction regulator**, **one (1) reusable 600 ml collection jar**, and all accessories, suitable for connection to the medical vacuum terminal unit. The suction regulator shall provide an adjustable vacuum range from **0 to –760 mmHg (0 to –100 kPa)** with an integrated vacuum gauge of minimum **63 mm diameter**, accuracy **±2% Full Scale**, regulator control knob, overflow safety shut-off valve, hydrophobic bacterial filter, quick-release mounting arrangement, probe/adaptor compatible with the specified vacuum outlet, vacuum tubing, patient tubing connector and all accessories required for complete operation. The collection jar shall have a **minimum capacity of 600 ml**, manufactured from **medical-grade transparent autoclavable polysulfone or polycarbonate**, with graduated volume markings, leak-proof lid, silicone gasket, overflow protection, reusable float valve assembly and quick-connect fittings. The complete assembly shall be wall-mounted or rail-mounted as indicated in the approved drawings, suitable for continuous clinical use, and shall comply with **ISO 10079-3**, **ISO 7396-1**, and **ISO 9170-1**. Complete with testing, commissioning, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
6.5	**Surgical Suction Unit (Major/Minor Operation Theatre):** Supply, installation, testing and commissioning of a **mobile Surgical Suction Unit** comprising a **medical vacuum regulator** (analogue or digital) with calibrated vacuum gauge, mounted on a **fully welded SS304 stainless steel trolley** with anti-static swivel castors (two lockable), accessory basket and hose holder. The unit shall include **316L stainless steel regulator body and wetted parts**, overflow safety shut-off device, vacuum relief valve, **dual hydrophobic bacterial filters**, anti-foam device, quick-release jar mounting system, medical-grade silicone suction tubing, probe/adaptor compatible with the installed **ISO 9170-1** vacuum terminal unit and all accessories required for complete operation. The vacuum regulator shall provide an adjustable vacuum range of **0 to –760 mmHg (0 to –100 kPa)** with a gauge accuracy of **±2% Full Scale**. For **Major Operation Theatres**, each unit shall be provided with **two (2) reusable autoclavable polysulfone/polycarbonate collection jars**, each of **minimum 3-litre capacity**, with a **minimum free air flow rate of 120 L/min**, suitable for major surgical, trauma, cardiovascular, neurosurgical and transplant procedures. For **Minor Operation Theatres/Procedure Rooms**, each unit shall be provided with **two (2) reusable autoclavable polysulfone/polycarbonate collection jars**, each of **minimum 2-litre capacity**, with a **minimum free air flow rate of 60**	11	Nos.

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	L/min, suitable for minor surgical procedures, endoscopy, dressing rooms and day-care interventions. The complete unit shall comply with **ISO 10079-3**, **ISO 9170-1**, **ISO 7396-1**, and **IEC 60601-1**. Complete with testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.		
6.6	**Medical Vacuum Flexible Hose Assembly:** Supply, installation, testing and commissioning of **medical vacuum flexible hose assemblies** complete with vacuum pipeline connection, equipment connection, stainless steel end fittings, quick-connect couplings (where specified), sealing washers and all accessories required for complete installation. The hose shall be **yellow in colour** for vacuum service, manufactured from reinforced, non-kinking, anti-static, flexible medical-grade material resistant to collapse under full vacuum conditions and compatible with hospital disinfectants. The hose shall have a **minimum internal diameter of 10 mm (or as required for the connected equipment)** and shall be suitable for continuous operation under **full vacuum (−100 kPa)** without deformation or leakage. Each hose assembly shall be factory-tested for vacuum integrity and supplied complete with reusable hose connectors and strain-relief fittings. The hose assembly shall comply with **ISO 7396-1** and **ISO 9170-1**, and shall be fully compatible with the specified medical vacuum terminal units and suction equipment. Complete with testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	As per design	Mtrs
7	**AGSS PLANT SYSTEM (Major OT only)**		
7.1	**Anaesthetic Gas Scavenging System (AGSS) Plant:** Supply, installation, testing and commissioning of a **Duplex AGSS Plant** comprising **two (2) oil-free AGSS blowers/exhaust pumps** configured as **1 Duty + 1 Standby (100% redundancy)**. Each unit shall be sized to provide a **minimum capacity of 2,500 LPM (±5%)**, adequate to serve the diversified demand of **five (5) Major Operation Theatres** and a minimum **20% provision for future expansion**, while maintaining one complete unit on standby at all times. The system shall include inlet particulate filters, silencers, isolation valves, non-return valves, flexible connectors, vibration isolators, pressure/vacuum gauges, differential pressure switches, PLC-based automatic duty alternation, automatic standby changeover, local audible and visual alarms, and **Ethernet/Modbus TCP/IP communication** for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. The complete system shall comply with **ISO 7396-2**, **ISO 80601-2-13**, and **HTM 02-01**. Complete with testing, commissioning, performance validation, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
7.2	**AGSS Remote Indicator:** Supply, installation, testing and commissioning of an **AGSS Remote Status Indicator** for monitoring the operational status of the Anaesthetic Gas Scavenging System (AGSS). The unit shall provide continuous indication of **system operational status**, **normal operation**, **high/low pipeline vacuum**,	5	Nos

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	pump/blower failure, **power supply failure**, **high differential pressure across filters (where applicable)**, and **common fault alarm** through LED indications with audible and visual alarms. The indicator shall incorporate alarm mute, lamp test, alarm reset functions and shall be suitable for flush or surface wall mounting adjacent to the anaesthesia workstation or at other locations as indicated in the approved drawings. The unit shall communicate with the AGSS control panel through a fault-tolerant communication interface and shall support **Ethernet/Modbus TCP/IP** integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. The equipment shall comply with **ISO 7396-2** and **HTM 02-01**. Complete with all interconnecting cables, accessories, testing, commissioning, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
7.3	**AGSS Flexible Hose Assembly:** Supply, installation, testing and commissioning of **Anaesthetic Gas Scavenging System (AGSS) flexible hose assemblies** complete with equipment connection, pipeline connection, stainless steel end fittings, quick-connect couplings (where specified), sealing washers and all accessories required for complete installation. The hose shall be manufactured from reinforced, anti-static, non-kinking, medical-grade material compatible with waste anaesthetic gases and hospital disinfectants, and shall be suitable for continuous AGSS service without collapse, leakage or degradation. Each hose assembly shall be factory-tested and shall comply with **ISO 7396-2**. **No specific hose colour shall be specified; the hose shall be the manufacturer's standard colour for AGSS service and shall be permanently and legibly marked "AGSS" at intervals not exceeding 3 m and at both ends to ensure positive identification and to avoid confusion with medical gas hose assemblies.** Complete with testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	As per design	Mtr
8	**MISCELLANEOUS ITEMS**		
8.1	**Combined Electrical Control Panel for Medical Vacuum and Medical Compressed Air Systems:** Supply, installation, testing and commissioning of a **floor-mounted, free-standing Combined Electrical Control Panel** for the Medical Vacuum Plant and Medical Compressed Air Plant, complete with independent control sections for each plant and automatic cascading/sequencing logic. The panel shall incorporate a **PLC/HMI-based intelligent control system** with automatic duty rotation, load sharing, automatic standby changeover, fault diagnostics, event logging, runtime equalisation, automatic restart after power restoration, motor protection, soft starters/VFDs (where applicable), MCCBs, contactors, overload relays, phase failure/phase reversal protection, surge protection devices (SPD), control transformers, power supplies, indicating lamps, audible and visual alarms, emergency stop, digital displays for operating parameters, voltmeter, ammeter, hour meters, communication modules, and all internal wiring, terminals and accessories required for complete operation. The control panel shall support **Ethernet/Modbus TCP/IP communication** for seamless integration with the **Medical Gas Alarm Monitoring System (MGAMS)**, **Building Management System (BMS)** and other building automation systems. The enclosure shall be	1	No

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	fabricated from **minimum 2.0 mm thick CRCA sheet steel**, epoxy powder-coated to **IP54** protection class for indoor installation, with segregated power and control compartments, cable management system and engraved mimic diagram. The scope shall include complete design, manufacture, supply, installation, interconnection, plant room wiring, cabling, conduits, glands, terminations, sensors, actuators, field devices, power and control wiring, testing, commissioning and integration of all associated equipment necessary for a fully functional Medical Vacuum and Medical Compressed Air control system. **All PLC, HMI, SCADA, monitoring, communication and associated software required for complete operation of the system shall be supplied with perpetual, transferable, unrestricted licences in the name of the Employer, without recurring subscription or annual licence fees. All firmware updates, software patches and version upgrades released during the warranty period shall be provided at no additional cost.** The control panel shall comply with **IEC 61439** and **IEC 60204-1**. Complete with factory acceptance testing (FAT), site acceptance testing (SAT), testing, commissioning, O&M manuals, operator training, and a **minimum 2-year comprehensive on-site warranty**.		
9	**Medical Gas Copper Pipeline:** Supply, installation, testing and commissioning of **half-hard drawn, seamless, phosphorus-deoxidised, non-arsenical, oxygen-clean copper tubes (Cu-DHP, CW024A)** conforming to **BS EN 13348**, complete with compatible wrought copper fittings conforming to **EN 1254**. All pipes and fittings shall be factory degreased for medical gas service, internally free from oil, grease, moisture and contaminants, with both ends securely capped until installation. Copper tubes shall have permanent identification indicating the manufacturer, standard, size, wall thickness, batch/heat number and date of manufacture, and shall be accompanied by manufacturer's test certificates for chemical composition, mechanical properties, dimensional compliance and oxygen-cleanliness. The copper tubes shall be independently inspected and certified by an **NABL/IAF-accredited third-party inspection agency**. Installation shall be carried out strictly in accordance with **ISO 7396-1** and **HTM 02-01**, using **cadmium-free silver brazing alloy containing a minimum of 45% silver**, under continuous nitrogen purging to prevent internal oxidation. The scope shall include all fittings, valves, supports, hangers, anchors, sleeves, fire stopping, expansion provisions, identification bands, colour coding, gas identification labels, flow direction arrows, pipe markers, earthing/bonding (where applicable), and all accessories necessary for a complete installation. **All brazed joints in plant rooms, medical gas shafts and Operation Theatre areas shall be 100% radiographically inspected, with**		

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	random radiographic inspection of joints in other areas as directed by the Engineer-in-Charge. The completed pipeline system shall undergo pressure testing, strength testing, leak testing, cross-connection testing, cleanliness verification, gas identity verification and commissioning in accordance with **ISO 7396-1**. The Contractor shall submit complete as-built drawings, pipeline identification schedules, test reports, third-party inspection certificates, O&M manuals and commissioning records. Complete with testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
8.2	76 mm OD x 1.5 mm thick	As per design	mtr
9.1	54 mm OD x 1.2 mm thick	As per design	mtr
9.2	42 mm OD x 1.2 mm thick	As per design	mtr
9.2	28 mm OD x 0.9 mm thick	As per design	mtr
9.3	22 mm OD x 0.9 mm thick	As per design	mtr
9.4	15 mm OD x 0.9 mm thick	As per design	mtr
9.5	12 mm OD x 0.7 mm thick	As per design	mtr
10	**Area Valve Service Unit (AVSU):** Supply, installation, testing and commissioning of **Medical Gas Area Valve Service Units (AVSU)** in **6-service (5 Gas + 1 Vacuum), 4-service (3 Gas + 1 Vacuum), 3-service (2 Gas + 1 Vacuum), and 2-service (1 Gas + 1 Vacuum)** modular configurations, as indicated in the BOQ. Each AVSU shall comprise **full-port three-piece stainless steel quarter-turn ball valves** with blow-out proof stems, PTFE seats, oxygen-cleaned copper stub connections, gas-specific indexed maintenance connections compatible with the installed medical gas system, **upstream and downstream pressure gauges or digital pressure indicators**, and **dedicated pressure transmitters for continuous monitoring and integration with the Medical Gas Alarm Monitoring System (MGAMS)**. The unit shall provide permanent gas identification, colour coding, flow direction arrows and engraved identification of the clinical area served. The AVSU shall be housed in a **lockable, tamper-proof, zinc-coated mild steel enclosure** with durable epoxy powder-coated finish and a **toughened safety glass viewing window** permitting inspection of valve position and pressure indication without		

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	opening the enclosure. The enclosure shall incorporate **break-glass emergency access** while preventing unauthorised operation. All components in contact with medical gases shall be factory oxygen-cleaned and degreased. The design shall permit safe isolation and maintenance of individual clinical zones without interruption to adjacent pipeline systems. Each AVSU shall be factory assembled, pressure tested and oxygen-cleaned prior to dispatch. The complete unit shall support **Ethernet/Modbus TCP/IP or BACnet/IP** communication through the connected pressure monitoring system for integration with the **Medical Gas Alarm Monitoring System (MGAMS)** and **Building Management System (BMS)**. The complete assembly shall comply with **ISO 7396-1**, **HTM 02-01**, **ISO 15001**, and **DIN 13260-4** (where applicable). Complete with testing, commissioning, certification, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
10.1	6 gases (5 Gas+1 Vacuum)	10	Nos.
10.2	4 gases (3 Gas+1 Vacuum)	13	Nos.
10.3	3 gases (2 Gas+1 Vacuum)	42	Nos.
11	**Medical Gas Alarm Monitoring System (MGAMS):** Supply, installation, testing and commissioning of a **microprocessor/PLC-based Medical Gas Alarm Monitoring System (MGAMS)** for continuous monitoring of all medical gas and vacuum systems through pressure/vacuum transmitters installed at plant rooms, Area Valve Service Units (AVSUs) and other designated monitoring locations. The system shall continuously monitor pipeline operating conditions and generate **audible and colour-coded visual alarms** (**Green – Normal, Amber – Warning, Red – Critical**) for high/low pressure, high/low vacuum, equipment failure, sensor failure, communication failure, power failure and other abnormal operating conditions. Audible alarms shall be individually muteable without cancelling the corresponding visual indication, which shall remain active until the fault is rectified and acknowledged. The system shall comprise an **industrial-grade PLC/controller**, **minimum 10-inch colour touch-screen HMI**, pressure/vacuum transmitters, alarm repeater panels (where indicated), dual redundant power supplies with integral battery backup, redundant Ethernet communication ports, self-diagnostics, watchdog monitoring, sensor health monitoring, event logging with date/time stamping, historical trending, alarm acknowledgement records, audit trail, minimum **90 days local data storage**, data export facility, automatic notification through		

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	SMS, e-mail and mobile application to authorised personnel, and automatic time synchronisation using NTP. The MGAMS shall support **Modbus TCP/IP** and **BACnet/IP** open communication protocols for seamless integration with the **Building Management System (BMS)** and other building automation systems. **All monitoring software, HMI software, server software, communication software and associated licences shall be supplied with perpetual, transferable, unrestricted licences in the name of the Employer, without recurring subscription or annual licence fees. All firmware updates, software patches and version upgrades released during the warranty period shall be provided at no additional cost.** The complete system shall comply with **ISO 7396-1**, **HTM 02-01**, **IEC 60601-1**, and **IEC 60601-1-2**. Complete with design, supply, installation, calibration, testing, commissioning, operator training, O&M manuals, as-built documentation, and a **minimum 2-year comprehensive on-site warranty**.		
11.1	6 gases (5 Gas+1 Vacuum)	10	Nos
11.2	4 gases (3 Gas+1 Vacuum)	13	Nos
11.3	3 gases (2 Gas+1 Vacuum)	42	Nos
12	**Central Master Medical Gas Alarm System (CMGAS):** Supply, install, test and commission a **microprocessor-based Central Master Medical Gas Alarm System (CMGAS)** comprising a **minimum 32-inch industrial-grade Full HD capacitive touch display** with an interactive graphical dashboard for centralized monitoring and control of the complete Medical Gas Pipeline System (MGPS). The system shall provide continuous real-time monitoring of **all medical gas plants, manifolds, Area Valve Service Units (AVSUs), medical air systems, surgical air systems, vacuum systems, AGSS, oxygen generation plants, bulk oxygen systems and associated pipeline pressures/vacuum levels**, including duty/standby equipment status, compressor/pump operating status, oxygen purity, plant alarms and communication status. The system shall generate **audible and colour-coded visual alarms** (Green–Normal, Amber–Warning, Red–Critical) for high/low pressure, vacuum deviation, plant failure, sensor failure, communication failure and power failure, with alarm acknowledge, mute and reset functions, while maintaining visual indication until the fault is rectified. The Master Alarm System shall provide **event and alarm history with date/time stamping, trend graphs, user authentication, password-protected access, self-diagnostics, battery backup, Ethernet and Wi-Fi connectivity**, and secure remote monitoring through **SMS, e-mail and mobile application** (where supported by the OEM). The system shall support **Modbus TCP/IP, BACnet, OPC UA or equivalent open communication protocols** for seamless integration with the Building Management System (BMS), SCADA and Hospital Management Systems. The platform shall be based on an **industrial embedded operating system (Windows,**	1	Nos

Medical Gas Pipeline system (MGPS)			
S.No	**Description**	**Qty**	**Unit**
	Linux, Android or equivalent) and shall be supplied complete with all controllers, communication modules, software licences, cables, mounting hardware, mouse, keyboard (where required), UPS interface, testing, commissioning, operator training and documentation. The complete system shall comply with **ISO 7396-1, HTM 02-01 Part B, NFPA 99:2021, IEC 60601-1, IEC 60601-1-2, IEC 62443 (Industrial Cybersecurity, where applicable)** and applicable BIS requirements, and shall be supplied with a **minimum 2-year comprehensive warranty**.		
13	**Medical Gas Isolation Valves:** Supply, installation, testing and commissioning of **lockable quarter-turn full-port ball isolation valves** for medical gas pipeline systems, complete with oxygen-cleaned copper stub connections, compatible fittings, valve identification tags, and all accessories required for a complete installation. The valves shall be **factory degreased for oxygen service**, suitable for the specified medical gas, and supplied with stuffed pipe sections where required for site installation. Valve bodies shall be of **forged brass or stainless steel**, with **blow-out proof stems**, **PTFE seats**, and **full-port construction** to minimise pressure drop. Each valve shall be permanently identified with the gas service and flow direction, and shall be capable of being locked in the normal operating position. The complete valve assembly shall be factory pressure-tested, oxygen-cleaned, and supplied with manufacturer's test certificates. Installation shall include all brazing, supports, identification labels, testing and commissioning necessary for a complete and operational system. The complete assembly shall comply with **ISO 7396-1**, **HTM 02-01**, and **DIN 13260-4** (where applicable). Complete with testing, commissioning, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
13.1	12 MM.	20	Nos
13.1	15 MM.	85	Nos
13.2	22 MM.	60	Nos
13.3	28 MM.	30	Nos
13.4	42 MM	24	Nos
13.5	54 MM	16	Nos
13.6	76 MM	6	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	Supply Installation Testing & Commissioning of Nurse Call System complete with the following.		
1	**Supply of VDE 0834 certified/ approved System Switch:**		
	IP System Communication Switch: Supply, installation, testing and commissioning of an **industrial-grade Layer 2 managed IP Communication System Switch**, compliant with **VDE 0834 or equivalent**, for the Nurse Call/Patient Communication System, serving as a decentralised communication node for data exchange between field devices and the central management system. The switch shall support	27	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	10/100/1000 Mbps Gigabit Ethernet, with a minimum of **16 auto-sensing RJ45 Gigabit Ethernet ports with IEEE 802.3af/at PoE**, together with a minimum of **2 Gigabit SFP uplink ports** for fibre backbone connectivity. All ports shall provide galvanic isolation and support automatic device detection. The switch shall support **VLAN, QoS, IGMP Snooping, RSTP/MSTP, SNMP v1/v2/v3, LLDP, DHCP Snooping, port mirroring, link aggregation (LACP), dual redundant ring/network topology, IEEE 802.1X port authentication, Access Control Lists (ACL), HTTPS, SSH, secure user authentication, and other industrial cybersecurity features**. The switch shall support seamless integration of nurse call stations, patient terminals, staff terminals, control workstations, annunciation panels and other IP-enabled devices, and shall be fully compatible with the hospital LAN and Building Management System (BMS), where applicable. The switch shall be of **fanless industrial design**, suitable for continuous 24×7 operation, with **dual redundant power inputs**, DIN-rail or rack mounting, LED status indicators, industrial operating temperature range, surge protection, and electromagnetic compatibility suitable for hospital environments. The complete assembly shall comply with **VDE 0834 (or equivalent)**, **IEEE 802.3**, **IEC 62368-1**, and **IEC 60601-1-2** (where applicable). **All switch firmware, management software, configuration software and associated licences required for complete operation of the system shall be supplied with perpetual, transferable, unrestricted licences in the name of the Employer, without recurring subscription or annual licence fees.** Complete with configuration, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
2	**VDE 0834 certified / approved Nurse Station Terminal**		
	Nurse Station/Ward Terminal: Supply, install, test and commission a **microprocessor-based IP Nurse Station/Ward Terminal** comprising a **minimum 7-inch capacitive colour touch screen** (or larger) protected by **toughened antimicrobial glass**, integrated handset for discrete communication, full-duplex hands-free microphone and loudspeaker with adjustable volume, and automatic switching between handset and hands-free operation. The terminal shall provide **real-time display of date, time, patient presence, staff presence, reminders, emergency calls, nurse calls, assistance calls, technical alarms and system status**, with **colour-coded priority indication** and precise identification of the originating room, bed and location in accordance with **VDE 0834**. The terminal shall maintain	50	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	event history, support call acknowledgement, transfer and escalation, and provide continuous monitoring of all connected nurse call devices. The unit shall incorporate **10/100/1000 Mbps Gigabit Ethernet interface** with **IEEE 802.3af/at Power over Ethernet (PoE)** or equivalent, RJ45 connectivity, automatic self-diagnostics, firmware upgrade capability, and seamless integration with the hospital IP network, central nurse call management system and communication server. The terminal shall be supplied complete with connection module, flush-mounted back box, mounting accessories, configuration software, cables and all necessary hardware for a complete installation. The complete system shall comply with **VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 62368-1, IEEE 802.3**, and applicable BIS requirements, and shall be supplied complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.		
3	**Supply of module providing DVI output**		
	External Display Interface Module: Supply, install, test and commission an **IP-based Display Interface Module** for interfacing the Nurse Call System with third-party LCD/LED displays supplied by the Employer. The module shall provide **HDMI and/or DisplayPort digital video output**, with **DVI compatibility where required**, and shall support a minimum **Full HD (1920 × 1080)** output resolution. The module shall display real-time nurse call notifications, emergency calls, Code Blue alerts, staff presence, technical alarms, room/bed identification, call priority, date and time, and other configurable system information. The module shall support configurable display layouts, multilingual display, automatic screen updates, and seamless integration with the Nurse Call Management Server over the hospital IP network. The equipment shall be supplied complete with all interface modules, software licences, mounting accessories, cables and connectors required for a complete installation and shall comply with **VDE 0834, IEC 62368-1, IEEE 802.3**, and other applicable international standards.	29	Nos
4	**Supply, Installation, Testing and commissioning of VDE 0834 certified/ approved Patient Handset - Without Speech**		
	Supply, install, test and commission a **VDE 0834-compliant non-voice patient handset** with an ergonomic **antimicrobial, disinfectant-resistant and impact-resistant enclosure**, incorporating a **nurse call button with integrated reassurance and finder LED**, membrane keypad with **minimum two (2) programmable call/function keys and two (2) lighting control keys**, visual status indicators, and a **minimum 2.8 m medical-grade strain-relieved detachable cable** with **auto-disconnecting safety connector (RJ45 or equivalent locking medical connector compatible with the certified nurse call system)**. The handset shall be supplied complete with wall/bed-mounted cradle, patient connection module, mounting accessories and all necessary hardware. The unit shall support automatic self-diagnostics, plug-and-play replacement, and seamless integration with the IP Nurse Call System. The handset shall comply	500	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	with **VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 62368-1 (where applicable), RoHS**, and other relevant international standards, and shall be supplied complete with testing, commissioning and a **minimum-2 year comprehensive warranty**.		
5	**Supply, Installation, Testing and commissioning of VDE 0834 certified/ approved connection module for Patient Terminal**		
	Patient Connection Module: Supply, install, test and commission a **VDE 0834-compliant Patient Connection Module** for interfacing the patient handset with the IP Nurse Call System. The module shall comprise a **colour-coded patient handset interface (RJ45 or equivalent medical connector compatible with the certified system)** incorporating an **automatic safety disconnect mechanism**, a membrane keypad with **one (1) nurse call button (red) incorporating reassurance/finder LED**, **one (1) nurse presence/cancel button (green) with status LED**, and **one medical device interface (DIN or equivalent)** for connection of compatible patient care equipment. The module shall provide automatic handset detection, communication status indication, self-diagnostics, protection against incorrect connection, and support for future expansion to bed occupancy or patient monitoring interfaces where required. The unit shall be housed in an **antimicrobial, disinfectant-resistant enclosure** and shall communicate through the **OEM-certified loop or redundant IP communication architecture**. The module shall be supplied complete with a flush-mounted back box, mounting accessories, wiring, testing, commissioning, and shall comply with VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 62368-1 (where applicable), and other applicable international standards and shall be supplied complete with testing, commissioning and a **minimum 2-year comprehensive Warranty**	500	Nos
6	**Supply, Installation, Testing and commissioning of VDE 0834 certified Room Terminal**		
	Room Terminal (Without Voice): Supply, install, test and commission a **VDE 0834-compliant IP-based Room Terminal (without voice communication and display)** suitable for installation in patient rooms and staff areas. The terminal shall comprise an **antimicrobial, disinfectant-resistant, impact-resistant enclosure** with an integrated electronic sounder/buzzer, a membrane keypad incorporating a nurse call button with finder/reassurance LED, a nurse presence/cancel button with status LED, and a minimum of **three (3) programmable function keys** for configurable system functions. The unit shall provide **a minimum of two (2) RJ45 Ethernet interfaces (or equivalent OEM-certified communication interfaces) and a minimum of five (5) programmable interfaces for connection of bathroom pull cords, corridor lamp modules, patient connection modules,**	As per design	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	Code Blue stations, bed modules, or other peripheral devices. The terminal shall support automatic device recognition, self-diagnostics, communication status indication, firmware upgrades, and seamless integration with the IP Nurse Call System using the OEM-certified loop or redundant communication architecture. The terminal shall be suitable for continuous **24×7 operation** and shall be supplied complete with flush-mounted back box, mounting accessories, wiring and all necessary hardware. The complete assembly shall comply with **VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 62368-1, IEEE 802.3**, and other applicable international standards, complete with testing, commissioning, documentation and a **minimum 2-year comprehensive warranty**.		
7	**Supply of VDE 0834 certified/ approved Patient Handset - With Speech**		
	Voice-Enabled Patient Handset: Supply, install, test and commission a **VDE 0834-compliant voice-enabled patient handset** for bedside communication, incorporating **two-way full-duplex voice communication** with the Nurse Call System through **SIP-based VoIP** (with optional H.323 interoperability where supported). The handset shall provide **nurse call**, **service call**, and **programmable assistance call** functions with voice communication, together with independent control of **minimum two lighting circuits** and provision for control of compatible room environmental functions, where provided. The handset shall comprise an **ergonomic antimicrobial, disinfectant-resistant and impact-resistant enclosure** with **minimum IPX4 splash protection**, integrated **call button with nurse symbol**, reassurance/finder LED, loudspeaker, microphone, headphone socket, adjustable automatic volume control, and a **minimum 2.4-inch graphical display (colour) or equivalent** for displaying call status, system messages and operating functions. The handset shall be provided with a **minimum 2.8 m medical-grade strain-relieved detachable cable** with **protected auto-disconnecting RJ45 or equivalent OEM-certified medical connector**, complete with bedside cradle. The unit shall support automatic self-diagnostics, plug-and-play replacement, firmware upgrades and seamless integration with the IP Nurse Call System. The handset shall comply with **VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 62368-1, IEEE 802.3**, and other applicable international standards, and shall be supplied complete with testing, commissioning, documentation and a **minimum 2-year comprehensive warranty**.	15	Nos
8	**Supply of VDE 0834 certified/ approved Small Nurse Station Terminal for smaller Wards**		

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	Communication Terminal with VoIP (Small Nurse Station Terminal): Supply, install, test and commission a **VDE 0834-compliant IP-based Communication Terminal with integrated VoIP** for use in satellite nurse stations, small wards and clinical support areas. The terminal shall provide **real-time display of ward calls, emergency calls, Code Blue alerts, staff presence, reminders and system status**, together with **two-way full-duplex SIP-based voice communication**, ward announcements and intercom functionality. The unit shall comprise a **minimum 4.3-inch colour graphical display** (or equivalent), integrated microphone and loudspeaker with echo cancellation and adjustable volume, **minimum two (2) Gigabit Ethernet (10/100/1000 Mbps) RJ45 ports** with IEEE 802.3af/at Power over Ethernet (PoE), antimicrobial and disinfectant-resistant enclosure, membrane keypad incorporating **Call, Code Blue, Query, Nurse Presence, Doctor Presence and Staff Presence buttons** with colour-coded finder/reassurance LEDs, and **minimum three (3) programmable function keys** for configurable system functions. The terminal shall support call acknowledgement, escalation, event history, automatic self-diagnostics, firmware upgrades, user authentication, ward broadcast, group paging, and seamless integration with the IP Nurse Call System, Hospital LAN, Building Management System (BMS) and VoIP communication network. The equipment shall be supplied complete with flush-mounted back box, mounting accessories, wiring, configuration software and all necessary hardware for a complete installation. The complete system shall comply with **VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 62368-1, IEEE 802.3, IEC 62443 (Cybersecurity)** and other applicable international standards, complete with testing, commissioning, documentation and a **minimum 2-year comprehensive warranty**.	As per design	Nos
9	**VDE 0834 certified/ approved Pull Cord with cancel Button for Bath area**		
	Bathroom/WC Emergency Pull Cord Unit: Supply, install, test and commission a **VDE 0834-compliant emergency bathroom pull cord call unit** comprising an **emergency pull cord with integrated call switch**, reassurance/finder LED, **nurse presence/cancel button** with status LED, and a **minimum 2.0 m replaceable pull cord** fitted with a luminous emergency grip incorporating the nurse call symbol. The pull cord shall operate a positive-action microswitch with a **minimum breaking force of 120 N**, and shall be easily replaceable by means of a snap-hook or equivalent hygienic fixing arrangement. The unit shall be housed in an **antimicrobial, disinfectant-resistant, moisture-resistant enclosure** with a **minimum ingress protection rating of IPX4** (or higher where specified), suitable for installation in bathrooms, toilets and wet areas. The device shall provide automatic self-diagnostics, communication status indication and emergency call priority, and shall communicate through the **OEM-certified loop or redundant IP communication architecture** of the Nurse Call System. The complete assembly shall comply with **VDE 0834, IEC 60601-1, IEC 60601-1-2, IEC 60529**, applicable accessibility requirements, and other relevant international standards, complete with mounting accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	198	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
10	**VDE 0834 certified/ approved Code Blue button - Doctor call-Cancel button for wards**		
	Code Blue / Doctor Call Station: Supply, install, test and commission a **VDE 0834-compliant IP-based Code Blue/Doctor Call Station** for installation in wards and critical care areas. The station shall comprise a **high-priority Code Blue/Doctor Call button (blue)** with integrated finder/reassurance LED, **Doctor Presence/Cancel button**, antimicrobial membrane keypad, integrated electronic sounder for local call confirmation, colour-coded status indicators and communication status LED. The unit shall generate the **highest-priority emergency alarm** within the Nurse Call System and provide local audible and visual confirmation, automatic event logging with date/time stamping, self-diagnostics, continuous communication monitoring and automatic fault reporting. The station shall be housed in an **antimicrobial, disinfectant-resistant, impact-resistant flush-mounted enclosure** complete with back box and mounting accessories. It shall incorporate a **minimum of two (2) Gigabit Ethernet (10/100/1000 Mbps) RJ45 ports or equivalent OEM-certified communication interfaces**, supporting **Power over Ethernet (IEEE 802.3af/at)** and the OEM-certified **loop or redundant IP communication architecture**. The station shall support integration with the **central Nurse Call Management System, SIP/VoIP communication system, mobile notification platform, Hospital Information System (HIS), Building Management System (BMS), and Code Blue management system**, where provided. Activation of the Code Blue button shall automatically generate the highest-priority alarm at all designated nurse stations, communication terminals, and central monitoring workstations, with configurable notification to authorised personnel through VoIP handsets, DECT/Wi-Fi devices, or mobile applications, where applicable. The complete assembly shall comply with **VDE 0834 Parts 1 & 2, IEC 60601-1, IEC 60601-1-2, IEC 62368-1, IEC 62443 (Cybersecurity), IEEE 802.3**, and other applicable international standards. It shall be supplied complete with software licences, testing, commissioning, operator training, documentation and a **minimum 2-year comprehensive warranty**.	111	Nos
11	**Supply of VDE 0834 certified/ approved Lamp Module**		
	Supply, install, test and commission a **VDE 0834-compliant LED Corridor Lamp Module** for visual indication of nurse calls, emergency calls, Code Blue calls, staff presence, reminders and technical alarms. The module shall comprise **high-intensity, long-life LED indicators** providing **minimum five (5) independent colour-coded visual indications** (Red, White, Green, Blue and Yellow, or equivalent configurable colours) with uniform illumination and clear visibility from a minimum distance of **20 metres** under normal hospital lighting conditions. The LEDs shall have a **minimum service life of 100,000 operating hours** and shall provide distinct visual indication of call priority and system status in accordance with the configured Nurse Call System logic. The module shall be housed in an **antimicrobial, disinfectant-resistant, impact-resistant enclosure** with a **minimum IP54 ingress protection rating**, suitable for continuous **24×7 operation**. The unit shall incorporate **minimum two**	110	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	(2) Gigabit Ethernet (10/100/1000 Mbps) RJ45 ports or equivalent OEM-certified communication interfaces, supporting **Power over Ethernet (IEEE 802.3af/at)** where applicable, and shall communicate through the **OEM-certified loop or redundant IP communication architecture**. The module shall support automatic self-diagnostics, communication status monitoring, firmware upgrades and seamless integration with the Nurse Call System. The complete assembly shall comply with **VDE 0834 Parts 1 & 2, IEC 60529, IEC 60601-1, IEC 60601-1-2, IEEE 802.3**, and other applicable international standards, and shall be supplied complete with mounting accessories, testing, commissioning, documentation and a **minimum 2-year comprehensive warranty**.		
12	**Networking, Software & Integration**		
	Supply of Management center - Nurse Call Server		
	Supply, install, test and commission a **high-availability Central Nurse Call Management Server** for centralized configuration, monitoring, firmware management, event logging, reporting, diagnostics and remote maintenance of the complete IP-based Nurse Call System. The server shall comply with **VDE 0834 Parts 1 & 2** and shall support centralized system configuration, firmware distribution, event and alarm management, audit trails, user administration, remote diagnostics, and integration with third-party systems including the **Hospital Information System (HIS), Building Management System (BMS), Fire Alarm System, Code Blue System and VoIP communication platform**, where provided. The server shall be based on a **current-generation enterprise server platform** with a **minimum 8-core server-grade processor (or equivalent performance), minimum 32 GB ECC RAM, redundant hot-swappable SSD storage configured in RAID-1 or better, hardware RAID controller, dual hot-swappable redundant power supplies, dual 10/100/1000 Mbps Gigabit Ethernet ports with failover, USB 3.0 or higher interfaces**, and support virtualization platforms such as **VMware, Hyper-V, Proxmox or equivalent**. The system shall be deployed in a **redundant active-passive or clustered high-availability configuration** to ensure uninterrupted operation. The server shall operate on a **currently supported enterprise Windows Server or Linux operating system**, incorporate automatic backup and restore, NTP time synchronization, UPS interface for graceful shutdown, encrypted HTTPS/TLS communication, role-based user authentication, audit logging, and cybersecurity features compliant with **IEC 62443**. The complete system shall support **HL7/FHIR, SIP, BACnet, Modbus TCP/IP or equivalent open communication protocols**, where applicable, and shall be supplied complete with all operating system licences, database software, application software, configuration tools, testing, commissioning, documentation, operator training and a **minimum 2-year comprehensive warranty**.	1	Nos
13	**Supply of Backbone Switch**		
	Network Backbone/Floor Switch: Supply, installation, testing and commissioning of **enterprise-grade managed Layer-2/Layer-3 Ethernet Backbone Switches**, supplied as a **minimum of two (2) switches** configured in a **redundant high-**	2	Nos

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	availability architecture to eliminate any single point of failure in the IP-based Nurse Call System network. Each switch shall provide a minimum of **twenty-four (24) auto-negotiating 10/100/1000 Mbps Gigabit RJ45 ports** and **four (4) SFP/SFP+ uplink ports** supporting **1 Gbps and 10 Gbps** optical fibre connectivity. Each switch shall support **IEEE 802.3**, **IEEE 802.3af/at Power over Ethernet (PoE/PoE+)** where required, **VLAN (IEEE 802.1Q)**, **QoS**, **IGMP Snooping**, **LACP**, **RSTP/MSTP**, **IPv4/IPv6**, **static routing**, **Layer-3 switching**, **SNMP v3**, **DHCP Snooping**, **Dynamic ARP Inspection**, **IEEE 802.1X port authentication**, **Access Control Lists (ACLs)**, **port security**, and secure device management through **HTTPS** and **SSH**. The switches shall operate in a **redundant high-availability configuration** with automatic failover and recovery, interconnected through redundant high-speed fibre uplinks, and shall support resilient network protocols to ensure uninterrupted communication between all Nurse Call devices, servers, workstations and peripheral equipment in the event of failure of any single switch, uplink or communication path. The switches shall be fully compatible with the Hospital LAN, Nurse Call System, VoIP network, Building Management System (BMS) and other authorised IP-based hospital systems. Each switch shall be suitable for continuous **24×7** operation and shall be provided with **dual hot-swappable redundant power supplies**, industrial-grade surge protection, comprehensive diagnostic LEDs, rack-mounting accessories, optical transceivers, fibre patch cords and all accessories necessary for a complete installation. The switches shall comply with **IEEE 802.3** and **IEC 62368-1**. **All switch firmware, management software, configuration software and associated licences required for complete operation of the system shall be supplied with perpetual, transferable, unrestricted licences in the name of the Employer, without recurring subscription or annual licence fees. All firmware updates, software patches and version upgrades released during the warranty period shall be provided at no additional cost.** Complete with configuration, testing, commissioning, documentation, operator training, and a **minimum 2-year comprehensive on-site warranty**		
14	**Software- Event Database Software**		

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	Supply, install, configure, test and commission **Event Database and Management Software** for the IP-based Nurse Call System, installed on the Central Nurse Call Management Server. The software shall automatically record, archive and manage all system events in real time, including but not limited to **patient calls, emergency calls, Code Blue calls, staff presence, doctor presence, call acknowledgements, reminders, technical alarms, communication failures, equipment faults, user logins, configuration changes and system diagnostics**. The software shall maintain a secure **date/time-stamped audit trail**, provide configurable event filtering, searching, sorting, reporting and graphical dashboards, and support automatic report generation and data export in standard formats (CSV, PDF or equivalent). The application shall support configurable event retention, automatic database backup and restoration, role-based user authentication, password protection, audit logging, encrypted communications, and remote diagnostics. It shall provide interfaces for integration with the Hospital Information System (HIS), Building Management System (BMS), Fire Alarm System, Code Blue System, and other authorised third-party systems through HL7/FHIR, SIP, BACnet, Modbus TCP/IP, **or equivalent open communication protocols**, where applicable. The software shall support multi-user operation, centralized configuration management, firmware management, real-time notifications, and secure remote access. The complete software shall comply with **VDE 0834 Parts 1 & 2, IEC 62443 (Industrial Cybersecurity), IEC 80001-1 (Risk Management for Medical IT Networks), ISO/IEC 27001**, and other applicable international standards, and shall be supplied complete with all perpetual software licences, database licences (where applicable), installation, configuration, testing, commissioning, operator training, documentation, and **minimum 5 years of software updates and technical support**.	1	Nos
15	**Cyber Security**		
	Network Security / Firewall: The Nurse Call System network shall be protected by an **enterprise-grade Next Generation Firewall (NGFW)** supplied, installed, configured and commissioned as part of the system. The firewall shall support **stateful packet inspection, deep packet inspection (DPI), application awareness and control, Intrusion Prevention System (IPS), Intrusion Detection System (IDS), anti-malware protection, URL filtering, geo-IP filtering, Denial-of-Service (DoS/DDoS) protection, VPN (IPSec and SSL), NAT, VLAN segmentation, access control policies, secure remote maintenance, logging and audit trails**. The firewall shall support **a minimum of 1 Gbps firewall throughput, a minimum of 500 Mbps IPS throughput, a minimum of 250 concurrent SSL VPN sessions, and not less than 1 million concurrent sessions, with support for IPv4/IPv6, High Availability (Active/Standby), automatic configuration backup, centralis**ed management, and role-based administration. The firewall shall support secure communication protocols including **HTTPS, TLS 1.2/1.3, SSH, SNMPv3, Syslog, RADIUS, LDAP/Active Directory**, and integration with SIEM platforms where applicable. The complete cybersecurity architecture shall comply with **IEC 62443 (Industrial Cybersecurity), IEC 80001-1 (Risk Management for IT Networks Incorporating**		

Nurse Call System			
S.No	**Particulars**	**Qty**	**Unit**
	Medical Devices), ISO/IEC 27001, IEEE 802.1X, and applicable CERT-In guidelines. The firewall shall be supplied complete with all software licences (perpetual), security subscriptions (perpetual), configuration, testing, commissioning, documentation and integration with the hospital IT infrastructure.		

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	Supply & installation Testing & Commissioning of Curtain Track & I.V. Hanger System		
1	**CURTAIN TRACK :**		
	Cubicle Curtain Track System: Supply, install, test and commission a **ceiling-mounted cubicle curtain track system** fabricated from **extruded aluminium alloy (minimum grade 6063-T5/T6 or equivalent)** with a minimum **25-micron polyester powder-coated finish**, complete with suspension hangers, wall brackets, concealed fixing accessories, bends, connectors, end caps, end stops and all hardware required for a complete installation. The track shall be fitted with **self-lubricating nylon rollers/runners** and **SS 304 hooks**, ensuring smooth, silent and snag-free movement. The curtain shall be manufactured from **healthcare-grade polyester fabric** having **antimicrobial, antifungal, water-repellent, and stain-resistant properties, suitable for repeated hospital laundering at a minimum of 70°C**. The fabric shall comply with **BS 5867 Part 2 Type C, NFPA 701, IS 15741, or equivalent internationally recognized flame-retardant standard**. An **open mesh panel of approximately 450 mm (18 inches)** at the top shall be provided **where required**. Curtain size shall be as indicated in the approved drawings, with adequate fullness (minimum 80%) to ensure complete patient privacy. The system shall incorporate **quick-release curtain removal** for easy laundering and replacement without dismantling the track and shall be suitable for continuous use in hospitals. The complete system shall comply with **NABH infection control guidelines**, applicable fire safety requirements, and relevant **BIS/international standards**. It shall be supplied complete with all accessories, testing, commissioning and a **minimum 2-year warranty**.	500	Beds
2	**IV Hanger System**		

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	Ceiling-Mounted I.V. Hanger: Supply, install, test and commission a **ceiling-mounted movable I.V. hanger** compatible with the **dedicated I.V. carrier channel of the specified integrated cubicle curtain track system**. The unit shall comprise a **height-adjustable SS 304 stainless steel pole** with a mirror-polished finish, minimum 25 mm OD, fitted with a minimum of **five (5) stainless steel hooks** and having a **minimum safe working load of 15 kg**. The pole shall be suspended from a **low-friction nylon or sealed ball-bearing trolley** to ensure smooth, silent and independent movement along the track without interfering with curtain operation. All exposed components shall be corrosion-resistant and suitable for repeated hospital cleaning and disinfection. The complete assembly shall include all compatible trolley fittings, connectors and accessories required for installation and shall comply with applicable **BIS standards**, **NABH Infection Prevention and Control requirements**, and accepted hospital engineering practices, complete with testing, commissioning and a **minimum 2-year warranty**.	500	Beds
3	**Wall and Corner Guard System**		
	Corner Guard System: Supply, installation, testing and commissioning of a **heavy-duty healthcare Corner Guard System** comprising a **minimum 3.0 mm thick solid through-coloured high-impact engineered polymer cover** specifically manufactured for healthcare wall protection systems, mounted on a **continuous heavy-duty extruded aluminium retainer of minimum 2.0 mm thickness** with concealed mechanical fixings. The system shall incorporate **continuous energy-absorbing resilient cushions** between the impact cover and the aluminium retainer to absorb repeated impacts from hospital beds, stretchers, wheelchairs, trolleys and mobile medical equipment without permanent deformation, cracking or delamination. Corner guards shall have **equal wing dimensions of 75 mm × 75 mm** and a **minimum height of 1500 mm above finished floor level**, unless otherwise indicated in the approved drawings. The exposed surface shall be **smooth, non-porous, through-coloured, scratch-resistant, stain-resistant, UV-stable, graffiti-resistant, and resistant to repeated cleaning with hospital-grade disinfectants**, including sodium hypochlorite, hydrogen peroxide, quaternary ammonium compounds, alcohol-based disinfectants and phenolic cleaning agents, without deterioration of colour, finish or performance. The surface shall **not support microbial growth** and shall be free from sharp edges. The system shall be supplied complete with factory-manufactured end caps, transition pieces, internal and external corner accessories, joint covers and all accessories necessary for a continuous hygienic installation.	As per design	Mtr.

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	The aluminium retainer shall be corrosion-resistant and securely fixed using concealed mechanical fasteners suitable for the wall substrate. The impact cover shall be **snap-fit and individually replaceable** without removal of the aluminium retainer. The complete system shall be supplied in the manufacturer's standard colour as approved by the Engineer-in-Charge. The complete corner guard system shall comply with **EN 13501-1** with a minimum **Class B-s2,d0** reaction to fire. Complete with all accessories, cutting, jointing, fixing, testing, cleaning, manufacturer's installation instructions, and a **minimum 2-year comprehensive on-site warranty**.		
	Corner Guard System: Supply, installation, testing and commissioning of a **heavy-duty healthcare Corner Guard System** comprising a **minimum 3.0 mm thick solid through-coloured high-impact engineered polymer cover** specifically manufactured for healthcare wall protection systems, mounted on a **continuous heavy-duty extruded aluminium retainer of minimum 2.0 mm thickness** with concealed mechanical fixings. The system shall incorporate **continuous energy-absorbing resilient cushions** between the impact cover and the aluminium retainer to absorb repeated impacts from hospital beds, stretchers, wheelchairs, trolleys and mobile medical equipment without permanent deformation, cracking or delamination. Corner guards shall have **equal wing dimensions of 75 mm × 75 mm** and a **minimum height of 1500 mm above finished floor level**, unless otherwise indicated in the approved drawings. The exposed surface shall be **smooth, non-porous, through-coloured, scratch-resistant, stain-resistant, UV-stable, graffiti-resistant, and resistant to repeated cleaning with hospital-grade disinfectants**, including sodium hypochlorite, hydrogen peroxide, quaternary ammonium compounds, alcohol-based disinfectants and phenolic cleaning agents, without deterioration of colour, finish or performance. The surface shall **not support microbial growth** and shall be free from sharp edges. The system shall be supplied complete with factory-manufactured end caps, transition pieces, internal and external corner accessories, joint covers and all accessories necessary for a continuous hygienic installation. The aluminium retainer shall be corrosion-resistant and securely fixed using concealed mechanical fasteners suitable for the wall substrate. The impact cover shall be **snap-fit and individually replaceable** without removal of the aluminium retainer. The complete system shall be supplied in the manufacturer's standard colour as approved by the Engineer-in-Charge.	As per design	Mtr.

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	The complete corner guard system shall comply with **EN 13501-1** with a minimum **Class B-s2,d0** reaction to fire. Complete with all accessories, cutting, jointing, fixing, testing, cleaning, manufacturer's installation instructions, and a **minimum 2-year comprehensive on-site warranty**.		

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Central Sterile Supply Department (CSSD) complete with the following		
Part A	**CSSD Furniture Equipment**		
1	**Steam Sterilizer (Pass-Through, Double Door):** Supply, install, test and commission a **fully automatic horizontal pass-through double-door Steam Sterilizer** of **1450–1500 litre chamber capacity (minimum 18 STU)** complete with **minimum two (2) internal transfer trolleys, two (2) external loading/unloading trolleys and eighteen (18) SS 304 baskets**. The sterilizer shall have an **SS 316L chamber and jacket**, PLC-based automatic cycle control, **minimum 15-inch colour touch-screen HMI**, independent pressure and temperature monitoring, electronic cycle recording, USB/Ethernet connectivity, and interface with the CSSD tracking and barcode system. It shall perform **automatic Bowie-Dick/Helix tests**, vacuum leak tests, and support **Class 5/Class 6 chemical indicators for every load** and **biological indicator monitoring** in accordance with **ISO 17665-1** and the hospital sterilization quality assurance programme. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training. The sterilizer shall comply with **EN 285, ISO 17665-1, ISO 17665-2, ISO 11140, IEC 61010**, and applicable BIS requirements, and shall be **CE certified under EU MDR 2017/745 by a Notified Body** and manufactured under an **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.	1	Nos.
2	**Steam Sterilizer (Pass-Through, Double Door):** Supply, install, test and commission a **fully automatic horizontal pass-through double-door Steam Sterilizer** of **850–900 litre chamber capacity (minimum 12 STU)** complete with **minimum two (2) internal transfer trolleys, two (2) external loading/unloading trolleys and twelve (12) SS 304 baskets**. The sterilizer shall have an **SS 316L chamber and jacket**, PLC-based automatic controls, **minimum 15-inch colour touch-screen HMI**, electronic cycle recording, and USB/Ethernet connectivity with provision for CSSD tracking and barcode integration. The system shall perform **automatic Bowie-Dick/Helix and vacuum leak tests**, support **Class 5/Class 6 chemical indicators for every load** and **biological indicator monitoring** in accordance with the hospital's sterilization quality assurance programme. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training. The sterilizer shall comply with **ISO 17665-1, EN 285, ISO 11140, IEC 61010**, applicable **BIS requirements**, and shall be **CE certified under EU MDR 2017/745 by a Notified Body** and manufactured under an **ISO 13485-certified Quality Management System**. All certifications shall	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	be issued by accredited independent third-party certification bodies. The complete system shall be supplied with a **minimum 2-year comprehensive warranty**.		
3	**Low Temperature Steam Formaldehyde (LTSF) Sterilizer (Pass-Through, Double Door):** Supply, install, test and commission a **fully automatic horizontal pass-through double-door LTSF Sterilizer** of **400–450 litre chamber capacity (minimum 6 STU)** complete with **minimum one (1) internal transfer trolley, two (2) external loading/unloading trolleys and six (6) SS 304 baskets (1 STU each)**. The sterilizer shall have an **SS 316L chamber**, PLC-based automatic cycle control, **minimum 15-inch colour touch-screen HMI**, electronic cycle recording, USB/Ethernet connectivity, and interface with the CSSD tracking and barcode system. The system shall perform validated low-temperature steam formaldehyde sterilization cycles with automatic leak testing and process monitoring, and support routine validation using chemical and biological indicators in accordance with the hospital sterilization quality assurance programme. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training, and shall comply with **EN 14180, ISO 25424, ISO 11140, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and manufactured under an **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.	3	Nos.
4	**Double-Door Washer/Disinfector:** Supply, install, test and commission a **fully automatic pass-through double-door Washer/Disinfector** with **minimum 15 DIN capacity**, complete with **minimum two (2) internal surgical instrument trolleys, two (2) external loading/unloading trolleys and fifteen (15) stainless steel 1-DIN instrument trays**. The washer/disinfector shall be suitable for automated cleaning, thermal disinfection and drying of surgical instruments and reusable medical devices through programmable **pre-wash, enzymatic/detergent wash, rinsing, thermal disinfection and hot-air drying** cycles. Thermal disinfection shall achieve a **minimum A_0 value of 3000** (minimum **A_0 600** for heat-sensitive items where applicable) in accordance with **EN ISO 15883-1 and EN ISO 15883-2**. The unit shall have a PLC-based control system with **minimum 15-inch colour touch-screen HMI**, electronic cycle recording, USB/Ethernet connectivity, and interface with the CSSD tracking and barcode system. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training, and shall comply with **EN ISO 15883-1/-2, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and manufactured under an **ISO**	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	13485-certified Quality Management System, with a **minimum 2-year comprehensive warranty**.		
5	**Ultrasonic Cleaner (Bench Top):** Supply, install, test and commission a **bench-top Ultrasonic Cleaner** of **minimum 45-litre capacity**, suitable for operation on **230 V ±10%, 50 Hz AC** supply. The unit shall comprise a **SS 304/316 stainless steel tank** with ultrasonic transducers operating at **approximately 40 kHz**, a solid-state ultrasonic generator, thermostatically controlled electric heating, digital temperature and timer controls, stainless steel basket and lid, drain valve, and electronic safety/overload protection. The equipment shall be suitable for ultrasonic cleaning of surgical instruments using approved cleaning solutions and shall be supplied complete with testing, commissioning and operator training. The equipment shall comply with **IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.	2	Nos.
6	**Endoscope Reprocessing System (ERS):** Supply, install, test and commission a **fully automatic Endoscope Reprocessing System (AER/ERS)** for cleaning, leak testing, washing, high-level disinfection, rinsing and drying of flexible endoscopes, complete with integrated chemical dosing, channel irrigation, leak detection, self-disinfection cycle and **aseptic storage cabinet** for maintaining endoscope integrity after reprocessing. The system shall provide validated, programmable reprocessing cycles with electronic cycle recording, barcode/RFID traceability, USB/Ethernet connectivity, and interface capability with the hospital endoscope tracking system where provided. The equipment shall be supplied complete with all accessories, IQ/OQ/PQ validation, testing, commissioning and operator training. It shall comply with ISO 15883-1, ISO 15883-4, ISO 14937, IEC 61010, applicable BIS requirements, be CE certified under EU MDR 2017/745 by a Notified Body. The manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.	1	Nos.
7	**CSSD Tracking & Barcoding Software:** Supply, install, test and commission a **CSSD Tracking & Barcoding Software** complete with **minimum 21-inch touch-screen workstation**, **Intel Core i7 or equivalent processor**, minimum **16 GB RAM**, **512 GB SSD**, Gigabit Ethernet connectivity, barcode scanner, barcode label printer, keyboard and mouse, operating on a **currently supported Windows Professional or Enterprise operating system**. The software shall provide end-to-end tracking and traceability of instruments and sterile sets from decontamination through washing, packing, sterilisation, storage and issue, with unique barcode identification, user authentication, electronic cycle data capture from all washer/disinfectors and sterilisers, inventory management, tray configuration, audit trail, real-time dashboards, reporting and recall management. The software shall support integration with the Hospital Information System (HIS) through **HL7 or**	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	equivalent, and interface with all supplied CSSD equipment through **Ethernet/USB** for automatic import of cycle records. The system shall comply with **ISO 13485**, **ISO 14971**, **IEC 62304** (where applicable), applicable **BIS requirements**, and shall be **CE certified under EU MDR 2017/745** (where classified as a medical device), complete with software licences (perpetual), configuration, data backup, testing, commissioning, user training.		
8	**Rotary Heat Sealing Machine:** Supply, install, test, and commission a microprocessor-controlled continuous rotary heat-sealing machine suitable for sealing medical-grade sterilis**ation reels and paper/plastic laminate pouches**. The unit shall provide **validated seals** with adjustable temperature and sealing speed, digital display, automatic seal monitoring with alarm, and electronic recording of sealing parameters. The machine shall be compatible with the CSSD tracking and barcoding system and comply with **ISO 11607-1 & 2, EN 868, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	2	Nos.
9	**Air & Water Spray Gun:** Supply, install, test and commission an **Air & Water Spray Gun** suitable for manual pre-cleaning of surgical instruments, cannulated devices, catheters, cannulas, pipettes and syringes. The unit shall be designed for connection to **compressed medical air and treated water**, with independent trigger control, adjustable spray pressure, interchangeable nozzles, flexible hose, and **SS 304 construction** for wetted parts. The equipment shall comply with applicable **IEC 61010**, **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	2	Nos.
10	**UV-C Disinfection Robot:** Supply, install, test and commission an **autonomous UV-C Disinfection Robot** for terminal disinfection of operating theatres, isolation rooms, ICUs and other critical hospital areas. The robot shall provide **360° UV-C irradiation** with autonomous or assisted navigation to achieve uniform room disinfection while minimizing shadowed areas, and shall incorporate obstacle detection, emergency stop, motion sensors and automatic UV shut-off upon human entry for operator safety. The unit shall be constructed from **corrosion-resistant material**, be compact and easily movable, and include a **minimum 7-inch colour touch-screen display**, remote operation, electronic cycle recording, storage of **minimum 10,000 disinfection records**, USB/Ethernet/Wi-Fi connectivity for data transfer, and visual and audible alarms. The system shall support validated room disinfection cycles with configurable exposure parameters and printable/electronic reports. The equipment shall comply with **IEC 62471, IEC 61010**, applicable	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	BIS requirements, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.		
11	**Disinfection and Decontamination Device:** Supply, install, test and commission a **Disinfection and Decontamination Device** for manual pre-cleaning of reusable medical devices and surgical instruments. The unit shall comprise an **ergonomically designed hand-insert cleaning chamber with integrated seating/workstation**, controlled water and compressed air flushing system, splash protection, SS 304/316 construction, and provision for connection to treated water and compressed air. The equipment shall be suitable for cleaning cannulated and non-cannulated instruments before automated reprocessing. The unit shall comply with applicable **IEC 61010**, **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	1	Nos.
12	**Ethylene Oxide (ETO) Steriliser: Supply, install, test, and commission a fully automatic Ethylene Oxide (ETO) steriliser with a minimum 250-litre chamber capacity, suitable for sterilis**ation of heat- and moisture-sensitive medical devices. The unit shall have an **SS 316L chamber**, PLC-based automatic cycle control with **a minimum 7-inch colour touch-screen HMI, programmable sterilisation and aeration cycles, automatic temperature, humidity, pressure,** and gas concentration control, electronic cycle recording, and integrated safety interlocks with exhaust and catalytic/aeration system. The equipment shall comply with **ISO 11135, ISO 14937, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**. The system shall be supplied complete with IQ/OQ/PQ validation, testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	1	Nos.
Part B	**Furniture for CSSD**		
12	**Double-Door Drying Cabinet:** Supply, installation, testing, and commissioning of a fully automatic pass-through double-door drying cabinet with a minimum 275-litre usable chamber capacity, designed for drying cleaned and disinfected surgical instruments, anaesthesia equipment, hollow instruments, glassware, and reusable medical devices. The cabinet shall	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	comprise a **minimum SS 304 stainless steel inner chamber** with smooth radiused corners and a **minimum 1.2 mm thick epoxy polyester powder-coated CRCA steel outer enclosure** mounted on a rigid structural frame. The unit shall be provided with **interlocked double doors** to maintain segregation between clean and sterile areas and prevent simultaneous opening. The drying cabinet shall incorporate **forced hot-air circulation** with HEPA-filtered intake air (**minimum H14 efficiency as per EN 1822**), adjustable drying temperature from **40°C to 90°C**, digitally controlled heating system with **minimum 2 kW stainless steel heating elements**, PLC-based automatic operation with **minimum 7-inch colour touch-screen HMI**, programmable drying cycles, digital temperature display, cycle timer, automatic cool-down cycle, over-temperature protection, door safety interlocks, visual and audible fault alarms, and electronic cycle recording with USB/Ethernet connectivity. The cabinet shall provide uniform temperature distribution throughout the chamber, with automatic shutdown upon completion of the drying cycle. The system shall be suitable for continuous 24×7 operation and shall be supplied complete with adjustable stainless steel shelves/racks, all accessories, IQ, OQ and PQ validation, calibration, testing, commissioning, operator training and O&M manuals. The drying cabinet shall comply with **IEC 61010**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and shall be manufactured under an **ISO 13485-certified Quality Management System**. Complete with a **minimum 2-year comprehensive on-site warranty**.		
13	**Stainless Steel Washing Station (Double Sink):** Supply, installation, testing and commissioning of a **double-sink Stainless Steel Washing Station** for the decontamination area of the Central Sterile Supply Department (CSSD), complete with two deep seamless sinks, integral drain boards, backsplash, splash guards, and all accessories required for complete installation. The unit shall be fabricated entirely from **minimum 1.5 mm thick AISI 304 stainless steel** with continuously welded construction, ground smooth and polished to a satin finish. All exposed edges shall be rounded, and all internal corners shall have a minimum radius of **25 mm** to facilitate cleaning and prevent accumulation of contaminants. The washing station shall have **two deep bowls of minimum 500 mm × 500 mm × 350 mm**, complete with removable perforated stainless steel strainers, anti-splash overflow, heavy-	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	duty waste fittings, and corrosion-resistant bottle traps. The worktop shall incorporate **integral sloping drain boards** on both sides with raised edges and a **minimum 150 mm high integral backsplash**. The station shall be mounted on heavy-duty stainless steel tubular legs with adjustable stainless steel levelling feet and shall be capable of supporting dynamic operational loads without deformation. The unit shall be provided complete with **gooseneck swivel spout mixing faucets**, elbow-operated controls, thermostatic mixing valve, treated water and hot/cold water connections, air and water spray gun with flexible hose for instrument flushing, provision for connection to compressed air, and all pipework, valves, traps, fittings and accessories necessary for complete operation. The design shall minimise splashing and facilitate one-way workflow within the decontamination area. The complete assembly shall comply with **EN ISO 15883-1** (manual pre-cleaning workflow requirements), **IEC 61010** (where applicable), and shall be manufactured under an **ISO 13485-certified Quality Management System**. Complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
14	**Stainless Steel Control & Packing Table:** Supply, installation, testing and commissioning of a **CSSD Control & Packing Table** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The table shall have minimum dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)**, with a reinforced worktop, **100 mm high rear upstand**, full-width undershelf, minimum three lockable drawers, adjustable storage shelf, and provision for mounting an inspection lamp, barcode scanner, barcode printer and heat sealer. The table shall be supported on heavy-duty stainless steel tubular legs with adjustable levelling feet and shall be resistant to corrosion and hospital-grade disinfectants. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
15	**Stainless Steel Linen Folding Table:** Supply, installation, testing and commissioning of a **CSSD Linen Folding Table** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The table shall have minimum dimensions of **1800 mm (L) × 900 mm (W) × 900 mm (H)** with a reinforced smooth worktop, **100 mm high rear upstand**, full-width undershelf, and heavy-duty stainless steel tubular legs with adjustable levelling feet. The work surface shall be non-porous, corrosion-resistant, easy to clean, and resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
16	**Stainless Steel Storage Shelf:** Supply, installation, testing and commissioning of a **free-standing Stainless Steel Storage Shelf** for CSSD, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The unit shall have minimum overall dimensions of **1200 mm (L) × 600 mm (W) × 1800 mm (H)** and shall be provided with **five (5) adjustable stainless steel shelves**, each capable of supporting a uniformly distributed load of **not less than 100 kg**. The shelf shall be supported on a heavy-duty stainless steel tubular frame with cross bracing and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete unit shall be corrosion-resistant, non-porous, easy to clean, and resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	5	Nos.
17	**Stainless Steel Pass Box:** Supply, installation, testing and commissioning of a **double-door Stainless Steel Pass Box** for transfer of sterilized materials within the CSSD, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The pass box shall have **minimum internal dimensions of 600 mm × 600 mm × 600 mm** and shall be provided with **interlocked double doors** incorporating **toughened safety glass viewing panels**, ensuring that both doors cannot be opened simultaneously. The unit shall be fitted with **EPDM door gaskets**, heavy-duty stainless steel hinges, flush handles, magnetic door locks, and removable stainless steel shelves. The pass box shall incorporate **LED internal illumination**, UV-resistant viewing panels, and all accessories required for complete installation. The complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for flush mounting in partition walls. Complete with installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	4	Nos.
18	**Stainless Steel Closed Trolley for Sterile Material Transport:** Supply, installation, testing and commissioning of a **fully enclosed Stainless Steel Sterile Material Transport Trolley** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The trolley shall have **minimum overall dimensions of 900 mm (L) × 600 mm (W) × 1500 mm (H)** and shall be provided with **double hinged lockable doors**, removable and adjustable stainless steel shelves, heavy-duty stainless steel push handles on both sides, and a fully enclosed dust-proof construction for safe transport of sterile supplies. The trolley shall be mounted on **four heavy-duty 150 mm diameter non-marking swivel castors**, two with brakes, suitable for smooth and quiet operation. The base shall be reinforced with peripheral bumpers for impact protection. The trolley shall be	6	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for routine CSSD operations. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
19	**Stainless Steel Working Table:** Supply, installation, testing and commissioning of a **general-purpose Stainless Steel Working Table** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The table shall have minimum dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)** with a reinforced smooth worktop, full-width undershelf, and heavy-duty stainless steel tubular legs with adjustable stainless steel levelling feet. The worktop shall be capable of supporting a uniformly distributed load of **not less than 250 kg** without permanent deformation. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, and resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	4	Nos.
20	**Stainless Steel Basket Trolley:** Supply, installation, testing and commissioning of a **Stainless Steel Basket Trolley** suitable for safe transportation and handling of CSSD sterilization baskets and instrument trays. The trolley shall be fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. It shall have a heavy-duty tubular frame with **minimum four (4) adjustable guide rails** suitable for accommodating standard **ISO 600 mm × 300 mm sterilization baskets/trays**, with anti-dislodgement stops to prevent accidental movement during transport. The trolley shall have minimum overall dimensions of **700 mm (L) × 500 mm (W) × 1100 mm (H)** and shall be mounted on **four heavy-duty 125 mm diameter non-marking swivel castors**, two with brakes. The trolley shall be provided with stainless steel push handles, corner bumpers, and a reinforced frame capable of supporting a uniformly distributed load of **not less than 150 kg**. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for routine CSSD operations. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	6	Nos.
21	**Stainless Steel Operator Stool:** Supply, installation, testing and commissioning of an **ergonomically designed Stainless Steel Operator Stool** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with satin finish. The stool shall be provided with a **height-adjustable cushioned seat** upholstered in seamless medical-grade PU, a **360° swivel mechanism**, **five-star stainless steel base** with **50 mm non-marking twin-wheel antistatic castors**, and a **minimum load capacity of 150 kg**. The seat height shall be adjustable from **450 mm to 650 mm** by means of a gas-lift mechanism. The stool shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous use in CSSD clean and packing areas.	10	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
22	**Stainless Steel Change Locker (4 Compartments):** Supply, installation, testing and commissioning of a **four-compartment Stainless Steel Change Locker** fabricated from **minimum 0.8 mm thick AISI 304 stainless steel** with satin finish. The locker shall have minimum overall dimensions of **1200 mm (W) × 500 mm (D) × 1800 mm (H)** and shall comprise **four individual full-height lockable compartments**, each provided with a stainless steel coat hook, hat shelf, hanging rail, louvred ventilation openings, name card holder, and sloping top to prevent dust accumulation. Each compartment shall be fitted with a recessed handle and heavy-duty locking arrangement suitable for padlock or built-in cam lock. The locker shall be mounted on adjustable stainless steel levelling feet and shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for CSSD personnel changing areas. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	4	Nos.
23	**Closed Sterilization Container (300 mm × 290 mm × 110 mm):** Supply, installation, testing and commissioning of a **reusable rigid Closed Sterilization Container** of nominal dimensions **300 mm × 290 mm × 110 mm (±10%)**, suitable for steam sterilization, storage and aseptic transport of surgical instruments and procedure sets. The container shall be fabricated from **anodized aluminium alloy** with a corrosion-resistant, scratch-resistant finish and shall be provided with a rigid lid incorporating a **tamper-evident locking mechanism**, stainless steel latches, silicone gasket, reusable microbial barrier filter system, carrying handles, identification card holder, laser-etched unique identification number and colour coding for tray identification. The container shall be compatible with standard CSSD sterilization racks, washer-disinfectors and steam sterilizers. The complete assembly shall withstand repeated sterilization cycles without deformation or deterioration and shall comply with **ISO 11607-1**, **ISO 17665-1**, and **EN 868**. Complete with all accessories, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	15	Nos.
24	**Closed Sterilization Container (300 mm × 290 mm × 140 mm):** Supply, installation, testing and commissioning of a **reusable rigid Closed Sterilization Container** of nominal dimensions **300 mm × 290 mm × 140 mm (±10%)**, suitable for steam sterilization, storage and aseptic transport of surgical instruments and procedure sets. The container shall be fabricated from **anodized aluminium alloy** with a corrosion-resistant, scratch-resistant finish and shall be provided with a rigid lid incorporating a **tamper-evident locking mechanism**, stainless steel latches, silicone gasket, reusable microbial barrier filter system, carrying handles, identification card holder, laser-etched unique identification number and colour coding for tray identification. The container shall be compatible with standard CSSD sterilization racks, washer-disinfectors and steam	15	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	sterilizers. The complete assembly shall withstand repeated sterilization cycles without deformation or deterioration and shall comply with **ISO 11607-1**, **ISO 17665-1**, and **EN 868**. Complete with all accessories, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
25	**Closed Sterilization Container (590 mm × 280 mm × 260 mm):** Supply, installation, testing and commissioning of a **reusable rigid Closed Sterilization Container** of nominal dimensions **590 mm × 280 mm × 260 mm (±10%)**, suitable for steam sterilization, storage and aseptic transport of large surgical instrument sets, orthopaedic sets and procedure trays. The container shall be fabricated from **anodized aluminium alloy** with a corrosion-resistant, scratch-resistant finish and shall be provided with a rigid lid incorporating a **tamper-evident locking mechanism**, stainless steel latches, silicone gasket, reusable microbial barrier filter system, ergonomic carrying handles, identification card holder, laser-etched unique identification number and colour coding for tray identification. The container shall be compatible with standard CSSD sterilization racks, washer-disinfectors and steam sterilizers. The complete assembly shall withstand repeated sterilization cycles without deformation or deterioration and shall comply with **ISO 11607-1**, **ISO 17665-1**, and **EN 868**. Complete with all accessories, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	15	Nos.
26	**Stainless Steel Shoe Rack:** Supply, installation, testing and commissioning of a **free-standing Stainless Steel Shoe Rack** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The shoe rack shall have minimum overall dimensions of **1200 mm (L) × 400 mm (W) × 900 mm (H)** and shall be provided with **minimum four (4) sloping perforated stainless steel shelves**, capable of accommodating **not less than 24 pairs of footwear**. The rack shall be supported on a heavy-duty stainless steel tubular frame with adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for installation in CSSD changing areas. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
27	**Stainless Steel Receiving Counter:** Supply, installation, testing and commissioning of a **CSSD Receiving Counter** for receipt and inspection of contaminated reusable medical devices and surgical instruments, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The counter shall have minimum overall dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)** and shall be provided with a reinforced worktop, **100 mm high rear upstand**, full-width undershelf, lockable storage cabinet with hinged doors, and heavy-duty stainless steel tubular frame with adjustable stainless steel levelling feet. The worktop shall be capable of supporting a uniformly distributed load of **not less than 250 kg** without permanent deformation. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean,	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the CSSD decontamination area. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
28	**Stainless Steel Issue Counter:** Supply, installation, testing and commissioning of a **CSSD Issue Counter** for storage, verification and issue of sterile supplies, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The counter shall have minimum overall dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)** and shall be provided with a reinforced smooth worktop, **100 mm high rear upstand**, full-width undershelf, lockable storage cabinet with hinged doors, integrated document shelf, and heavy-duty stainless steel tubular frame with adjustable stainless steel levelling feet. The worktop shall be capable of supporting a uniformly distributed load of **not less than 250 kg** without permanent deformation. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the sterile storage and issue area of the CSSD. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos
29	**Pedal-Operated Stainless Steel Waste Bin:** Supply, installation, testing and commissioning of a **pedal-operated Stainless Steel Waste Bin** fabricated from **minimum 1.0 mm thick AISI 304 stainless steel** with seamless construction and satin finish. The waste bin shall have a **minimum capacity of 60 litres** and shall be provided with a foot-operated lid opening mechanism, self-closing lid, removable high-density polyethylene (HDPE) inner liner with handles, heavy-duty pedal assembly, non-slip rubber base, and corrosion-resistant fittings. The lid shall permit hands-free operation to minimise the risk of cross-contamination. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for CSSD use. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	6	Nos.
30	**Stainless Steel Storage Cupboard:** Supply, installation, testing and commissioning of a **free-standing Stainless Steel Storage Cupboard** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The cupboard shall have minimum overall dimensions of **1200 mm (W) × 600 mm (D) × 1800 mm (H)** and shall be provided with **double lockable hinged doors**, **minimum four (4) adjustable stainless steel shelves**, each capable of supporting a uniformly distributed load of **not less than 100 kg**, heavy-duty stainless steel hinges, recessed handles, and a three-point locking arrangement. The cupboard shall be mounted on adjustable stainless steel levelling feet and shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for storage of sterile supplies and consumables in the CSSD. Complete with all accessories, installation, testing, commissioning, and a	3	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	minimum 2-year comprehensive on-site warranty.		
31	**Inspection Lamp with Magnifier:** Supply, installation, testing and commissioning of a **LED Inspection Lamp with Magnifier** for inspection and assembly of surgical instruments and sterile packs in the CSSD. The unit shall comprise a **minimum 5-dioptre optical-grade glass magnifying lens of 125 mm diameter**, high-intensity **shadow-free LED illumination** with adjustable brightness, colour temperature of **4000–6500 K**, and **minimum 1,500 lux** illumination at the working surface. The lamp shall be mounted on a **balanced articulated arm** with minimum **800 mm reach**, providing smooth multi-axis positioning and secure locking. The unit shall be suitable for table mounting, supplied with a heavy-duty mounting clamp, electronic driver, and **230 V, 50 Hz** power supply. The housing shall be fabricated from corrosion-resistant material with a smooth, easy-to-clean finish suitable for hospital environments. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
32	**Stainless Steel Roll Holder with Cutting Knife:** Supply, installation, testing and commissioning of a **wall-mounted or table-mounted Stainless Steel Roll Holder with Integrated Cutting Knife** for dispensing and cutting medical-grade sterilization wraps, crepe paper and paper/plastic sterilization reels in the CSSD. The unit shall be fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. It shall accommodate rolls up to **600 mm width** and **300 mm diameter**, complete with stainless steel support shaft, low-friction bearings, adjustable roll guides, and a **full-width enclosed stainless steel serrated cutting blade** with safety guard to ensure clean, straight and safe cutting. The unit shall be provided with a heavy-duty mounting arrangement, corrosion-resistant fittings, and all accessories required for complete installation. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the CSSD packing area. Complete with installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
33	**Gauze Cutting Machine:** Supply, installation, testing and commissioning of a **microprocessor-controlled Gauze Cutting Machine** for precision cutting of medical-grade gauze, cotton fabric and dressing materials in the CSSD. The machine shall be suitable for processing rolls up to **1200 mm width** and shall provide **adjustable cutting lengths from 100 mm to 3000 mm** with a cutting accuracy of **±2 mm**. The unit shall incorporate a **rotary or guillotine stainless steel cutting blade**, digital length setting, electronic length counter, programmable batch quantity, automatic feed and cut operation, emergency stop, overload protection, safety interlocks, and a **minimum 5-inch colour touch-screen HMI**. The machine shall be fabricated from **AISI 304 stainless steel** with corrosion-resistant components and enclosed moving parts for operator safety. It shall operate on **230 V ±10%, 50 Hz AC supply**, be	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	suitable for continuous operation in a CSSD environment, and be resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
34	**Documentation Labeler:** Supply, installation, testing and commissioning of a **thermal transfer Documentation Labeler** for printing sterilization process labels, traceability labels and identification labels for sterile packs and instrument sets in the CSSD. The unit shall provide a minimum print resolution of **300 dpi**, minimum print speed of **150 mm/sec**, and support printing of **text, barcodes (1D/2D), QR codes, Data Matrix codes, graphics, date/time, batch numbers, cycle numbers and user-defined information**. The labeler shall support labels of **25 mm to 110 mm width** and shall be compatible with medical-grade sterilization labels suitable for steam, ETO and low-temperature sterilization processes. The unit shall be provided with **USB, Ethernet and serial communication interfaces** and shall integrate seamlessly with the CSSD Tracking & Barcoding System for automatic printing of sterilization records and traceability labels. It shall support automatic date/time synchronization, barcode verification, configurable print templates and user authentication. The labeler shall operate on **230 V ±10%, 50 Hz AC supply** and shall be suitable for continuous operation in a CSSD environment. The printer shall comply with **IEC 62368-1** and shall support barcode generation in accordance with **ISO/IEC 15417 (Code 128)**, **ISO/IEC 16022 (Data Matrix)** and **ISO/IEC 18004 (QR Code)**. Complete with all accessories, label design software with **perpetual licence**, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
35	**Office Table:** Supply, installation, testing and commissioning of an **office table** fabricated from **minimum 25 mm thick pre-laminated high-density engineered wood board** with **2 mm thick PVC edge banding** on all exposed edges, supported on a **powder-coated CRCA steel frame**. The table shall have minimum overall dimensions of **1500 mm (L) × 750 mm (W) × 750 mm (H)** and shall be provided with a lockable pedestal having **three drawers** (two utility drawers and one filing drawer), keyboard tray, CPU holder, cable management grommets, modesty panel, adjustable levelling feet and all necessary hardware. The work surface shall be scratch-resistant, moisture-resistant, stain-resistant and suitable for continuous office use in a healthcare environment. The table shall comply with **BIFMA X5.5** and **EN 527**. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-**	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	year comprehensive on-site warranty.		
37	**Transport Trolley (Four Swivel Wheels):** Supply, installation, testing and commissioning of a **Stainless Steel Transport Trolley** for transportation of sterile supplies, instrument trays and CSSD materials, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The trolley shall have minimum overall dimensions of **900 mm (L) × 600 mm (W) × 900 mm (H)** and shall be provided with **two stainless steel shelves** having raised edges of **minimum 25 mm height**, capable of supporting a uniformly distributed load of **not less than 150 kg**. The trolley shall be fitted with **four heavy-duty 125 mm diameter non-marking swivel castors**, all with precision bearings, of which **two shall be provided with foot-operated brakes**. It shall be equipped with ergonomic push handles, protective corner bumpers, and a rigid reinforced frame suitable for continuous hospital use. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for CSSD operations. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	6	Nos.
38	**Paper Dispensing Trolley:** Supply, installation, testing and commissioning of a **Stainless Steel Paper Dispensing Trolley** for storage and dispensing of medical-grade sterilization wraps, crepe paper and packaging materials in the CSSD. The trolley shall be fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. It shall have minimum overall dimensions of **900 mm (L) × 600 mm (W) × 1200 mm (H)** and shall be provided with **minimum two roll dispensing shafts** suitable for rolls up to **600 mm width**, enclosed storage compartment with lockable doors for packing materials, integrated full-width enclosed stainless steel serrated cutting blade with safety guard, stainless steel push handle, and accessory tray for packing consumables. The trolley shall be mounted on **four heavy-duty 125 mm diameter non-marking swivel castors**, two with foot-operated brakes, and shall have a reinforced frame capable of supporting a uniformly distributed load of **not less than 150 kg**. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the CSSD packing area. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
39	**Reverse Osmosis (RO) Water Treatment Plant:** Supply, installation, testing and commissioning of a **Reverse Osmosis (RO) Water Treatment Plant** comprising **two (2) independent 5000 LPH RO units configured as 1 Duty + 1 Standby (N+1 redundancy)**, complete with raw water feed system, multimedia filter, activated carbon filter, water softener, cartridge filtration, antiscalant dosing system, high-pressure stainless steel pumps with variable frequency drives, thin-film composite RO membranes, automatic membrane flushing, Clean-in-Place (CIP) system, UV disinfection unit, online	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	conductivity meter, pH meter, flow meters, pressure gauges, automatic control valves, PLC-based control panel with **minimum 10-inch colour touch-screen HMI**, Ethernet connectivity, data logging, alarms, automatic duty/standby changeover, and Building Management System (BMS) integration. The system shall be provided with a **minimum 15,000-litre AISI 304 stainless steel treated water storage tank** complete with level sensors, overflow, vent filter, manhole, drain, sampling point, recirculation loop, and all interconnecting pipework, valves and accessories. The complete installation shall include a weatherproof prefabricated equipment shed with insulated roofing, ventilation, illumination, drainage, cable management, and all civil, mechanical and electrical works required for a fully operational system. The RO plant shall consistently produce treated water conforming to the **water quality requirements of EN 285 and ISO 15883** for CSSD washer-disinfectors and steam sterilizers, with **RO permeate conductivity not exceeding 30 µS/cm at 25°C**. The system shall comply with **EN 285**, **ISO 15883**, **IEC 60204-1**, and applicable **BIS** requirements. Complete with testing, commissioning, IQ/OQ/PQ validation (where applicable), operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
40	**Incidental Items for Complete CSSD:** The Contractor shall supply, install, test and commission all accessories, fittings, fixtures, consumables for commissioning, supports, utility connections, software, licences, documentation, tools, and all incidental items necessary for complete, safe and fully operational functioning of the CSSD, whether specifically indicated in the BOQ or not. All such items shall be deemed included in the Contract, and no additional payment shall be admissible.		

Theatre Sterile Supply Unit (TSSU)			
S.No	**Particulars**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Theatre Sterile Supply Unit (TSSU) complete with following		
1	**Table Top Steriliser (Benchtop Autoclave – 24 L): Supply, install, test, and commission a fully automatic Class B pre-vacuum benchtop steam steriliser of minimum 24-litre chamber capacity, suitable for sterilisation of wrapped, unwrapped, hollow,** and porous medical instruments. The unit shall have an **SS 316L chamber**, microprocessor/PLC-based automatic cycle control with digital touch-screen display, pre-vacuum and post-vacuum drying, electronic cycle recording (USB/Ethernet), and automatic Bowie-Dick, vacuum leak and Helix test programmes. The equipment shall comply with **EN**		Nos.

	13060, ISO 17665-1, IEC 61010, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.		
2	**Table Top Sterilizer (Benchtop Autoclave – 45–50 L):** Supply, install, test and commission a **fully automatic Class B pre-vacuum benchtop steam sterilizer** of **45–50 litre capacity** with **SS 316L chamber**, microprocessor control, digital touch-screen display, pre-vacuum, post-vacuum drying, electronic cycle recording, and automatic Bowie-Dick, Helix and vacuum leak test programmes. The equipment shall comply with **EN 13060, ISO 17665-1, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	2	Nos.
3	**Plasma (Hydrogen Peroxide) Sterilizer (Double Door – 120 L):** Supply, install, test and commission a **fully automatic pass-through double-door Hydrogen Peroxide Gas Plasma Sterilizer** of **minimum 120-litre chamber capacity**, suitable for sterilization of heat- and moisture-sensitive medical devices. The unit shall have an **SS 316L chamber**, PLC/microprocessor-based automatic cycle control with touch-screen display, electronic cycle recording, USB/Ethernet connectivity, and validated sterilization cycles with integrated safety interlocks. The equipment shall comply with **ISO 14937, ISO 22441, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with IQ/OQ/PQ validation, testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	2	Nos.
4	**SS Working table - Minimum Size (LxWxH): 1800x650x900 mm Stainless steel tables specially designed for inspection and sorting of goods in and for general purpose pre-storage. The work tables should have a rigid stainless-steel construction which is easy to clean and should not have sharp edges or corners.**	2	Nos.
5	**SS Storage Shelf 5 shelves - based on single free-standing shelf modules for storage of clean linen, instruments, and packing material or sterilized goods, including disposables & Minimum Size (LxWxH) :1500x450x1900 mm (For Dirty, Clean & Sterilization Zone)**	4	Nos.
6	**Barcode/Documentation Workstation:** Supply, install, test and commission a **Barcode/Documentation Workstation** comprising a desktop computer with **Intel Core i7 or equivalent processor**, minimum **16 GB RAM**, **512 GB SSD**, **21-inch LED monitor**, handheld barcode scanner, thermal barcode label printer, keyboard and mouse. The workstation shall be fully integrated with the **CSSD Tracking & Barcoding Software** for real-time instrument identification, documentation and traceability, and shall support barcode printing, scanning, electronic record management and report generation. The workstation shall be supplied complete with all software licences, testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	1	

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Laundry Equipment (electrical safety of all washing/drying/ironing machines to conform to IEC 60335-2-7 / IS 302-2-7, the India-adopted equivalent for commercial laundry appliances) complete with following		
1	**Washer Extractor – 60 kg:** Supply, installation, testing and commissioning of a **fully automatic, high-spin, soft-mounted Washer Extractor** of **minimum 60 kg dry linen capacity**, designed for continuous heavy-duty hospital laundry operation. The machine shall have an **AISI 304 stainless steel inner drum, outer drum and cabinet**, with programmable **microprocessor/PLC-based controls**, **minimum 7-inch colour touch-screen HMI**, automatic chemical dosing interface, inverter-driven motor, automatic water level and temperature control, imbalance detection, door safety interlock, operating hour counter, fault diagnostics, and automatic cycle optimisation for water and energy efficiency. The washer shall be provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric immersion heating as the secondary/standby heat source**, with automatic heat source selection through the PLC control system without interruption of the washing cycle. The machine shall be mounted on a **soft-mount suspension system** eliminating the need for inertia foundations and shall achieve a **minimum extraction factor of 350 G** with variable-speed extraction, automatic balancing and low vibration. The unit shall be complete with stainless steel drain valve, detergent injection ports, hot/cold water inlet valves, steam control valve, condensate outlet, lint collection arrangement, Ethernet connectivity, and Building Management System (BMS) interface. The equipment shall comply with **IEC 60335-2-7**, **IS 302-2-7**, **IEC 60204-1**, applicable **BIS** requirements, and shall be manufactured under an **ISO 9001-certified Quality Management System**. Complete with all accessories, factory testing, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Each
2	**Washer Extractor – 30 kg:** Supply, installation, testing and commissioning of a **fully automatic, high-spin, soft-mounted Washer Extractor** of **minimum 30 kg dry linen capacity** with **AISI 304 stainless steel inner drum, outer drum and cabinet**, inverter-driven motor, programmable microprocessor/PLC control with **minimum 7-inch touch-screen HMI**, automatic chemical dosing, water level and	4	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	temperature control, imbalance detection, door safety interlock, fault diagnostics, and operating hour counter. The machine shall be provided with **dual heating comprising automatic steam heating as the primary heat source and electric heating as the standby heat source** with automatic changeover. The unit shall achieve a **minimum extraction factor of 350 G**, complete with stainless steel drain valve, detergent injection ports, hot/cold water connections, steam control valve, Ethernet/BMS interface, and all accessories. The equipment shall comply with **IEC 60335-2-7**, **IS 302-2-7**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
3	**Drying Tumbler – 60 kg:** Supply, installation, testing and commissioning of a **fully automatic front-loading Drying Tumbler** of **minimum 60 kg dry linen capacity**, designed for continuous heavy-duty hospital laundry operation. The machine shall have an **AISI 304 stainless steel drum and cabinet**, programmable microprocessor/PLC control with **minimum 7-inch touch-screen HMI**, inverter-driven motor, automatic moisture sensing, temperature control, cool-down cycle, lint filtration system, door safety interlock, fault diagnostics, and operating hour counter. The dryer shall be provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric heating as the secondary/standby heat source**, with automatic heat source selection through the PLC control system. The unit shall include variable airflow control, Ethernet/BMS interface, and all accessories for complete installation. The equipment shall comply with **IEC 60335-2-11**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Each
4	**Drying Tumbler – 30 kg:** Supply, installation, testing and commissioning of a **fully automatic front-loading Drying Tumbler** of **minimum 30 kg dry linen capacity**, designed for continuous heavy-duty hospital laundry operation. The machine shall have an **AISI 304 stainless steel drum and cabinet**, programmable microprocessor/PLC control with **minimum 7-inch touch-screen HMI**, inverter-driven motor, automatic moisture sensing, temperature control, cool-down cycle, lint filtration system, door safety interlock, fault diagnostics, and operating hour counter. The dryer shall be	4	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric heating as the secondary/standby heat source**, with automatic heat source selection through the PLC control system. The unit shall include Ethernet/BMS interface and all accessories for complete installation. The equipment shall comply with **IEC 60335-2-11**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
5	**Flatwork Ironer:** Supply, installation, testing and commissioning of a **fully automatic Flatwork Ironer** suitable for rapid drying and ironing of hospital flat linen including bed sheets, draw sheets, pillow covers, OT linen and table linen. The machine shall have a **minimum roller diameter of 800 mm and minimum working width of 3000 mm**, chrome-plated steel roller, **AISI 304 stainless steel feeding and delivery tables**, variable ironing speed, adjustable temperature control, automatic finger guard, emergency stop, anti-wrap protection, fault diagnostics, and programmable microprocessor/PLC control with digital display. The ironer shall be provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric heating as the secondary/standby heat source**, with automatic heat source selection through the control system. The unit shall be complete with linen feeding and delivery arrangements, inverter drive, operating hour counter, Ethernet/BMS interface, and all accessories required for complete installation. The equipment shall comply with **IEC 60335-2-44**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Each
6	**Rectangular Vacuum Ironing Table:** Supply, installation, testing and commissioning of a **rectangular vacuum ironing table** suitable for finishing hospital garments, uniforms, scrubs, gowns and small linen articles. The table shall have a **minimum ironing surface of 1500 mm × 800 mm**, perforated galvanized steel worktop with heat-resistant padding and cover, integrated vacuum suction system with **minimum 0.5 HP motor**, thermostatically controlled electric heated work surface, adjustable height, foot-operated vacuum control, garment support arm, steam iron connection, condensate collection arrangement, and programmable control with operating hour counter. The unit shall be complete with all accessories required for operation and shall comply with **IEC 60335-2-44**, **IEC 60204-1**,	4	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
7	**Flat Bed Press:** Supply, installation, testing and commissioning of a **fully automatic Flat Bed Press** suitable for finishing hospital linen, garments, scrubs, gowns and uniforms. The machine shall have a **minimum heated head size of 1500 mm × 750 mm**, electrically heated pressing head with thermostatic temperature control, **pneumatically operated** pressing mechanism, moisture suction through the lower buck, automatic timed press release, pressure adjustment, safety two-hand operation, emergency stop, fault diagnostics, and programmable microprocessor control with digital display and operating hour counter. The unit shall be complete with all accessories, pneumatic connections and controls, and shall comply with **IEC 60335-2-44**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Each
8	**Spring Bottom Laundry Trolley (100 kg):** Supply, installation, testing and commissioning of a **spring-bottom laundry trolley** of **minimum 100 kg load capacity** for collection and transport of soiled or clean hospital linen. The trolley shall be fabricated from **AISI 304 stainless steel** with seamless welded construction and satin finish, and shall be provided with a **spring-loaded adjustable base** that automatically rises and lowers with the linen load to maintain an ergonomic loading height. The trolley shall have a heavy-duty tubular frame, removable washable laundry bag or perforated stainless steel basket (as applicable), protective corner buffers, push handle, and **four heavy-duty 125 mm non-marking swivel castors**, two with foot-operated brakes. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	8	Each
9	**Dry Linen Trolley (50 kg):** Supply, installation, testing and commissioning of a **Stainless Steel Dry Linen Trolley** of **minimum 50 kg load capacity** for transport and distribution of clean hospital linen. The trolley shall be fabricated from **AISI 304 stainless steel** with seamless welded construction and satin finish, and shall be provided with an enclosed or open-top stainless steel body with smooth internal surfaces, ergonomic push handle, protective corner buffers, and **four heavy-duty 125 mm diameter non-marking swivel castors**, two with foot-operated brakes. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for	10	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
10	**Dry Linen Trolley (50 kg):** Supply, installation, testing and commissioning of a **Stainless Steel Dry Linen Trolley** of **minimum 50 kg load capacity** for transport and distribution of clean hospital linen. The trolley shall be fabricated from **AISI 304 stainless steel** with seamless welded construction and satin finish, and shall be provided with an enclosed or open-top stainless steel body with smooth internal surfaces, ergonomic push handle, protective corner buffers, and **four heavy-duty 125 mm diameter non-marking swivel castors**, two with foot-operated brakes. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	10	Each
11	**Storage Rack:** Supply, installation, testing and commissioning of a **free-standing Storage Rack** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The rack shall have minimum overall dimensions of **1500 mm (L) × 600 mm (D) × 1800 mm (H)** and shall be provided with **minimum five (5) adjustable stainless steel shelves**, each capable of supporting a uniformly distributed load of **not less than 150 kg**. The rack shall be supported on a heavy-duty tubular frame with cross bracing and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	10	Each
12	**Scrub Station with Two Sinks:** Supply, installation, testing and commissioning of a **Stainless Steel Scrub Station** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The unit shall have minimum overall dimensions of **1600 mm (L) × 500 mm (W) × 900 mm (H)** and shall be provided with **two deep sinks** for separate washing and rinsing operations, **hot and cold water mixer taps** for each sink, a **central stainless steel scrubbing board**, **100 mm high rear splash back**, full-width undershelf, waste fittings, bottle trap, and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Each
13	**Air Compressor:** Supply, installation, testing and commissioning of a **fully automatic, oil-lubricated, two-stage reciprocating air**	1	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	compressor with **minimum 5 HP motor**, **220-litre horizontal air receiver**, and maximum working pressure of **8 kg/cm² (8 bar)**, suitable for continuous operation with laundry finishing equipment. The compressor shall be complete with aftercooler, automatic pressure switch, safety relief valve, pressure gauge, air filter, moisture separator, drain valve, non-return valve, vibration isolators, and starter panel with motor protection. The unit shall deliver a **minimum free air delivery (FAD) of 500 LPM** at rated pressure and shall comply with **IS 5456**, **IS 2825**, **IEC 60204-1**, and applicable **BIS** requirements. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
14	**Electronic Platform Weighing Scale (100 kg):** Supply, installation, testing and commissioning of an **electronic platform weighing scale** with a **minimum capacity of 100 kg** and **accuracy of ±10 g**, suitable for weighing hospital linen. The scale shall have a **minimum platform size of 500 mm × 500 mm**, heavy-duty stainless steel weighing platform, digital LCD/LED display with backlight, zero, tare and hold functions, overload protection, rechargeable battery with AC mains operation, and adjustable levelling feet. The equipment shall comply with the **Legal Metrology Act, 2009**, **Legal Metrology (General) Rules, 2011**, and shall be **verified and stamped by the Legal Metrology Department**. Complete with all accessories, installation, testing, commissioning, calibration, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Each

Kitchen Equipment for 450 Bedded Hospital

S.No	Particulars	Specification	Qty	Unit
1	**Work Table with Single Sink 750 x 600 x 850**	SS304 16 SWG top & sink (bowl 450x450x250mm), 38mm dia SS waste/valve fitting, SS304 frame, 38mm dia SS304 tube legs, 25mm SS cross bracing. Top and sink bowl in AISI 304 stainless steel conforming to IS 6911:2017, sheet not leaner than 16 SWG (1.6 mm nominal), No. 4 brushed finish. All internal corners coved/bull-nosed (min. 10 mm radius) and joints continuously seam-welded, ground and polished to remove weld discolouration, per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) hygienic-design requirements for food-contact surfaces. Table to safely carry a minimum UDL of 100 kg; legs fitted with SS adjustable bullet feet for levelling.	4	Nos
2	**Work Table with Single Sink 1200 x 600 x 850+150**	Same construction as Item 1, larger size. Material grade, weld/edge finish and hygienic-design requirements as Item 1 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)), scaled to the stated dimensions; minimum two cross-braces per leg pair over the extended span.	2	Nos

Kitchen Equipment for 450 Bedded Hospital

S.No	Particulars	Specification	Qty	Unit
3	**Work Table with Single Sink 1800 x 600 x 850+150**	Same construction as Item 1, larger size. Material grade, weld/edge finish and hygienic-design requirements as Item 1 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)), scaled to the stated dimensions; minimum three cross-braces per leg run to suit the extended 1800 mm span.	2	Nos
4	**Two Sink Unit 1200 x 700 x 850+150**	SS304 16 SWG top/sink (bowl 450x450x250mm), SS304 frame, SS304 legs & cross bracing. Material and fabrication as IS 6911:2017 and hygienic-design norms of FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011). Each bowl to have an independent 38 mm dia. waste/overflow coupling with a pipe partition between bowls; drain outlets aligned to a gravity-fall floor trap per NBC 2026(Plumbing Services).	1	Nos
5	**Three Sink Unit 1800 x 600 x 850+150**	Same construction as Item 4. Construction, drainage and hygienic-design requirements as Item 4 (IS 6911:2017; NBC 2026). Three-bowl sequence (wash/rinse/sanitise) to be colour-coded/labelled per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) good-hygiene practice.	1	Nos
6	**3 Burner Indian Gas Range (2 HP + 1 LP) with full-length simmer plate 1800 x 600 x 850**	Top 16 SWG SS304; front/side/rear 18 SWG SS304; SS bracing & bullet feet. Heat output 2,01,000 BTU/hr. Body fabrication per IS 6911:2017. LPG pressure-regulating train to comply with IS 4246 (Pressure Regulators for LPG, low pressure) and installation as per IS 6044 (Part 1):2018 (LPG Storage Installations - Code of Practice). Each burner fitted with an ISI-marked control cock and a flame-failure/thermocouple safety device; gas train to be leak/pressure-tested per PESO (Chief Controller of Explosives) requirements before commissioning.	3	Nos
7	**2 Burner Range (1 HP + 1 LP) 1200 x 600 x 600**	Top 16 SWG SS; body 18 SWG SS; SS304 legs. Heat output 91,000 BTU/hr. Gas train, regulator and flame-safety-device requirements as Item 6 (IS 4246; IS 6044 (Part 1):2018; PESO commissioning norms); body fabrication per IS 6911:2017.	3	Nos
8	**Work Table with Two Undershelves 1100 x 650 x 850**	Top 16 SWG SS304, SS304 frame, SS304 legs, 18 SWG undershelves. Material and hygienic edge/weld detailing per IS 6911:2017 and FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011). Lowest undershelf set a minimum 150 mm clear of finished floor level to meet FSSAI raised-storage norms and permit floor cleaning beneath.	4	Nos
9	**Worktable with Two Undershelves 1800 x 700 x 850**	Same construction as Item 8. Material, floor-clearance and hygienic-finish requirements as Item 8 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)), scaled to the stated dimensions.	2	Nos
10	**Work Table with Two Undershelves 1300 x 700 x 850**	Same construction as Item 8. Material, floor-clearance and hygienic-finish requirements as Item 8 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations,	1	Nos

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S.No	Particulars	Specification	Qty	Unit
		2011)).		
11	**Work Table with Two Undershelves 1500 x 600 x 850**	Same construction as Item 8. Material, floor-clearance and hygienic-finish requirements as Item 8 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)).	2	Nos
12	**Clean Dish Table with Two Undershelves 1500 x 700 x 850**	Same construction as Item 8. Construction as Item 8 (IS 6911:2017). To be positioned on the clean-side, downstream of the dishwasher, per the FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) clean/dirty-side segregation principle, to prevent cross-contamination of washed crockery.	3	Nos
13	**Receiving Worktable with Two Under Shelf 1800 x 700 x 850**	Same construction as Item 8. Construction as Item 8 (IS 6911:2017). Positioned at the goods-receipt point with clearance for the weighing scale (Item 53) and for FSSAI-compliant visual/quality inspection of incoming produce prior to store transfer.	2	Nos
14	**Chapati Rolling Marble Top Table with One Under Shelf 1500 x 700 x 850**	Top 16 SWG SS304, SS304 frame, SS304 legs, 18 SWG undershelf. Frame, legs and undershelf per IS 6911:2017. Marble slab (minimum 20 mm thick) bedded flush within an SS304 border and sealed at the perimeter with food-grade silicone sealant to prevent moisture ingress, per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) hygienic-surface requirements.	2	Nos
15	**Chapati Dumping Table with One Undershelf 1500 x 700 x 850**	Top 16 SWG SS304, SS304 frame, SS304 legs, 18 SWG undershelf. Material and hygienic-finish requirements as Item 8 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)); positioned adjacent to the griddle (Item 67) in the service-flow sequence.	3	Nos
16	**Bulk Cooker, Gas fired, Triple-walled Insulated 1100 x 815 x 1270**	150 L capacity; 14 SWG inner / 20 SWG outer SS tank; 75mm glass wool insulation; spring-loaded SS lid; rear flue riser; tilting gear, gas-operated. Pan 580mm dia x 610mm deep. Heat output 1,40,000 BTU/hr. Tank in AISI 304 SS per IS 6911:2017; glass-wool insulation to conform to IS 8183:1993 (Bonded Mineral Wool for Thermal Insulation). Gas train, regulator and burner assembly per IS 4246 and IS 6044 (Part 1):2018, with a mandatory flame-failure device. Tilting gearbox to be self-locking (worm-type) and rated for the fully loaded pan to prevent accidental tipping.	5	Nos
17	**Tilting Braising/Frying Pan, SS Reinforced 1430 x 600 x 900**	90 L capacity, Electric. Pan size 700x600x230mm; 12 SWG SS base tank; tilting gear; counter-balanced lid. Base tank in AISI 304 SS per IS 6911:2017. Heating elements, controls and enclosure to comply with IS 302-1:2008 (Safety of Household and Similar Electrical Appliances - General Requirements), earthed per IS 3043:1987 (Code of Practice for Earthing). Counter-balanced lid to remain stable at any tilt angle without external support.	3	Nos
18	**Tea/Water Boiler**	25 L capacity, SS electric heater, 3 kW / 1 Ph / 220V. Inner pan	3	Nos

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S.No	Particulars	Specification	Qty	Unit
		300mm dia x 380mm deep. SS body per IS 6911:2017. Heating element and electrical enclosure to IS 302-1:2008, fused and earthed supply, fitted with a low-water-level cut-off to prevent dry-firing.		
19	**Milk Warmer, SS**	25 L capacity, 3 kW / 1 Ph. Inner pan 300mm dia x 385mm high. SS body per IS 6911:2017. Electrical safety per IS 302-1:2008, with an earthed supply and a thermostatic over-temperature cut-off to prevent scorching.	3	Nos
20	**Exhaust Hood 4000 x 1000 x 500**	20 SWG SS wall type. Hood shell in minimum 20 SWG AISI 304 SS per IS 6911:2017; connected ductwork fabricated and gauged per IS 655:2006 (Specification for Metal Air Ducts). Hood to be fitted with baffle-type (not mesh) grease filters and a perimeter grease gutter with drain-off point, per the kitchen-exhaust fire-safety provisions of NBC 2026 (Fire and Life Safety); filters removable and dishwasher-washable.	5	Nos
21	**Wall Mounted SS Shelf 1200 x 300**	18 SWG sheet, 14 SWG SS bracket. Sheet and bracket per IS 6911:2017; brackets fixed with SS anchor fasteners at maximum 600 mm centres, rated for a distributed load of not less than 40 kg/m run.	5	Nos
22	**Wall Mounted SS Shelf 1500 x 300**	18 SWG sheet, 14 SWG SS bracket. Material and fixing requirements as Item 21 (IS 6911:2017), scaled to the 1500 mm length.	5	Nos
23	**Wall Mounted SS Shelf 1800 x 300**	18 SWG sheet, 14 SWG SS bracket. Material and fixing requirements as Item 21 (IS 6911:2017); intermediate bracket to be added for the 1800 mm length to maintain the 600 mm maximum bracket spacing.	2	Nos
24	**Masala Trolley**	Top 16 SWG SS304; SS304 angle frame with SS handle; SS304 leg & undershelf; 4x 4" PU wheels (2 brake); 15 nos. SS masala containers. Top, frame and containers per IS 6911:2017. Castors to be heavy-duty, ball-bearing, PU-tread swivel type with 2 lockable brakes, rated for the fully loaded trolley weight. Container lids to be food-grade and individually removable to permit FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)-compliant cleaning.	4	Nos
25	**Drain Through Grating 2000 x 250**	SS304 25x4mm flat grating. Grating per IS 6911:2017, laid over a floor channel graded to a minimum fall of 1:100 towards the nearest floor trap per NBC 2016, Part 9 (Plumbing Services); slot width restricted to limit food-waste blockage while remaining slip-resistant underfoot.	8	Nos
26	**Soup Server, Electric 10.4 Ltrs**	Moulded body, SS soup well & lid, temperature knob, 450 W / 1 Ph. Outer 380mm dia x 330mm high. SS soup-well per IS 6911:2017; heating element, thermostat and enclosure to comply with IS 302-1:2008, earthed 3-pin supply.	4	Nos
27	**Potato Peeler**	10 kg/charge, belt drive, 1 HP motor / 230V / 1Ph, 100 kg/hr. SS304 body, SS shaft/housing, 16 SWG SS square-tube legs. Drive motor to conform to IS 325:1996 (Three Phase/Single Phase Induction Motors) or the IS 12615:2018 energy-efficiency class	4	Nos

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S.No	Particulars	Specification	Qty	Unit
		specified, minimum IP55 enclosure; body and abrasive-drum housing per IS 6911:2017, food-grade finish; belt and pulley fully guarded per standard machine-safety practice.		
28	**Dough Kneader 25 kg**	2 HP motor (Crompton/Siemens/Bharat Bijlee), 1 Ph, SS bowl & steel arm, belt drive. Motor per IS 325:1996, minimum IP55 enclosure; SS bowl per IS 6911:2017; belt drive fully guarded; bowl and mixing arm designed for tool-free removal to permit FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)-compliant cleaning between batches.	3	Nos
29	**Masala Grinder Non-Tilting 10 kg**	SS body, heavy reduction gearbox, SS grinding drum & stone, 1 HP / 1 Ph / 750 W. Motor per IS 325:1996, minimum IP55; body and drum per IS 6911:2017; grinding stone to be food-grade and readily demountable for cleaning/replacement.	2	Nos
30	**Pulveriser 45 kg**	45 kg/hr, 1 HP motor, 2900 RPM, 230/220V / 1 Ph. Motor per IS 325:1996, minimum IP55 enclosure; all product-contact parts in food-grade SS per IS 6911:2017.	4	Nos
31	**Vegetable Cutter**	50 kg capacity, SS body, 5 blade types, 0.5 HP / 1 Ph / 375 W. Motor per IS 325:1996, minimum IP55; blades, discs and body in food-grade SS per IS 6911:2017; feed-hopper guard to be safety-interlocked to prevent operation with the guard open.	4	Nos
32	**Hood Type Dishwasher**	AISI304 SS construction, 80 racks/hr, 24 L tank, tank heating 3 kW, boiler heating 3 kW, final rinse 82-84 degC (HACCP-ready), auto cycle. Construction per IS 6911:2017; electrical heating elements, controls and enclosure to comply with IS 302-1:2008. Final-rinse temperature (82-84°C) to be continuously monitored/logged to satisfy FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) (Part II) sanitising requirements and the hospital's HACCP/infection-control protocol.	3	Nos
33	**Floor Mounted Pot Wash 1200 x 700 x 150**	Top 16 SWG SS304, SS304 frame. Construction per IS 6911:2017; positioned over a floor trap graded per NBC 2016, Part 9; corners and edges coved/hygienic per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011).	2	Nos
34	**Dish Landing Table with Cross Bracing 1500 x 600 x 850+450**	Top 16 SWG SS304 with 18 SWG SS glass rack; SS304 frame; SS304 legs & cross bracing. Construction per IS 6911:2017; positioned at dishwasher infeed with adequate scrap-waste disposal provision per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011).	2	Nos
35	**Pot Rack Four Shelf and Vertical Leg SS Tube 1200 x 600 x 1650**	16 SWG SS304 legs & shelves with adjustable bullet feet. Legs and shelves per IS 6911:2017; each shelf rated to carry a minimum UDL of 50 kg; adjustable SS bullet feet for floor levelling.	2	Nos
36	**Clean Dish Rack with Five Shelf**	16 SWG SS legs & hat-channel, 18 SWG shelves. Material and load rating as Item 35 (IS 6911:2017); lowest shelf	2	Nos

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S.No	Particulars	Specification	Qty	Unit
	1000 x 450 x 1800	minimum 150 mm off finished floor per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) raised-storage requirement, uppermost shelf set with adequate clearance to ceiling/services for inspection access.		
37	**Storage Rack with Five Shelf 1000 x 450 x 1800**	Same construction as Item 36. Material, load rating and floor-clearance requirements as Item 36 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)).	2	Nos
38	**Storage Rack with Five Shelf 900 x 450 x 1800**	Same construction as Item 36. Material, load rating and floor-clearance requirements as Item 36 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)).	2	Nos
39	**Storage Rack with Five Shelf 600 x 450 x 1800**	Same construction as Item 36. Material, load rating and floor-clearance requirements as Item 36 (IS 6911:2017; FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)).	2	Nos
40	**Wall Mounted Pot Rack Shelf 3000 x 300**	25mm SS square tube, 14 SWG SS bracket. Tube and bracket per IS 6911:2017; fixings at maximum 600 mm centres, rated for the intended pot/pan load with an adequate safety margin.	3	Nos
41	**Pre-Rinse Spray Unit**	SS tube & adjustable unit. SS tube/hose assembly per IS 6911:2017; water fittings and backflow protection to comply with NBC 2026 (Plumbing Services); spray valve to be self-closing (dead-man action) to conserve water.	4	Nos
42	**Dunage Rack 1200 x 600 x 250**	16 SWG 38x38mm outer / 25x25mm inner SS square-tube frame, SS legs with adjustable bullet feet. Frame per IS 6911:2017; deck set a minimum 150 mm clear of the floor per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) raised-storage requirement to prevent moisture wicking and pest access to sacks/cartons.	3	Nos
43	**Aata Meda Bin 600 x 450 x 600**	18 SWG SS body, hinged SS lid, 4x 4" dia PU wheels (2 brake). Body per IS 6911:2017, close-fitting/pest-proof hinged lid per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) dry-storage requirements; heavy-duty lockable castors for mobility.	3	Nos
44	**Onion Potato Bin**	SS body, hinged wired lid, 4x 100mm dia PU wheels (2 brake). Body per IS 6911:2017; ventilated wired lid to control condensation/sprouting while remaining pest-proof per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011).	3	Nos
45	**Sandwich Griller, Double, Electric**	SS, outer 520x375x190mm, 1.55 kW + 1.55 kW, 1 Ph. Heating elements and SS-clad enclosure to comply with IS 302-1:2008; food-contact plates in food-grade SS/non-stick coated SS	3	Nos

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S.No	Particulars	Specification	Qty	Unit
		conforming to IS 6911:2017.		
46	**Conveyor Toaster**	Drip-tray design, temp control, Electric/Gas, 150-180 slices/hr, 1340 W, 220V/50Hz/1Ph. Heating elements, drive motor and enclosure to comply with IS 302-1:2008 (electric option) or IS 4246/IS 6044 (Part 1):2018 (gas option); drip tray removable, food-grade, for FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)-compliant cleaning.	3	Nos
47	**1/1 Five GN Pan with Tray Slide, SS Tube 1800 x 650 x 850+300**	SS304 frame, 16 SWG SS top/water tank, 18 SWG bottom shelf, 20 SWG side covers. 5x 1/1 GN 150mm pans (20 L each) or 10x 1/2 GN (10 L each). Electric 4 kW, thermostat control, 50mm glass wool insulation, SS304 legs. GN pans & water inlet/outlet not included. Top, tank and shelving per IS 6911:2017; glass-wool insulation to IS 8183:1993; electrical heating, thermostat and enclosure to IS 302-1:2008 with earthed supply. Water-bath temperature to be maintained at not less than 65°C at point of service per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) hot-holding norms.	2	Nos
48	**Worktable with Three Side Covering & Sliding Door 1800 x 750 x 850**	Top 16 SWG SS; 18 SWG shelves; SS304 angle frame; 20 SWG SS side panels; SS sliding door; SS304 legs. Fabrication per IS 6911:2017; sliding door detailed for smooth operation and unobstructed access, permitting FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011)-compliant cleaning of the enclosed compartment.	2	Nos
49	**Worktable with Three Side Covering, Front Open 1300 x 700 x 850**	Same construction as Item 50, front open. Fabrication per IS 6911:2017, front-open configuration for direct access; hygienic-finish requirements per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011).	2	Nos
50	**Hot Food Trolley 1200 x 750 x 1200**	16 SWG SS top; 20 SWG inner tank & outer paneling; 18 SWG undershelf; SS tray-slide angle; rubber corner guards; 1.5 kW electric heating, thermostat control; SS304 frame, 60mm glass wool insulation; 4x 6" PU wheels (2 brake). Tray capacity 48 (300x405mm). SS body per IS 6911:2017; glass-wool insulation to IS 8183:1993; electric heating element, thermostat and enclosure to IS 302-1:2008 with earthed supply. Food-holding temperature to be maintained at not less than 65°C at point of service per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) hot-holding norms; castors heavy-duty, PU-tread, rated for the fully loaded trolley weight.	5	Nos
51	**Plate Form Trolley 900 x 600 x 250**	SS304 16 SWG top; SS304 angle frame; 4x 6" PU wheels (2 brake); SS handle; load capacity 250 kg. Top and frame per IS 6911:2017; heavy-duty, ball-bearing, PU-tread swivel castors with 2 lockable brakes, rated for the stated 250 kg load.	3	Nos
52	**Multi-Purpose Trolley 1200 x 700 x 850**	18 SWG SS304 3-tier tray (4" deep); SS304 legs; SS handle; 4x 100mm PU wheels (2 brake). Tiers and frame per IS 6911:2017; each tier rated to a minimum	4	Nos

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S.No	Particulars	Specification	Qty	Unit
		UDL of 40 kg; castors as specified for Item 51.		
53	**Weighing Scale (Electronic) 100-300 kg**	To be verified and stamped under the Legal Metrology Act, 2009 and the Legal Metrology (National Standards) Rules, 2011, minimum Class-III accuracy, with a valid Legal Metrology/BIS certificate of conformity; platform in food-grade stainless steel.	2	Nos
54	**Centrifugal Blower System 20000 CFM**	SS304 body, 7.5 HP motor, 3 Ph / 240V, belt drive. Fan/impeller to conform to IS 4894:1987 (Specification for Centrifugal Fans and Blowers); drive motor per IS 325:1996 or IS 12615:2018 energy-efficiency class, minimum IP55 enclosure; connected ductwork per IS 655:2006.	1	Set
55	**Ducting**	GI ducting (fresh air & exhaust), 22 SWG GI sheet. Ducting to be fabricated, gauged, jointed, reinforced and supported per IS 655:2006 (Specification for Metal Air Ducts); sheet zinc-coating class per IS 277:2018. Duct routing and fire-damper provisions per NBC 2026 (Air Conditioning, Heating and Mechanical Ventilation) and (Fire and Life Safety) for kitchen exhaust runs.	-	Sq.ft (as per design)
56	**Fresh Air System**	Centrifugal blower with drive/base frame/anti-vibration mounts, electric motor, pre & fine filters, cooling media, SS304 water tank, pump sets, valves, spray header, outlet damper. Blower per IS 4894:1987, drive motor per IS 325:1996/IS 12615:2018; SS304 tank per IS 6911:2017; connected ducting per IS 655:2006. Overall fresh-air change rate and kitchen pressure balance to be designed per NBC 2026.	-	Sq.ft (as per design)
57	**Gas Pipeline (with all accessories)**	MS pipe and fittings to IS 1239 (Part 1):2004 (Mild Steel Tubes, Tubular and Other Wrought Steel Fittings) of the class approved by the Oil Marketing Company; installation, pressure-testing and commissioning per IS 6044 (Part 1):2018 and Chief Controller of Explosives (PESO) licensing requirements. Regulators per IS 4246; pipeline route to be colour-marked and pressure-tested prior to handover.	-	Sq.ft (as per design)
58	**Mobile Dust Bin**	Body in SS304 (IS 6911:2017) or food-grade HDPE, foot-pedal-operated, close-fitting lid; colour-coding of waste streams per the Solid Waste Management Rules, 2016 and, for kitchen waste adjoining clinical areas, the Bio-Medical Waste Management Rules, 2016; mounted on lockable castors.	6	Nos
59	**Insect Killer**	Electrical unit to comply with IS 302-1:2008. Non-electrocuting, glue-board type to be used within food-preparation/serving areas per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) good-hygiene-practice guidance, to avoid insect-fragment fallout onto exposed food; unit positioned away from open food-handling lines and not facing entry doors.	5	Nos
60	**Air Curtain**	Motor and electrical enclosure to comply with IS 302-1:2008; mounted over external/service doorways to maintain a positive air-velocity barrier against fly/dust ingress, supporting the FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) pest-control requirement for food premises.	2	Nos

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S.No	Particulars	Specification	Qty	Unit
61	**LPG Cylinder Bank (20 cylinders, one working bank + one standby bank)**	1" dia Class C seamless pipe with pressure gauges (0-15 PSIG & 0-5 PSIG); main line to kitchen 25mm ball valve flanged end, second-stage filter, 25/25 gas filter, NCV, 25mm gas strainer, U-clamp, pipe bend, T-elbow, socket, reducer, yellow paint. Manifold, regulators, piping and fittings to comply with IS 6044 (Part 1):2018 (LPG Storage Installations - Code of Practice) and IS 4246 (Pressure Regulators for LPG); installation to be licensed/approved by the Chief Controller of Explosives (PESO) under the Gas Cylinder Rules, 2016. Cylinder-bank enclosure to be fire-separated, naturally ventilated and static-earthed per IS 3043:1987, with an automatic changeover device between the working and standby banks.	1	Nos
62	**Walk-in Cold Room - Vegetables**	SS304-lined PUF insulated panel walk-in, approx. 15-20 cu.m, +2 to +8 degC. Addresses the reach-in-only cold storage gap noted at Item 45. PUF panels to conform to IS 12436:1988 (Rigid Polyurethane Foam for Thermal Insulation), minimum 80 mm thick; SS304 interior lining per IS 6911:2017. Refrigerant to comply with the Ozone Depleting Substances (Regulation and Control) Rules, 2000, with a BEE-rated compressor/condensing unit. Door fitted with a safety pressure-relief port, anti-condensation heater strip and an internal emergency-release handle.	1	Set
63	**Walk-in Chiller - Non-Veg Protein Items (Fish/Chicken/Egg) & Dairy**	SS304-lined PUF insulated panel walk-in, approx. 10-12 cu.m, +2 to +8 degC, kept separate from the vegetable store. Sized for the fish/chicken/egg/paneer protein-exchange items used across the Odisha diet menu. Construction and refrigerant compliance as Item 62 (IS 12436:1988; IS 6911:2017; Ozone Depleting Substances Rules, 2000). Maintained as a physically separate unit from the vegetable store per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) cross-contamination-prevention requirement.	1	Set
64	**High-Capacity Rice Washing & Soaking Sink Unit**	SS304, multi-bowl, high-throughput. Bowls, drain and overflow fittings per IS 6911:2017 and FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) hygienic-design norms; drainage graded to a floor trap per NBC 2026 (Plumbing Services).	1	Nos
65	**Non-Vegetarian (Fish/Chicken/Egg) Preparation Table with Segregated Sink**	SS304, colour-coded/dedicated boards and sink, physically separated from vegetarian prep per food-safety cross-contamination practice Top and sink per IS 6911:2017. Cutting boards to be colour-coded, food-grade HDPE conforming to IS 10146:1982 (Specification for Polyethylene in Contact with Foodstuffs); station physically segregated from the vegetarian preparation area per FSSAI Schedule 4 (Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011) cross-contamination-prevention guidance.	1	Nos
66	**Idli Steamer (approx. 50-54 idli capacity)**	SS304 multi-tier steamer. Idli Body and trays per IS 6911:2017. Heat source, if electric, to comply with IS 302-1:2008; if gas-fired, per IS 4246 and IS 6044 (Part 1):2018; steam chamber fitted with a pressure-relief/safety valve.	1	Nos
67	**Dosa / Chakuli**	SS304 flat-top gas griddle.	1	Nos

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S.No	Particulars	Specification	Qty	Unit
	Griddle Plate with Undershelf	Frame and undershelf per IS 6911:2017; gas train, burner and regulator per IS 4246 and IS 6044 (Part 1):2018, with flame-failure protection.		
69	**Automatic Chapati Making Machine**	SS304 roller/press type, approx. 1,000-2,000 pcs/hr class. Food-contact rollers/press per IS 6911:2017; drive motor per IS 325:1996, minimum IP55 enclosure, fully guarded per standard machine-safety practice.	1	Nos
70	**Combi Oven**	SS304, 6-10 GN tray capacity, for controlled steaming/baking of therapeutic (renal/diabetic/low-sodium) diets and moist-heat non-veg preparations. Cavity and exterior per IS 6911:2017. Electrical heating/steam-generation elements and enclosure to comply with IS 302-1:2008; integral steam generator, if fitted, to comply with IS 2825:1969 (Code for Unfired Pressure Vessels). Programmable, HACCP-loggable cook cycles suited to therapeutic diet protocols.	1	Nos

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
PART A – SCHEDULE ITEMS			
1	**1. Autopsy Table with Integrated Sink and Drain Pipes** **Electro-Hydraulic Autopsy/Postmortem Table:** Supply, installation, testing and commissioning of an **electro-hydraulically height-adjustable and tilting Autopsy/Postmortem Table** with integrated hand-wash/instrument-rinse sink, fabricated from **minimum 1.5 mm thick AISI 316L stainless steel conforming to IS 6911:2017**, with seamless welded construction, radiused corners and satin finish. The table shall be provided with a **perforated worktop**, removable perforated body support trays, integral body-fluid collection and drainage channels, trapped waste outlet, integrated sink with hot and cold water mixer, foot-operated and sensor-operated water controls, adjustable head and foot sections, splash guards, removable strainers, and all plumbing accessories. The electro-hydraulic lifting mechanism shall provide a **minimum height adjustment range of 750–1050 mm**, **Trendelenburg and reverse Trendelenburg tilt of ±15°**, and a **minimum safe working load of 300 kg**. All electrical equipment associated with the table shall comply with **IEC 60204-1**, and electrical installations within the wet procedure area shall comply with **NFPA 99 (Chapter 6)**. The table shall be installed in an **air-conditioned negative-pressure autopsy room** designed in accordance with **ANSI/ASHRAE/ASHE Standard 170:2021 (Autopsy Room)**. Complete with all plumbing and electrical connections, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
2	**Wash Basin (Scrub Station):** Supply, installation, testing and commissioning of a **touch-free surgical scrub-type wash basin** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless	3	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	welded construction, radiused corners, satin finish, and integral **minimum 300 mm high backsplash**. The basin shall be provided with **sensor-operated and knee-operated controls**, a thermostatic mixing valve with adjustable temperature control, hot and cold water supply, bottle trap, waste fitting, liquid soap dispenser, hand sanitiser dispenser, paper towel dispenser, and all necessary plumbing accessories. The unit shall be connected to the building drainage system through a trapped waste connection conforming to **IS 2065** and to the water supply installations conforming to IS 2065 and the **CPHEEO Manual on Water Supply and Treatment**. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants, and suitable for continuous operation in a mortuary environment. Complete with all accessories, installation, testing, commissioning, operator training, and a **minimum 2-year comprehensive on-site warranty**.		
3	**Body Transport Trolley with Docking Bay:** Supply, installation, testing and commissioning of a **Body Transport Trolley complete with Docking Bay**, designed for safe transport, temporary parking and ergonomic transfer of cadavers between the mortuary chamber and autopsy table. The **Body Transport Trolley** shall be fabricated from **minimum 1.5 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless welded construction, satin finish, removable body tray, heavy-duty tubular frame, ergonomic push handles, side safety rails, drainage provision, and a **minimum safe working load of 300 kg**. The trolley shall be mounted on **four heavy-duty 200 mm diameter non-marking swivel castors**, all with sealed precision bearings, of which **two shall be provided with foot-operated brakes** and directional locks. The trolley height shall be hydraulically or mechanically adjustable to match the autopsy table height for safe lateral transfer. The **Docking Bay** shall comprise heavy-duty **AISI 304 stainless steel guide rails**, self-locking wheel stops, anti-impact bumpers, and trolley alignment guides matching the transfer height of the autopsy table to facilitate safe and stable docking. One docking bay shall be provided for each body transport trolley. The complete assembly shall be corrosion-resistant, easy to clean, resistant to formalin and hospital-grade disinfectants, and suitable for continuous mortuary operation. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**	3	Nos.
4	**Mortuary Refrigeration Chamber (12-Body):** Supply, installation, testing and commissioning of a **modular 12-body Mortuary Refrigeration Chamber** comprising **twelve (12) individual body storage compartments arranged in three tiers (4 × 3 configuration)**, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017** for both internal and external surfaces, with seamless hygienic construction and CFC/HCFC-free high-density **polyurethane foam insulation of minimum 40 kg/m³ density and 80 mm thickness**. The chamber shall maintain a uniform storage temperature of **+2°C to +4°C** for normal body preservation and shall incorporate a **dedicated sub-zero compartment operating between –15°C and –20°C** for long-term or unidentified body storage. Each compartment shall be provided with **heavy-duty telescopic stainless steel roller trays** having a **minimum safe working load of 200 kg**, positive locking arrangement, body stop, and ergonomic pull handles. The chamber shall be equipped with **dual refrigeration units (1 Duty + 1 Standby)** with automatic changeover, hermetically sealed compressors, digital	3	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	temperature controller, LED temperature display, audible and visual high/low temperature alarms, door-open alarm, temperature data logging, battery-backed controller, and automatic defrost system. Doors shall be insulated, gasketed and individually lockable with heavy-duty stainless steel hardware. The refrigeration system shall use environmentally acceptable refrigerant and comply with **ISO 21942**, **IEC 60335-2-89**, **IEC 60204-1**, and **ISO 5149**. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
5	**Unidirectional Downflow Canopy (Laminar Air Flow System):** Supply, installation, testing and commissioning of a **ceiling-mounted unidirectional downflow canopy** for installation above the designated high-risk autopsy workstation, providing **vertical HEPA H13-filtered unidirectional airflow** at an average face velocity of **0.30–0.45 m/s** over the complete working area. The canopy shall be fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless construction, integral **LED task lighting providing minimum 1000 lux** at work surface level, differential pressure gauge across the HEPA filter, pre-filter section, low-noise direct-drive fan assembly, airflow balancing arrangement, and removable filter access panels. The **HEPA H13 filter** shall comply with **ISO 29463** and **EN 1822**, with a minimum efficiency of **99.95% at MPPS**. The complete assembly shall be performance tested and validated in accordance with **ISO 14644-3** and shall operate as part of the **negative-pressure autopsy room ventilation system designed in accordance with ANSI/ASHRAE/ASHE Standard 170:2021**. The unit shall be complete with controls, installation, testing, commissioning, airflow validation, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
6	**Hermetically Sealed Door:** Supply, installation, testing and commissioning of **hermetically sealed stainless steel doors** for the autopsy suite, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with polyurethane foam insulated core, seamless hygienic construction, radiused edges, antimicrobial gasket system, and flush surfaces suitable for frequent cleaning and disinfection. Each door shall provide a **minimum clear opening of 1200 mm × 2100 mm** to permit unrestricted passage of body transport trolleys and stretchers and shall be fitted with a **laminated safety-glass vision panel**, heavy-duty stainless steel hinges or automatic sliding mechanism (where specified), door closer or automatic operator, stainless steel kick plate, flush pull handles, emergency manual override, and full-perimeter compression seals to maintain the designed **negative-pressure differential** of the autopsy suite. The doors shall be corrosion-resistant, resistant to formalin and hospital-grade disinfectants, and suitable for continuous mortuary operation. Complete with all hardware, controls, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
7	**Professional LED Display (65-inch):** Supply, installation, testing and commissioning of a **minimum 65-inch Professional 4K UHD LED Display** with **minimum resolution of 3840 × 2160 pixels**, designed for continuous operation in the autopsy/procedure room. The display shall have a **medical-grade anti-glare matte panel**, minimum **500 cd/m² brightness**, minimum **1200:1 contrast ratio**, **178° viewing angle**, and **24×7 continuous operation** capability. The unit shall be wall-mounted using a heavy-duty **VESA-compatible stainless steel mounting bracket** with tilt adjustment and shall have	1	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	a **minimum front protection rating of IP65 and rear protection rating of IP54 conforming to IEC 60529**. The display shall support **HDMI, DisplayPort, USB and Gigabit Ethernet interfaces**, integrated stereo speakers, Picture-in-Picture (PiP), Picture-by-Picture (PbP), remote management, and direct compatibility with the autopsy room imaging and documentation system for real-time display of camera feeds, medical images and teaching content. The display shall provide a **DICOM simulation mode** for improved grayscale rendering of medical images and shall comply with **IEC 62368-1**, **IEC 60601-1-2** (electromagnetic compatibility where connected to medical electrical equipment), and **IEC 60529**. Complete with all accessories, mounting hardware, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
8	**LED Surgical/Procedure Light:** Supply, installation, testing and commissioning of a **ceiling-mounted shadow-free LED Surgical/Procedure Light** for installation directly above each autopsy table. The light shall provide **adjustable illumination from 100,000 to 160,000 lux at 1 m**, **adjustable colour temperature between 3500 K and 5000 K**, **Colour Rendering Index (CRI) ≥95**, **R9 ≥90**, and a **minimum LED service life of 60,000 hours**. The light head shall incorporate **flicker-free LED technology**, electronic dimming, homogeneous shadow reduction, low heat radiation, and a **sterilizable removable central handle** for positioning. The luminaire shall have a **minimum protection rating of IP65 for the light head conforming to IEC 60529**, articulated ceiling suspension arm with horizontal and vertical movement, and stable positioning without drift. The equipment shall comply with **IEC 60601-1**, **IEC 60601-1-2**, **IEC 60601-2-41**, and **IEC 60529**. Complete with all suspension hardware, controls, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
9	**Autopsy Documentation Camera:** Supply, installation, testing and commissioning of a **ceiling-mounted IP-based 4K Ultra HD Autopsy Documentation Camera** with **minimum 8 MP CMOS sensor**, motorised optical zoom, autofocus, low-light colour imaging, wide dynamic range, and **Power over Ethernet (PoE)** connectivity. The camera shall support **4K (3840 × 2160 pixels) resolution at minimum 30 fps**, H.265/H.264 video compression, electronic image stabilisation, digital privacy masking, date/time stamping, microphone input, secure user authentication, encrypted recording, and network streaming. The system shall be integrated with the **Professional LED Display**, network video recorder (NVR), and the hospital's **Hospital Information System (HIS)/Medical Records Management System (MRMS)** for secure recording, retrieval and archival of medico-legal documentation. The recording system shall support **continuous recording, event recording, audit trails, user access logs, tamper detection, chain-of-custody documentation**, and storage for not less than **90 days**. The camera shall comply with **IEC 62368-1**, **IEC 60529 (minimum IP66)**, **IEEE 802.3af/at (PoE)**, and the **National Human Rights Commission (NHRC), Government of India, Guidelines on Videography of Post-Mortem Examination**. Complete with mounting hardware, network accessories, configuration, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
10	**Down-Draft Grossing/Dissection Workstation:** Supply, installation, testing and commissioning of an **electrically height-adjustable Down-Draft Grossing/Dissection Workstation** fabricated from **minimum 1.5 mm thick**	2	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	AISI 316L stainless steel conforming to IS 6911:2017, with seamless welded construction, radiused corners and satin finish. The workstation shall be provided with an **integral down-draft extraction system** delivering a **minimum capture velocity of 0.5 m/s** uniformly across the working surface, connected to the dedicated **negative-pressure exhaust ventilation system** of the mortuary. The unit shall incorporate a removable perforated work surface, integral sink with hot and cold water mixer, flexible tissue rinse spray, trapped waste outlet, removable strainers, specimen collection tray, instrument holders, splash guards, LED task lighting providing **minimum 1000 lux**, and programmable **electrical height adjustment** over a minimum range of **750–1050 mm**. The workstation shall be resistant to formalin, biological fluids and hospital-grade disinfectants and shall be suitable for continuous mortuary operation. All electrical components shall comply with **IEC 60204-1** and **IEC 60529 (minimum IP65)**. Complete with all plumbing, electrical connections, installation, testing, commissioning, airflow balancing, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
11	**Formalin Collection, Neutralization and Disposal Station:** Supply, installation, testing and commissioning of a **Formalin Collection, Neutralization and Disposal Station** comprising an **AISI 316L stainless steel collection sink and work surface conforming to IS 6911:2017**, chemical-resistant polypropylene (PP) or high-density polyethylene (HDPE) neutralization tank, automatic chemical dosing system, bunded reagent storage, and transfer system for pre-treated effluent to the hospital **Effluent Treatment Plant (ETP)**. The station shall be provided with an **integral local exhaust hood** connected to the dedicated negative-pressure exhaust system, corrosion-resistant ductwork, sink with hot and cold water supply, flexible rinse spray, trapped waste outlet, splash guards, spill containment tray, eyewash station, emergency shower connection, PPE storage cabinet, chemical storage cabinet, and hazard identification signage. The station shall incorporate automatic mixing, level indication, overflow protection, leak-proof chemical transfer piping, sampling point, and control panel with audible and visual alarm for high tank level and dosing failure. All electrical components shall comply with **IEC 60204-1** and shall have a **minimum enclosure protection rating of IP65 conforming to IEC 60529**. The system shall comply with the **Bio-Medical Waste Management Rules, 2016 (as amended)** for handling and pre-treatment of chemical liquid waste prior to discharge to the ETP. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
12	**Open Storage Shelving Unit:** Supply, installation, testing and commissioning of a **free-standing three-tier Open Storage Shelving Unit** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless welded construction, radiused corners and satin finish. The unit shall have **minimum overall dimensions of 1200 mm (L) × 500 mm (D) × 1800 mm (H)** and shall be provided with **three adjustable perforated stainless steel shelves** to facilitate drainage and air circulation, each having a **minimum uniformly distributed load capacity of 100 kg**. The shelving unit shall be supported on a heavy-duty tubular stainless steel frame with cross bracing and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and	2	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	the complete assembly shall be corrosion-resistant, easy to clean, resistant to formalin, biological fluids and hospital-grade disinfectants, and suitable for continuous operation in a mortuary environment. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
13	**Mortuary Suction System:** Supply, installation, testing and commissioning of a **dedicated Mortuary Suction System** comprising **two vacuum pumps (1 Duty + 1 Standby)** with automatic changeover, vacuum receiver, moisture separator, bacterial/hydrophobic filters, non-return valves, vacuum gauges, automatic control panel, alarm system, and stainless steel distribution pipework. The system shall provide **dedicated wall- or table-mounted suction outlets at each autopsy workstation**, complete with suction regulators, autoclavable collection jars, overflow protection, quick-connect couplings, flexible suction tubing and disposable hydrophobic filters. The vacuum system shall maintain a minimum operating vacuum of **–70 kPa** at all outlets under design load and shall be designed for continuous operation. All wetted metallic components shall be fabricated from **AISI 316L stainless steel conforming to IS 6911:2017**, and all pipework and fittings shall be corrosion-resistant and suitable for biological fluids and disinfectants. The system shall discharge collected fluids through a sealed collection system to the designated mortuary drainage connected to the hospital **Effluent Treatment Plant (ETP)**. Electrical equipment shall comply with **IEC 60204-1**, enclosure protection shall comply with **IEC 60529 (minimum IP55)**, and the complete installation shall be provided with vibration isolation, acoustic enclosure, automatic duty/standby alternation, and audible and visual fault alarms. Complete with all accessories, installation, testing, commissioning, performance testing, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
14	**Body Roller Transfer System with Integrated Weighing Scale:** Supply, installation, testing and commissioning of a **Body Roller Transfer System** with integrated **digital weighing scale**, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, comprising heavy-duty roller conveyors for smooth transfer of bodies between transport trolley and mortuary chamber. The weighing scale shall have a **minimum capacity of 300 kg**, **minimum resolution of 100 g**, and conform to **Accuracy Class III** under the **Legal Metrology (General) Rules, 2011**. The system shall be provided with a digital display, tare and hold functions, overload protection, rechargeable battery with AC mains operation, and shall be **verified and stamped by the Legal Metrology Department**. Complete with all accessories, installation, testing, commissioning, calibration, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
15	**Low Height Base Storage Cabinet:** Supply, installation, testing and commissioning of **modular Low Height Base Storage Cabinets** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless hygienic construction, radiused corners and satin finish. The cabinets shall have **standard module dimensions of 1200 mm (L) × 600 mm (D) × 900 mm (H)** and shall be installed in continuous lengths as indicated on the approved GFC drawings. The worktop shall be fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with a marine plywood or equivalent	1	R.m.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	reinforced substrate and a **minimum 100 mm high integral backsplash** where installed against a wall. The cabinets shall be provided with adjustable stainless steel shelves, lockable hinged or sliding shutters, heavy-duty stainless steel hinges, soft-close hardware, recessed handles, adjustable stainless steel levelling feet, and removable kick plates. The complete assembly shall be corrosion-resistant, resistant to formalin, biological fluids and hospital-grade disinfectants, and suitable for continuous mortuary operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
16	**Preparation Cabinet:** Supply, installation, testing and commissioning of a **Mortuary Preparation Cabinet** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless hygienic construction, radiused corners and satin finish. The cabinet shall have **minimum overall dimensions of 1200 mm (L) × 600 mm (D) × 1800 mm (H)** and shall be provided with a **minimum 1.5 mm thick AISI 304 stainless steel worktop with 100 mm high integral backsplash**, lockable upper glazed storage compartment, lockable lower cabinet, **minimum three adjustable stainless steel shelves**, stainless steel drawers for instruments and consumables, utility rail, heavy-duty stainless steel hinges, soft-close hardware, recessed handles, and adjustable stainless steel levelling feet. The cabinet shall be suitable for storage of autopsy instruments, PPE, disinfectants, embalming and preparation materials, specimen containers, and consumables. The complete assembly shall be corrosion-resistant, resistant to formalin, biological fluids and hospital-grade disinfectants, and suitable for continuous operation in a mortuary and autopsy environment. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
17	**Instrument Cupboard:** Supply, installation, testing and commissioning of a **Surgical Instrument Cupboard** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless hygienic construction, radiused corners and satin finish. The cupboard shall have **minimum overall dimensions of 1200 mm (L) × 500 mm (D) × 1800 mm (H)** and shall be provided with **lockable toughened safety-glass double doors**, **minimum four adjustable stainless steel shelves**, recessed handles, heavy-duty stainless steel hinges, magnetic door seals, and adjustable stainless steel levelling feet. The cupboard shall be designed for **clean, dust-free storage of sterilized autopsy instruments, PPE, and related accessories** and shall be corrosion-resistant, resistant to formalin, biological fluids and hospital-grade disinfectants, and suitable for continuous operation in a mortuary and autopsy environment. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
PART B –ITEMS (Life-Safety / Chemical-Safety / Infection-Control Provisions			
18	**Emergency Eyewash Station:** Supply, installation, testing and commissioning of a **wall-mounted Emergency Eyewash Station** complete with twin aerated eyewash nozzles with dust covers, stay-open hands-free operating valve, thermostatic mixing valve delivering **tepid water at 16–38°C**, high-visibility safety signage, and dedicated isolation valve. The eyewash shall deliver a **minimum flow rate of 1.5 L/min** and provide continuous flushing for **not less than 15 minutes**. The equipment shall comply with **ANSI/ISEA Z358.1** and shall be suitable for installation adjacent to areas handling formalin and other hazardous chemicals in the mortuary. Complete with all plumbing connections, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
19	**Chemical Spill Containment Kit:** Supply, installation and commissioning of a **wall-mounted Chemical Spill Containment Kit** suitable for containment and clean-up of formalin and other hazardous chemical spills in the mortuary and autopsy suite. The kit shall be housed in a clearly labelled, impact-resistant cabinet and shall include chemical absorbent pads and pillows, absorbent granules, formaldehyde neutralising agent, chemical-resistant nitrile gloves, chemical splash goggles, disposable apron, shoe covers, respirator, disposable scoop and scraper, waste collection bags with ties, caution signage, and operating instructions. The kit shall be suitable for handling **minimum 20 litres** of chemical spill and shall be installed adjacent to the **Formalin Collection, Neutralization and Disposal Station** and **Grossing Workstations**. Complete with all accessories, installation, commissioning, operator training, replenishment schedule, and a **minimum 2-year comprehensive on-site warranty** for the cabinet and reusable components.	1	Nos.
20	**PPE Donning/Doffing Station:** Supply, installation, testing and commissioning of a **PPE Donning/Doffing Station** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with seamless hygienic construction, radiused corners and satin finish. The station shall have **minimum overall dimensions of 1800 mm (L) × 600 mm (D) × 2100 mm (H)** and shall comprise open storage racks and hooks for gowns, aprons, gloves, face shields, masks, head covers and gumboots, lockable storage cabinet, bench seating, full-length mirror, hand sanitiser dispenser, glove dispenser, waste bin holder, and a **foot-operated biohazard waste bin**. The complete assembly shall be corrosion-resistant, resistant to hospital-grade disinfectants and cleaning chemicals, easy to clean, and suitable for continuous operation in a mortuary and autopsy environment. Complete with all accessories, installation, testing, commissioning, operator training, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
21	**Segregated Bio-Medical Waste Bin Set (Colour-Coded):** Supply, installation and commissioning of **foot-operated, colour-coded Bio-Medical Waste Bin Sets** for segregation of waste at each autopsy workstation, comprising **Yellow (50 L)** for anatomical, soiled and chemical waste, **Red (50 L)** for contaminated recyclable plastics, **White translucent puncture-proof sharps container (minimum 15 L)**, and **Blue (50 L)** for glassware and metallic implant waste. The bins shall be fabricated from high-impact, chemical-resistant HDPE and mounted on a **minimum 1.2 mm thick AISI 304 stainless steel trolley/frame conforming to IS 6911:2017**, complete with soft-close foot-operated lids, removable inner liners, heavy-duty swivel castors (two with brakes), colour-coded labels, and biohazard symbols. The complete assembly shall comply with the **Bio-Medical Waste Management Rules, 2016 (as amended)** and be resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	3	Sets
22	**Seamless Chemical-Resistant Flooring, Coved Skirting & Floor Drains:** Supply and laying of **seamless, non-porous, chemical- and formalin-resistant self-levelling epoxy flooring** of **minimum 4 mm thickness** conforming to **EN 1504-2**, finished with a slip-resistant surface suitable for wet areas. The flooring shall be laid over a suitably prepared concrete substrate and shall be provided with **integral coved epoxy skirting of minimum 100 mm height and 50 mm radius** at all wall-floor junctions to eliminate dirt traps and facilitate cleaning. The floor shall be uniformly graded towards **AISI 304 stainless steel trapped floor drains** with removable grating and deep-seal trap, connected to the building drainage system. The flooring system shall be resistant to formalin, biological	TBC	Sqm

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	fluids, blood, hospital-grade disinfectants, cleaning chemicals and mechanical abrasion, and shall have a **minimum compressive strength of 70 MPa** and **bond strength of not less than 2.0 MPa**. Stainless steel floor drains shall conform to **IS 2065** for sanitary drainage installations. Complete with all materials, surface preparation, installation, testing, and a **minimum 5-year warranty** against debonding, cracking and chemical deterioration.		
23	**Emergency Power Backup for Mortuary Refrigeration System:** Supply, installation, testing and commissioning of an **Automatic Mains Failure (AMF)/Automatic Transfer Switch (ATS) Panel** dedicated to the Mortuary Refrigeration System, complete with automatic changeover between normal electrical supply and the hospital standby diesel generator (DG) supply to ensure uninterrupted operation of all mortuary refrigeration chambers. The panel shall be provided with electrically and mechanically interlocked switching devices, digital multifunction meter, phase failure and phase reversal protection, under/over-voltage protection, control relays, status indication, audible and visual alarms, manual bypass facility, and lockable enclosure. The panel shall be sized for the connected refrigeration load with **minimum 25% spare capacity** for future expansion. The equipment shall comply with **IEC 60947 (Low-Voltage Switchgear and Controlgear)**, **IEC 61439 (Low-Voltage Switchgear and Controlgear Assemblies)**, and **IS/IEC 60947**. Complete with all power and control cabling, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
24	**Fire Detection & Suppression System:** Supply, installation, testing and commissioning of a **Fire Detection & Suppression System** for the Mortuary and Autopsy Suite comprising addressable multi-sensor smoke/heat detectors, manual call points, hooters with visual strobes, monitor/control modules, and **automatic wet-pipe sprinkler system** complete with piping, sprinkler heads, valves, hangers and accessories. The system shall be fully integrated with the hospital's **Addressable Fire Alarm System** and **Automatic Sprinkler System**, with alarm annunciation at the central Fire Command Centre. The complete installation shall be designed and installed in accordance with **NBC 2016 Part 4 – Fire and Life Safety**, **IS 2189** (Selection, Installation and Maintenance of Automatic Fire Detection and Alarm Systems), **IS 15105** (Automatic Sprinkler Systems – Code of Practice), and **IS 2190** (Selection, Installation and Maintenance of First-Aid Fire Extinguishers). Complete with all materials, installation, testing, commissioning, demonstration, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
25	**Access-Controlled Entry System:** Supply, installation, testing and commissioning of an **electronic Access-Controlled Entry System** for the Mortuary and Autopsy Suite comprising **RFID smart card and biometric (fingerprint) readers** installed at each controlled entrance, electromagnetic or electric mortise locks with **minimum 600 kg holding force**, door position sensors, request-to-exit devices, **emergency break-glass release units**, and local door controllers. The system shall provide **role-based access control**, time-based access scheduling, electronic audit trail, event logging, user authentication, anti-passback, and automatic door release upon fire alarm activation. Each door shall be provided with a **manual mechanical override key** and **fail-safe emergency release mechanism** to permit immediate egress during fire, power failure, or other emergency conditions. The system shall support integration with the hospital's **Integrated Building Management System (IBMS)** and Security Management System over **TCP/IP** using **IEEE 802.3 Ethernet** and **OSDP v2 Secure Channel (IEC 60839-11-5)** for encrypted communication between	3	Nos.

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	readers and controllers. Electrical equipment shall comply with **IEC 62368-1**, electromagnetic compatibility shall comply with **IEC 61000**, and enclosure protection shall comply with **IEC 60529 (minimum IP54)**. Complete with all controllers, power supplies, cabling, software licences, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
26	**Wash-Down Hose Reel Station:** Supply, installation, testing and commissioning of a **wall-mounted retractable Wash-Down Hose Reel Station** for cleaning and disinfection of autopsy tables, floors and equipment. The unit shall comprise an **AISI 304 stainless steel enclosure conforming to IS 6911:2017**, **minimum 15 m long heavy-duty reinforced hose** suitable for hot and cold water service, automatic spring rewind mechanism, **thermostatic mixing valve**, adjustable high-pressure spray gun with trigger control, stainless steel swivel joints, isolation valve, hose guide rollers, wall mounting bracket, and all plumbing accessories. The system shall be designed for a **minimum working pressure of 6 bar** and **maximum working pressure of 10 bar**, with operating water temperature adjustable between **20°C and 60°C**. All wetted components shall be corrosion-resistant and suitable for continuous use with hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
27	**Wall-Mounted First-Aid Station:** Supply, installation, testing and commissioning of a **wall-mounted First-Aid Station** comprising a lockable powder-coated steel or high-impact ABS cabinet with transparent front panel, internal shelving, first-aid inventory holder, and high-visibility identification signage. The cabinet shall have **minimum overall dimensions of 450 mm (H) × 350 mm (W) × 150 mm (D)** and shall be securely wall-mounted at an easily accessible location near the entrance/exit of the mortuary and autopsy suite. Complete with all mounting hardware, installation, testing, commissioning, and a **minimum 2-year warranty** on the cabinet and fittings.	1	Nos.
28	**Statutory & Hazard Signage Package:** Supply, installation, testing and commissioning of a **Statutory & Hazard Signage Package** for the Mortuary and Autopsy Suite comprising **Biohazard Warning Signs**, **Chemical Hazard (Formalin) Warning Signs**, **Authorised Personnel Only** access signs, **PPE Mandatory** signs, **Emergency Eyewash Station** signs, **Bio-Medical Waste Segregation** signs, **No Smoking/Open Flame** signs, **Emergency Contact Information**, and **illuminated EXIT signs**. All signage shall be fabricated from chemical-resistant, high-impact material with permanent UV-stable graphics and shall be suitable for continuous indoor hospital use. Illuminated EXIT signs shall be LED type with battery backup. The signage package shall comply with the **Bio-Medical Waste Management Rules, 2016 (as amended)**, **IS 9457 (Safety Colours and Safety Signs)**, **IS 12349 (Fire Safety Signs)**, and **NBC 2016 Part 4 – Fire and Life Safety**. Complete with all mounting hardware, installation, testing, commissioning, and a **minimum 2-year warranty**.	1	Set
PART C – Dedicated HVAC, Ventilation & Environmental Control System for Mortuary and Autopsy Suite			
29	**Dedicated 100% Fresh-Air Air Handling Unit (AHU):** Supply, installation, testing and commissioning of a **dedicated single-pass 100% Fresh-Air Air Handling Unit (AHU)** exclusively serving the Mortuary and Autopsy Suite, complete with outdoor air intake louvre incorporating bird and insect screens, **G4 pre-filters and ePM1 80% fine filters conforming to ISO 16890**, double-skin	1	Set

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	insulated aluminium/GI construction with **minimum 43 mm PUF insulation**, stainless steel drain pan, chilled water cooling coil, **UV-C coil irradiation system**, and **dual EC plug supply fans (1 Duty + 1 Standby)** with automatic changeover and Variable Frequency Drives (VFDs). The AHU shall maintain an indoor design condition of **20–24°C** and **relative humidity not exceeding 60%**, and shall supply sufficient outdoor air to achieve a **minimum of 12 air changes per hour (ACH)** with **0% air recirculation**. The unit shall be provided with motorised isolation dampers, differential pressure gauges across filters, temperature and humidity sensors, vibration isolators, flexible connections, access doors, internal LED service light, and complete **BMS integration** for monitoring and control. The AHU shall comply with **ANSI/ASHRAE/ASHE Standard 170:2021**, **ISO 16890**, **IS 655**, **IS 1391**, and **IEC 60335-2-40**. Complete with insulated ductwork, controls, installation, testing, air balancing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
30	**Dedicated Exhaust Air System with HEPA Filtration & Heat Recovery:** Supply, installation, testing and commissioning of a **dedicated 100% Exhaust Air System** exclusively serving the Mortuary and Autopsy Suite, comprising **low-level AISI 316L stainless steel exhaust grilles conforming to IS 6911:2017** positioned adjacent to each autopsy table, grossing workstation and formalin handling area, **dual EC plug exhaust fans (1 Duty + 1 Standby)** with automatic changeover and Variable Frequency Drives (VFDs), and **HEPA H14 filters** housed in **Bag-In/Bag-Out (BIBO) safe-change housings**. The exhaust system shall maintain the autopsy suite under continuous **negative pressure** by providing exhaust airflow greater than the supply airflow and shall discharge **100% exhaust air directly to atmosphere** without recirculation. Exhaust ductwork exposed to formalin vapours shall be fabricated from **AISI 316L stainless steel conforming to IS 6911:2017**, complete with motorised isolation dampers, backdraft dampers, flexible connections, vibration isolators, differential pressure gauges across filters, room differential pressure monitor with audible and visual alarms, and complete **BMS integration**. The system shall incorporate a **closed-loop Run-Around Coil Heat Recovery System** comprising supply and exhaust air coils interconnected through a glycol-water circuit with circulation pumps (1 Duty + 1 Standby), expansion vessel, control valves, air separator, balancing valves and associated piping. The heat recovery system shall provide **complete physical separation between the supply and exhaust air streams**, ensuring **zero cross-contamination**, and shall achieve a **minimum sensible heat recovery efficiency of 45%** while maintaining 100% fresh-air operation. The heat recovery system shall be fully integrated with the Building Management System (BMS) for automatic operation, monitoring and energy optimisation. The **HEPA H14 filters** shall comply with **ISO 29463** and **EN 1822**, and the ventilation system shall comply with **ANSI/ASHRAE/ASHE Standard 170:2021**. Complete with ductwork, controls, installation, testing, air balancing (TAB), commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
31	**Differential Pressure Monitoring & Alarm System:** Supply, installation, testing and commissioning of a **continuous Differential Pressure Monitoring & Alarm System** for the Mortuary and Autopsy Suite comprising calibrated electronic differential pressure sensors, room pressure monitors with LCD	1	Set

AIR-CONDITIONED NEGATIVE-PRESSURE AUTOPSY SUITE & MORTUARY			
S.No.	**Particulars**	**Qty**	**Unit**
	display, audible and visual alarms, local alarm acknowledge/reset facility, and continuous data logging. One monitoring station shall be provided at each entrance to continuously measure and display the pressure differential between the autopsy suite and the adjacent area. The system shall maintain and continuously monitor a **minimum negative pressure differential of –5 Pa**, with configurable high/low alarm set points, trend recording, and event logging. The system shall support **BACnet/IP or Modbus TCP** communication for integration with the Building Management System (BMS) and shall be provided with UPS-backed operation to ensure continuous monitoring during power interruptions. The equipment shall comply with **ANSI/ASHRAE/ASHE Standard 170:2021**, **IEC 61010-1**, **IEC 61326-1**, and **IEC 60529 (minimum IP54)**. Complete with all sensors, transmitters, controllers, cabling, installation, testing, calibration, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
32	**Motorised Airflow-Tracking Pressure-Control Dampers:** Supply, installation, testing and commissioning of **low-leakage motorised airflow-tracking pressure-control dampers** installed in the dedicated supply and exhaust ductwork serving the Mortuary and Autopsy Suite. The system shall comprise **modulating Class 4 low-leakage dampers conforming to EN 1751**, spring-return actuators, airflow measuring stations, differential pressure controller, and associated sensors to continuously regulate supply and exhaust airflows and maintain a constant volumetric offset with **exhaust airflow exceeding supply airflow**, thereby maintaining a **minimum room negative pressure of –5 Pa** under all operating conditions, including door opening, filter loading and varying room occupancy. The system shall have a **maximum response time of 5 seconds**, automatic fail-safe operation upon power failure, and shall integrate with the **Dedicated Fresh-Air AHU (Item 29)**, **Dedicated Exhaust Air System (Item 30)**, **Differential Pressure Monitoring & Alarm System (Item 31)**, and the hospital **Building Management System (BMS)** through **BACnet/IP or Modbus TCP**. The equipment shall comply with **ANSI/ASHRAE/ASHE Standard 170:2021**, **EN 1751**, **IEC 60730**, and **IEC 60529 (minimum IP54)**. Complete with all dampers, actuators, controllers, sensors, cabling, installation, testing, air balancing (TAB), commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Set
Note: *Any item(s), material(s), accessory, fitting, fixing, control wiring/cabling, civil/structural support, or ancillary work not specifically itemised above but which is incidental to, and necessary for, the complete, safe and functional supply, installation, testing, commissioning and handing-over of the Autopsy Suite in accordance with the intent of this schedule, the referenced codal/statutory standards, and good engineering practice, shall be deemed to be included within the Contractor's scope of work at no extra cost to the Employer, and no separate claim on this account shall be entertained.*			

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	Supply, Installation, Testing & Commissioning of Pneumatic Waste & Laundry Collection System		
1	**Blower / Vacuum Exhauster Assembly:** Supply, installation, testing and commissioning of **Vacuum Exhauster/Blower Assemblies (2 Sets comprising 1 Duty + 1 Standby)** for the Pneumatic Waste and	2	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	Laundry Collection System, complete with high-efficiency centrifugal blowers, Variable Frequency Drives (VFDs), flexible connectors, anti-vibration mounts, inlet filters, isolation dampers, pressure and temperature sensors, vibration monitoring, local control panel, and all associated accessories. The blower assemblies shall generate and maintain the required negative pressure within the dedicated waste and laundry pipeline networks to convey waste and soiled linen at a **minimum conveying air velocity of 18–22 m/s**. Each blower shall have a **minimum motor rating of 90 kW or as determined by the approved system pressure-loss and airflow calculations**, and shall be capable of continuous operation under the design duty conditions. Motors shall be **IE4 premium-efficiency** conforming to **IEC 60034-30-1** and controlled through VFDs to maintain the required conveying velocity under varying load conditions. The blower assemblies shall be designed for **N+1 redundancy**, with automatic changeover to the standby unit upon fault, high vibration, high bearing temperature, motor overload, or other critical alarm conditions. Each blower shall be provided with independent isolation dampers and electrical isolation to permit maintenance without interruption of system operation. Fan performance shall be tested in accordance with **ISO 5801 / IS 4894**, electrical equipment shall comply with **IEC 60204-1**, and sound power levels shall be determined in accordance with **ISO 3744**. Complete with all supports, controls, interlocks, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
1A	**Vacuum/Pressure Relief (Safety) Valve – Blower Protection:** Supply, installation, testing and commissioning of **automatic Vacuum/Pressure Relief Valves (2 Nos.)**, one installed on each blower assembly (Duty and Standby) for protection against excessive negative pressure, over-pressure, surge and abnormal operating conditions. Each valve shall be sized to suit the blower duty and system pressure-loss calculations and shall automatically open at the preset operating limits and automatically reseat when normal operating conditions are restored. The valve shall comprise a corrosion-resistant body with **AISI 304 or AISI 316 stainless-steel wetted components**, adjustable set point, pressure indication, manual test facility, and position/alarm feedback integrated with the system PLC and Building Management System (BMS). Each blower shall have an independently isolable protection valve to permit maintenance without interrupting operation of the standby blower. Relief device sizing and set-point selection shall conform to the protective-device principles of **ASME B31.3**, and where the valve constitutes a pressure-retaining component, its design, manufacture and testing shall comply with **IS 2825** or **ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1**, as applicable. Complete with all accessories, supports, installation, testing, commissioning, calibration, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	2	Nos
1B	**Noise Attenuators/Silencers – Blowers & Compressors:** Supply, installation, testing and commissioning of **acoustic inlet and discharge silencers** for each **Vacuum Exhauster/Blower Assembly (Item 1)** and **Air Compressor (Item 20)**, complete with galvanized	1	Lot

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	steel or epoxy-coated steel casing, corrosion-resistant internal perforated liner, non-combustible acoustic infill protected against fibre erosion, flanged connections, flexible connectors, supports and all accessories. Silencers shall be designed to suit the system airflow and operating pressure without adversely affecting conveying performance, with a **maximum pressure drop of 100 Pa** across each silencer. The complete installation shall be designed to limit the **overall noise level in the blower/compressor room to not more than 85 dB(A) measured at 1 m from the equipment** under full-load operation. Sound power and sound pressure levels shall be determined in accordance with **ISO 3744**, and the complete installation shall comply with the **Noise Pollution (Regulation and Control) Rules, 2000** and applicable State Pollution Control Board requirements. Complete with all supports, installation, testing, commissioning, acoustic performance verification, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
2	**Velocity Monitoring & Pressure Control Unit:** Supply, installation, testing and commissioning of **Velocity Monitoring & Pressure Control Units (2 Sets)**, one each for the **Waste Collection System** and the **Laundry Collection System**, comprising airflow velocity sensors, differential pressure transmitters, Variable Frequency Drive (VFD), PLC-based control system, HMI interface, and associated instrumentation for continuous monitoring and automatic regulation of conveying air velocity and system negative pressure. The control system shall continuously compare the measured airflow velocity with the programmed set point and automatically modulate the blower speed through the VFD to maintain the required conveying velocity of **18–22 m/s** under varying loading conditions. The system shall provide real-time monitoring, automatic fault detection, alarm annunciation, event logging, and seamless integration with the Building Management System (BMS). The control enclosure shall have a **minimum IP54 degree of protection**, and the VFD shall comply with **IEC 61800-3**, enclosure protection shall comply with **IEC 60529**, PLC programming shall comply with **IEC 61131-3**, and industrial communication shall comply with **IEC 62443**. The control system shall automatically transfer operation to the standby blower during N+1 changeover without interruption of airflow regulation. Complete with all sensors, transmitters, control panels, wiring, software, installation, testing, calibration, commissioning, operator training, O&M manuals, and a **minimum 2-year**	2	Set
3	**Sub Control Panel for Waste & Laundry Collection System:** Supply, installation, testing and commissioning of **Sub Control Panels (2 Sets)** for the Pneumatic Waste and Laundry Collection System, complete with PLC-based local control, HMI interface, input/output modules, power supplies, control relays, MCBs/MCCBs, terminal blocks, surge protection devices, Ethernet communication module, and all associated wiring and accessories. Each panel shall control and monitor the operation of the chute inlet doors, pneumatic valves, diverter valves, discharge valves, sensors and field devices within its designated service zone. The panels shall be designed with **completely independent control circuits, wiring, input/output**	2	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	modules and interlocks for the Waste and Laundry systems, ensuring that waste and soiled linen are conveyed through dedicated inlet stations, valves and pipelines with no possibility of cross-connection. The panels shall provide equipment status monitoring, fault diagnostics, alarm annunciation, event logging, local/manual operation, and seamless integration with the central PLC/SCADA system and Building Management System (BMS). Panel construction shall comply with **IEC 61439-1 & IEC 61439-2**, enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**, PLC programming shall comply with **IEC 61131-3**, and industrial communication shall comply with **IEC 62443**. Complete with all internal wiring, interconnections, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
4	**Wet Waste Collector with Air Separation Unit:** Supply, installation, testing and commissioning of a **Wet Waste Collector with Air Separation Unit (2 Sets – 1 Duty + 1 Standby)** for the Pneumatic Waste Collection System, comprising a heavy-duty **AISI 304 stainless steel collection vessel conforming to IS 6911:2017**, cyclonic air separation chamber, automatic discharge arrangement, airtight inspection door, quick-opening maintenance access, level sensors (High/Low), pressure monitoring, condensate drain, odour-sealed construction, and all associated supports and accessories. The collector shall be designed to efficiently separate conveyed wet waste from the conveying air stream while preventing carry-over into the blower system and shall be suitable for continuous automatic operation under the design conveying velocity and system vacuum conditions. The unit shall be provided with automatic level monitoring, overflow protection, inspection ports, maintenance access, and interlocks with the PLC/SCADA system and Building Management System (BMS). The storage vessel shall be fabricated from **AISI 304 stainless steel conforming to IS 6911:2017**, with all welding carried out in accordance with **ASME Section IX**. The complete assembly shall be corrosion-resistant, leak-proof, easy to clean, and suitable for handling wet municipal and hospital waste. Complete with all supports, piping connections, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	2	Set
5	**Wet Waste Storage Container:** Supply, installation, testing and commissioning of **Wet Waste Storage Containers (2 Nos. – 1 Duty + 1 Standby/Changeover)** for installation within the Central Collection Room, fabricated from **minimum 2.0 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with a **minimum storage capacity of 1.0 m^3 (1000 litres)** each or as determined by the approved waste-generation calculations. Each container shall be of fully enclosed, leak-proof and odour-tight construction, mounted on heavy-duty swivel castors (two with brakes) conforming to **EN 840**, and provided with an **integral screw conveyor** for automatic transfer of wet waste to the downstream processing/disposal system. The container shall incorporate airtight covers, level sensors (High/High-High), inspection and cleaning access, quick-connect/disconnect arrangement, lifting points, and interlocks with the system PLC to	2	Nos.

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	prevent overfilling. The screw conveyor shall be driven by a geared motor with overload protection and shall automatically operate based on waste level. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital disinfectants, and suitable for continuous operation in a healthcare environment. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
6	**Dry Waste Collector with Air Separation Unit:** Supply, installation, testing and commissioning of **Dry Waste Collectors with Air Separation Units (2 Sets – 1 Duty + 1 Standby)** for the Pneumatic Waste Collection System, comprising a heavy-duty **AISI 304 stainless steel collection vessel conforming to IS 6911:2017**, cyclonic air separation chamber, airtight inspection door, automatic discharge arrangement, quick-opening maintenance access, level sensors (High/Low), pressure monitoring, and all associated supports and accessories. The collector shall efficiently separate conveyed dry waste from the conveying air stream while preventing carry-over into the blower system and shall be suitable for continuous automatic operation under the design conveying velocity and system vacuum conditions. The unit shall incorporate automatic level monitoring, overflow protection, maintenance access, and interlocks with the PLC/SCADA system and Building Management System (BMS). The storage vessel shall be fabricated from **AISI 304 stainless steel conforming to IS 6911:2017**, with all welding carried out in accordance with **ASME Section IX**. The complete assembly shall be corrosion-resistant, dust-tight, easy to maintain, and suitable for handling non-putrescible municipal and hospital dry waste. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**	2	Set
8	**Laundry Collector with Air Separation Unit:** Supply, installation, testing and commissioning of **Laundry Collectors with Air Separation Units (2 Sets – 1 Duty + 1 Standby)** for the Pneumatic Laundry Collection System, comprising a heavy-duty **AISI 304 stainless steel collection vessel conforming to IS 6911:2017**, cyclonic air separation chamber, airtight inspection door, automatic discharge arrangement, quick-opening maintenance access, level sensors (High/Low), pressure monitoring, and all associated supports and accessories. The collector shall be designed to efficiently separate conveyed soiled linen from the conveying air stream while preventing carry-over into the blower system and shall be suitable for continuous automatic operation under the design conveying velocity and system vacuum conditions. The storage vessel shall be of fully enclosed, leak-proof and dust-tight construction, corrosion-resistant, and suitable for handling soiled hospital linen. The collector shall be connected **exclusively to the dedicated Laundry Collection Pipeline Network** and shall remain completely independent of the Dry Waste and Wet Waste collection systems. The unit shall be integrated with the PLC/SCADA system and Building Management System (BMS) for automatic operation, level monitoring, alarm annunciation and fault diagnostics. The storage vessel shall be fabricated from **AISI 304 stainless steel conforming to IS 6911:2017**, with welding carried out	2	Nos.

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	in accordance with **ASME Section IX**. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
9	**Laundry Waste Collection Trolley:** Supply, installation and commissioning of **Laundry Waste Collection Trolleys (4 Nos.)** for use in the Central Collection Room, fabricated from **minimum 2.0 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, with a **minimum capacity of 1.0 m³ (1000 litres)** and a **minimum safe working load of 250 kg**. The trolley shall be of fully enclosed construction with smooth internal surfaces, rounded corners, hinged top cover, and bottom discharge arrangement compatible with the Laundry Collector discharge system. Each trolley shall be mounted on **heavy-duty swivel castors (two fixed and two swivel with brakes)** conforming to **EN 840**, and provided with ergonomic push handles, towing provision, identification plates, and locking arrangement for safe transportation. The trolley shall be corrosion-resistant, leak-proof, washable, resistant to hospital-grade disinfectants, and suitable for repeated cleaning and disinfection. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	4	Nos.
10	**Filtration Unit:** Supply, installation, testing and commissioning of **Exhaust Air Filtration Units (2 Sets)** for the Pneumatic Waste and Laundry Collection System, comprising **G4 pre-filters conforming to ISO 16890**, **ePM1 80% fine filters conforming to ISO 16890**, and **HEPA H14 final filters conforming to EN 1822 and ISO 29463**, housed in corrosion-resistant, airtight filter casings with differential pressure gauges, pressure transmitters, filter access doors, inspection ports, and all associated supports and accessories. The filtration units shall remove particulate matter from the exhaust air prior to atmospheric discharge and shall be designed for continuous operation with **parallel filter banks and isolation dampers**, permitting filter inspection, replacement and maintenance without interruption of system operation. Each filtration unit shall be sized for the design airflow of its respective collection system and shall be integrated with the PLC/SCADA system and Building Management System (BMS) for continuous monitoring of filter differential pressure, alarm annunciation, filter clogging indication and maintenance scheduling. The complete exhaust filtration system shall comply with **ISO 16890**, **EN 1822**, **ISO 29463**, and the applicable **Central Pollution Control Board (CPCB)** and **State Pollution Control Board (SPCB)** requirements for exhaust emissions. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	2	Set
10A	**Odour Control Unit (Activated Carbon):** Supply, installation, testing and commissioning of **Activated Carbon Odour Control Units (2 Sets)** for the **Waste Collection System**, installed downstream of the particulate filtration units to remove odorous compounds and volatile organic compounds (VOCs) from the waste exhaust air prior to atmospheric discharge. Each unit shall comprise a corrosion-resistant housing, deep-bed activated carbon adsorption modules, pre-filter section, differential pressure gauges, sampling ports, inspection	2	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	doors, isolation dampers, and all associated supports and accessories. The activated carbon media shall be selected based on the manufacturer's certified adsorption capacity and expected contaminant loading and shall be easily replaceable without interrupting operation of the remaining system. The units shall be integrated with the PLC/SCADA system and Building Management System (BMS) for differential pressure monitoring, filter status indication and maintenance alarms. Exhaust emissions shall comply with the applicable **Central Pollution Control Board (CPCB)** and **State Pollution Control Board (SPCB)** requirements. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
11	**Horizontal Diverter Assembly:** Supply, installation, testing and commissioning of **Horizontal Pneumatic Multi-Port Diverter Assemblies (2 Sets)** for the **Waste Collection System**, suitable for **500 mm diameter** pneumatic conveying pipelines, comprising pneumatically operated multi-port diverter valves for automatic routing of **Dry Waste**, **Wet Waste**, and **Biomedical Waste** from the main waste pipeline to their respective collection containers within the Central Collection Area (CCA). The diverter assembly shall be fabricated from **minimum 3 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, complete with heavy-duty pneumatic actuators, position sensors, limit switches, airtight wear-resistant seals, inspection doors, maintenance access covers, flange connections, supports, and all associated accessories. The assembly shall be designed for continuous operation under the specified system vacuum, provide leak-tight sealing with minimum pressure loss, and permit maintenance without interruption of the remaining waste streams. Pneumatic actuation components shall comply with **ISO 4414**, and the complete assembly shall be fully integrated with the PLC/SCADA system and Building Management System (BMS) for automatic operation, position monitoring, fault diagnostics and alarm annunciation. Reducers, transition pieces and flange adaptors required for interfacing with adjoining pipework shall be included as part of the scope. **The Laundry Collection System shall have an entirely separate and dedicated pipeline network, diverter assembly and collection system, and shall not be connected to this Horizontal Diverter Assembly.** Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	1	Set
12	**Pneumatic Air Intake Valve Assembly:** Supply, installation, testing and commissioning of **Pneumatic Air Intake Valve Assemblies (2 Sets)** suitable for **500 mm diameter** pneumatic conveying pipelines, comprising pneumatically operated quick-opening air intake valves, airtight valve housings, **minimum 3 mm thick AISI 304 stainless steel construction conforming to IS 6911:2017**, replaceable wear-resistant sealing elements, compressed-air actuators, position sensors, limit switches, manual override, inspection access, flanged connections, supports, and all associated accessories. The valve assembly shall admit atmospheric air into the conveying pipeline under PLC control to establish and maintain the required conveying airflow	2	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	and system vacuum during waste transport operations. The valves shall provide leak-tight sealing during idle conditions, rapid opening and closing, low pressure loss, and reliable operation under continuous cyclic service. Pneumatic actuation components shall comply with **ISO 4414** and shall include air preparation units, solenoid valves, pressure regulators, air filters, pressure gauges, and position feedback devices. The assembly shall be fully integrated with the **PLC/SCADA system** and **Building Management System (BMS)** for automatic operation, position monitoring, fault diagnostics, alarm annunciation, event logging, and automatic sequencing with the blower, diverter and discharge valve operations. Reducers, transition pieces, flexible connectors, compressed-air piping, supports, mounting hardware, and all accessories necessary for a complete operational installation shall be included. The valve assembly shall be suitable for continuous operation under the specified system vacuum and conveying air velocity, with all internal components designed for abrasion resistance and long service life. **The Bottom Discharge Valve for the Vertical Riser shall be provided as a separate item under the Discharge Valve Assembly and is not included in this item.** Complete with installation, testing, commissioning, calibration, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
13	**Vertical Pneumatic Diverter Assembly:** Supply, installation, testing and commissioning of **Vertical Pneumatic Diverter Assemblies (2 Sets)** suitable for installation at the base of each waste collection riser for automatic diversion of **Dry Waste**, **Wet Waste**, and **Biomedical Waste** to their respective collection containers within the Central Collection Area (CCA). The assembly shall comprise pneumatically operated multi-port diverter valves suitable for **500 mm diameter** pneumatic conveying pipelines, fabricated from **minimum 3 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, complete with heavy-duty pneumatic actuators, position sensors, limit switches, airtight wear-resistant seals, inspection doors, maintenance access covers, flanged connections, supports, and all associated accessories. The assembly shall provide leak-tight sealing under the specified system vacuum, minimum pressure loss, rapid changeover between waste streams, and reliable operation under continuous cyclic service. Pneumatic actuation components shall comply with **ISO 4414** and shall include air preparation units, solenoid valves, pressure regulators, air filters, pressure gauges, and position feedback devices. The diverter assembly shall be fully integrated with the **PLC/SCADA system** and **Building Management System (BMS)** for automatic sequencing, position monitoring, fault diagnostics, alarm annunciation, and event logging. The assembly shall be designed for continuous operation under the specified conveying vacuum and airflow conditions, with abrasion-resistant internal components and provision for maintenance without interruption of the remaining collection system. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	2	Sets

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
14	**Pneumatic Discharge Valve Assembly:** Supply, installation, testing and commissioning of **Pneumatically Operated Discharge Valve Assemblies (4 Sets)** suitable for **500 mm diameter** pneumatic waste conveying pipelines, for installation at the **Central Collection Area (CCA)** beneath the respective storage sections to control automatic discharge of collected waste into the designated storage containers. Each assembly shall comprise a **minimum 3 mm thick AISI 304 stainless steel valve body conforming to IS 6911:2017**, heavy-duty pneumatically operated slide/flap gate, compressed-air actuator, position sensors, limit switches, manual override, airtight wear-resistant sealing system, inspection access, flange connections, supports, and all associated accessories. The valve shall provide leak-tight sealing under the specified conveying vacuum, rapid opening and closing, minimum pressure loss, abrasion-resistant internal components, and reliable continuous cyclic operation. Pneumatic actuation components shall comply with **ISO 4414** and shall include air preparation units, solenoid valves, pressure regulators, air filters, pressure gauges, and position feedback devices. The discharge valve assemblies shall be fully integrated with the **PLC/SCADA system** and **Building Management System (BMS)** for automatic sequencing, position monitoring, fault diagnostics, alarm annunciation, event logging, and interlocking with the diverter assemblies and blower system. The valve shall be designed in accordance with the vacuum piping principles of **ASME B31.3**. Complete with all cutting, fabrication, welding, erection, supports, gaskets, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	4	Set
15	**Pneumatic Section (Sliding) Valve Assembly:** Supply, installation, testing and commissioning of **Pneumatically Operated Section (Sliding) Valve Assemblies (2 Sets)** suitable for **500 mm diameter** pneumatic conveying pipelines, comprising pneumatically operated heavy-duty slide gate valves for isolation of pipeline sections during normal operation, maintenance, emergency shutdown, and fault conditions. The valve body and gate shall be fabricated from **minimum 3 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, complete with heavy-duty pneumatic actuator, compressed-air cylinder, position sensors, limit switches, manual override, airtight wear-resistant sealing system, inspection access, flanged connections, supports, gaskets, and all associated accessories. The valve shall provide leak-tight sealing under the specified conveying vacuum, minimum pressure loss, rapid operation, abrasion-resistant internal components, and reliable continuous cyclic service. Pneumatic actuation components shall comply with **ISO 4414** and shall include air preparation units, solenoid valves, pressure regulators, air filters, pressure gauges, and position feedback devices. The valve assemblies shall be fully integrated with the **PLC/SCADA system** and **Building Management System (BMS)** for automatic sequencing, position monitoring, fault diagnostics, alarm annunciation, event logging, and interlocking with the blower, diverter and discharge valve systems. Welding shall comply with **ASME Section IX**, and the valve assembly shall be designed in accordance with the vacuum piping principles of	2	Nos

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	ASME B31.3. Complete with all cutting, fabrication, welding, erection, supports, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
16	**Main Isolation Valve Assembly:** Supply, installation, testing and commissioning of **Pneumatically Operated Main Isolation Valve Assemblies (2 Sets)** suitable for **500 mm diameter** pneumatic conveying pipelines, comprising heavy-duty pneumatically operated isolation valves for complete isolation of the main waste conveying pipeline during normal operation, maintenance, emergency shutdown and system fault conditions. The valve body and gate shall be fabricated from **minimum 3 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, complete with heavy-duty pneumatic actuator, compressed-air cylinder, airtight wear-resistant sealing system, position sensors, limit switches, manual override, inspection access, flanged connections, supports, gaskets, and all associated accessories. The valve shall provide **100% leak-tight sealing** under the specified conveying vacuum, minimum pressure loss, rapid operation, abrasion-resistant internal components, and reliable continuous cyclic service. Pneumatic actuation components shall comply with **ISO 4414** and shall include air preparation units, solenoid valves, pressure regulators, air filters, pressure gauges, and position feedback devices. The Main Isolation Valve shall be fully integrated with the **PLC/SCADA system** and **Building Management System (BMS)** for automatic sequencing, position monitoring, fault diagnostics, alarm annunciation, event logging, and interlocking with the blower, diverter, section valve and discharge valve systems. Welding shall comply with **ASME Section IX**, and the valve assembly shall be designed in accordance with the vacuum piping principles of **ASME B31.3**. Where external carbon-steel support members are provided, they shall be protected with **epoxy coating of minimum 100 µm dry film thickness (DFT)**. Complete with all cutting, fabrication, welding, erection, supports, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	2	Sets
17	**Automation, PLC/SCADA Control System:** Supply, installation, testing and commissioning of a complete **PLC/SCADA-based Automation and Control System (1 Set)** for the Pneumatic Waste and Laundry Collection System, comprising **dual redundant (Hot-Standby) PLC CPUs**, redundant power supplies, remote I/O stations, industrial managed Ethernet switches, industrial SCADA server, engineering workstation, operator workstation, industrial-grade PC, Human Machine Interface (HMI), **perpetual software licences**, historian, alarm and event management system, printers, networking equipment, and all associated hardware and software necessary for fully automatic operation of the complete system. The system shall be protected by an **online UPS** with adequate battery backup for the PLC, SCADA server, networking equipment and operator workstation to ensure uninterrupted operation during power disturbances.	1	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	The Automation System shall continuously monitor and control all **Vacuum Blower Assemblies, Air Intake Valves, Main Isolation Valves, Section Valves, Diverter Assemblies, Discharge Valves, Collectors, Air Separation Units, Filtration Units, Activated Carbon Odour Control Units, Compressors, Differential Pressure Sensors, Air Velocity Sensors, Pressure Transmitters, Level Sensors, Safety Interlocks, and all field devices** associated with the Pneumatic Waste and Laundry Collection Systems. Automatic operation shall be based on programmable **time schedules, waste/linen accumulation level, equipment status, operating demand, and system priorities**, with operating cycles fully configurable by authorised personnel to optimise collection efficiency and minimise energy consumption. The control system shall provide **automatic equipment sequencing, N+1 equipment management, automatic duty/standby changeover, blower speed control through Variable Frequency Drives (VFDs), automatic fault detection, predictive maintenance alerts, event logging, historical data storage, trend analysis, audit trail, remote diagnostics, equipment runtime monitoring, preventive maintenance scheduling, alarm annunciation, and comprehensive system health monitoring.** The Automation System shall incorporate **Role-Based Access Control (RBAC)** with configurable user privileges (**Administrator, Engineer, Operator, Maintenance and Read-only**), secure user authentication, configurable password policies, electronic audit trail, activity logging, and user session management. All operator actions, alarms, configuration changes and system events shall be automatically recorded with date and time stamps for complete traceability. The Industrial Automation and Control System (IACS) shall comply with **IEC 62443** and incorporate cybersecurity measures including **encrypted communications, secure user authentication, Role-Based Access Control (RBAC), security event logging, configuration backup and restoration, malware protection, secure software updates, and encrypted VPN-based remote access**. The PLC programming shall comply with **IEC 61131-3**, structured cabling shall comply with **ISO/IEC 11801**, and Ethernet communication shall support **Modbus TCP/IP**, **Profinet**, **EtherNet/IP**, and **BACnet/IP**, enabling seamless integration with the Hospital **Building Management System (BMS)**. The SCADA system shall support **secure remote diagnostics, health monitoring, fault analysis, performance monitoring, software updates, configuration management, and OEM technical support** through an **encrypted VPN connection**, with all remote access subject to **Role-Based Access Control (RBAC)**, secure user authentication, and comprehensive audit logging. Remote access shall be configurable		

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	to permit authorised personnel only and shall be capable of being enabled or disabled by the hospital administrator. The Waste Collection System and Laundry Collection System shall operate through a **common SCADA platform** while maintaining **completely independent field equipment, pipelines, risers, valves, collectors, actuators, PLC I/O, control logic, operating sequences, and safety interlocks**. Under no operating condition shall the control software permit waste and laundry to share a common conveying pipeline or simultaneously operate through the same conveying path. Software and hardware interlocks shall positively prevent cross-connection between the two systems. The Automation System shall provide colour graphical process mimics of the complete installation, real-time equipment status, conveyor route visualisation, alarm summaries, trend displays, historical reporting, automatic report generation, data export facilities, operator activity logging, configurable dashboards, equipment performance analytics, and configurable user access levels. The Contractor shall provide complete software development, PLC programming, SCADA configuration, Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), loop checking, I/O testing, functional testing, integrated system testing, performance validation, commissioning, operator and maintenance training, **perpetual software licences** for all supplied software, software upgrades, patches and OEM technical support during the warranty period, source-code backup, configuration backup, as-built documentation, O&M manuals, and a **minimum 2-year comprehensive warranty**. Any recurring software subscription, software assurance or technical support charges beyond the warranty period shall be **clearly identified separately in the bid** and shall not be mandatory for continued operation of the installed system. The complete Automation and Control System shall be fully compatible with future expansion of the Pneumatic Waste and Laundry Collection System without replacement of the central controller, PLC hardware or SCADA platform.		
17A	**Level ("Bin-Full") Sensor System:** Supply, installation, testing and commissioning of **Level Sensor Assemblies** for all Waste Collectors, Laundry Collectors and Storage Containers (Items 4, 5, 6, 7 and 8), comprising **non-contact ultrasonic or radar level sensors** suitable for continuous level measurement of solid waste and soiled linen, complete with mounting brackets, inspection access, local status indication, signal conditioning modules, junction boxes, field cabling, and all associated accessories. Each collector and container shall be provided with a minimum of **two independent level sensors (High Level and High-High Level)** to provide operational control and overflow protection. The sensors shall continuously monitor the fill	Minimum **2 sensors per collector /container (High and High-High Level)**.	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	level and transmit signals to the **PLC/SCADA Control System (Item 17)** to automatically initiate the programmed **time- and level-based discharge cycle**, generate visual and audible alarms, record historical trends, and prevent overfilling. The sensors shall provide **4–20 mA and digital communication outputs**, be suitable for dusty and humid environments, and have a minimum enclosure protection of **IP67** in accordance with **IEC 60529**. The complete system shall be integrated with the **Building Management System (BMS)** for alarm monitoring and event logging. The Contractor shall include calibration, functional testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.		
17B	**Fire, Spark Detection & Automatic Suppression System – Pneumatic Pipeline Network:** Supply, installation, testing and commissioning of a complete **Fire, Spark Detection and Automatic Suppression System (1 Set)** for the Pneumatic Waste Collection System, comprising **infrared spark detectors, heat detectors, flame detectors (where required), automatic water-mist suppression nozzles or other OEM-recommended extinguishing system compatible with the conveyed waste stream, spark-resistant blower construction, fire isolation valves, automatic shutdown interlocks, control panel, field cabling, piping, and all associated accessories**. Spark and fire detectors shall be installed at the waste collection room, main conveying pipelines, vertical risers, blower inlet, filtration units and other critical locations identified through the system fire-risk assessment. Detection logic shall incorporate **dual-detector voting (2oo2)** or equivalent fail-safe architecture to minimise false alarms while ensuring rapid response. Upon detection of a fire or spark event, the system shall automatically **activate the suppression system, isolate the affected pipeline section, stop the blower and associated conveying equipment, close the main isolation and section valves, generate audible and visual alarms, and transmit alarm and status signals to the PLC/SCADA Control System and the Hospital Building Management System (BMS)**. The suppression system shall be designed to avoid damage to the pneumatic conveying equipment while effectively preventing propagation of fire through the pipeline network. The spark detection and suppression system shall be designed in accordance with **NFPA 91**, spark and fire isolation measures shall comply with **NFPA 69**, and fire detection, alarm initiation and system interfaces shall comply with **NFPA 72**. The complete installation shall also comply with the applicable provisions of **NBCS 2026, Part F (Fire and Life Safety)** and the requirements of the **State Fire Services Department** for obtaining Fire No Objection Certificate (Fire NOC). The Contractor shall provide complete installation, Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), functional testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	1	Complete system

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
18	**Stainless Steel Vertical Waste Conveying Pipeline:** Supply, installation, testing and commissioning of **500 mm diameter, minimum 1.5 mm thick AISI 304 stainless steel vertical pneumatic conveying pipeline conforming to IS 6911:2017**, dedicated exclusively to the Pneumatic Waste Collection System (Dry Waste, Wet Waste and Biomedical Waste), complete with flanged pipe sections, long-radius bends, tees, Y-branches, sockets, inspection and cleaning doors, expansion joints, flexible connectors, airtight sealing gaskets, supports, anchor brackets, guide supports, vibration isolators, nuts, bolts and all accessories. The pipeline shall be designed for the specified operating vacuum in accordance with **ASME B31.3**, with fabrication and welding complying with **ASME Section IX** and flanged joints complying with **ASME B16.5**. The scope shall include **16 SWG earthing conductor**, **Type 8×2×0.5 mm² control cables**, instrumentation cables, **CAT 6A Ethernet cables**, optical fibre cables (where required), conduits, junction boxes and all accessories for integration with the **PLC/SCADA Control System** and **Building Management System (BMS)**. Instrumentation cables shall comply with **IEC 60332**, structured cabling with **ISO/IEC 11801**, and earthing with **IS 3043**. The pipeline shall be vacuum leak tested, pressure tested and commissioned complete. **The Waste Collection Pipeline shall remain completely independent of the Laundry Collection System throughout its entire length.** Complete with installation, testing, commissioning, O&M manuals, training and **2-year comprehensive warranty**.	As per design	Mtr
18A	**Stainless Steel Vertical Laundry Conveying Pipeline:** Supply, installation, testing and commissioning of **500 mm diameter, minimum 1.5 mm thick AISI 304 stainless steel vertical pneumatic conveying pipeline conforming to IS 6911:2017**, dedicated exclusively to conveying soiled linen from the Laundry Inlet Stations to the Laundry Collector. The pipeline shall be physically and operationally independent of the Waste Collection System and shall comprise flanged pipe sections, bends, tees, Y-branches, sockets, inspection and cleaning doors, expansion joints, flexible connectors, airtight sealing gaskets, supports and all accessories. The pipeline shall be designed for the specified operating vacuum in accordance with **ASME B31.3**, with fabrication and welding complying with **ASME Section IX** and flanged joints complying with **ASME B16.5**. The scope shall include all instrumentation, communication and control cabling for integration with the **PLC/SCADA Control System** and **Building Management System (BMS)**. Instrumentation cables shall comply with **IEC 60332**, structured cabling with **ISO/IEC 11801**, and earthing with **IS 3043**. The pipeline shall be vacuum leak tested, pressure tested and commissioned complete. **The Laundry Pipeline shall remain physically and operationally independent of the Waste Collection System throughout its entire length.** Complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive warranty**.	As per design	Mtr

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
19	**Stainless Steel Horizontal Waste Conveying Pipeline:** Supply, installation, testing and commissioning of **500 mm diameter, minimum 2.5 mm thick AISI 304 stainless steel horizontal pneumatic conveying pipeline conforming to IS 6911:2017**, dedicated exclusively to the Pneumatic Waste Collection System (Dry Waste, Wet Waste and Biomedical Waste), complete with flanged pipe sections, long-radius bends, tees, Y-branches, sockets, expansion joints, flexible connectors, airtight sealing gaskets, inspection and cleaning access doors, supports, anchor brackets, guide supports, vibration isolators, nuts, bolts and all accessories necessary for a complete installation. **Long-radius bends, elbows, tees, Y-branches, diverter connections and other high-abrasion locations shall be fabricated from minimum 4.0 mm thick AISI 304 stainless steel or provided with OEM-approved replaceable abrasion-resistant wear liners.** The pipeline shall be designed for the specified operating vacuum in accordance with **ASME B31.3**, with fabrication and welding complying with **ASME Section IX** and flanged joints complying with **ASME B16.5**. The scope shall include **16 SWG earthing conductor**, **Type 8×2×0.5 mm² control cables**, instrumentation cables, **CAT 6A Ethernet cables**, optical fibre cables (where required), conduits, junction boxes, field interface units and all accessories for complete integration with the **PLC/SCADA Control System** and **Building Management System (BMS)**. Instrumentation cables shall comply with **IEC 60332**, structured cabling with **ISO/IEC 11801**, and earthing shall comply with **IS 3043**. The complete pipeline shall be vacuum leak tested, pressure tested and functionally tested prior to commissioning. **The Waste Collection Pipeline shall remain completely independent of the Laundry Collection System throughout its entire length, with no shared pipelines, valves or conveying paths.** Complete with installation, testing, commissioning, operator training, O&M manuals, as-built drawings, and a **minimum 2-year comprehensive warranty**.	As per design	Mtr
19A	**Stainless Steel Horizontal Laundry Conveying Pipeline:** Supply, installation, testing and commissioning of **500 mm diameter, minimum 2.5 mm thick AISI 304 stainless steel horizontal pneumatic conveying pipeline conforming to IS 6911:2017**, dedicated exclusively to conveying soiled linen from the Laundry Inlet Stations to the Central Laundry Collection Room. The pipeline shall be physically and operationally independent of the Waste Collection System and shall comprise flanged pipe sections, long-radius bends, tees, Y-branches, sockets, expansion joints, flexible connectors, airtight sealing gaskets, inspection and cleaning access doors, supports, anchor brackets, guide supports, vibration isolators, nuts, bolts and all accessories necessary for a complete installation. The pipeline shall be designed for the specified operating vacuum in accordance with **ASME B31.3**, with fabrication and welding complying with **ASME Section IX** and flanged joints complying with **ASME B16.5**. The scope shall include **16 SWG earthing conductor**, **Type 8×2×0.5 mm² control cables**, instrumentation cables, **CAT 6A Ethernet cables**, optical fibre cables (where required), conduits, junction boxes, field interface units and all accessories for complete integration with the	As per design	Mtr

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	PLC/SCADA Control System and **Building Management System (BMS)**. Instrumentation cables shall comply with **IEC 60332**, structured cabling shall comply with **ISO/IEC 11801**, and earthing shall comply with **IS 3043**. The complete pipeline shall be vacuum leak tested, pressure tested and functionally tested prior to commissioning. **The Laundry Collection Pipeline shall remain completely independent of the Waste Collection System throughout its entire length, with no shared pipelines, valves, collectors or conveying paths.** Complete with installation, testing, commissioning, operator training, O&M manuals, as-built drawings, and a **minimum 2-year comprehensive warranty**.		
19B	**Inspection/Cleanout Access Doors – Waste & Laundry Pipelines:** Supply, installation, testing and commissioning of **minimum 500 mm × 500 mm gasketed, vacuum-tight inspection/cleanout access doors** fabricated from **AISI 304 stainless steel conforming to IS 6911:2017**, complete with quick-release locking mechanism, replaceable EPDM/silicone airtight gaskets, heavy-duty hinges, inspection covers, supports and all associated accessories. Access doors shall be provided at **intervals not exceeding 25 m** on straight pipeline runs and additionally at **every change in direction, long-radius bend, Y-branch, diverter assembly, vertical-to-horizontal transition, and terminal/end section** to facilitate inspection, cleaning and blockage removal without cutting the pipeline. The access doors shall provide **100% leak-tight sealing** under the specified operating vacuum and shall be designed in accordance with **ASME B31.3**, with fabrication and welding complying with **ASME Section IX**. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos
20	**Compressed Air System for Pneumatic Waste & Laundry Collection:** Supply, installation, testing and commissioning of **Oil-Free Air Compressors (5 Nos. – 4 Duty + 1 Standby)**, each **minimum 4 kW, 400 V ±10%, 50 Hz, 3 Phase**, complete with **minimum 100 L air receiver**, refrigerated air dryer, pre-filter, after-filter, automatic condensate drain, pressure regulator, pressure gauges, safety relief valve, isolation valves, pressure switches, electronic controller, automatic start/stop control, automatic duty/standby changeover, common air manifold, compressed-air distribution piping, nylon tubing, fittings and all accessories required for supplying compressed air to pneumatic cylinders, air intake valves, diverter valves, discharge valves, section valves, inlet stations and all other pneumatic actuators. The compressed air system shall be designed to deliver **oil-free, dry compressed air at a working pressure of 6–8 bar**, with a **minimum free air delivery (FAD) of 400 L/min per compressor**, pressure dew point of **+3°C or better**, residual oil content complying with **ISO 8573-1 Class 1**, particulate quality **Class 2**, moisture quality **Class 4 or better**, and receiver pressure rating **not less than 10 bar**. The air receiver shall be provided with drain valve, inspection opening, pressure gauge, safety relief valve and isolation valve. The complete compressor package shall have a **minimum IP54 enclosure**,	5	Nos

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	maximum **noise level of 75 dB(A) at 1 m**, and shall be suitable for continuous industrial duty. The compressors shall comply with **ISO 1217**, the refrigerated air dryer shall comply with **ISO 7183**, compressed-air quality shall comply with **ISO 8573-1**, and the air receiver shall be designed, fabricated, tested and certified in accordance with **IS 2825** or **ASME BPVC Section VIII Division 1**, with statutory inspection and registration wherever applicable. The complete system shall be integrated with the **PLC/SCADA Control System** and **Building Management System (BMS)** for automatic duty/standby sequencing, pressure monitoring, fault diagnostics, alarm annunciation, runtime monitoring and preventive maintenance scheduling. The scope shall include all foundations, anti-vibration mounts, electrical wiring, compressed-air piping, manifolds, supports, leak testing, performance testing, commissioning, operator training, O&M manuals, as-built documentation, recommended spare parts, and a **minimum 2-year comprehensive warranty**.		
21	**Waste In-Building Station (IBS):** Supply, installation, testing and commissioning of **Waste In-Building Stations (IBS) (20 Nos.)** complete with **minimum 7-inch colour touch-screen HMI**, PLC-compatible controller, RFID/password-based user authentication, automatic waste-type selection interface, status indicators, emergency stop, and event logging. Each station shall comprise a **minimum 300 mm × 300 mm double-door inlet**, with the **outer access door** provided with electromagnetic interlocking and authorised password/RFID access, and the **inner pneumatically operated sliding door** interlocked with the outer door to prevent simultaneous opening. The inlet assembly shall be fabricated from **minimum 2.0 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, complete with airtight seals, safety interlocks, door position sensors, obstruction detection, support frame, floor fixing arrangement, and all accessories required for complete installation. The HMI enclosure shall have a **minimum IP54 protection rating** in accordance with **IEC 60529**, and the electrical control system shall comply with **IEC 60204-1**. The IBS shall be fully integrated with the **PLC/SCADA Control System** and **Building Management System (BMS)** for user authentication, waste selection, event logging, fault diagnostics, alarm annunciation and operational monitoring. Each station shall provide visual and audible indication of operating status, door interlock status, system ready, fault condition and communication failure. Each IBS shall be supported on a structural mounting frame anchored to the building structure and connected to the **500 mm diameter stainless steel vertical waste conveying pipeline**. The Contractor shall provide all supports, electrical wiring, control cabling, communication cabling, conduits, junction boxes, testing,	20	Nos

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	commissioning, operator training, O&M manuals, as-built drawings, and a **minimum 2-year comprehensive warranty**. **The Waste In-Building Stations shall be dedicated exclusively to the Waste Collection System. The Laundry Collection System shall be provided with separate and independent Laundry Inlet Stations, with no shared inlets, valves or conveying paths.**		
21A	**Laundry (Soiled Linen) In-Building Station (LIBS):** Supply, installation, testing and commissioning of **Laundry (Soiled Linen) In-Building Stations (20 Nos.)**, comprising a **minimum 500 mm × 500 mm** double-door inlet assembly fabricated from **minimum 2.0 mm thick AISI 304 stainless steel conforming to IS 6911:2017**, dedicated exclusively for depositing soiled linen into the Pneumatic Laundry Collection System. The station shall comprise a **lockable outer access door** with **RFID/password-controlled staff-only access**, and an **inner pneumatically operated sliding door** interlocked with the outer door to prevent simultaneous opening and integrated with the pneumatic conveying sequence. The inlet shall be connected exclusively to the dedicated **500 mm diameter Laundry Vertical Conveying Pipeline (Item 18A)** and shall include airtight EPDM/silicone seals, door position sensors, obstruction detection, emergency stop push button, structural support frame, floor fixing arrangement, visual status indicators (Ready, Busy, Fault), and all accessories required for a complete installation. The station enclosure shall have a **minimum IP54 protection rating** in accordance with **IEC 60529**, and the electrical control system and interlocks shall comply with **IEC 60204-1**. The station shall be fully integrated with the **PLC/SCADA Control System** and **Building Management System (BMS)** for access control, operational monitoring, event logging, fault diagnostics and alarm annunciation. **The Laundry In-Building Station shall remain physically and operationally independent of the Waste In-Building Station, with no shared inlet doors, valves, pipelines or conveying paths.** Complete with installation, testing, commissioning, operator training, O&M manuals, as-built documentation and a **minimum 2-year comprehensive warranty**.	20	Nos
22	**Main Electrical Control Panel & Sub Control Panels – Pneumatic Waste & Laundry Collection System** Supply, installation, testing and commissioning of **Main Electrical Control Panel (1 Set)** and **Sub Control Panels (minimum 4 Sets or as per approved system design)** for the Pneumatic Waste and Laundry Collection System, complete with all power, control and communication wiring, interconnections, cable trays, conduits, terminal blocks, cable glands, identification labels, earthing, supports and accessories required for complete operation. The Main Control Panel shall house the **PLC/SCADA interface, redundant power**	1	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	supplies, motor starters/VFDs, MCCBs, MCBs, contactors, relays, surge protection devices (SPD), control transformers, HMI interface, industrial Ethernet switches, communication modules, annunciation, metering and auxiliary equipment required for operation of the complete system. The Sub Control Panels shall serve the respective risers/zones and shall control the In-Building Stations, Laundry In-Building Stations, compressors, valves, diverters, level sensors and associated field devices. The panels shall support automatic and manual operation, local/remote selector switches, emergency stop, fault indication, equipment status indication and communication with the Main Control Panel through an industrial Ethernet network. The panels shall be **floor-mounted, front-access, modular, indoor type**, fabricated from **minimum 2.0 mm CRCA sheet steel**, epoxy powder-coated (minimum **80 µm DFT**, RAL 7035 or approved equivalent), with a **minimum protection rating of IP54** in accordance with **IEC 60529**, Form **3b** internal segregation (minimum), and suitable for continuous operation under ambient conditions of **0–50°C** and **95% RH (non-condensing)**. The panel shall be designed with a **minimum 25% spare space** for future expansion and **20% spare terminals** for additional field devices. The complete panel assembly shall comply with **IEC 61439-1 & IEC 61439-2**, earthing shall comply with **IS 3043**, and all internal wiring shall be flame-retardant copper conductors with ferruled terminations. The panel shall have a minimum **fault withstand capacity of 50 kA for 1 second**, or as determined by the project fault-level study. Communication shall support **Modbus TCP/IP, Profinet, EtherNet/IP and BACnet/IP** for seamless integration with the **PLC/SCADA Control System** and **Building Management System (BMS)**. The scope shall include complete wiring, factory wiring tests, insulation resistance tests, functional tests, Factory Acceptance Test (FAT), Site Acceptance Test (SAT), commissioning, operator training, O&M manuals, as-built drawings and a **minimum 2-year comprehensive warranty**.		
22A	**Static Electricity Earthing & Bonding – Pipeline Network:** Supply, installation, testing and commissioning of a complete **static electricity earthing and equipotential bonding system** for the Waste and Laundry Pipeline Networks (Items 18, 18A, 19 and 19A), comprising **minimum 16 mm² stranded copper bonding conductors or 25 mm × 3 mm tinned copper strips** across all flanged, flexible and mechanical joints, bonded to the facility earthing system through dedicated earth continuity conductors. The scope shall include bonding clamps, lugs, terminals, earth bars, inspection/test links, identification tags and all accessories necessary to ensure continuous electrical continuity throughout the pipeline network. The bonding system shall be independent of the control-panel earthing (Item 22) and shall	1	Lot

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	comply with **NFPA 77** and **IS 3043**. Electrical continuity shall be verified during commissioning, with **joint continuity resistance ≤0.1 Ω** and **earthing resistance ≤1 Ω** or as specified in the project earthing design. Complete with testing, commissioning, test reports and a **minimum 2-year comprehensive warranty**.		
22B	**Uninterruptible Power Supply (UPS) – Control System & Critical Instrumentation:** Supply, installation, testing and commissioning of **Online Double-Conversion UPS (1 Set)** with **N+1 redundant architecture**, dedicated to the **PLC/SCADA Control System (Item 17)**, redundant PLC CPUs, HMI, industrial Ethernet switches, critical instrumentation, interlocks, fire/spark detection system (Item 17B), communication equipment and associated control circuits. The UPS shall be complete with maintenance bypass, static bypass, battery bank, battery rack, battery monitoring system, input/output isolation, surge protection, alarm annunciation and all accessories required for uninterrupted operation during mains failure. The system shall provide a **minimum battery autonomy of 30 minutes at 100% connected load**, with provision for safe system shutdown or continued operation as required by the approved control philosophy. The UPS shall comply with **IEC 62040-1**, **IEC 62040-2** and **IEC 62040-3**, and shall be integrated with the **PLC/SCADA Control System** and **Building Management System (BMS)** for status monitoring, alarms and diagnostics. Complete with installation, testing, commissioning, O&M manuals, training and a **minimum 2-year comprehensive warranty**.	2	Set
23	**Exhaust Air Discharge Duct/Stack – Waste & Laundry System:** Supply, installation, testing and commissioning of **AISI 304 stainless steel exhaust air discharge duct/stack (minimum 2.0 mm thick)** complete with supports, anchor brackets, weatherproof rain cowl, bird/insect screen, expansion joints, flexible connectors, vibration isolators, flanged joints, sealing gaskets and all accessories required to convey filtered exhaust air from the Central Collection Centre to atmosphere. The exhaust system shall be designed for the specified airflow with **minimum outlet velocity of 10 m/s**, **maximum air leakage of 2%**, and discharge at a location **minimum 3 m above the highest adjacent roof level and at least 10 m from outdoor air intakes, operable windows and occupied areas**, or as required by the applicable **CPCB/SPCB** regulations. The duct shall comply with **NFPA 91** and **ASME B31.3**, complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Mtr
24	**Vertical Diverter, Discharge Valve & Inlet Storage Assembly – Waste:** Supply, installation, testing and commissioning of a complete **Vertical Diverter, Pneumatic Discharge Valve and Inlet Storage Assembly** for the Waste In-Building Stations, comprising **500 mm diameter AISI 304 stainless steel** vertical diverter, pneumatically operated discharge valve, temporary inlet storage chamber, level sensor, position sensors, pneumatic actuators, inspection access, airtight seals, structural supports and all accessories required for complete operation. The assembly shall be integrated with the **Waste In-Building Station (Item 21)** and the **PLC/SCADA Control System** for automatic operation, sequencing and interlocking. The temporary storage section shall be designed to prevent waste accumulation within	2	Set

Pneumatic Waste & Laundry Collection System			
S.No.	**DESCRIPTION**	**Quantity as per design**	
	the riser during conveying cycles and shall operate under the specified conveying vacuum. Fabrication shall comply with **ASTM A240** and **ASME B31.3**, with welding in accordance with **ASME Section IX**. Complete with installation, testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**. **Minimum Design Criteria: 500 mm diameter**, **minimum 2.5 mm thick AISI 304 stainless steel**, **6–8 bar pneumatic actuators**, **IP67 position and level sensors**, **vacuum-tight EPDM/silicone seals**, **PLC/SCADA and BMS integration**, **minimum 2-year comprehensive warranty**.		
25	**Operation & Maintenance Manuals & Training:** Supply and hand over comprehensive **Operation & Maintenance (O&M) Manuals** in **two hard copies and one searchable electronic copy**, including equipment data sheets, as-built drawings, P&IDs, single-line diagrams, wiring and piping schematics, PLC/SCADA architecture, software backups, control philosophy, I/O lists, equipment schedules, preventive maintenance schedules, troubleshooting guides, calibration procedures and manufacturer's literature. Conduct **classroom and hands-on training** for the Employer's operation and maintenance personnel covering system operation, PLC/SCADA interface, safety procedures, fault diagnosis, preventive maintenance, emergency operation and routine servicing. The scope shall include pre-commissioning, Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), performance testing, final commissioning, submission of test certificates, as-built documentation and handover. The Contractor shall provide **all consumables required for routine operation, preventive maintenance, calibration and servicing of the system during the 2-year comprehensive warranty period**. The comprehensive warranty shall include all labour, replacement parts, consumables, software updates, calibration, technical support and on-site service required to maintain the system in full working order at **no additional cost to the Employer**.	1	Lot
26	**System Performance Acceptance:** Upon completion of installation and commissioning, the Contractor shall conduct an integrated **minimum 72-hour continuous performance trial** of the complete Pneumatic Waste and Laundry Collection System under normal operating conditions. The trial shall demonstrate compliance with all specified design parameters, including conveying velocity, blower performance, compressed-air quality, PLC/SCADA functionality, automatic sequencing, safety interlocks, alarm functions, communication, waste and laundry segregation, and overall system reliability. Successful completion of the performance trial and submission of the acceptance test reports shall be a prerequisite for Taking Over Certificate (TOC)/Provisional Acceptance. Any defects identified during the trial shall be rectified and the trial repeated until the specified performance requirements are achieved.	1	Lot
	Grand Total		

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply, installation, testing and commissioning of a fully automatic **Hospital Pneumatic Tube System (PTS)** for safe, rapid and secure transportation of blood samples, blood products, laboratory specimens, pharmaceuticals, documents and other approved hospital materials, comprising central control system, sending/receiving stations, diverters, blowers with VFD, rotary transfer unit, carriers, tube network, electrical control panels, PLC/SCADA-based control, communication network and all accessories required for complete operation. The system shall be designed for **24×7 continuous operation**, expandable by **minimum 20%** without replacement of the central controller, and capable of automatic routing, priority handling, RFID-based carrier identification, event logging, self-diagnostics and fault recovery. The **control panel and electrical safety** shall comply with **IEC 60204-1**, electrical panels with **IEC 61439-1/2**, enclosure protection **minimum IP54** in accordance with **IEC 60529**, and industrial control system cybersecurity in accordance with **IEC 62443**. The system shall operate at a **carrier velocity of 6–8 m/s**, **minimum system availability of 99.5%**, **maximum operational noise level of 75 dB(A)** at 1 m from equipment, and **minimum 30-minute UPS backup** for the control system. All sending and receiving stations shall incorporate manufacturer type-tested safety interlocks, obstruction detection and emergency stop functions. The scope shall include complete installation, testing, Factory Acceptance Test (FAT), Site Acceptance Test (SAT), performance testing, commissioning, operator training, O&M manuals, as-built documentation and a **minimum 2-year comprehensive warranty**, including all replacement parts, consumables, labour, software updates and technical support		
1	**Main Control & Software System:** Supply, installation, testing and commissioning of a **Central Control & Software System (1 Set)** comprising redundant industrial controller(s), industrial workstation(s), HMI, managed industrial Ethernet switches, redundant power supplies, communication interfaces, software licences and all hardware/software required for complete operation of the Pneumatic Tube System. The system shall provide automatic routing, priority management, carrier tracking, RFID identification, real-time system monitoring, self-diagnostics, alarm management, event and audit logging (including source, destination, timestamp and carrier identification), role-based user access, cybersecurity, automatic data backup and recovery, remote diagnostics, and integration with the Hospital Information System (HIS), Laboratory Information System (LIS) and Building Management System (BMS) through **open communication protocols**. The system shall be configured with **redundant controllers/servers**, **minimum 30-minute UPS backup**, **minimum 20% spare processing and I/O capacity** for future expansion, and **minimum 99.5% system availability**. The control panel shall comply with **IEC 60204-1**, **IEC 61439-1/2**, **IEC 62443**, **ISO/IEC 11801** and **IEC 60529 (minimum IP54)**. Complete with Factory Acceptance Test (FAT), Site Acceptance Test (SAT), testing, commissioning, operator training, O&M manuals, software licences and a **minimum 2-year comprehensive warranty**.	1	Nos.

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
1A	**Uninterruptible Power Supply (UPS) – PTS Control System:** Supply, installation, testing and commissioning of an **Online Double-Conversion UPS (minimum 5 kVA)** dedicated exclusively to the critical components of the Pneumatic Tube System, comprising the Central Control System, PLC/controller, operator workstation/HMI, network switches, communication equipment, RFID controller, critical station controllers and associated control circuits. The UPS shall be complete with maintenance bypass, static bypass, battery bank, battery monitoring system, surge protection and all accessories required for uninterrupted operation during mains power failure. The UPS shall provide **minimum 30 minutes autonomy at 100% connected load**, enabling completion of active carrier transport, data retention and controlled system shutdown. The UPS shall have **minimum 95% efficiency**, **unity output power factor**, and support **open communication protocols** for remote monitoring and integration with the Building Management System (BMS). The UPS shall comply with **IEC 62040-1**, **IEC 62040-2**, **IEC 62040-3** and **IEC 60529** (minimum **IP31** for indoor installation). Complete with installation, testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**.	1	Set
2	**Supply, installation, testing and commissioning of NW 160 mm Top/Front Load Sending/Receiving Station** complete with automatic door mechanism, carrier identification system, user interface, destination selection, visual and audible status indicators, obstruction detection, emergency release, carrier presence sensors, airtight sealing, station controller, communication interface and all accessories required for complete operation. The station shall be suitable for the safe transport of blood samples, blood products, laboratory specimens, pharmaceuticals and documents. The station shall accommodate **NW 160 mm carriers**, support **minimum carrier payload of 5 kg**, operate at a **carrier velocity of 6–8 m/s**, and incorporate **electromagnetic safety interlocks** preventing door opening during carrier transit. The enclosure shall be fabricated from **minimum 1.5 mm AISI 304 stainless steel** with **minimum IP54 protection** in accordance with **IEC 60529** and comply with **IEC 60204-1** for electrical safety. The carrier identification system shall use **open-standard RFID technology compliant with ISO/IEC 15693 or equivalent**, enabling automatic carrier recognition and traceability. The station shall support **role-based user authentication**, automatic routing, priority handling, event logging and integration with the Central Control System. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	48	Nos.
3	**Supply, installation, testing and commissioning of NW 160 mm Compact End Station** complete with automatic send/receive mechanism, carrier identification system, destination selection interface, visual and audible status indicators, carrier presence sensors, obstruction detection, electromagnetic safety interlocks, emergency release, station controller, communication interface and all accessories required for complete operation. The station shall be compatible with **NW 160 mm carriers**, support a **minimum payload of 5 kg**, operate at a **carrier velocity of 6–8 m/s**, and be designed for installation in space-constrained clinical areas. The enclosure shall be fabricated from	6	Nos.

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	minimum 1.5 mm thick AISI 304 stainless steel with **minimum IP54 protection** in accordance with **IEC 60529**. The carrier identification system shall comply with **ISO/IEC 15693 or equivalent open standard**, and the station shall comply with **IEC 60204-1**. The station shall support automatic routing, priority handling, event logging and integration with the Central Control System. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.		
4	**Supply, installation, testing and commissioning of NW 160 mm Multi-Send Station** complete with **minimum four-carrier buffer capacity**, automatic carrier queuing and dispatch, carrier identification system, destination selection interface, visual and audible status indicators, carrier presence sensors, obstruction detection, electromagnetic safety interlocks, emergency release, station controller, communication interface and all accessories required for complete operation. The station shall be compatible with **NW 160 mm carriers**, support a **minimum payload of 5 kg**, operate at a **carrier velocity of 6–8 m/s**, and automatically queue, prioritise and dispatch carriers without operator intervention. The enclosure shall be fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with **minimum IP54 protection** in accordance with **IEC 60529**. The carrier identification system shall comply with **ISO/IEC 15693 or equivalent open standard**, and the station shall comply with **IEC 60204-1**. The station shall support automatic routing, priority handling, event logging, user authentication, and integration with the Central Control System. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	2	Nos.
5	**Supply, installation, testing and commissioning of NW 160 mm Multi-Receive Station** complete with **minimum four-carrier receiving buffer capacity**, automatic carrier receipt and unloading, carrier identification system, visual and audible status indicators, carrier presence sensors, obstruction detection, electromagnetic safety interlocks, emergency release, station controller, communication interface and all accessories required for complete operation. The station shall be compatible with **NW 160 mm carriers**, support a **minimum payload of 5 kg**, operate at a **carrier velocity of 6–8 m/s**, and automatically receive, queue and process incoming carriers without operator intervention. The enclosure shall be fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with **minimum IP54 protection** in accordance with **IEC 60529**. The carrier identification system shall comply with **ISO/IEC 15693 or equivalent open standard**, and the station shall comply with **IEC 60204-1**. The Central Control System shall support **automatic rerouting of carriers to designated alternate receiving stations in the event of station unavailability**, without loss of carrier tracking. The station shall support priority handling, event logging, user authentication and integration with the Central Control System. Complete with installation, testing, commissioning and a **minimum 2-year**	2	Nos.

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	comprehensive warranty		
6	**Supply, installation, testing and commissioning of NW 160 mm, 3-Way, air-tight, electrically actuated Diverter**, complete with **minimum 1.5 mm thick fabricated steel housing**, optical carrier detection sensors, non-contact position sensors, position feedback, fail-safe actuator, inspection access, airtight seals, mounting supports, communication interface and all accessories required for complete operation. The diverter shall be compatible with **NW 160 mm tube systems**, suitable for **carrier payloads up to 5 kg**, operate at **carrier velocities of 6–8 m/s**, and achieve a **minimum switching time of 1 second** with **100% airtight sealing** during operation. The diverter shall be designed for a **minimum service life of 1 million switching cycles**, with automatic fault detection and position monitoring. The housing shall be fabricated from **minimum 1.5 mm thick galvanized steel or AISI 304 stainless steel**, with **minimum IP54 protection** in accordance with **IEC 60529**. Electrical equipment and control circuits shall comply with **IEC 60204-1**. The diverter shall support automatic routing, self-diagnostics, event logging and integration with the Central Control System. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	14	Nos.
7	Supply, installation, testing and commissioning of centrifugal Blower(s) with Variable Frequency Drive (VFD), complete with IE3 premium-efficiency motor, vibration isolators, flexible connectors, inlet/outlet silencers, non-return valves, isolation dampers, pressure and temperature sensors, control panel, communication interface and all accessories required for complete operation of the Pneumatic Tube System. The blower system shall be designed to maintain a **carrier velocity of 6–8 m/s** throughout the network under all operating conditions and shall comprise **minimum seven duty blowers (2.2 kW each) with one additional standby blower (N+1 redundancy)** capable of automatic changeover upon failure or maintenance of any duty unit. Each blower shall be VFD-controlled for energy-efficient operation, have **minimum IE3 motor efficiency** in accordance with **IEC 60034-30-1**, comply with **IEC 61800-3**, **ISO 5801**, **ISO 3744**, and achieve a **maximum noise level of 75 dB(A) at 1 m**. The blower system shall support automatic sequencing, runtime balancing, fault diagnostics and integration with the Central Control System. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**. The blower system shall incorporate protection against abnormal pressure and vacuum conditions that may arise due to blockage, closed diverters, pipeline obstruction or control system malfunction. Protection shall be provided through a dedicated pressure/vacuum relief valve or an equivalent OEM-engineered protection system, ensuring that the blower, pipeline network and associated equipment are not subjected to pressures or vacuum levels exceeding their design limits. The protection system shall automatically restore normal operation once the fault condition is cleared and shall generate alarms to the Central Control System.	7+1	Nos.

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply, installation, testing and commissioning of a Compact Rotary Transfer Unit (RTU), NW 160 mm, complete with rotary transfer mechanism, drive assembly, controller, non-contact position sensors, optical carrier detection sensors, communication interface, maintenance access, emergency manual override and all accessories required for complete operation. The RTU shall be capable of connecting **minimum 10 transport lines** without additional diverters and shall transfer carriers through **bi-directional (clockwise and anti-clockwise) rotation** to provide the shortest available routing path. The unit shall incorporate **minimum 24 dedicated carrier storage positions** for emergency carriers, support **NW 160 mm carriers** with a **minimum payload capacity of 5 kg**, operate at **carrier velocities of 6–8 m/s**, and be designed for a **minimum service life of 1 million switching cycles**. The enclosure shall be fabricated from **minimum 2.0 mm thick AISI 304 stainless steel or galvanized steel** with **minimum IP54 protection** in accordance with **IEC 60529**. Electrical equipment shall comply with **IEC 60204-1**, and the mechanical design shall conform to **ISO 12100**. The RTU shall provide automatic routing, priority handling, self-diagnostics, fault detection, event logging, automatic recovery following power restoration, emergency manual override and seamless integration with the Central Control System. Complete with installation, testing, Factory Acceptance Test (FAT), Site Acceptance Test (SAT), commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**.	1	Nos.
8	**Supply, installation, testing and commissioning of 160 mm nominal diameter PVC-U tube network**, manufactured from **rigid, impact-resistant PVC-U** with a **minimum wall thickness of 3.2 mm**, smooth low-friction internal bore, airtight joints and fittings, complete with bends, tees, Y-branches, couplings, expansion joints, supports, inspection/access fittings, identification labels and all accessories required for a complete installation. The tube network shall be designed to withstand the specified operating pressure/vacuum without deformation and shall be suitable for **carrier velocities of 6–8 m/s** and **minimum carrier payload of 5 kg**. Pipe material shall comply with **ISO 1452** or **ASTM D1785**, and all penetrations through fire-rated walls and floors shall be sealed using approved fire-stop systems complying with **ASTM E814/UL 1479** and **NBCS 2026, Part F (Fire and Life Safety), Clause 2.32**. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Mtr.
9	**Supply, installation, testing and commissioning of 160 mm nominal diameter PVC-U tube bends**, manufactured from rigid impact-resistant PVC-U with a smooth low-friction internal bore, factory-fabricated long-radius bends, airtight joints and all accessories required for complete installation. The bends shall be designed to withstand the specified operating pressure/vacuum and dynamic carrier impact without deformation throughout the service life, maintain uninterrupted carrier movement at **6–8 m/s**, and be suitable for **minimum 5 kg carrier payloads**. The minimum bend radius shall be as established by the OEM's proven system design to ensure reliable carrier transport and minimise wear. The material shall comply with **ISO 1452** or equivalent international standard. Complete with installation, testing, commissioning and a **minimum 2-year**	As per design	Nos.

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	comprehensive warranty.		
10	**Supply, installation, testing and commissioning of 160 mm nominal diameter transparent inspection tube**, manufactured from **clear, impact-resistant rigid PVC-U or equivalent transparent engineering polymer** compatible with the Pneumatic Tube System, complete with airtight couplings, supports and all accessories required for complete installation. The inspection tube shall provide **visual monitoring of carrier movement** and facilitate inspection and clearance of carrier blockages without dismantling the pipeline. It shall be compatible with **NW 160 mm carriers**, suitable for **carrier velocities of 6–8 m/s**, and designed to withstand the specified operating pressure/vacuum without deformation. The transparent section shall provide optical clarity without affecting system performance and shall comply with the mechanical performance requirements of the adjoining PVC-U pipeline. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Mtr.
11	**Supply, installation, testing and commissioning of 160 mm nominal diameter transparent inspection tube bends**, manufactured from **clear, impact-resistant engineering polymer** compatible with the Pneumatic Tube System, complete with airtight couplings, supports and all accessories required for complete installation. The transparent bends shall provide **visual monitoring of carrier movement** through directional changes and facilitate inspection and clearance of carrier blockages without dismantling the pipeline. The bends shall be compatible with **NW 160 mm carriers**, suitable for **carrier velocities of 6–8 m/s**, have a **minimum centreline bend radius as per the OEM's proven system design**, and be designed to withstand the specified operating pressure/vacuum without deformation. The transparent material shall provide high optical clarity and mechanical performance equivalent to the adjoining pipeline. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos.
11A	Supply, installation, testing and commissioning of approved through-penetration firestop systems at every location where the Pneumatic Tube System pipeline penetrates fire-rated walls, floors or shafts, complete with firestop sealants, collars, wraps, backing materials, sleeves, supports, identification labels and all accessories required to restore the fire-resistance and smoke-sealing performance of the penetrated assembly. The firestop system shall be compatible with the tube material and building construction, maintain the required fire compartmentation, and accommodate thermal movement and vibration without loss of integrity. Firestop systems shall be tested in accordance with ASTM E814 or UL 1479, with **F-, T- and L-ratings not less than the fire-resistance rating of the penetrated assembly**, and shall comply with the firestop and penetration-sealing requirements of **NBCS 2026, Part F (Fire and Life Safety), Clause 2.32 (Fire Stop and Notes 1 & 2)** and, where penetrations occur through service shafts and ducts, **Clause**	As per design	Lot

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	3.5.4.4. Complete with installation, testing, certification, commissioning and a **minimum 2-year comprehensive warranty**.		
12	**Supply, installation, testing and commissioning of NW 160 mm reusable carrier**, complete with **minimum internal dimensions of 330 mm × 115 mm**, high-impact engineering polymer body, transparent inspection window, shock-absorbing end caps, replaceable sealing rings, automatic electronic identification system, and all accessories required for complete operation. The carrier shall be suitable for the safe transportation of blood samples, blood products, laboratory specimens, pharmaceuticals and documents, with a **minimum payload capacity of 5 kg**, and shall be designed for continuous operation at **carrier velocities of 6–8 m/s**. The carrier shall incorporate an **electronic identification system complying with ISO/IEC 15693 or equivalent open standard** to enable automatic routing, tracking, inventory management and return of empty carriers. The carrier shall be resistant to repeated impact, abrasion and hospital cleaning and disinfecting agents without degradation of performance. Complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	112	Nos.
13	**Supply, installation, testing and commissioning of NW 160 mm reusable carrier**, complete with **minimum internal dimensions of 400 mm × 115 mm**, high-impact engineering polymer body, transparent inspection window, shock-absorbing end caps, replaceable sealing rings, automatic electronic identification system and all accessories required for complete operation. The carrier shall be suitable for the safe transportation of blood samples, blood products, laboratory specimens, pharmaceuticals, medical consumables and documents, with a **minimum payload capacity of 5 kg**, and shall be designed for continuous operation at **carrier velocities of 6–8 m/s**. The carrier shall incorporate an **electronic identification system complying with ISO/IEC 15693 or equivalent open standard** to enable automatic routing, tracking, inventory management and return of empty carriers. The carrier shall be resistant to repeated impact, abrasion and hospital cleaning and disinfecting agents without degradation of performance. Complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	112	Nos.
14	**Supply, installation, testing and commissioning of all installation accessories required for complete installation of the Pneumatic Tube System**, including pipe supports, clamps, brackets, anchors, threaded rods, fasteners, cable trays, cable clips, hose clamps, vibration isolation pads, station mounting frames, equipment racks, protective guards, identification labels, sleeves, sealants and all incidental hardware required for proper support, alignment, protection and operation of the system. All accessories shall be manufactured from **hot-dip galvanized steel, stainless steel or corrosion-resistant materials** suitable for the installation environment. Supports shall be designed to withstand the dead load, operating loads and vibration of the system with an **overall minimum factor of safety of 2.0**, and all fasteners shall be of **minimum Grade 8.8** or **AISI 304 stainless steel** where exposed to corrosive or wet environments. Installation shall comply with the approved shop drawings and the manufacturer's	1	Job

Pneumatic Tube System			
S.No.	**Item Description**	**Qty**	**Unit**
	installation requirements. Complete with installation, testing, commissioning and a **minimum 2-year comprehensive warranty**.		

Integrated Sterilizer with Shredder			
S.no.	**Particulars**	**Qty**	**Unit**
1	**Supply, installation, testing and commissioning of an Integrated Steam Sterilizer with Shredder Unit**, **minimum 150-litre usable chamber capacity**, suitable for on-site treatment of infectious bio-medical waste, complete with **integrated oil-free silent air compressor**, integrated electric steam generator, RO water treatment unit, automatic PLC-based control system, minimum **7-inch colour touch-screen HMI**, impact printer, stainless steel loading trolley, condensate collection system, automatic door locking arrangement, pressure and temperature sensors, biological and chemical indicator ports, integrated shredder, safety devices and all accessories required for complete operation. The sterilizer chamber shall be fabricated from **minimum SS316L**, with outer jacket and cladding in **minimum SS304**, insulated with **minimum 50 mm mineral wool**. The chamber shall be designed for **minimum 3 bar working pressure** and hydrostatically tested at **1.5 times the design pressure**, complete with safety relief valve, pressure gauge, temperature transmitter, automatic air removal, condensate drain and vacuum breaker. The sterilization process shall be fully automatic and programmable with **pre-vacuum, sterilization, holding, exhaust and drying cycles**, achieving **minimum sterilization conditions of 121°C, 15 psi and 30 minutes holding time**, or an equivalent validated cycle complying with the **Bio-Medical Waste Management Rules, 2016 (as amended)**. The sterilization cycle shall be validated using **Geobacillus stearothermophilus** biological indicators containing **minimum 1×10^6 spores**, with automatic electronic recording of cycle number, date, time, temperature, pressure, holding time, operator identification and alarm history. The integrated shredder shall operate **only after successful completion of the sterilization cycle**, be interlocked with the sterilizer control system, reduce treated waste to particles **not exceeding 50 mm**, and render the waste **unrecognisable and non-reusable**. The shredder shall be provided with a **minimum 5 kW IE3 motor**, hardened alloy-steel cutters, overload protection, reverse-jog facility, jam detection, emergency stop and automatic shutdown under abnormal operating conditions. The **integrated oil-free silent air compressor** shall be suitable for **continuous duty (Duty Type S1) in accordance with IEC 60034-1**, capable of delivering the air pressure and flow required for all	2	Nos.

Integrated Sterilizer with Shredder			
S.no.	**Particulars**	**Qty**	**Unit**
	pneumatic functions of the unit, with **minimum 8 bar working pressure**, **minimum 150 LPM Free Air Delivery (FAD)**, **minimum 50-litre air receiver**, integrated refrigerant air dryer, pre-filter, coalescing filter, automatic condensate drain, pressure regulator, safety relief valve and anti-vibration mounts. The compressed-air quality shall comply with **ISO 8573-1 Class 2:4:2 or better**, the motor shall conform to **IEC 60034-30-1 (minimum IE3 efficiency)**, and the compressor shall have a **maximum noise level of 65 dB(A) measured at 1 m** in accordance with **ISO 3744**. Where the air receiver falls within the statutory scope, it shall comply with the **Indian Boiler Regulations, 1950**, or **ASME BPVC Section VIII Division 1**, as applicable. The integrated steam generator shall be fully automatic with automatic water level control, low-water protection, pressure control, safety relief valve and blowdown arrangement, designed and certified in accordance with the **Indian Boiler Regulations, 1950**, wherever applicable. The integrated RO system shall have a **minimum permeate capacity of 250 LPH**, automatic flushing, conductivity monitoring and low-water protection, suitable for the steam generator demand. The control system shall comprise PLC-based automation with password-protected user access, cycle data storage for **minimum 10,000 cycles**, USB/Ethernet data export, remote diagnostics, alarm logging, trend recording and provision for integration with the Hospital Building Management System (BMS) through open communication protocols. Electrical equipment shall comply with **IEC 60204-1**, control panels with **IEC 61439-1/2**, enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**, and motors shall comply with **IEC 60034-1** and **IEC 60034-30-1 (minimum IE3 efficiency)**. The installation shall comply with the requirements for utility rooms and mechanical services under **NBCS 2026, Part D (Building Services), Section D-5**, and the fire protection requirements for utility rooms under **NBCS 2026, Part F (Fire and Life Safety), Section F-4**. The scope shall include Factory Acceptance Test (FAT), Site Acceptance Test (SAT), biological validation, installation, testing, commissioning, calibration, operator training, O&M manuals, as-built documentation and a **minimum 2-year comprehensive warranty**, including all consumables required for routine operation and validation during the warranty period.		

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
1	**General Requirements:** Design, manufacture, supply, installation, testing and commissioning of a complete, fully integrated **Electronic Queue Management System (QMS)** for the hospital, including all hardware, software, networking, power supplies, licences, accessories and services necessary for reliable operation. The system shall provide centralized queue management, appointment integration, token generation, patient routing, counter management, real-time monitoring, audio-visual announcements, reporting, audit trails, role-based access control, cybersecurity, and integration with the Hospital Information System (HIS) through open APIs/HL7 FHIR, where applicable. The system shall be scalable, modular and capable of future expansion without replacement of the core infrastructure. **Standards & Validation:** All electronic equipment shall comply with **IEC 62368-1**. Industrial automation and cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. Patient and appointment data processing shall comply with the **Digital Personal Data Protection Act, 2023** and rules issued thereunder. Structured cabling shall comply with **ISO/IEC 11801**. Building services, electrical installations and ICT infrastructure shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. Accessibility of all patient-facing kiosks, displays and interfaces shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021 (CPWD/MoHUA)**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**, including wheelchair-accessible mounting heights, tactile and audible guidance, high-contrast displays and screen-reader compatibility.	1	Job
2	**Supply, installation, testing and commissioning of a Central Application Server Suite**, comprising Web Server, Application Server, Database Server, Appointment/Scheduling Server, API Gateway, SMS/Email Notification Server and all system software, operating system, middleware, virtualization software, licences, server hardware, storage, networking components and accessories required for complete operation. The solution may be deployed on **physical or virtualized enterprise-class infrastructure** and shall include **High Availability (HA)** architecture with redundant server configuration, automatic failover, database replication, load balancing, automated backup and disaster recovery. The server platform shall comprise **minimum two (2) enterprise rack-mounted servers (1 Duty + 1 Hot Standby/HA)**, each equipped with:	1	Set

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	• Minimum **2 × Intel Xeon Silver/Gold or AMD EPYC enterprise-class processors**, **minimum 16 physical cores per server** • **Minimum 128 GB ECC DDR4/DDR5 RAM**, expandable to **512 GB** • **Dual hot-pluggable power supplies** • **Hardware RAID controller** with cache protection • **Dual 10 Gigabit Ethernet ports** and **dual 1 Gigabit management ports** • Enterprise remote management interface (IPMI/iDRAC/iLO or equivalent) • Virtualization support • Redundant cooling fans • 19-inch rack mount configuration The storage subsystem shall comprise: • **Minimum 4 TB usable enterprise SSD storage** configured as **RAID-10** for operating system, database and applications. • **Minimum 8 TB enterprise Nearline SAS storage** configured as **RAID-6** for reports, logs, audit trails and backups. • Hot-swappable enterprise drives with online rebuild capability. • Storage shall be scalable to **minimum 20 TB** without replacement of the storage controller. The server suite shall support **minimum 100 concurrent operator sessions**, **10,000 patient transactions per day**, **100 configurable service counters**, **200 configurable service queues**, and **500,000 patient transaction records** without degradation of system performance. The software shall provide automatic token generation, appointment-based and walk-in queue management, priority queuing, multi-department routing, dynamic counter allocation, real-time dashboards, audit trails, role-based access control, multilingual user interface (minimum English and Odia), SMS/Email notifications, comprehensive reporting, remote diagnostics, health monitoring, automatic database backup and seamless integration with Hospital Information Systems (HIS), EMR and third-party applications through **RESTful APIs, HL7 v2.x and HL7 FHIR**. A dedicated **Online UPS** shall be provided with **minimum 30 minutes battery autonomy at 100% server load**, automatic shutdown/startup capability and SNMP-based monitoring. **Standards & Validation:** Server hardware shall comply with **IEC 62368-1**. Cybersecurity shall comply with **IEC 62443** or **ISO/IEC**		

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	27001. Structured cabling shall comply with **ISO/IEC 11801**. Data processing shall comply with the **Digital Personal Data Protection Act, 2023**. Electrical equipment shall comply with **IEC 60204-1** and **IEC 61439-1/2**. Installation of ICT equipment shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. Complete with installation, testing, commissioning, migration, training, O&M manuals, as-built documentation and **minimum 2-year comprehensive warranty**.		
3	**Self-Service Token/Ticket Dispensing Kiosk:** Supply, installation, testing and commissioning of minimum 10 **Nos.** floor/wall-mounted self-service touchscreen kiosks with **minimum 21.5-inch Full HD (1920 × 1080) projected capacitive multi-touch display** (minimum 10-point touch), **minimum Intel Core i5 or equivalent industrial processor**, **minimum 8 GB RAM**, **minimum 256 GB SSD**, integrated **minimum 80 mm direct thermal ticket printer with auto-cutter** (minimum print speed 150 mm/s), **1D/2D barcode and QR code scanner**, speaker and microphone for voice guidance, multilingual user interface (minimum English and Odia), **Gigabit Ethernet (mandatory)** with **Wi-Fi (optional)**, USB interfaces, UPS-backed power supply, status indicators, and all accessories required for complete operation. The kiosk shall support walk-in registration, appointment check-in, token generation, department/service selection, queue information display, QR/barcode appointment retrieval, feedback collection, and seamless integration with the Hospital Information System (HIS) through open APIs/HL7 FHIR, where applicable. The enclosure shall be fabricated from **minimum 1.5 mm CRCA steel with powder-coated finish or minimum SS304 stainless steel**, tamper-resistant, corrosion-resistant and suitable for continuous public use in healthcare facilities. The kiosk shall be designed for **24 × 7 continuous operation**, with an operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. Enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**. Accessibility shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**, including wheelchair-accessible operating height, tactile and audible guidance, high-contrast display and screen-reader compatibility. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.. Complete with installation, testing, commissioning, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty,**	Minumum 10	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	including all parts, labour, firmware/software updates and preventive maintenance		
4	**Supply, installation, testing and commissioning of 32 Nos. Counter Operator Workstations**, comprising an **industrial-grade operator terminal** with **minimum 10.1-inch projected capacitive multi-touch display**, **minimum Full HD (1920 × 1200) resolution**, **minimum Intel Core i5 processor (12th Generation or higher) or equivalent x86-64 enterprise-class processor**, **minimum 8 GB DDR4 RAM**, **minimum 256 GB industrial-grade SSD**, integrated Gigabit Ethernet interface, USB ports, audio interface, status indicators, power supply, mounting accessories and all hardware, software and licences required for complete operation. The workstation shall support **role-based secure login**, token generation, token calling, recall, transfer, hold/resume, priority queue handling, queue reassignment, patient lookup, counter status management, multilingual operation (minimum English and Odia), real-time synchronization with the Central Application Server, visual and audible announcements, audit logging and integration with the Hospital Information System (HIS) through open APIs/HL7 FHIR where applicable. The operator terminal shall support **minimum 1 Gbps network interface**, automatic reconnection after network interruption, local buffering of transactions during temporary network failure with automatic synchronization on restoration, automatic software updates from the central server, remote diagnostics and centralized configuration management. The workstation shall be designed for **24 × 7 continuous operation**, with an operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, **minimum service life of 10 years**, and **minimum display brightness of 350 cd/m²**. The touchscreen shall support **minimum 10 simultaneous touch points**, have **minimum 7H surface hardness**, and be rated for **minimum 50 million touch operations**. Where Power over Ethernet (PoE) is adopted, the workstation shall support **IEEE 802.3af/at**. The workstation shall provide **minimum one Gigabit Ethernet port**, **minimum four USB ports**, HDMI or DisplayPort output, integrated speaker/buzzer for local annunciation, and **TPM 2.0** for hardware-based security. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. Network interfaces shall comply with **IEEE 802.3**, with **IEEE 802.3af/at** where PoE is used. Electromagnetic compatibility shall comply with the **IEC 61000** series. Installation of	32	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	ICT equipment shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. Complete with installation, testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**.		
5	**Supply, installation, testing and commissioning of 32 Nos. Counter/Room Token Number Displays**, comprising **minimum 21-inch LED/LCD display** with **minimum Full HD (1920 × 1080) resolution**, **minimum brightness of 350 cd/m²**, **minimum contrast ratio of 1000:1**, **minimum viewing angle of 178°**, and capable of displaying the current token number, counter/room identification, service status, directional messages and configurable text/graphics. The display shall incorporate an **integrated audible chime** with adjustable volume on token change and shall communicate with the Central Application Server over **Gigabit Ethernet**, with **PoE (IEEE 802.3af/at)** where adopted. The display shall support automatic brightness adjustment, multilingual display (minimum English and Odia), automatic synchronization with the Queue Management System, remote configuration, firmware updates and automatic recovery following power restoration. The enclosure shall be fabricated from **minimum 1.2 mm CRCA steel with powder-coated finish or minimum SS304 stainless steel**, with **minimum 3 mm tempered anti-glare protective glass**, suitable for continuous operation in healthcare environments. The display shall be designed for **24 × 7 continuous operation**, with an operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, **minimum LED backlight life of 50,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. LED photobiological safety shall comply with **IEC 62471**. Enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**. Network interfaces shall comply with **IEEE 802.3**, with **IEEE 802.3af/at** where Power over Ethernet (PoE) is adopted. Display visibility and accessibility shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, testing, commissioning, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance**	32	Nos.
6	**Supply, installation, testing and commissioning of 17 Nos. Main Waiting Area/Lobby Displays**, comprising **minimum 55-inch commercial-grade LED/LCD display** with **minimum Ultra HD**	17	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	(3840 × 2160) resolution, **minimum brightness of 500 cd/m²**, **minimum contrast ratio of 4000:1**, **minimum viewing angle of 178° (H/V)**, **minimum refresh rate of 60 Hz**, and designed for **24 × 7 continuous operation**. The display shall support simultaneous presentation of **multi-counter and multi-department queue status**, token numbers, counter information, real-time announcements, audio notifications, hospital information, emergency messages, health education content, public notices and multimedia content through split-screen or multi-window display. The display shall be provided with an **integrated media player** having a **minimum Intel Core i5 processor (12th Generation or higher)**, **minimum 8 GB DDR4 RAM**, **minimum 256 GB SSD**, **Gigabit Ethernet interface**, HDMI input, USB ports, integrated speakers, centralized content management, remote monitoring, automatic synchronization with the Central Application Server Suite, automatic brightness control, remote firmware/software updates and automatic recovery following power restoration. The display enclosure shall be of **commercial-grade construction**, suitable for continuous operation in hospital environments, with **minimum 3 mm tempered anti-glare protective glass**, operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, **minimum LED backlight life of 50,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. LED photobiological safety shall comply with **IEC 62471**. Enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**, where installed in semi-exposed locations. Network interfaces shall comply with **IEEE 802.3**. Accessibility, viewing height and readability shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, testing, commissioning, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance.**		
7	**Supply, installation, configuration, testing and commissioning of an enterprise Patient Notification Gateway**, integrated with the Central Application Server Suite, for automatic transmission of **SMS notifications** relating to appointment confirmation, token generation, estimated waiting time, queue status, token call alerts, appointment reminders, service completion and other configurable patient	1	Set

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	notifications. The system shall support **API-based integration** with TRAI-approved SMS service providers and, where required, GSM modem-based messaging. The gateway shall support **minimum 10 messages per second**, message scheduling, delivery status reporting, retry mechanism, message templates, multilingual messaging (minimum English and Odia), audit logs, configurable notification rules and integration with the Hospital Information System (HIS) through open APIs. The notification gateway shall support secure communication using **TLS 1.2 or higher**, role-based administration, message encryption in transit, centralized monitoring, automatic failover, queue management, reporting and archival of transaction logs for **minimum one year**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**, where hardware is supplied. Cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. SMS services shall comply with the **Telecom Commercial Communications Customer Preference Regulations (TCCCPR), 2018**, issued by **TRAI**, as amended, including DLT registration requirements where applicable. Processing of patient information shall comply with the **Digital Personal Data Protection Act, 2023** and rules issued thereunder. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, configuration, testing, commissioning, integration with the Central Application Server Suite and Hospital Information System (HIS), operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, software updates and preventive maintenance.**		
8	**Supply, installation, testing and commissioning of enterprise-grade Layer-2/Layer-3 Managed PoE Network Switches**, dedicated to the Queue Management System (QMS) network, complete with all accessories, mounting hardware, power cords, software licences and configuration required for complete operation. The switches shall provide **10/100/1000Base-T PoE+ (IEEE 802.3at) access ports**, **10 Gigabit SFP+ uplink ports**, enterprise switching performance, Layer-3 static routing, VLANs, QoS, Link Aggregation (LACP), RSTP/MSTP, IGMP Snooping, DHCP Snooping, Access Control Lists (ACL), IEEE 802.1X authentication, SNMP v3, IPv4/IPv6 support and centralized management. The PoE power budget and switching capacity shall be adequate to support all connected QMS devices. The network shall be designed with **a minimum 20% spare active switch ports and 20% spare PoE power capacity** after connecting all QMS devices to accommodate future expansion without replacement of the switching infrastructure. The switches shall	As per design	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	support dedicated VLAN segregation from the hospital ICT network, secure remote management, automatic configuration backup and firmware upgrade capability. The equipment shall be designed for **24 × 7 continuous operation**, with an operating temperature of **0°C to 50°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 200,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Ethernet interfaces shall comply with **IEEE 802.3**. Power over Ethernet shall comply with **IEEE 802.3af/at**. Structured cabling shall comply with **ISO/IEC 11801**. Cybersecurity and network segmentation shall comply with **IEC 62443** or **ISO/IEC 27001**. Installation of ICT infrastructure shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, configuration, testing, commissioning, VLAN configuration, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware updates and preventive maintenance.**		
9	**Supply, installation, testing and commissioning of an Online Double-Conversion UPS** dedicated to the **Central Application Server Suite**, database server, storage system, core network switches and associated critical QMS infrastructure. The UPS shall be sized to support the **connected load with a minimum 25% spare capacity** for future expansion and shall provide **minimum 30 minutes battery autonomy at 100% connected load**. The UPS shall incorporate **DSP-controlled true online double-conversion technology**, **static and maintenance bypass**, automatic battery management, battery health monitoring, overload and short-circuit protection, surge protection, remote monitoring through SNMP, dry contacts and Modbus TCP/IP, and automatic shutdown/start-up of protected equipment. The battery system shall comprise **maintenance-free VRLA or Lithium-ion batteries**, complete with battery racks, interconnecting cables and protection devices, suitable for an ambient operating temperature of **40°C**. The UPS shall operate on **415/230 V AC, 50 Hz**, with an **input power factor ≥ 0.99**, **output power factor 1.0**, **minimum efficiency of 95% in online mode and 98% in ECO mode**, **total harmonic distortion (THDi) ≤ 3%**, and **output voltage regulation within ±1%**. The equipment shall be designed for **24 × 7 continuous operation**, with **minimum MTBF of 200,000 hours** and **minimum service life of 10 years**. **Standards & Validation:** UPS shall comply with **IEC 62040-1** (Safety), **IEC 62040-2** (EMC) and **IEC 62040-3** (Performance and	1	Set

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	Test Requirements). Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.** and the project electrical specifications. **Complete with installation, testing, commissioning, battery bank, battery racks, monitoring software, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance.**		
10	**Supply, installation, configuration, testing and commissioning of enterprise-grade Queue Management System (QMS) Application Software**, including all software licences required for the Central Application Server Suite, database, web services, application services, operator workstations, self-service kiosks, counter displays, waiting area displays, notification gateway, reporting modules and all client devices forming part of the QMS. The software shall be supplied with **perpetual, transferable licences**, registered in the name of the **Employer**, with no recurring licence fees for the specified system capacity. The software shall support **minimum 100 operator users**, **100 service counters**, **200 configurable service queues**, **10,000 patient transactions per day**, **500,000 transaction records**, unlimited departments and services, multilingual operation (minimum English and Odia), role-based access control, configurable workflows, appointment scheduling, token generation, queue prioritization, real-time dashboards, analytics, audit trails, reporting, SMS/email notifications, remote diagnostics, automatic backup, disaster recovery, and seamless integration with the Hospital Information System (HIS), Electronic Medical Records (EMR) and other third-party systems through **RESTful APIs, HL7 v2.x and HL7 FHIR**, where applicable. The software architecture shall be modular and scalable to accommodate future expansion without replacement of the core application. The software shall support **automatic software updates**, centralized configuration management, encrypted communications using **TLS 1.2 or higher**, secure password policies, role-based authentication, audit logging, and database backup and restore functions. **Standards & Validation:** Cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. Software licences, source configuration data, databases and all application ownership rights for the licensed software shall be registered in the name of the **Employer**. Processing and storage of patient information shall comply with the **Digital Personal Data Protection Act, 2023** and rules issued thereunder.	1	Lot

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	Complete with installation, configuration, testing, commissioning, database configuration, software documentation, administrator and operator training, O&M manuals, licence certificates issued in the name of the Employer, and a minimum 2-year comprehensive software warranty and support, including software updates, security patches, bug fixes, technical support and preventive maintenance.		
11	**Supply, installation, testing and commissioning of complete Category 6A LSZH structured cabling infrastructure**, including **Category 6A U/FTP or F/UTP solid copper cables (23 AWG)**, patch panels, information outlets, face plates, keystone jacks, patch cords, connectors, cable management accessories, cable trays/conduits, identification labels, earthing, fire stopping at all wall/floor penetrations, testing and all accessories required for complete connectivity of all QMS kiosks, operator workstations, displays, servers, network switches and associated equipment. The structured cabling system shall support **10 Gigabit Ethernet (10GBASE-T)** with a **minimum operating bandwidth of 500 MHz**, and shall be designed with **minimum 20% spare data outlets and cable capacity** for future expansion. Horizontal cable length shall not exceed **90 m**, with the total channel length not exceeding **100 m**. All cables shall be **100% annealed bare copper conductors**, **23 AWG solid conductors**, **Low Smoke Zero Halogen (LSZH)** jacketed, **flame-retardant**, and suitable for continuous operation in healthcare facilities. Patch cords shall be **factory-terminated stranded copper Category 6A LSZH**, minimum **26 AWG**, with snagless boots. RJ-45 connectors and outlets shall be **Category 6A shielded**, supporting **10 Gbps transmission**, with **minimum 750 insertion cycles**. Patch panels shall be **19-inch rack-mountable**, modular type, with rear cable management and front port numbering. Cable management shall include horizontal and vertical cable organizers, bend-radius protection and strain-relief arrangements. All cables, outlets and patch panels shall be permanently labelled using machine-printed identification markers in accordance with the approved cable identification schedule. The completed installation shall be **100% tested and certified** using a **Level VI or higher field cable certifier**, including wire map, continuity, insertion loss, return loss, NEXT, PSNEXT, ACR-F, propagation delay, delay skew and shield continuity (where applicable). Test reports for every installed link shall be submitted before commissioning. **Standards & Validation:** Structured cabling shall comply with **ISO/IEC 11801 Class EA**, **ANSI/TIA-568.2-D**, and **IEC 14763-2**. LSZH cable characteristics shall comply with **IEC 60754-1**, **IEC 60754-2** and **IEC 61034-2**. Flammability shall comply with **IEC**	As per design	Mtr.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	60332-3. Installation of ICT infrastructure shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, testing, certification, commissioning, cable identification schedules, as-built drawings, test reports, O&M manuals and a minimum 2-year comprehensive warranty, including all materials, workmanship and corrective maintenance.**		
12	**Supply, installation, testing and commissioning of all installation accessories** required for the complete installation of the Queue Management System (QMS), including kiosk floor stands/plinths, wall-mounting brackets, display mounting frames, equipment supports, cable trays, raceways, conduits, trunking, cable management systems, junction boxes, anchor fasteners, fixing hardware, identification labels, earthing accessories, firestop materials, protective covers and all incidental materials necessary for a complete installation. All floor stands, brackets and support structures shall be fabricated from **minimum 2.0 mm CRCA steel with minimum 70-micron epoxy polyester powder coating** or **minimum SS304 stainless steel**, designed to safely support **at least four (4) times** the operating load of the mounted equipment without permanent deformation. All exposed fasteners shall be **stainless steel (minimum SS304)** or **zinc-coated high-tensile steel** suitable for indoor hospital environments. PVC conduits and trunking shall be **heavy-duty, self-extinguishing and FRLS/LSZH**, with a **minimum wall thickness of 2.0 mm**. Metallic cable trays and trunking shall be **minimum 1.6 mm thick pre-galvanized steel** with factory-finished corrosion protection. Cable management shall maintain the minimum bend radius recommended by the cable manufacturer and provide segregation between power and data circuits. All wall and floor penetrations shall be sealed using approved firestop systems maintaining the required fire-resistance rating of the penetrated assembly. **Standards & Validation:** Steel fabrication shall comply with **IS 2062 Grade E250** or equivalent. Fasteners shall comply with **ISO 898-1**. Cable trays shall comply with **IEC 61537**. PVC conduit and trunking shall comply with **IS 9537 (Parts 1–3)**. Firestop systems shall be tested in accordance with **ASTM E814 / UL 1479**. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.** and **Part F – Fire and Life Safety**, including the relevant provisions for maintaining fire compartmentation at service penetrations. **Complete with installation, testing, commissioning, alignment, identification, cleaning, as-built documentation and a minimum 2-year comprehensive warranty, including all materials, workmanship and corrective maintenance.**	1	Job

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
13	**Testing, commissioning and Site Acceptance Testing (SAT)** of the complete Queue Management System, including all servers, kiosks, operator workstations, displays, notification gateway, network infrastructure, software, databases and third-party integrations. The scope shall include functional testing, performance testing, failover testing, network verification, user acceptance testing, system optimization, operator and administrator training, and supply of comprehensive O&M manuals, software licences, configuration records, backup and recovery procedures, test certificates and as-built drawings. **Standards & Validation:** Site Acceptance Testing shall be carried out in accordance with the approved Acceptance Test Procedure (ATP). The system shall demonstrate **100% functional compliance** with the Contract Specifications, successful integration with all interfaced systems, and **continuous fault-free operation for a minimum period of 72 hours** before final acceptance. **Complete with submission of SAT reports, training records, O&M manuals, as-built documentation and a minimum 2-year comprehensive warranty, including software support, updates, preventive maintenance and corrective maintenance.**	1	Job

MEDICAL SERVICES FOR DENTAL BUILDING ARE MENTIONED BELOW:

Medical Gas Pipeline System (MGPS)

Section / Item	Item No.	Description	Qty	Unit
1. OXYGEN SUPPLY				
	1.1	Fully automatic duplex oxygen cylinder manifold, 15 + 15 cylinders, complete with changeover/control panel, regulators, alarms and headers. Cylinders to be provided by the End user unless stated otherwise.	1	Set
	1.2	High-pressure oxygen pigtail assemblies for 15 + 15 cylinder manifold, oxygen-clean, gas-specific and compliant with applicable high-pressure medical-gas connector requirements.	30	Nos
	1.3	Medical oxygen terminal unit with gas-specific probe/adaptor, metallic first/second fix and permanent identification.	41	Nos
	1.4	Oxygen flowmeter 0-15 L/min with reusable humidifier bottle, compatible with installed oxygen terminal unit.	41	Nos
	1.5	Oxygen engineering/pharmaceutical plant test point with lockable isolation, clearly identified; not to be counted as patient terminal unit.	1	No

2. DENTAL COMPRESSED AIR	2.1	Central/split dental compressed-air plant for the dental teaching facility, oil-free compressor arrangement with service protection, receiver(s), dryer, filtration, automatic drains, pressure control, monitoring and alarms. Minimum available design duty 9,500 L/min at nominal 600 kPa plant outlet with 550 kPa minimum at dental floor-box connection under design flow. Final packaged selection shall not be below calculated duty.	1	Set
	2.2	Dental compressed-air service connection / chair or wall point as indicated in the submitted matrix and coordinated dental-equipment drawings.	190	Points
	2.3	Dental compressed-air distribution piping, fittings, supports, isolation valves and identification, material technically suited to dental air service. Sizes and measured lengths to be determined from the approved hydraulic/pressure-drop calculation and coordinated route drawings.	As per approved route	Mtr
3. MEDICAL AIR 400 kPa	3.1	Triplex or equivalent N+1 medical compressed-air plant, oil-free, with automatic sequencing and one standby package, complete with receiver(s), 100% standby drying/filtration arrangement, bacterial final filtration, pressure control, monitoring, alarms, emergency inlet/reserve provision and PLC/HMI. Minimum combined available duty 300 L/min at the required medical-air pipeline pressure.	1	Set
	3.2	Medical Air 400 kPa terminal unit with gas-specific probe/adaptor and permanent identification.	34	Nos
	3.3	Medical-air plant test point with lockable isolation and identification.	1	No
4. DENTAL HIGH-VOLUME VACUUM	4.1	Dedicated central dental high-volume vacuum system for the dental teaching facility, dry/wet/semi-dry configuration selected with the dental user and equipment supplier, with multiple pumps providing service protection, separators, large-particle filtration, amalgam separation, bacterial exhaust filtration where required, controls, monitoring and safe discharge. Minimum available design duty 57,000 L/min at the specified cannula performance.	1	Set
	4.2	Dental high-volume suction/cannula connection point at dental chair/consultant/service location as indicated in the submitted matrix and dental-equipment drawings.	190	Points
	4.3	Dental vacuum distribution and exhaust piping, fittings and supports. Material shall be compatible with the selected dry/wet/semi-dry system and resistant to carried liquids/detritus; copper shall not be used for wet dental vacuum where exposed to amalgam compounds. Sizes/lengths as per approved dental-vacuum hydraulic calculation and route drawings.	As per approved route	Mtr
5. MEDICAL VACUUM	5.1	Triplex medical vacuum plant, 2 duty/automatic alternating + 1 standby or equivalent N+1 arrangement, complete with duplex inlet bacterial filtration, receiver(s), non-return/isolation valves, gauges/transmitters, controls, alarms and safe exhaust. Minimum available duty 600 L/min at the specified pipeline vacuum.	1	Set
	5.2	Medical vacuum terminal unit with gas-specific	41	Nos

		probe/adaptor and permanent identification.		
	5.3	Ward vacuum unit comprising continuously variable suction regulator, reusable approximately 600 ml collection jar, overflow protection, hydrophobic filter, probe and tubing.	39	Nos
	5.4	Medical-vacuum plant test point with lockable isolation and identification.	1	No
6. AVSU & ALARMS	6.1	Area Valve Service Unit - 2-service configuration, complete with gas-specific isolation valves, gauges/transmitters/test connections, enclosure, identification and emergency access. Service composition to match the approved floor zone.	1	No
	6.2	Area Valve Service Unit - 3-service configuration, complete as above. Quantity retained from submitted matrix; final service composition/zone limits to be checked against plotted floor plans before tender freeze.	40	Nos
	6.3	Local medical gas area alarm - 2-service configuration corresponding to the associated monitored zone.	1	No
	6.4	Local medical gas area alarm - 3-service configuration corresponding to the associated monitored zone.	40	Nos
	6.5	Central Master Medical Gas Alarm System with Colour HMI, event/alarm history, monitored plant/source status and open BMS interface for installed MGPS services only.	1	No
7. CONTROLS	7.1	Combined electrical/control panel for medical compressed-air and medical-vacuum plant, with segregated control sections, PLC/HMI, automatic sequencing, fault indication, essential-supply interface and BMS communication. Dental air/vacuum plant shall have its own integral OEM controls.	1	No
8. MGPS COPPER PIPEWORK	8.1	Oxygen-clean seamless copper tube, 76 mm OD × 1.5 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.	As per approved route	Mtr
	8.2	Oxygen-clean seamless copper tube, 54 mm OD × 1.2 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.	As per approved route	Mtr
	8.3	Oxygen-clean seamless copper tube, 42 mm OD × 1.2 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.	As per approved route	Mtr
	8.4	Oxygen-clean seamless copper tube, 28 mm OD × 0.9 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.	As per approved route	Mtr
	8.5	Oxygen-clean seamless copper tube, 22 mm OD × 0.9 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing	As per approved route	Mtr

		and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.		
	8.6	Oxygen-clean seamless copper tube, 15 mm OD × 0.9 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.	As per approved route	Mtr
	8.7	Oxygen-clean seamless copper tube, 12 mm OD × 0.7 mm, complete with compatible fittings, brazing, supports, sleeves, fire stopping, identification, testing and commissioning. Quantity shall be measured from the final approved MGPS route drawing; no route length was available in the submitted matrix.	As per approved route	Mtr
9. PIPELINE ISOLATION VALVES	9.1	Lockable full-bore medical-gas pipeline isolation valve, 12 mm, oxygen-cleaned/degassed as applicable, permanently identified and complete with fittings and testing.	2	Nos
	9.2	Lockable full-bore medical-gas pipeline isolation valve, 15 mm, oxygen-cleaned/degassed as applicable, permanently identified and complete with fittings and testing.	1	Nos
	9.3	Lockable full-bore medical-gas pipeline isolation valve, 22 mm, oxygen-cleaned/degassed as applicable, permanently identified and complete with fittings and testing.	7	Nos
	9.4	Lockable full-bore medical-gas pipeline isolation valve, 28 mm, oxygen-cleaned/degassed as applicable, permanently identified and complete with fittings and testing.	5	Nos
	9.5	Lockable full-bore medical-gas pipeline isolation valve, 42 mm, oxygen-cleaned/degassed as applicable, permanently identified and complete with fittings and testing.	10	Nos
	9.6	Lockable full-bore medical-gas pipeline isolation valve, 54 mm, oxygen-cleaned/degassed as applicable, permanently identified and complete with fittings and testing.	5	Nos
10. TESTING / DOCUMENTATION	10.1	Complete MGPS and DAVS testing, pressure/leak/cross-connection/identity/cleanliness verification as applicable, plant performance tests, dental air/vacuum performance testing, commissioning, calibration records, third-party/statutory documentation, as-built drawings, O&M manuals and operator training.	1	Job

5.1 General MGPS requirements

• Design, manufacture, supply, installation, testing and commissioning shall form a complete system. Medical compressed gases and medical vacuum shall comply with ISO 7396-1 and the healthcare engineering provisions of HTM 02-01 Part A; patient terminal units shall comply with ISO 9170-1.

• Patient safety requirements shall preserve quantity, identity, continuity and quality of supply. Medical air and medical vacuum plant shall maintain standby capability; essential electrical supply shall be

provided to plant controls and alarms.

• All gas-specific components shall be permanently identified. Medical-gas terminal units shall be non-interchangeable between services. Pressure/vacuum transmitters, alarm set points and BMS signals shall be commissioned and documented.

5.2 Dental compressed air system (DAVS)

• Dental compressed air is a separate engineering system from Medical Air 400 kPa. Medical air shall not be used as the normal source for dental instruments.

• At the dental chair, the system shall provide at least 50 L/min at the instrument connection under design flow. Design shall target approximately 550 kPa at the floor-box outlet and nominal 600 kPa at the plant outlet.

• For this dental teaching facility the matrix identifies 190 explicit teaching chairs.

• Compressor arrangement shall be oil-free or otherwise demonstrably capable of the specified dental air quality, with intake filtration, post-compression filtration and drying. Air shall be clean and dry and plant monitoring shall include pressure, temperature, dryer/filter condition and common fault.

• For a large central system, provide service protection by multiple/split compressor packages so that loss of one package does not disable the complete dental department. Emergency connection/provision shall be addressed by the plant supplier and user risk assessment.

• Pipework sizing shall be based on the approved pressure-drop calculation. No route-dependent diameters or lengths shall be accepted without the coordinated dental-equipment/floor routing.

5.3 Dental high-volume vacuum system (DAVS)

• Dental vacuum shall be separate from the medical vacuum pipeline system. ISO 7396-1 medical-vacuum provisions are not a substitute for dental high-volume vacuum performance requirements.

• The selected system may be dry, wet or semi-dry as agreed with the dental user/equipment supplier. Pump/separator selection shall be suitable for the actual liquid/solid load and shall include service protection, large-particle separation, safe drainage and monitoring.

• An amalgam separator shall be provided for dental vacuum systems. Exhaust shall terminate safely outdoors away from air intakes/openings and shall include appropriate bacterial filtration in accordance with the dental guidance and OEM system design.

• Dental vacuum pipe material shall suit the selected system. Copper shall not be used for wet dental vacuum where it may be attacked by amalgam compounds. Pipe diameter and configuration shall be based on hydraulic calculation and approved equipment connection details.

5.4 Medical air 400 kPa plant

• The medical-air plant is dedicated to the 34 clinical Medical Air 400 kPa terminal units identified after separating the 190 dental-air points from the matrix total.

• The HTM diversity calculation from the submitted fourth-floor clinical schedule is approximately 227.5 L/min; therefore the packaged plant shall provide not less than 300 L/min available design duty at the required pipeline pressure while maintaining the specified standby philosophy.

• The plant shall include oil-free compressor packages, automatic sequencing, air receiver(s), duty/standby drying and filtration, final bacterial filtration, automatic drains, pressure monitoring, pressure control, high/low alarm, emergency inlet/reserve arrangement and PLC/HMI.

• Air delivered to the medical pipeline shall meet the applicable medical-air purity requirements. Final air-quality testing shall be completed at commissioning using an accredited laboratory where required by the project quality plan.

5.5 Medical vacuum plant and suction accessories

• The medical-vacuum system serves 41 clinical terminal units .

• The HTM diversity calculation from the fourth-floor clinical schedule is approximately 530 L/min. Select a triplex or equivalent N+1 plant with not less than 600 L/min available design duty and one complete pump package on standby.

• Provide inlet bacterial filtration in duplex arrangement, receiver(s), isolation/non-return valves, vacuum gauges/transmitters, automatic controls, high/low vacuum alarm and safe exhaust termination.

• Provide 39 ward vacuum regulator/jar assemblies exactly as scheduled in the matrix.

5.6 AVSUs, local alarms and master alarm

• AVSUs shall allow safe isolation of the designated clinical zone and shall be accessible for emergency/maintenance use while protected against unauthorized operation. Each valve shall be permanently identified with service and area served.

• Local alarm panels shall monitor the services provided in the associated zone and provide distinct normal, high/low pressure/vacuum and fault indication as applicable. Alarm mute shall not cancel the visual fault indication.

• The central master alarm shall monitor only installed MGPS sources/plants and associated alarms. Dental air/vacuum plant status may be integrated as engineering plant status but shall be clearly distinguished from medical-gas alarm conditions.

5.7 Medical-gas copper pipeline and isolation valves

• MGPS copper tube shall be seamless, phosphorus-deoxidized, oxygen-clean and capped, conforming to BS EN 13348 or approved equivalent, with compatible copper fittings.

• Provide pipe supports, sleeves, fire stopping, identification, gas labels and flow-direction marking. Pressure testing, leak testing, cross-connection tests, gas identity and cleanliness verification shall be completed before clinical handover.

• Isolation-valve matrix totals: 12 mm - 2 Nos; 15 mm - 1 No; 22 mm - 7 Nos; 28 mm - 5 Nos; 42 mm - 10 Nos; 54 mm - 5 Nos. No 76 mm isolation-valve

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following		
Particulars	**Qty**	**Unit**
MODULAR WALL SYSTEM		
WALL PANEL		
Supply, installation, testing and commissioning of a **flush-mounted Modular Operation Theatre wall panel system** fabricated from **minimum 6 mm thick homogeneous Solid Mineral Composite Sheet (SMS/SMC)** or equivalent **High-Pressure Laminate (HPL)-faced panel**, factory finished with a non-porous, seamless, scratch-resistant, stain-resistant and chemical-resistant surface suitable for hospital cleanroom applications. The panels shall be mounted on a corrosion-resistant aluminium/GI sub-frame using a **clamp-on, removable modular system** to permit maintenance of concealed services. All panel joints shall be flush, airtight and sealed with **hospital-grade antimicrobial silicone sealant**. The wall system shall be designed to integrate the hermetically sealed door, vision panel, wall-integrated cabinet, writing board, medical gas terminal units, electrical/data outlets, HVAC grilles, pressure relief dampers, control panel and all concealed MEP services. The wall panels shall be **Class B-s1,d0 or better** for reaction to fire as per **EN 13501-1**, with low VOC emissions. The complete system shall comply with **ISO 14644-4 & ISO 14644-5**, **ASHRAE/ASHE Standard 170**, **NBCS 2026** , **EN 13501-1** and applicable **BIS standards**, complete with all trims, sealants, testing, commissioning, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	As per design	Sq. Mtr.
MODULAR CEILING PANELING SYSTEM		
Modular Ceiling Panel System: Supply, installation, testing and commissioning of a **flush-mounted Modular Ceiling Panel System** for the Minor Operation Theatre, comprising **minimum 0.8–1.0 mm thick AISI 304 stainless steel panels** (or powder-coated GI panels of equivalent hygienic finish as an economical alternative), **No. 4 Scotch-Brite finish**, mounted on a corrosion-resistant aluminium/GI suspension framework with concealed fixing. The ceiling shall be fully modular, gasketed and removable, providing an airtight, dust-free, seamless surface, with all joints sealed using **hospital-grade antimicrobial silicone sealant**. The ceiling shall be designed to accommodate the **HEPA terminal filtration module(s)**, single dome surgical light, general/peripheral LED lighting, access panels, fire detection devices and other concealed MEP services, without vibration, deflection or loss of alignment. The system shall comply with **ISO 14644-4 & ISO 14644-5**, **ASHRAE/ASHE Standard 170**, **NBCS 2026** , **EN 13501-1** and applicable **BIS standards**, complete with testing, commissioning, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	As per design	Sq. Mtr.
FLOORING WITH SELF-LEVELING		
Provide and lay **minimum 2.5–3.0 mm thick seamless, solvent-free, self-levelling, static-dissipative epoxy flooring system** comprising surface preparation, epoxy primer, conductive copper foil grounding grid, conductive epoxy intermediate coat and conductive epoxy wearing course, complete with **75 mm high integral coved skirting**, terminations, earthing and testing. The flooring shall be non-porous, jointless, abrasion-	As per design	Sq. Mtr.

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following

Particulars	Qty	Unit
resistant, chemical-resistant, anti-microbial, low VOC, easy to clean and disinfect, with a **matt/satin slip-resistant surface (minimum R10)**. It shall achieve electrical resistance to ground and point-to-point resistance within **10^6–10^9 Ω** when tested in accordance with **IEC 61340-4-1**. The system shall comply with **IEC 61340-6-1, ASTM F150, ASTM C722, ISO 14644 (where applicable), and NFPA 99 requirements, complete with manufacturer's test certificates, conductivity/adhesion test reports, and a minimum 5-year warranty against delamination, loss of conductivity,** and material defects.		
HEPA TERMINAL FILTRATION SYSTEM (IN LIEU OF LAMINAR AIR FLOW PLENUM)		
Supply, installation, testing and commissioning of **ceiling-mounted HEPA Terminal Filtration Module(s)** (non-laminar diffusive type), factory-fabricated of minimum size **600 × 600 mm** (typically 2–4 modules per OT, as per design), fitted with **H13 HEPA filters** having filtration efficiency **≥99.97% at MPPS**, individually tested as per **EN 1822**, with a perforated diffuser face providing uniform, low-turbulence downward airflow over the procedure zone, suitable for achieving **ISO Class 7** (or better) cleanliness. The system shall include airtight filter housing, gasketed filter mounting, access panel, supports and all accessories. The OT Contractor shall supply and install the complete terminal filtration assembly, while the AHU and external ducting shall be in the HVAC contractor's scope. The system shall be validated through **TAB, HEPA integrity (PAO/DOP) testing, air velocity measurement, particle count and room pressure validation**. The system shall comply with **ISO 14644-1, 3, 4 & 5, EN 1822, ASHRAE/ASHE Standard 170, NABH OT Air Conditioning Guidelines (latest edition), NBCS 2026** and applicable **BIS standards**, complete with testing, commissioning, validation reports, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	As per design	Nos.
HERMETICALLY SEALED DOOR (ONE DOOR PER MINOR OT)		
Provide, install, test and commission a **single hermetically sealed manual or semi-automatic sliding door**, complete with door leaf, frame, vision panel, accessories and all associated hardware. The door shall maintain the positive/negative pressure differential of the room by providing **airtight sealing on all four sides** through continuous EPDM/silicone compression gaskets and a bottom sealing mechanism, with **air leakage not exceeding Class 3 as per EN 12207**. The door leaf shall comprise a minimum **40–50 mm thick insulated core** faced with **1.0 mm thick SS 304 stainless steel (No. 4 satin finish)**, with smooth flush surfaces and concealed joints for infection control. The frame shall be heavy-duty anodised aluminium or SS 304 with flush installation. Where motorised, the door shall be operated by a **24 V DC motor** with manual override during power failure and shall comply with **EN 16005**. The system shall include a **vision panel of minimum 300 × 300 mm**, stainless steel recessed handles and emergency release. The complete assembly shall be easy to clean, corrosion-resistant, anti-bacterial and suitable for ISO 14644 cleanroom applications, and shall carry a **minimum 2-year comprehensive warranty**. Approximate size: **(1200-1500) × 2100 mm**.	2	Nos.
BASIC OT CONTROL PANEL		
Supply, installation, testing and commissioning of a flush-mounted **Basic OT Control Panel** with a **minimum 15-inch capacitive touch display**, providing local control of OT ceiling/peripheral lights (ON/OFF and dimming), a digital clock with elapsed-procedure timer, and display of room temperature, relative humidity and HVAC status.	2	Nos.

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following

Particulars	Qty	Unit
The panel shall be operable with surgical gloves and have **minimum IP54** front protection, interfaced with the local lighting circuit and HVAC monitoring sensors. Full integration with BMS/HIS/MGPS/Nurse Call. The system shall comply with **IEC 60601-1, IEC 60601-1-2 (where applicable) and NBCS 2026**, complete with cabling, mounting accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.		
X-RAY VIEW SCREEN		
X-Ray Viewing Screen *. A single-plate LED X-ray viewer of size (approx. 450 × 500 × 30 mm*	2	--
WALL INTEGRATED WRITING WHITE BOARD		
Wall-Integrated Writing Board: Supply, installation, testing and commissioning of a wall-integrated magnetic writing board, flush-mounted with the modular wall panel. The writing surface shall be **tempered safety glass (minimum 4 mm thick)** or vitreous enamel steel, white in colour, non-porous and suitable for dry-erase markers, sealed with a continuous **medical-grade silicone gasket**. The board size shall be approximately **600 mm × 450 mm** (or manufacturer's nearest standard equivalent). The assembly shall comply with **NBCS 2026, ISO 14644-4 & 14644-5**, and **IS 2553 (Part 1)/EN 12150** for tempered safety glass, complete with mounting accessories, testing, commissioning and a **minimum 2-year comprehensive warranty**.	2	Nos.
WALL INTEGRATED STORAGE UNIT		
Wall Integrated Storage Unit: Supply, installation, testing and commissioning of a wall-integrated storage cabinet, fully flush-mounted with the modular wall panel system. The cabinet shall be fabricated from **minimum 1.0 mm thick AISI 304 stainless steel** with Scotch-Brite internal finish, provided with **minimum two adjustable SS304 shelves (minimum 30 kg UDL per shelf)**. Overall dimensions shall be approximately **600 mm (W) × 2100 mm (H) × 400 mm (D)**. The cabinet shall be fitted with **toughened safety glass hinged door(s)** conforming to **IS 2553 (Part 1)/EN 12150**, mounted in a powder-coated stainless steel frame matching the wall finish, with concealed hinges, flush handles and lockable hardware. The unit shall comply with **ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170, NBCS 2026** and applicable **BIS standards**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	2	Nos.
PRESSURE RELIEF DAMPERS		
Pressure Relief Dampers (PRD)/Overflow Ports: Supply, installation, testing and commissioning of factory-fabricated Pressure Relief Dampers and/or Overflow Ports, complete with mounting frames, airtight seals and accessories, for maintaining the specified room pressure differential in the Minor OT. The units shall be gravity-operated or counterbalanced, fabricated from minimum SS304 or powder-coated galvanised steel (**minimum 1.0 mm thick**), with field-adjustable opening pressure (typically **2.5–15 Pa**) and **EN 1751 Class 3 or better** leakage performance. Performance shall be verified during **Testing, Adjusting & Balancing (TAB)**. The system shall comply with **ISO 14644-1 & 3, ASHRAE/ASHE 170, NABH Guidelines, NBCS 2026 and EN 1751**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos.

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following		
Particulars	**Qty**	**Unit**
PERIPHERAL LIGHT		
Supply, installation, testing and commissioning of **recess-mounted, bottom-opening LED peripheral luminaires** providing uniform, shadow-free illumination flush with the modular ceiling system. The luminaire shall have a **powder-coated CRCA/aluminium housing**, tempered safety glass or high-impact opal diffuser, **minimum IP54 protection**, antimicrobial gasket, **CRI ≥80**, correlated colour temperature of **4000 K** (or as specified), **luminaire efficacy ≥90 lm/W**, flicker-free electronic driver and **LED life ≥50,000 hours (L70)**. The luminaire shall support ON/OFF and dimming control locally or through the OT Control Panel. The luminaire shall comply with **IS 10322, IS 16101, IS 16102, IEC 60598-1, IEC 60598-2-2, IEC 61347 and IEC 62471**, complete with testing, commissioning and a **minimum 2-year comprehensive warranty**.	16 (approx. 8 per OT, as per design)	Nos.
CEILING SERVICE PENDANT / WALL-MOUNTED SERVICE PANEL		
Supply, installation, testing and commissioning of either **(a)** a ceiling-mounted **single-arm combined anaesthesia-cum-surgical services pendant** providing a **minimum horizontal reach of 800 mm**, **minimum 300° rotation**, gas-spring/manual-assisted vertical adjustment, **minimum safe working load of 60 kg**, **minimum one height-adjustable SS304 equipment shelf (minimum 40 kg capacity)**, **minimum two medical gas terminal units**, **minimum four 5/15 A switched hospital-grade electrical sockets** and **one RJ45 data outlet**; or **(b)**, as an economical alternative where a pendant is not specified, a **wall-mounted flush service panel/trunking** integrated with the modular wall system providing equivalent gas and electrical outlets at bed-head level. The system shall permit equipment positioning without cable/hose strain, include mechanical end stops and overload protection, and comply with **ISO 11197, ISO 7396-1, IEC 60601-1, IEC 60601-1-2** and applicable **BIS standards**, complete with testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**.	2	Nos.
SURGICAL SCRUB STATION		
Single-Bay Surgical Scrub Sink: Supply, installation, testing and commissioning of a wall-mounted, seamless single-bay surgical scrub sink fabricated from **minimum 1.0 mm thick AISI 304 stainless steel** with satin finish, radiused internal corners and integral backsplash. The bay shall be provided with a **sensor-operated (touch-free) hot and cold water mixing faucet** with thermostatic mixing valve, adjustable temperature control (35–45°C) and anti-scald protection, together with a **sensor-operated soap dispenser, sensor-operated hand sanitiser dispenser, digital scrub timer** and removable SS drain strainer. Point-of-use RO water purification may be provided optionally where mains water quality requires treatment. The complete assembly shall comply with **HTM 64, ISO 14644-4 & 14644-5, NABH Guidelines, IS 10500 (where applicable)** and applicable **BIS plumbing/electrical standards**, complete with a **minimum 2-year comprehensive warranty**.	2	Nos.
HATCH BOX		
Supply, installation, testing and commissioning of a wall-integrated **single or double-door interlocking hatch box (pass box)** for transfer of sterile supplies/instruments into the Minor OT, flush-mounted with the modular wall system and fabricated from **minimum 1.0 mm thick AISI SS304** with satin finish. The internal clear opening shall be **minimum 450 mm × 450 mm × 450 mm** (or as specified). Where double-door, the unit shall have interlocked doors, **toughened safety glass viewing windows** and	2(clean transfer); dirty-utility hatch —	Nos.

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following		
Particulars	**Qty**	**Unit**
silicone gaskets to prevent simultaneous opening; UV-C germicidal irradiation may be provided optionally. A **separate hatch box for dirty/contaminated waste transfer may be provided as an optional additional item** where the department workflow requires segregated clean/dirty transfer. The equipment shall comply with **ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170, NABH Guidelines, IS 2553 (Part 1)** and applicable **BIS standards**, complete with a **minimum 3-year comprehensive warranty**.	Optional	
AIR RETURN GRILLE SYSTEM		
Supply, installation, testing and commissioning of **flush-mounted return air grille(s)**, complete with mounting frame, opposed blade volume control damper (OBD), airtight gaskets and accessories. The grille shall be fabricated from **minimum 1.0 mm thick extruded aluminium alloy** with antimicrobial polyester powder-coated finish and a removable core for cleaning. The nominal face size shall be approximately **300 mm × 300 mm** (or as shown on approved drawings), with **maximum face velocity of 2.0 m/s** and noise level not exceeding **NC-30**. The complete assembly shall comply with **IS 655, SMACNA HVAC Duct Construction Standards, ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170** and **NBCS 2026**, complete with testing, air balancing, commissioning and a **minimum 2-year comprehensive warranty**.	As per design	Nos.
Internal HVAC Ducting & Exhaust System: Supply, fabrication, installation, testing and commissioning of the complete internal supply, return and exhaust air ducting system within the Minor OT, including ductwork, fittings, balancing dampers, access doors, supports, sealing, insulation and accessories, sized to achieve a **minimum of 15–20 air changes per hour (ACH)**, in line with NABH/ASHRAE guidance for minor/procedure rooms (as against 20–25 ACH for Major OT). All ductwork shall be fabricated from **Aluminium Alloy 3103-H14 or equivalent**, sheet thickness conforming to **SMACNA HVAC Duct Construction Standards**, with airtight sealed flanged joints and **minimum 25 mm thick closed-cell elastomeric insulation** on supply air ducts. Performance shall be verified during **Testing, Adjusting & Balancing (TAB)**. The installation shall comply with **SMACNA Standards, ISO 14644-4 & 14644-5, ASHRAE/ASHE Standard 170, NBCS 2026** and applicable **BIS standards**, complete with a **minimum 2-year comprehensive warranty**.	As per design	--
MEDICAL GAS LINE INSTALLATION (MGPS WORK INSIDE MINOR OT)		
Supply, installation, testing and commissioning of the **Medical Gas Pipeline System (MGPS)** within the Minor OT, including seamless, degreased, deoxidized high-phosphorus (DHP) copper pipes conforming to **EN 13348/ISO 7396-1 and IS 2501** or equivalent. All joints shall be **silver brazed (minimum 45% silver brazing alloy) under continuous nitrogen purging** by qualified personnel in accordance with **ASME Section IX**. The system shall provide, as a minimum, **Oxygen (O_2) – 1 outlet, Medical Air (MA4) – 1 outlet, and Vacuum (VAC) – 1 outlet at the service pendant/panel, including Nitrous Oxide (N_2O) and Surgical Air** . Medical gas terminal units shall be gas-specific, non-interchangeable and self-sealing. The complete installation shall undergo **100% strength, leak, cross-connection, pipeline purity and terminal functional testing** prior to commissioning. The installation shall comply with **ISO 7396-1, EN 13348, HTM 02-01, IS 2501, ASME Section IX** and applicable **BIS standards**, complete with testing, validation, commissioning, as-built drawings and a **minimum 2-year comprehensive warranty**.	2	Sets
ELECTRICAL WORK + DISTRIBUTION BOX INSIDE MINOR OT		

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following

Particulars	Qty	Unit
Supply, installation, testing and commissioning of the complete internal electrical installation for the Minor OT, including **one (01) flush-mounted IP54 minimum Essential/UPS Distribution Board** (combined normal and essential power, sized for the reduced connected load of a Minor OT), MCBs/RCBOs, **Type II Surge Protection Device (SPD)**, wiring, conduiting, modular switches, hospital-grade socket outlets, earthing and equipotential bonding. The scope shall include internal wiring from the Distribution Board to lighting fixtures, the service pendant/panel, OT control panel, HVAC controls and other Minor OT equipment, complete with **1100 V grade FRLSH copper cables** and **FRLS/LSZH conduits**, **30 mA RCBO protection** for socket circuits, and **minimum 20% spare outgoing ways**. Provision of a dedicated Medical IT (isolated power) system is covered under Item 20 where specified. All components shall comply with **IEC 60364-7-710, IEC 61439-1 & 2, IEC 60601-1, IEC 61008/61009, IEC 61643-11, IS 732, IS/IEC 60364, NBCS 2026** and applicable **BIS standards**, complete with testing, commissioning, as-built drawings and a **minimum 2-year comprehensive warranty**.	2	Sets
MEDICAL ISOLATION PANEL		
Supply, installation, testing and commissioning of a **Medical Isolation Panel (Medical IT System)** of **minimum 5–7.5 kVA** for each Minor OT (sized to the reduced connected load, as against minimum 20 kVA for Major OT), comprising a medical-grade isolation transformer, **Line Isolation Monitor (LIM)**, insulation fault monitoring, audible and visual alarm indicators, test/mute functions, protective devices and **Type II Surge Protection Device (SPD)**. The system shall provide an isolated power supply with continuous insulation monitoring and automatic first-fault alarm without interruption of supply, and shall be wall/flush-mounted with a display of insulation resistance and system status. **Provision of a Medical Isolation Panel may be omitted, as an optional deletion,** for Minor OTs used exclusively for procedures under local anaesthesia not involving line-powered critical life-support equipment, subject to the treating clinicians' and Engineer-in-Charge's approval. Where provided, the system shall comply with **IEC 60364-7-710, IEC 61557-8, IEC 61558-2-15, IEC 61439-1 & 2, IEC 60601-1, IEC 61643-11** and applicable **BIS standards**, complete with FAT/SAT, functional testing, commissioning and a **minimum 2-year comprehensive warranty**.	2	Nos.
OT LIGHT		
Supply, installation, testing and commissioning of a ceiling-mounted **single dome LED Surgical Light System**, complete with ceiling suspension, control electronics and accessories, for the Minor Operation Theatre. The light head shall provide **minimum central illuminance of 100,000–120,000 lux at 1 m**, continuously adjustable illumination (10–100%), colour temperature of **4000 K–5000 K**, **CRI ≥90**, adjustable light field diameter, **LED life ≥50,000 hours (L70)**, flicker-free operation and negligible UV/IR radiation. The light head shall have an aerodynamic design, **minimum IP44 protection**, removable autoclavable handles, smooth disinfectant-resistant sealed surfaces and **minimum 360° horizontal rotation**. A third articulated monitor arm and HD camera integration are **not mandatory for Minor OT** and may be provided as optional items. The equipment shall comply with **IEC 60601-1, IEC 60601-1-2, IEC 60601-2-41, IEC 60529, IEC 62366-1, IEC 62471, ISO 13485** and applicable **BIS standards**, complete with testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
OT TABLE		

Supply & Installation, Testing & Commissioning of Modular Operation Theatre (Minor) — 2 Nos. as per following		
Particulars	**Qty**	**Unit**
Supply, installation, testing and commissioning of a **fully electro-hydraulic general-purpose operating table** suitable for minor surgical, gynaecological and endoscopic procedures. The table shall have a **radiolucent tabletop section** (minimum at the head/upper-body section for C-arm compatibility where required), powered or manual floor-locking base, and wired hand/foot control. It shall have a **minimum Safe Working Load (SWL) of 135 kg (dynamic) and 185 kg (static)**, height adjustment **700–950 mm** (or as per design), Trendelenburg/Reverse Trendelenburg **±15°**, back section **+70°/-25°**, and lateral tilt **±15°** (where electro-hydraulic). The table shall be supplied complete with head and leg sections, a pair of arm boards, anaesthesia screen, lithotomy stirrups (where applicable), restraint straps, gel pads and an electrically conductive antistatic mattress. The equipment shall comply with **IEC 60601-1, IEC 60601-1-2, IEC 60601-2-46, IEC 62366-1** and applicable **BIS standards**, complete with testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
Note: The Modular Operation Theatre (Minor) shall be delivered as a complete, fully integrated, functional and code-compliant facility, specified in accordance with standard industry practice (**NABH, NBCS 2026, ASHRAE/ASHE Standard 170 and ISO 14644**) for minor/day-care surgical and procedure rooms, as distinct from Major Operation Theatres. The Contractor shall provide all materials, equipment, accessories, fittings, interfaces, cables, supports, structural fixings, consumables, testing instruments and incidental works, whether or not specifically indicated in the BOQ, but necessary for the satisfactory installation, testing, commissioning and intended operation of the Minor OT in accordance with the approved drawings, applicable standards and the directions of the Engineer-in-Charge. All equipment shall be supplied complete with testing, commissioning and warranty as indicated against each item, including preventive maintenance and technical support during the warranty period.		

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Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Central Sterile Supply Department (CSSD) complete with following		
Part A	**CSSD Equipment**		
1	**Steam Sterilizer (Pass-Through, Double Door):** Supply, install, test and commission a **fully automatic horizontal pass-through double-door Steam Sterilizer** of 500**–600 litre chamber capacity (minimum 8 STU)** complete with **minimum two (1) internal transfer trolleys, two (2) external loading/unloading trolleys and eight (8) SS 304 baskets**. The sterilizer shall have an **SS 316L chamber and jacket**, PLC-based automatic cycle control, **minimum 15-inch colour touch-screen HMI**, independent pressure and temperature monitoring, electronic cycle recording, USB/Ethernet	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	connectivity, and interface with the CSSD tracking and barcode system. It shall perform **automatic Bowie-Dick/Helix tests**, vacuum leak tests, and support **Class 5/Class 6 chemical indicators for every load** and **biological indicator monitoring** in accordance with **ISO 17665-1** and the hospital sterilization quality assurance programme. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training. The sterilizer shall comply with **EN 285, ISO 17665-1, ISO 17665-2, ISO 11140, IEC 61010**, and applicable BIS requirements, and shall be **CE certified under EU MDR 2017/745 by a Notified Body** and manufactured under an **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.		
2	.**Low Temperature Steam Formaldehyde (LTSF) Sterilizer (Pass-Through, Double Door):** Supply, install, test and commission a **fully automatic horizontal pass-through double-door LTSF Sterilizer** of 250**–300 litre chamber capacity (minimum 4 STU)** complete with **minimum one (1) internal transfer trolley, two (2) external loading/unloading trolleys and six (6) SS 304 baskets (1 STU each)**. The sterilizer shall have an **SS 316L chamber**, PLC-based automatic cycle control, **minimum 15-inch colour touch-screen HMI**, electronic cycle recording, USB/Ethernet connectivity, and interface with the CSSD tracking and barcode system. The system shall perform validated low-temperature steam formaldehyde sterilization cycles with automatic leak testing and process monitoring, and support routine validation using chemical and biological indicators in accordance with the hospital sterilization quality assurance programme. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training, and shall comply with **EN 14180, ISO 25424, ISO 11140, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and manufactured under an **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.	1	Nos.
3	.**Double-Door Washer/Disinfector(200-250 ltr):** Supply, install, test and commission a **fully automatic pass-through double-door Washer/Disinfector** with **minimum 12 DIN capacity**, complete with **minimum one (1) internal surgical instrument trolleys, one (1) external loading/unloading trolleys and twelve (12) stainless steel 1-DIN instrument trays**. The washer/disinfector shall be suitable for automated cleaning, thermal disinfection and drying of surgical instruments and reusable medical devices through programmable **pre-wash, enzymatic/detergent wash, rinsing, thermal disinfection and hot-air drying** cycles. Thermal disinfection shall achieve a **minimum A_0 value of 3000** (minimum **A_0 600** for heat-sensitive items where applicable) in accordance with **EN ISO 15883-1 and EN ISO 15883-2**. The unit shall have a PLC-based control system with **minimum 15-inch colour touch-screen HMI**, electronic cycle recording, USB/Ethernet connectivity, and interface with the CSSD tracking and barcode system. The equipment shall be supplied complete with **IQ, OQ and PQ validation**, calibration, testing, commissioning and operator training, and shall comply with **EN ISO**	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	15883-1/-2, IEC 61010, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and manufactured under an **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.		
4	**Ultrasonic Cleaner (Bench Top):** Supply, install, test and commission a **bench-top Ultrasonic Cleaner** of **minimum 45-litre capacity**, suitable for operation on **230 V ±10%, 50 Hz AC** supply. The unit shall comprise a **SS 304/316 stainless steel tank** with ultrasonic transducers operating at **approximately 40 kHz**, a solid-state ultrasonic generator, thermostatically controlled electric heating, digital temperature and timer controls, stainless steel basket and lid, drain valve, and electronic safety/overload protection. The equipment shall be suitable for ultrasonic cleaning of surgical instruments using approved cleaning solutions and shall be supplied complete with testing, commissioning and operator training. The equipment shall comply with **IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, with a **minimum 2-year comprehensive warranty**.	2	Nos.
5	**Rotary Heat Sealing Machine:** Supply, install, test, and commission a microprocessor-controlled continuous rotary heat-sealing machine suitable for sealing medical-grade sterilis**ation reels and paper/plastic laminate pouches**. The unit shall provide **validated seals** with adjustable temperature and sealing speed, digital display, automatic seal monitoring with alarm, and electronic recording of sealing parameters. The machine shall be compatible with the CSSD tracking and barcoding system and comply with **ISO 11607-1 & 2, EN 868, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	1	Nos.
6	**Air & Water Spray Gun:** Supply, install, test and commission an **Air & Water Spray Gun** suitable for manual pre-cleaning of surgical instruments, cannulated devices, catheters, cannulas, pipettes and syringes. The unit shall be designed for connection to **compressed medical air and treated water**, with independent trigger control, adjustable spray pressure, interchangeable nozzles, flexible hose, and **SS 304 construction** for wetted parts. The equipment shall comply with applicable **IEC 61010**, **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	1	Nos.
7	.**Ethylene Oxide (ETO) Steriliser: Supply, install, test, and commission a fully automatic Ethylene Oxide (ETO) steriliser with a minimum 120-litre chamber capacity, suitable for sterilis**ation of heat- and moisture-sensitive medical devices. The unit shall have an **SS 316L chamber**, PLC-based automatic cycle control with **a minimum 7-inch colour touch-screen HMI, programmable**	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	sterilisation and aeration cycles, automatic temperature, humidity, pressure, and gas concentration control, electronic cycle recording, and integrated safety interlocks with exhaust and catalytic/aeration system. The equipment shall comply with **ISO 11135, ISO 14937, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**. The system shall be supplied complete with IQ/OQ/PQ validation, testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.		
Part B	**Furniture for CSSD**		
12	**Double-Door Drying Cabinet:** Supply, installation, testing, and commissioning of a fully automatic pass-through double-door drying cabinet with a minimum 275-litre usable chamber capacity, designed for drying cleaned and disinfected surgical instruments, anaesthesia equipment, hollow instruments, glassware, and reusable medical devices. The cabinet shall comprise a **minimum SS 304 stainless steel inner chamber** with smooth radiused corners and a **minimum 1.2 mm thick epoxy polyester powder-coated CRCA steel outer enclosure** mounted on a rigid structural frame. The unit shall be provided with **interlocked double doors** to maintain segregation between clean and sterile areas and prevent simultaneous opening. The drying cabinet shall incorporate **forced hot-air circulation** with HEPA-filtered intake air (**minimum H14 efficiency as per EN 1822**), adjustable drying temperature from **40°C to 90°C**, digitally controlled heating system with **minimum 2 kW stainless steel heating elements**, PLC-based automatic operation with **minimum 7-inch colour touch-screen HMI**, programmable drying cycles, digital temperature display, cycle timer, automatic cool-down cycle, over-temperature protection, door safety interlocks, visual and audible fault alarms, and electronic cycle recording with USB/Ethernet connectivity. The cabinet shall provide uniform temperature distribution throughout the chamber, with automatic shutdown upon completion of the drying cycle. The system shall be suitable for continuous 24×7 operation and shall be supplied complete with adjustable stainless steel shelves/racks, all accessories, IQ, OQ and PQ validation, calibration, testing, commissioning, operator training and O&M manuals. The drying cabinet shall comply with **IEC 61010**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and shall be manufactured under an **ISO 13485-certified Quality**	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	Management System. Complete with a **minimum 2-year comprehensive on-site warranty**.		
13	**Stainless Steel Washing Station (Double Sink):** Supply, installation, testing and commissioning of a **double-sink Stainless Steel Washing Station** for the decontamination area of the Central Sterile Supply Department (CSSD), complete with two deep seamless sinks, integral drain boards, backsplash, splash guards, and all accessories required for complete installation. The unit shall be fabricated entirely from **minimum 1.5 mm thick AISI 304 stainless steel** with continuously welded construction, ground smooth and polished to a satin finish. All exposed edges shall be rounded, and all internal corners shall have a minimum radius of **25 mm** to facilitate cleaning and prevent accumulation of contaminants. The washing station shall have **two deep bowls of minimum 500 mm × 500 mm × 350 mm**, complete with removable perforated stainless steel strainers, anti-splash overflow, heavy-duty waste fittings, and corrosion-resistant bottle traps. The worktop shall incorporate **integral sloping drain boards** on both sides with raised edges and a **minimum 150 mm high integral backsplash**. The station shall be mounted on heavy-duty stainless steel tubular legs with adjustable stainless steel levelling feet and shall be capable of supporting dynamic operational loads without deformation. The unit shall be provided complete with **gooseneck swivel spout mixing faucets**, elbow-operated controls, thermostatic mixing valve, treated water and hot/cold water connections, air and water spray gun with flexible hose for instrument flushing, provision for connection to compressed air, and all pipework, valves, traps, fittings and accessories necessary for complete operation. The design shall minimise splashing and facilitate one-way workflow within the decontamination area. The complete assembly shall comply with **EN ISO 15883-1** (manual pre-cleaning workflow requirements), **IEC 61010** (where applicable), and shall be manufactured under an **ISO 13485-certified Quality Management System**. Complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Nos.
14	**Stainless Steel Control & Packing Table:** Supply, installation, testing and commissioning of a **CSSD Control & Packing Table** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The table shall	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	have minimum dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)**, with a reinforced worktop, **100 mm high rear upstand**, full-width undershelf, minimum three lockable drawers, adjustable storage shelf, and provision for mounting an inspection lamp, barcode scanner, barcode printer and heat sealer. The table shall be supported on heavy-duty stainless steel tubular legs with adjustable levelling feet and shall be resistant to corrosion and hospital-grade disinfectants. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
15	**Stainless Steel Linen Folding Table:** Supply, installation, testing and commissioning of a **CSSD Linen Folding Table** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The table shall have minimum dimensions of **1800 mm (L) × 900 mm (W) × 900 mm (H)** with a reinforced smooth worktop, **100 mm high rear upstand**, full-width undershelf, and heavy-duty stainless steel tubular legs with adjustable levelling feet. The work surface shall be non-porous, corrosion-resistant, easy to clean, and resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
16	**Stainless Steel Storage Shelf:** Supply, installation, testing and commissioning of a **free-standing Stainless Steel Storage Shelf** for CSSD, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The unit shall have minimum overall dimensions of **1200 mm (L) × 600 mm (W) × 1800 mm (H)** and shall be provided with **five (5) adjustable stainless steel shelves**, each capable of supporting a uniformly distributed load of **not less than 100 kg**. The shelf shall be supported on a heavy-duty stainless steel tubular frame with cross bracing and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete unit shall be corrosion-resistant, non-porous, easy to clean, and resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	5	Nos.
17	**Stainless Steel Pass Box:** Supply, installation, testing and commissioning of a **double-door Stainless Steel Pass Box** for transfer of sterilized materials within the CSSD, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The pass box shall have **minimum internal dimensions of 600 mm × 600 mm × 600 mm** and shall be provided with **interlocked double doors** incorporating **toughened safety glass viewing panels**, ensuring that both doors cannot be opened simultaneously. The unit shall be fitted with **EPDM door gaskets**, heavy-duty stainless steel hinges, flush handles, magnetic door locks, and removable stainless steel shelves. The pass box shall incorporate **LED internal illumination**, UV-resistant viewing panels, and all accessories required for complete installation.	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	The complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for flush mounting in partition walls. Complete with installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
18	**Stainless Steel Closed Trolley for Sterile Material Transport:** Supply, installation, testing and commissioning of a **fully enclosed Stainless Steel Sterile Material Transport Trolley** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The trolley shall have **minimum overall dimensions of 900 mm (L) × 600 mm (W) × 1500 mm (H)** and shall be provided with **double hinged lockable doors**, removable and adjustable stainless steel shelves, heavy-duty stainless steel push handles on both sides, and a fully enclosed dust-proof construction for safe transport of sterile supplies. The trolley shall be mounted on **four heavy-duty 150 mm diameter non-marking swivel castors**, two with brakes, suitable for smooth and quiet operation. The base shall be reinforced with peripheral bumpers for impact protection. The trolley shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for routine CSSD operations. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
19	**Stainless Steel Working Table:** Supply, installation, testing and commissioning of a **general-purpose Stainless Steel Working Table** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The table shall have minimum dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)** with a reinforced smooth worktop, full-width undershelf, and heavy-duty stainless steel tubular legs with adjustable stainless steel levelling feet. The worktop shall be capable of supporting a uniformly distributed load of **not less than 250 kg** without permanent deformation. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, and resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	4	Nos.
20	**Stainless Steel Basket Trolley:** Supply, installation, testing and commissioning of a **Stainless Steel Basket Trolley** suitable for safe transportation and handling of CSSD sterilization baskets and instrument trays. The trolley shall be fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. It shall have a heavy-duty tubular frame with **minimum four (4) adjustable guide rails** suitable for accommodating standard **ISO 600 mm × 300 mm sterilization baskets/trays**, with anti-dislodgement stops to prevent accidental movement during transport. The trolley shall have minimum overall	6	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	dimensions of **700 mm (L) × 500 mm (W) × 1100 mm (H)** and shall be mounted on **four heavy-duty 125 mm diameter non-marking swivel castors**, two with brakes. The trolley shall be provided with stainless steel push handles, corner bumpers, and a reinforced frame capable of supporting a uniformly distributed load of **not less than 150 kg**. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for routine CSSD operations. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
21	**Stainless Steel Operator Stool:** Supply, installation, testing and commissioning of an **ergonomically designed Stainless Steel Operator Stool** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with satin finish. The stool shall be provided with a **height-adjustable cushioned seat** upholstered in seamless medical-grade PU, a **360° swivel mechanism**, **five-star stainless steel base** with **50 mm non-marking twin-wheel antistatic castors**, and a **minimum load capacity of 150 kg**. The seat height shall be adjustable from **450 mm to 650 mm** by means of a gas-lift mechanism. The stool shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous use in CSSD clean and packing areas. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	10	Nos.
22	**Stainless Steel Change Locker (4 Compartments):** Supply, installation, testing and commissioning of a **four-compartment Stainless Steel Change Locker** fabricated from **minimum 0.8 mm thick AISI 304 stainless steel** with satin finish. The locker shall have minimum overall dimensions of **1200 mm (W) × 500 mm (D) × 1800 mm (H)** and shall comprise **four individual full-height lockable compartments**, each provided with a stainless steel coat hook, hat shelf, hanging rail, louvred ventilation openings, name card holder, and sloping top to prevent dust accumulation. Each compartment shall be fitted with a recessed handle and heavy-duty locking arrangement suitable for padlock or built-in cam lock. The locker shall be mounted on adjustable stainless steel levelling feet and shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for CSSD personnel changing areas. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	4	Nos.
23	**Closed Sterilization Container (300 mm × 290 mm × 140 mm):** Supply, installation, testing and commissioning of a **reusable rigid Closed Sterilization Container** of nominal dimensions **300 mm × 290 mm × 140 mm (±10%)**, suitable for steam sterilization, storage and aseptic transport of surgical instruments and procedure sets. The container shall be fabricated from **anodized aluminium alloy** with a corrosion-resistant, scratch-resistant finish and shall be provided with a rigid lid incorporating a **tamper-evident locking mechanism**, stainless steel latches, silicone gasket, reusable microbial barrier	15	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	filter system, carrying handles, identification card holder, laser-etched unique identification number and colour coding for tray identification. The container shall be compatible with standard CSSD sterilization racks, washer-disinfectors and steam sterilizers. The complete assembly shall withstand repeated sterilization cycles without deformation or deterioration and shall comply with **ISO 11607-1**, **ISO 17665-1**, and **EN 868**. Complete with all accessories, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
24	**Stainless Steel Shoe Rack:** Supply, installation, testing and commissioning of a **free-standing Stainless Steel Shoe Rack** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The shoe rack shall have minimum overall dimensions of **1200 mm (L) × 400 mm (W) × 900 mm (H)** and shall be provided with **minimum four (4) sloping perforated stainless steel shelves**, capable of accommodating **not less than 24 pairs of footwear**. The rack shall be supported on a heavy-duty stainless steel tubular frame with adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for installation in CSSD changing areas. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
25	**Stainless Steel Receiving Counter:** Supply, installation, testing and commissioning of a **CSSD Receiving Counter** for receipt and inspection of contaminated reusable medical devices and surgical instruments, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The counter shall have minimum overall dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)** and shall be provided with a reinforced worktop, **100 mm high rear upstand**, full-width undershelf, lockable storage cabinet with hinged doors, and heavy-duty stainless steel tubular frame with adjustable stainless steel levelling feet. The worktop shall be capable of supporting a uniformly distributed load of **not less than 250 kg** without permanent deformation. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the CSSD decontamination area. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
26	**Stainless Steel Issue Counter:** Supply, installation, testing and commissioning of a **CSSD Issue Counter** for storage, verification and issue of sterile supplies, fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The counter shall have minimum overall dimensions of **1800 mm (L) × 750 mm (W) × 900 mm (H)** and shall be provided with a reinforced smooth worktop, **100 mm high rear upstand**, full-width undershelf, lockable storage cabinet with hinged doors, integrated document shelf, and heavy-duty stainless steel tubular frame with	1	Nos

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	adjustable stainless steel levelling feet. The worktop shall be capable of supporting a uniformly distributed load of **not less than 250 kg** without permanent deformation. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the sterile storage and issue area of the CSSD. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
27	**Pedal-Operated Stainless Steel Waste Bin:** Supply, installation, testing and commissioning of a **pedal-operated Stainless Steel Waste Bin** fabricated from **minimum 1.0 mm thick AISI 304 stainless steel** with seamless construction and satin finish. The waste bin shall have a **minimum capacity of 60 litres** and shall be provided with a foot-operated lid opening mechanism, self-closing lid, removable high-density polyethylene (HDPE) inner liner with handles, heavy-duty pedal assembly, non-slip rubber base, and corrosion-resistant fittings. The lid shall permit hands-free operation to minimise the risk of cross-contamination. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for CSSD use. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	6	Nos.
28	**Stainless Steel Storage Cupboard:** Supply, installation, testing and commissioning of a **free-standing Stainless Steel Storage Cupboard** fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The cupboard shall have minimum overall dimensions of **1200 mm (W) × 600 mm (D) × 1800 mm (H)** and shall be provided with **double lockable hinged doors**, **minimum four (4) adjustable stainless steel shelves**, each capable of supporting a uniformly distributed load of **not less than 100 kg**, heavy-duty stainless steel hinges, recessed handles, and a three-point locking arrangement. The cupboard shall be mounted on adjustable stainless steel levelling feet and shall be corrosion-resistant, non-porous, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for storage of sterile supplies and consumables in the CSSD. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
29	**Inspection Lamp with Magnifier:** Supply, installation, testing and commissioning of a **LED Inspection Lamp with Magnifier** for inspection and assembly of surgical instruments and sterile packs in the CSSD. The unit shall comprise a **minimum 5-dioptre optical-grade glass magnifying lens of 125 mm diameter**, high-intensity **shadow-free LED illumination** with adjustable brightness, colour temperature of **4000–6500 K**, and **minimum 1,500 lux** illumination at the working surface. The lamp shall be mounted on a **balanced articulated arm** with minimum **800 mm reach**, providing smooth multi-axis positioning and secure locking. The unit shall be suitable for table mounting, supplied with a heavy-duty mounting clamp, electronic driver, and **230 V, 50 Hz** power supply. The housing shall	2	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	be fabricated from corrosion-resistant material with a smooth, easy-to-clean finish suitable for hospital environments. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
30	**Stainless Steel Roll Holder with Cutting Knife:** Supply, installation, testing and commissioning of a **wall-mounted or table-mounted Stainless Steel Roll Holder with Integrated Cutting Knife** for dispensing and cutting medical-grade sterilization wraps, crepe paper and paper/plastic sterilization reels in the CSSD. The unit shall be fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. It shall accommodate rolls up to **600 mm width** and **300 mm diameter**, complete with stainless steel support shaft, low-friction bearings, adjustable roll guides, and a **full-width enclosed stainless steel serrated cutting blade** with safety guard to ensure clean, straight and safe cutting. The unit shall be provided with a heavy-duty mounting arrangement, corrosion-resistant fittings, and all accessories required for complete installation. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the CSSD packing area. Complete with installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	3	Nos.
31	**Gauze Cutting Machine:** Supply, installation, testing and commissioning of a **microprocessor-controlled Gauze Cutting Machine** for precision cutting of medical-grade gauze, cotton fabric and dressing materials in the CSSD. The machine shall be suitable for processing rolls up to **1200 mm width** and shall provide **adjustable cutting lengths from 100 mm to 3000 mm** with a cutting accuracy of **±2 mm**. The unit shall incorporate a **rotary or guillotine stainless steel cutting blade**, digital length setting, electronic length counter, programmable batch quantity, automatic feed and cut operation, emergency stop, overload protection, safety interlocks, and a **minimum 5-inch colour touch-screen HMI**. The machine shall be fabricated from **AISI 304 stainless steel** with corrosion-resistant components and enclosed moving parts for operator safety. It shall operate on **230 V ±10%, 50 Hz AC supply**, be suitable for continuous operation in a CSSD environment, and be resistant to hospital-grade disinfectants and cleaning chemicals. Complete with all accessories, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
32	**Documentation Labeler:** Supply, installation, testing and commissioning of a **thermal transfer Documentation Labeler** for printing sterilization process labels, traceability labels and identification labels for sterile packs and instrument sets in the CSSD. The unit shall provide a minimum print resolution of **300 dpi**, minimum print speed of **150 mm/sec**, and support printing of **text, barcodes (1D/2D), QR codes, Data Matrix**	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	codes, graphics, date/time, batch numbers, cycle numbers and user-defined information. The labeler shall support labels of **25 mm to 110 mm width** and shall be compatible with medical-grade sterilization labels suitable for steam, ETO and low-temperature sterilization processes. The unit shall be provided with **USB, Ethernet and serial communication interfaces** and shall integrate seamlessly with the CSSD Tracking & Barcoding System for automatic printing of sterilization records and traceability labels. It shall support automatic date/time synchronization, barcode verification, configurable print templates and user authentication. The labeler shall operate on **230 V ±10%, 50 Hz AC supply** and shall be suitable for continuous operation in a CSSD environment. The printer shall comply with **IEC 62368-1** and shall support barcode generation in accordance with **ISO/IEC 15417 (Code 128)**, **ISO/IEC 16022 (Data Matrix)** and **ISO/IEC 18004 (QR Code)**. Complete with all accessories, label design software with **perpetual licence**, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
33	**Office Table:** Supply, installation, testing and commissioning of an **office table** fabricated from **minimum 25 mm thick pre-laminated high-density engineered wood board** with **2 mm thick PVC edge banding** on all exposed edges, supported on a **powder-coated CRCA steel frame**. The table shall have minimum overall dimensions of **1500 mm (L) × 750 mm (W) × 750 mm (H)** and shall be provided with a lockable pedestal having **three drawers** (two utility drawers and one filing drawer), keyboard tray, CPU holder, cable management grommets, modesty panel, adjustable levelling feet and all necessary hardware. The work surface shall be scratch-resistant, moisture-resistant, stain-resistant and suitable for continuous office use in a healthcare environment. The table shall comply with **BIFMA X5.5** and **EN 527**. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
34	**Transport Trolley (Four Swivel Wheels):** Supply, installation, testing and commissioning of a **Stainless Steel Transport Trolley** for transportation of sterile supplies, instrument trays and CSSD materials, fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The trolley shall have minimum overall dimensions of **900 mm (L) × 600 mm (W) × 900 mm (H)** and shall be provided with **two stainless steel shelves** having raised edges of **minimum 25 mm height**, capable of supporting a uniformly distributed load of **not less than 150 kg**. The trolley shall be fitted with **four heavy-duty 125 mm diameter non-marking swivel castors**, all with precision bearings,	4	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	of which **two shall be provided with foot-operated brakes**. It shall be equipped with ergonomic push handles, protective corner bumpers, and a rigid reinforced frame suitable for continuous hospital use. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for CSSD operations. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
35	**Paper Dispensing Trolley:** Supply, installation, testing and commissioning of a **Stainless Steel Paper Dispensing Trolley** for storage and dispensing of medical-grade sterilization wraps, crepe paper and packaging materials in the CSSD. The trolley shall be fabricated from **minimum 1.2 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. It shall have minimum overall dimensions of **900 mm (L) × 600 mm (W) × 1200 mm (H)** and shall be provided with **minimum two roll dispensing shafts** suitable for rolls up to **600 mm width**, enclosed storage compartment with lockable doors for packing materials, integrated full-width enclosed stainless steel serrated cutting blade with safety guard, stainless steel push handle, and accessory tray for packing consumables. The trolley shall be mounted on **four heavy-duty 125 mm diameter non-marking swivel castors**, two with foot-operated brakes, and shall have a reinforced frame capable of supporting a uniformly distributed load of **not less than 150 kg**. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous operation in the CSSD packing area. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	1	Nos.
36	**Reverse Osmosis (RO) Water Treatment Plant:** Supply, installation, testing and commissioning of a **Reverse Osmosis (RO) Water Treatment Plant** comprising **two (2) independent 5000 LPH RO units configured as 1 Duty + 1 Standby (N+1 redundancy)**, complete with raw water feed system, multimedia filter, activated carbon filter, water softener, cartridge filtration, antiscalant dosing system, high-pressure stainless steel pumps with variable frequency drives, thin-film composite RO membranes, automatic membrane flushing, Clean-in-Place (CIP) system, UV disinfection unit, online conductivity meter, pH meter, flow meters, pressure gauges, automatic control valves, PLC-based control panel with **minimum 10-inch colour touch-screen HMI**, Ethernet connectivity, data logging, alarms, automatic duty/standby changeover, and Building Management System (BMS) integration. The system shall be provided with a **minimum 15,000-litre AISI 304 stainless steel treated water storage tank** complete with level sensors, overflow, vent filter, manhole, drain, sampling point, recirculation loop, and all interconnecting	1	Nos.

Central Sterile Supply Department (CSSD)			
S.No	**Particulars**	**Qty**	**Unit**
	pipework, valves and accessories. The complete installation shall include a weatherproof prefabricated equipment shed with insulated roofing, ventilation, illumination, drainage, cable management, and all civil, mechanical and electrical works required for a fully operational system. The RO plant shall consistently produce treated water conforming to the **water quality requirements of EN 285 and ISO 15883** for CSSD washer-disinfectors and steam sterilizers, with **RO permeate conductivity not exceeding 30 µS/cm at 25°C**. The system shall comply with **EN 285**, **ISO 15883**, **IEC 60204-1**, and applicable **BIS** requirements. Complete with testing, commissioning, IQ/OQ/PQ validation (where applicable), operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
37	**Incidental Items for Complete CSSD:** The Contractor shall supply, install, test and commission all accessories, fittings, fixtures, consumables for commissioning, supports, utility connections, software, licences, documentation, tools, and all incidental items necessary for complete, safe and fully operational functioning of the CSSD, whether specifically indicated in the BOQ or not. All such items shall be deemed included in the Contract, and no additional payment shall be admissible.		

Theatre Sterile Supply Unit (TSSU)			
S. No.	**Particulars**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Theatre Sterile Supply Unit (TSSU) complete with following		
1	**Table Top Steriliser (Benchtop Autoclave – 24 L): Supply, install, test, and commission a fully automatic Class B pre-vacuum benchtop steam steriliser of minimum 24-litre chamber capacity, suitable for sterilisation of wrapped, unwrapped, hollow,** and porous medical instruments. The unit shall have an **SS 316L chamber**, microprocessor/PLC-based automatic cycle control with digital touch-screen display, pre-vacuum and post-vacuum drying, electronic cycle recording (USB/Ethernet), and automatic Bowie-Dick, vacuum leak and Helix test programmes. The equipment shall comply with **EN 13060, ISO 17665-1, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**	1	Nos.
2	**Plasma (Hydrogen Peroxide) Sterilizer (Double Door – 120 L):** Supply, install, test and commission a **fully automatic pass-through**	1	Nos.

Theatre Sterile Supply Unit (TSSU)			
S. No.	**Particulars**	**Qty**	**Unit**
	double-door Hydrogen Peroxide Gas Plasma Sterilizer of **minimum 120-litre chamber capacity**, suitable for sterilization of heat- and moisture-sensitive medical devices. The unit shall have an **SS 316L chamber**, PLC/microprocessor-based automatic cycle control with touch-screen display, electronic cycle recording, USB/Ethernet connectivity, and validated sterilization cycles with integrated safety interlocks. The equipment shall comply with **ISO 14937, ISO 22441, IEC 61010**, applicable **BIS requirements**, be **CE certified under EU MDR 2017/745 by a Notified Body**, and the manufacturer shall possess a valid **ISO 13485-certified Quality Management System**, complete with IQ/OQ/PQ validation, testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.		
3	SS Working table - Minimum Size (LxWxH) : 1800x650x900 mm Stainless steel tables specially designed for inspection and sorting of goods in and for general purpose pre-storage. The work tables should have a rigid stainless-steel construction which is easy to clean and should not have sharp edges or corners.	1	Nos.
4	SS Storage Shelf 5 shelves - based on single free-standing shelf modules for storage of clean linen, instruments, and packing material or sterilized goods, including disposables & Minimum Size (LxWxH) :1500x450x1900 mm (For Dirty, Clean & Sterilization Zone)	1	Nos.
5	**Barcode/Documentation Workstation:** Supply, install, test and commission a **Barcode/Documentation Workstation** comprising a desktop computer with **Intel Core i7 or equivalent processor**, minimum **16 GB RAM**, **512 GB SSD**, **21-inch LED monitor**, handheld barcode scanner, thermal barcode label printer, keyboard and mouse. The workstation shall be fully integrated with the **CSSD Tracking & Barcoding Software** for real-time instrument identification, documentation and traceability, and shall support barcode printing, scanning, electronic record management and report generation. The workstation shall be supplied complete with all software licences, testing, commissioning, operator training and a **minimum 2-year comprehensive warranty**.	1	Nos

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of Laundry Equipment (electrical safety of all washing/drying/ironing machines to conform to IEC 60335-2-7 / IS 302-2-7, the India-adopted equivalent for commercial laundry appliances) complete with following		
1	**Washer Extractor – 25 kg:** Supply, installation, testing and commissioning of a **fully automatic, high-spin, soft-mounted Washer Extractor** of **minimum 25 kg dry linen capacity**, designed for continuous heavy-duty hospital laundry operation. The machine shall have an **AISI 304 stainless steel inner drum, outer drum and cabinet**, with programmable	2	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	microprocessor/PLC-based controls, **minimum 7-inch colour touch-screen HMI**, automatic chemical dosing interface, inverter-driven motor, automatic water level and temperature control, imbalance detection, door safety interlock, operating hour counter, fault diagnostics, and automatic cycle optimisation for water and energy efficiency. The washer shall be provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric immersion heating as the secondary/standby heat source**, with automatic heat source selection through the PLC control system without interruption of the washing cycle. The machine shall be mounted on a **soft-mount suspension system** eliminating the need for inertia foundations and shall achieve a **minimum extraction factor of 350 G** with variable-speed extraction, automatic balancing and low vibration. The unit shall be complete with stainless steel drain valve, detergent injection ports, hot/cold water inlet valves, steam control valve, condensate outlet, lint collection arrangement, Ethernet connectivity, and Building Management System (BMS) interface. The equipment shall comply with **IEC 60335-2-7**, **IS 302-2-7**, **IEC 60204-1**, applicable **BIS** requirements, and shall be manufactured under an **ISO 9001-certified Quality Management System**. Complete with all accessories, factory testing, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
2	**Drying Tumbler – 25 kg:** Supply, installation, testing and commissioning of a **fully automatic front-loading Drying Tumbler** of **minimum 25 kg dry linen capacity**, designed for continuous heavy-duty hospital laundry operation. The machine shall have an **AISI 304 stainless steel drum and cabinet**, programmable microprocessor/PLC control with **minimum 7-inch touch-screen HMI**, inverter-driven motor, automatic moisture sensing, temperature control, cool-down cycle, lint filtration system, door safety interlock, fault diagnostics, and operating hour counter. The dryer shall be provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric heating as the secondary/standby heat source**, with automatic heat source selection through the PLC control system. The unit shall include Ethernet/BMS interface and all accessories for complete installation. The equipment shall comply with **IEC 60335-2-11**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with	2	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
3	**Flatwork Ironer:** Supply, installation, testing and commissioning of a **fully automatic Flatwork Ironer** suitable for rapid drying and ironing of hospital flat linen including bed sheets, draw sheets, pillow covers, OT linen and table linen. The machine shall have a **minimum roller diameter of 800 mm and minimum working width of 3000 mm**, chrome-plated steel roller, **AISI 304 stainless steel feeding and delivery tables**, variable ironing speed, adjustable temperature control, automatic finger guard, emergency stop, anti-wrap protection, fault diagnostics, and programmable microprocessor/PLC control with digital display. The ironer shall be provided with a **dual heating arrangement comprising automatic steam heating as the primary heat source and electric heating as the secondary/standby heat source**, with automatic heat source selection through the control system. The unit shall be complete with linen feeding and delivery arrangements, inverter drive, operating hour counter, Ethernet/BMS interface, and all accessories required for complete installation. The equipment shall comply with **IEC 60335-2-44**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Each
4	**Rectangular Vacuum Ironing Table:** Supply, installation, testing and commissioning of a **rectangular vacuum ironing table** suitable for finishing hospital garments, uniforms, scrubs, gowns and small linen articles. The table shall have a **minimum ironing surface of 1500 mm × 800 mm**, perforated galvanized steel worktop with heat-resistant padding and cover, integrated vacuum suction system with **minimum 0.5 HP motor**, thermostatically controlled electric heated work surface, adjustable height, foot-operated vacuum control, garment support arm, steam iron connection, condensate collection arrangement, and programmable control with operating hour counter. The unit shall be complete with all accessories required for operation and shall comply with **IEC 60335-2-44**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	2	Each
5	**Flat Bed Press:** Supply, installation, testing and commissioning of a **fully automatic Flat Bed Press** suitable for finishing hospital linen, garments, scrubs, gowns and uniforms. The machine shall have a **minimum heated head size of 1500 mm × 750 mm**,	1	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	electrically heated pressing head with thermostatic temperature control, **pneumatically operated** pressing mechanism, moisture suction through the lower buck, automatic timed press release, pressure adjustment, safety two-hand operation, emergency stop, fault diagnostics, and programmable microprocessor control with digital display and operating hour counter. The unit shall be complete with all accessories, pneumatic connections and controls, and shall comply with **IEC 60335-2-44**, **IEC 60204-1**, applicable **BIS** requirements, be manufactured under an **ISO 9001-certified Quality Management System**, and be supplied complete with installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
6	**Spring Bottom Laundry Trolley (100 kg):** Supply, installation, testing and commissioning of a **spring-bottom laundry trolley** of **minimum 100 kg load capacity** for collection and transport of soiled or clean hospital linen. The trolley shall be fabricated from **AISI 304 stainless steel** with seamless welded construction and satin finish, and shall be provided with a **spring-loaded adjustable base** that automatically rises and lowers with the linen load to maintain an ergonomic loading height. The trolley shall have a heavy-duty tubular frame, removable washable laundry bag or perforated stainless steel basket (as applicable), protective corner buffers, push handle, and **four heavy-duty 125 mm non-marking swivel castors**, two with foot-operated brakes. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	8	Each
7	**Dry Linen Trolley (50 kg):** Supply, installation, testing and commissioning of a **Stainless Steel Dry Linen Trolley** of **minimum 50 kg load capacity** for transport and distribution of clean hospital linen. The trolley shall be fabricated from **AISI 304 stainless steel** with seamless welded construction and satin finish, and shall be provided with an enclosed or open-top stainless steel body with smooth internal surfaces, ergonomic push handle, protective corner buffers, and **four heavy-duty 125 mm diameter non-marking swivel castors**, two with foot-operated brakes. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	6	Each
8	**Dry Linen Trolley (50 kg) (dirty):** Supply, installation, testing and commissioning of a **Stainless Steel Dry Linen Trolley** of **minimum 50 kg load capacity** for transport and distribution of clean hospital linen. The trolley shall be	6	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	fabricated from **AISI 304 stainless steel** with seamless welded construction and satin finish, and shall be provided with an enclosed or open-top stainless steel body with smooth internal surfaces, ergonomic push handle, protective corner buffers, and **four heavy-duty 125 mm diameter non-marking swivel castors**, two with foot-operated brakes. The complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.		
9	**Storage Rack:** Supply, installation, testing and commissioning of a **free-standing Storage Rack** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The rack shall have minimum overall dimensions of **1500 mm (L) × 600 mm (D) × 1800 mm (H)** and shall be provided with **minimum five (5) adjustable stainless steel shelves**, each capable of supporting a uniformly distributed load of **not less than 150 kg**. The rack shall be supported on a heavy-duty tubular frame with cross bracing and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	10	Each
10	**Scrub Station with Two Sinks:** Supply, installation, testing and commissioning of a **Stainless Steel Scrub Station** fabricated from **minimum 1.5 mm thick AISI 304 stainless steel** with seamless welded construction and satin finish. The unit shall have minimum overall dimensions of **1600 mm (L) × 500 mm (W) × 900 mm (H)** and shall be provided with **two deep sinks** for separate washing and rinsing operations, **hot and cold water mixer taps** for each sink, a **central stainless steel scrubbing board**, **100 mm high rear splash back**, full-width undershelf, waste fittings, bottle trap, and adjustable stainless steel levelling feet. All exposed edges shall be rounded, and the complete assembly shall be corrosion-resistant, easy to clean, resistant to hospital-grade disinfectants and cleaning chemicals, and suitable for continuous hospital laundry operation. Complete with all accessories, installation, testing, commissioning, and a **minimum 2-year comprehensive on-site warranty**.	2	Each
11	**Air Compressor:** Supply, installation, testing and commissioning of a **fully automatic, oil-lubricated, two-stage reciprocating air compressor** with **minimum 5 HP motor**, **220-litre horizontal air receiver**, and maximum working pressure of **8 kg/cm² (8 bar)**, suitable for continuous operation with laundry finishing equipment. The compressor shall be complete with aftercooler, automatic pressure switch, safety relief valve, pressure gauge, air filter, moisture separator, drain valve, non-return valve, vibration isolators, and starter panel with motor protection. The unit shall deliver a **minimum free air delivery (FAD) of 500 LPM** at rated pressure	1	Each

Laundry			
S.No	**Particulars**	**Qty**	**Unit**
	and shall comply with **IS 5456**, **IS 2825**, **IEC 60204-1**, and applicable **BIS** requirements. Complete with all accessories, installation, testing, commissioning, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.		
12	**Electronic Platform Weighing Scale (100 kg):** Supply, installation, testing and commissioning of an **electronic platform weighing scale** with a **minimum capacity of 100 kg** and **accuracy of ±10 g**, suitable for weighing hospital linen. The scale shall have a **minimum platform size of 500 mm × 500 mm**, heavy-duty stainless steel weighing platform, digital LCD/LED display with backlight, zero, tare and hold functions, overload protection, rechargeable battery with AC mains operation, and adjustable levelling feet. The equipment shall comply with the **Legal Metrology Act, 2009**, **Legal Metrology (General) Rules, 2011**, and shall be **verified and stamped by the Legal Metrology Department**. Complete with all accessories, installation, testing, commissioning, calibration, operator training, O&M manuals, and a **minimum 2-year comprehensive on-site warranty**.	1	Each

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
1	**General Requirements:** Design, manufacture, supply, installation, testing and commissioning of a complete, fully integrated **Electronic Queue Management System (QMS)** for the hospital, including all hardware, software, networking, power supplies, licences, accessories and services necessary for reliable operation. The system shall provide centralized queue management, appointment integration, token generation, patient routing, counter management, real-time monitoring, audio-visual announcements, reporting, audit trails, role-based access control, cybersecurity, and integration with the Hospital Information System (HIS) through open APIs/HL7 FHIR, where applicable. The system shall be scalable, modular and capable of future expansion without replacement of the core infrastructure. **Standards & Validation:** All electronic equipment shall comply with **IEC 62368-1**. Industrial automation and cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. Patient and appointment data processing shall comply with the **Digital Personal Data Protection Act, 2023** and rules issued thereunder. Structured cabling shall comply with **ISO/IEC 11801**. Building services, electrical installations and ICT infrastructure shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. Accessibility of all patient-facing kiosks, displays and interfaces shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021 (CPWD/MoHUA)**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**, including wheelchair-accessible mounting heights, tactile and audible guidance, high-contrast displays and screen-reader compatibility.	1	Job
2	**Supply, installation, testing and commissioning of a Central Application Server Suite**, comprising Web Server, Application Server, Database Server, Appointment/Scheduling Server, API Gateway, SMS/Email Notification Server and all system software, operating system, middleware, virtualization software, licences, server hardware, storage, networking components and accessories required for complete operation. The solution may be deployed on **physical or virtualized enterprise-class infrastructure** and shall include **High Availability (HA)** architecture with redundant server configuration, automatic failover, database replication, load balancing, automated backup and disaster recovery. The server platform shall comprise **minimum two (2) enterprise rack-mounted servers (1 Duty + 1 Hot Standby/HA)**, each equipped with: • Minimum **2 × Intel Xeon Silver/Gold or AMD EPYC enterprise-class processors**, **minimum 16 physical cores per server** • **Minimum 128 GB ECC DDR4/DDR5 RAM**, expandable to **512 GB**	1	Set

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	• **Dual hot-pluggable power supplies** • **Hardware RAID controller** with cache protection • **Dual 10 Gigabit Ethernet ports** and **dual 1 Gigabit management ports** • Enterprise remote management interface (IPMI/iDRAC/iLO or equivalent) • Virtualization support • Redundant cooling fans • 19-inch rack mount configuration The storage subsystem shall comprise: • **Minimum 4 TB usable enterprise SSD storage** configured as **RAID-10** for operating system, database and applications. • **Minimum 8 TB enterprise Nearline SAS storage** configured as **RAID-6** for reports, logs, audit trails and backups. • Hot-swappable enterprise drives with online rebuild capability. • Storage shall be scalable to **minimum 20 TB** without replacement of the storage controller. The server suite shall support **minimum 100 concurrent operator sessions**, **10,000 patient transactions per day**, **100 configurable service counters**, **200 configurable service queues**, and **500,000 patient transaction records** without degradation of system performance. The software shall provide automatic token generation, appointment-based and walk-in queue management, priority queuing, multi-department routing, dynamic counter allocation, real-time dashboards, audit trails, role-based access control, multilingual user interface (minimum English and Odia), SMS/Email notifications, comprehensive reporting, remote diagnostics, health monitoring, automatic database backup and seamless integration with Hospital Information Systems (HIS), EMR and third-party applications through **RESTful APIs, HL7 v2.x and HL7 FHIR**. A dedicated **Online UPS** shall be provided with **minimum 30 minutes battery autonomy at 100% server load**, automatic shutdown/startup capability and SNMP-based monitoring. **Standards & Validation:** Server hardware shall comply with **IEC 62368-1**. Cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. Structured cabling shall comply with **ISO/IEC 11801**. Data processing shall comply with the **Digital Personal Data Protection Act, 2023**. Electrical equipment shall comply with **IEC 60204-1** and **IEC 61439-1/2**. Installation of ICT equipment shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. Complete		

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	with installation, testing, commissioning, migration, training, O&M manuals, as-built documentation and **minimum 2-year comprehensive warranty**.		
3	**Self-Service Token/Ticket Dispensing Kiosk:** Supply, installation, testing and commissioning of minimum 6 **Nos.** floor/wall-mounted self-service touchscreen kiosks with **minimum 21.5-inch Full HD (1920 × 1080) projected capacitive multi-touch display** (minimum 10-point touch), **minimum Intel Core i5 or equivalent industrial processor**, **minimum 8 GB RAM**, **minimum 256 GB SSD**, integrated **minimum 80 mm direct thermal ticket printer with auto-cutter** (minimum print speed 150 mm/s), **1D/2D barcode and QR code scanner**, speaker and microphone for voice guidance, multilingual user interface (minimum English and Odia), **Gigabit Ethernet (mandatory)** with **Wi-Fi (optional)**, USB interfaces, UPS-backed power supply, status indicators, and all accessories required for complete operation. The kiosk shall support walk-in registration, appointment check-in, token generation, department/service selection, queue information display, QR/barcode appointment retrieval, feedback collection, and seamless integration with the Hospital Information System (HIS) through open APIs/HL7 FHIR, where applicable. The enclosure shall be fabricated from **minimum 1.5 mm CRCA steel with powder-coated finish or minimum SS304 stainless steel**, tamper-resistant, corrosion-resistant and suitable for continuous public use in healthcare facilities. The kiosk shall be designed for **24 × 7 continuous operation**, with an operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. Enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**. Accessibility shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**, including wheelchair-accessible operating height, tactile and audible guidance, high-contrast display and screen-reader compatibility. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.. Complete with installation, testing, commissioning, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance**	Minumum 6	Nos.
4	**Supply, installation, testing and commissioning of 17 Nos. Counter Operator Workstations**, comprising an **industrial-grade**	17	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	operator terminal with **minimum 10.1-inch projected capacitive multi-touch display**, **minimum Full HD (1920 × 1200) resolution**, **minimum Intel Core i5 processor (12th Generation or higher) or equivalent x86-64 enterprise-class processor**, **minimum 8 GB DDR4 RAM**, **minimum 256 GB industrial-grade SSD**, integrated Gigabit Ethernet interface, USB ports, audio interface, status indicators, power supply, mounting accessories and all hardware, software and licences required for complete operation. The workstation shall support **role-based secure login**, token generation, token calling, recall, transfer, hold/resume, priority queue handling, queue reassignment, patient lookup, counter status management, multilingual operation (minimum English and Odia), real-time synchronization with the Central Application Server, visual and audible announcements, audit logging and integration with the Hospital Information System (HIS) through open APIs/HL7 FHIR where applicable. The operator terminal shall support **minimum 1 Gbps network interface**, automatic reconnection after network interruption, local buffering of transactions during temporary network failure with automatic synchronization on restoration, automatic software updates from the central server, remote diagnostics and centralized configuration management. The workstation shall be designed for **24 × 7 continuous operation**, with an operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, **minimum service life of 10 years**, and **minimum display brightness of 350 cd/m²**. The touchscreen shall support **minimum 10 simultaneous touch points**, have **minimum 7H surface hardness**, and be rated for **minimum 50 million touch operations**. Where Power over Ethernet (PoE) is adopted, the workstation shall support **IEEE 802.3af/at**. The workstation shall provide **minimum one Gigabit Ethernet port**, **minimum four USB ports**, HDMI or DisplayPort output, integrated speaker/buzzer for local annunciation, and **TPM 2.0** for hardware-based security. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. Network interfaces shall comply with **IEEE 802.3**, with **IEEE 802.3af/at** where PoE is used. Electromagnetic compatibility shall comply with the **IEC 61000** series. Installation of ICT equipment shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. Complete with installation, testing, commissioning, operator training, O&M manuals and a **minimum 2-year comprehensive warranty**.		
5	**Supply, installation, testing and commissioning of 17 Nos. Counter/Room Token Number Displays**, comprising **minimum**	17	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	21-inch LED/LCD display with **minimum Full HD (1920 × 1080) resolution**, **minimum brightness of 350 cd/m²**, **minimum contrast ratio of 1000:1**, **minimum viewing angle of 178°**, and capable of displaying the current token number, counter/room identification, service status, directional messages and configurable text/graphics. The display shall incorporate an **integrated audible chime** with adjustable volume on token change and shall communicate with the Central Application Server over **Gigabit Ethernet**, with **PoE (IEEE 802.3af/at)** where adopted. The display shall support automatic brightness adjustment, multilingual display (minimum English and Odia), automatic synchronization with the Queue Management System, remote configuration, firmware updates and automatic recovery following power restoration. The enclosure shall be fabricated from **minimum 1.2 mm CRCA steel with powder-coated finish or minimum SS304 stainless steel**, with **minimum 3 mm tempered anti-glare protective glass**, suitable for continuous operation in healthcare environments. The display shall be designed for **24 × 7 continuous operation**, with an operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, **minimum LED backlight life of 50,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. LED photobiological safety shall comply with **IEC 62471**. Enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**. Network interfaces shall comply with **IEEE 802.3**, with **IEEE 802.3af/at** where Power over Ethernet (PoE) is adopted. Display visibility and accessibility shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, testing, commissioning, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance**		
6	**Supply, installation, testing and commissioning of 10 Nos. Main Waiting Area/Lobby Displays**, comprising **minimum 55-inch commercial-grade LED/LCD display** with **minimum Ultra HD (3840 × 2160) resolution**, **minimum brightness of 500 cd/m²**, **minimum contrast ratio of 4000:1**, **minimum viewing angle of 178° (H/V)**, **minimum refresh rate of 60 Hz**, and designed for **24 × 7 continuous operation**. The display shall support simultaneous presentation of **multi-counter and multi-department queue status**, token numbers, counter information, real-time announcements, audio	10	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	notifications, hospital information, emergency messages, health education content, public notices and multimedia content through split-screen or multi-window display. The display shall be provided with an **integrated media player** having a **minimum Intel Core i5 processor (12th Generation or higher)**, **minimum 8 GB DDR4 RAM**, **minimum 256 GB SSD**, **Gigabit Ethernet interface**, HDMI input, USB ports, integrated speakers, centralized content management, remote monitoring, automatic synchronization with the Central Application Server Suite, automatic brightness control, remote firmware/software updates and automatic recovery following power restoration. The display enclosure shall be of **commercial-grade construction**, suitable for continuous operation in hospital environments, with **minimum 3 mm tempered anti-glare protective glass**, operating temperature of **5°C to 45°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 50,000 hours**, **minimum LED backlight life of 50,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**. LED photobiological safety shall comply with **IEC 62471**. Enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**, where installed in semi-exposed locations. Network interfaces shall comply with **IEEE 802.3**. Accessibility, viewing height and readability shall comply with the **Harmonised Guidelines and Standards for Universal Accessibility in India, 2021**, the **Ministry of Health & Family Welfare Guidelines for Accessibility of Healthcare Facilities and Services for Persons with Disabilities (2023)** and **IS 17802**. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, testing, commissioning, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance.**		
7	**Supply, installation, configuration, testing and commissioning of an enterprise Patient Notification Gateway**, integrated with the Central Application Server Suite, for automatic transmission of **SMS notifications** relating to appointment confirmation, token generation, estimated waiting time, queue status, token call alerts, appointment reminders, service completion and other configurable patient notifications. The system shall support **API-based integration** with TRAI-approved SMS service providers and, where required, GSM modem-based messaging. The gateway shall support **minimum 10 messages per second**, message scheduling, delivery status reporting, retry mechanism, message templates, multilingual messaging (minimum English and Odia), audit logs, configurable notification	1	Set

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	rules and integration with the Hospital Information System (HIS) through open APIs. The notification gateway shall support secure communication using **TLS 1.2 or higher**, role-based administration, message encryption in transit, centralized monitoring, automatic failover, queue management, reporting and archival of transaction logs for **minimum one year**. **Standards & Validation:** Electronic equipment shall comply with **IEC 62368-1**, where hardware is supplied. Cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. SMS services shall comply with the **Telecom Commercial Communications Customer Preference Regulations (TCCCPR), 2018**, issued by **TRAI**, as amended, including DLT registration requirements where applicable. Processing of patient information shall comply with the **Digital Personal Data Protection Act, 2023** and rules issued thereunder. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, configuration, testing, commissioning, integration with the Central Application Server Suite and Hospital Information System (HIS), operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, software updates and preventive maintenance.**		
8	**Supply, installation, testing and commissioning of enterprise-grade Layer-2/Layer-3 Managed PoE Network Switches**, dedicated to the Queue Management System (QMS) network, complete with all accessories, mounting hardware, power cords, software licences and configuration required for complete operation. The switches shall provide **10/100/1000Base-T PoE+ (IEEE 802.3at) access ports**, **10 Gigabit SFP+ uplink ports**, enterprise switching performance, Layer-3 static routing, VLANs, QoS, Link Aggregation (LACP), RSTP/MSTP, IGMP Snooping, DHCP Snooping, Access Control Lists (ACL), IEEE 802.1X authentication, SNMP v3, IPv4/IPv6 support and centralized management. The PoE power budget and switching capacity shall be adequate to support all connected QMS devices. The network shall be designed with **a minimum 20% spare active switch ports and 20% spare PoE power capacity** after connecting all QMS devices to accommodate future expansion without replacement of the switching infrastructure. The switches shall support dedicated VLAN segregation from the hospital ICT network, secure remote management, automatic configuration backup and firmware upgrade capability.	As per design	Nos.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	The equipment shall be designed for **24 × 7 continuous operation**, with an operating temperature of **0°C to 50°C**, relative humidity of **10–95% non-condensing**, **minimum MTBF of 200,000 hours**, and **minimum service life of 10 years**. **Standards & Validation:** Ethernet interfaces shall comply with **IEEE 802.3**. Power over Ethernet shall comply with **IEEE 802.3af/at**. Structured cabling shall comply with **ISO/IEC 11801**. Cybersecurity and network segmentation shall comply with **IEC 62443** or **ISO/IEC 27001**. Installation of ICT infrastructure shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, configuration, testing, commissioning, VLAN configuration, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware updates and preventive maintenance.**		
9	**Supply, installation, testing and commissioning of an Online Double-Conversion UPS** dedicated to the **Central Application Server Suite**, database server, storage system, core network switches and associated critical QMS infrastructure. The UPS shall be sized to support the **connected load with a minimum 25% spare capacity** for future expansion and shall provide **minimum 30 minutes battery autonomy at 100% connected load**. The UPS shall incorporate **DSP-controlled true online double-conversion technology**, **static and maintenance bypass**, automatic battery management, battery health monitoring, overload and short-circuit protection, surge protection, remote monitoring through SNMP, dry contacts and Modbus TCP/IP, and automatic shutdown/start-up of protected equipment. The battery system shall comprise **maintenance-free VRLA or Lithium-ion batteries**, complete with battery racks, interconnecting cables and protection devices, suitable for an ambient operating temperature of **40°C**. The UPS shall operate on **415/230 V AC, 50 Hz**, with an **input power factor ≥ 0.99**, **output power factor 1.0**, **minimum efficiency of 95% in online mode and 98% in ECO mode**, **total harmonic distortion (THDi) ≤ 3%**, and **output voltage regulation within ±1%**. The equipment shall be designed for **24 × 7 continuous operation**, with **minimum MTBF of 200,000 hours** and **minimum service life of 10 years**. **Standards & Validation:** UPS shall comply with **IEC 62040-1** (Safety), **IEC 62040-2** (EMC) and **IEC 62040-3** (Performance and Test Requirements). Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.** and the project electrical specifications.	1	Set

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	Complete with installation, testing, commissioning, battery bank, battery racks, monitoring software, integration with the Central Application Server Suite, operator training, O&M manuals, as-built documentation and a minimum 2-year comprehensive on-site warranty, including all parts, labour, firmware/software updates and preventive maintenance.		
10	**Supply, installation, configuration, testing and commissioning of enterprise-grade Queue Management System (QMS) Application Software**, including all software licences required for the Central Application Server Suite, database, web services, application services, operator workstations, self-service kiosks, counter displays, waiting area displays, notification gateway, reporting modules and all client devices forming part of the QMS. The software shall be supplied with **perpetual, transferable licences**, registered in the name of the **Employer**, with no recurring licence fees for the specified system capacity. The software shall support **minimum 100 operator users**, **100 service counters**, **200 configurable service queues**, **10,000 patient transactions per day**, **500,000 transaction records**, unlimited departments and services, multilingual operation (minimum English and Odia), role-based access control, configurable workflows, appointment scheduling, token generation, queue prioritization, real-time dashboards, analytics, audit trails, reporting, SMS/email notifications, remote diagnostics, automatic backup, disaster recovery, and seamless integration with the Hospital Information System (HIS), Electronic Medical Records (EMR) and other third-party systems through **RESTful APIs, HL7 v2.x and HL7 FHIR**, where applicable. The software architecture shall be modular and scalable to accommodate future expansion without replacement of the core application. The software shall support **automatic software updates**, centralized configuration management, encrypted communications using **TLS 1.2 or higher**, secure password policies, role-based authentication, audit logging, and database backup and restore functions. **Standards & Validation:** Cybersecurity shall comply with **IEC 62443** or **ISO/IEC 27001**. Software licences, source configuration data, databases and all application ownership rights for the licensed software shall be registered in the name of the **Employer**. Processing and storage of patient information shall comply with the **Digital Personal Data Protection Act, 2023** and rules issued thereunder. **Complete with installation, configuration, testing, commissioning, database configuration, software documentation, administrator and operator training, O&M manuals, licence certificates issued in the name of the Employer, and a minimum 2-year comprehensive software warranty and support, including**	1	Lot

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	software updates, security patches, bug fixes, technical support and preventive maintenance.		
11	**Supply, installation, testing and commissioning of complete Category 6A LSZH structured cabling infrastructure**, including **Category 6A U/FTP or F/UTP solid copper cables (23 AWG)**, patch panels, information outlets, face plates, keystone jacks, patch cords, connectors, cable management accessories, cable trays/conduits, identification labels, earthing, fire stopping at all wall/floor penetrations, testing and all accessories required for complete connectivity of all QMS kiosks, operator workstations, displays, servers, network switches and associated equipment. The structured cabling system shall support **10 Gigabit Ethernet (10GBASE-T)** with a **minimum operating bandwidth of 500 MHz**, and shall be designed with **minimum 20% spare data outlets and cable capacity** for future expansion. Horizontal cable length shall not exceed **90 m**, with the total channel length not exceeding **100 m**. All cables shall be **100% annealed bare copper conductors**, **23 AWG solid conductors**, **Low Smoke Zero Halogen (LSZH)** jacketed, **flame-retardant**, and suitable for continuous operation in healthcare facilities. Patch cords shall be **factory-terminated stranded copper Category 6A LSZH**, minimum **26 AWG**, with snagless boots. RJ-45 connectors and outlets shall be **Category 6A shielded**, supporting **10 Gbps transmission**, with **minimum 750 insertion cycles**. Patch panels shall be **19-inch rack-mountable**, modular type, with rear cable management and front port numbering. Cable management shall include horizontal and vertical cable organizers, bend-radius protection and strain-relief arrangements. All cables, outlets and patch panels shall be permanently labelled using machine-printed identification markers in accordance with the approved cable identification schedule. The completed installation shall be **100% tested and certified** using a **Level VI or higher field cable certifier**, including wire map, continuity, insertion loss, return loss, NEXT, PSNEXT, ACR-F, propagation delay, delay skew and shield continuity (where applicable). Test reports for every installed link shall be submitted before commissioning. **Standards & Validation:** Structured cabling shall comply with **ISO/IEC 11801 Class EA**, **ANSI/TIA-568.2-D**, and **IEC 14763-2**. LSZH cable characteristics shall comply with **IEC 60754-1**, **IEC 60754-2** and **IEC 61034-2**. Flammability shall comply with **IEC 60332-3**. Installation of ICT infrastructure shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.**. **Complete with installation, testing, certification, commissioning, cable identification schedules, as-built drawings, test reports,**	As per design	Mtr.

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	O&M manuals and a minimum 2-year comprehensive warranty, including all materials, workmanship and corrective maintenance.		
12	**Supply, installation, testing and commissioning of all installation accessories** required for the complete installation of the Queue Management System (QMS), including kiosk floor stands/plinths, wall-mounting brackets, display mounting frames, equipment supports, cable trays, raceways, conduits, trunking, cable management systems, junction boxes, anchor fasteners, fixing hardware, identification labels, earthing accessories, firestop materials, protective covers and all incidental materials necessary for a complete installation. All floor stands, brackets and support structures shall be fabricated from **minimum 2.0 mm CRCA steel with minimum 70-micron epoxy polyester powder coating** or **minimum SS304 stainless steel**, designed to safely support **at least four (4) times** the operating load of the mounted equipment without permanent deformation. All exposed fasteners shall be **stainless steel (minimum SS304)** or **zinc-coated high-tensile steel** suitable for indoor hospital environments. PVC conduits and trunking shall be **heavy-duty, self-extinguishing and FRLS/LSZH**, with a **minimum wall thickness of 2.0 mm**. Metallic cable trays and trunking shall be **minimum 1.6 mm thick pre-galvanized steel** with factory-finished corrosion protection. Cable management shall maintain the minimum bend radius recommended by the cable manufacturer and provide segregation between power and data circuits. All wall and floor penetrations shall be sealed using approved firestop systems maintaining the required fire-resistance rating of the penetrated assembly. **Standards & Validation:** Steel fabrication shall comply with **IS 2062 Grade E250** or equivalent. Fasteners shall comply with **ISO 898-1**. Cable trays shall comply with **IEC 61537**. PVC conduit and trunking shall comply with **IS 9537 (Parts 1–3)**. Firestop systems shall be tested in accordance with **ASTM E814 / UL 1479**. Installation shall comply with **NBCS 2026 (SP 7:2026), Part D – Building Services.** and **Part F – Fire and Life Safety**, including the relevant provisions for maintaining fire compartmentation at service penetrations. **Complete with installation, testing, commissioning, alignment, identification, cleaning, as-built documentation and a minimum 2-year comprehensive warranty, including all materials, workmanship and corrective maintenance.**	1	Job
13	**Testing, commissioning and Site Acceptance Testing (SAT)** of the complete Queue Management System, including all servers, kiosks, operator workstations, displays, notification gateway, network infrastructure, software, databases and third-party integrations. The scope shall include functional testing, performance testing, failover testing, network verification, user acceptance testing, system	1	Job

Queue management System (QMS) (all electronic display/kiosk/networking hardware to conform to IEC 62368-1, the current safety standard for audio/video, IT and communication equipment)			
S.no.	**Particulars**	**Qty**	**Unit**
	optimization, operator and administrator training, and supply of comprehensive O&M manuals, software licences, configuration records, backup and recovery procedures, test certificates and as-built drawings. **Standards & Validation:** Site Acceptance Testing shall be carried out in accordance with the approved Acceptance Test Procedure (ATP). The system shall demonstrate **100% functional compliance** with the Contract Specifications, successful integration with all interfaced systems, and **continuous fault-free operation for a minimum period of 72 hours** before final acceptance. **Complete with submission of SAT reports, training records, O&M manuals, as-built documentation and a minimum 2-year comprehensive warranty, including software support, updates, preventive maintenance and corrective maintenance.**		

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	Supply & installation Testing & Commissioning of Curtain Track & I.V. Hanger System		
1	**CURTAIN TRACK :**		
	Cubicle Curtain Track System: Supply, install, test and commission a **ceiling-mounted cubicle curtain track system** fabricated from **extruded aluminium alloy (minimum grade 6063-T5/T6 or equivalent)** with a minimum **25-micron polyester powder-coated finish**, complete with suspension hangers, wall brackets, concealed fixing accessories, bends, connectors, end caps, end stops and all hardware required for a complete installation. The track shall be fitted with **self-lubricating nylon rollers/runners** and **SS 304 hooks**, ensuring smooth, silent and snag-free movement. The curtain shall be manufactured from **healthcare-grade polyester fabric** having **antimicrobial, antifungal, water-repellent, and stain-resistant properties, suitable for repeated hospital laundering at a minimum of 70°C**. The fabric shall comply with **BS 5867 Part 2 Type C, NFPA 701, IS 15741, or equivalent internationally recognized flame-retardant standard**. An **open mesh panel of approximately 450 mm (18 inches)** at the top shall be provided **where required**. Curtain size shall be as indicated in the approved drawings, with adequate fullness (minimum 80%) to ensure complete patient privacy. The system shall incorporate **quick-release curtain removal** for easy laundering and replacement without dismantling the track and shall be suitable for continuous use in hospitals. The complete system shall comply with **NABH infection control guidelines**, applicable fire	224	Beds

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	safety requirements, and relevant **BIS/international standards**. It shall be supplied complete with all accessories, testing, commissioning and a **minimum 2-year warranty**.		
2	**IV Hanger System**		
	Ceiling-Mounted I.V. Hanger: Supply, install, test and commission a **ceiling-mounted movable I.V. hanger** compatible with the **dedicated I.V. carrier channel of the specified integrated cubicle curtain track system**. The unit shall comprise a **height-adjustable SS 304 stainless steel pole** with a mirror-polished finish, minimum 25 mm OD, fitted with a minimum of **five (5) stainless steel hooks** and having a **minimum safe working load of 15 kg**. The pole shall be suspended from a **low-friction nylon or sealed ball-bearing trolley** to ensure smooth, silent and independent movement along the track without interfering with curtain operation. All exposed components shall be corrosion-resistant and suitable for repeated hospital cleaning and disinfection. The complete assembly shall include all compatible trolley fittings, connectors and accessories required for installation and shall comply with applicable **BIS standards**, **NABH Infection Prevention and Control requirements**, and accepted hospital engineering practices, complete with testing, commissioning and a **minimum 2-year warranty**.	224	Beds
3	**Wall and Corner Guard System**		
	Corner Guard System: Supply, installation, testing and commissioning of a **heavy-duty healthcare Corner Guard System** comprising a **minimum 3.0 mm thick solid through-coloured high-impact engineered polymer cover** specifically manufactured for healthcare wall protection systems, mounted on a **continuous heavy-duty extruded aluminium retainer of minimum 2.0 mm thickness** with concealed mechanical fixings. The system shall incorporate **continuous energy-absorbing resilient cushions** between the impact cover and the aluminium retainer to absorb repeated impacts from hospital beds, stretchers, wheelchairs, trolleys and mobile medical equipment without permanent deformation, cracking or delamination. Corner guards shall have **equal wing dimensions of 75 mm × 75 mm** and a **minimum height of 1500 mm above finished floor level**, unless otherwise indicated in the approved drawings. The exposed surface shall be **smooth, non-porous, through-coloured, scratch-resistant, stain-resistant, UV-stable, graffiti-resistant, and resistant to repeated cleaning with hospital-grade disinfectants**, including sodium hypochlorite, hydrogen peroxide, quaternary ammonium compounds, alcohol-based disinfectants and phenolic cleaning agents, without deterioration of colour, finish or performance. The surface shall **not support microbial growth** and shall be free from sharp edges. The system shall be supplied complete with factory-manufactured end caps, transition pieces, internal and external corner accessories, joint covers and all accessories necessary for a continuous hygienic installation.	As per design	Mtr.

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	The aluminium retainer shall be corrosion-resistant and securely fixed using concealed mechanical fasteners suitable for the wall substrate. The impact cover shall be **snap-fit and individually replaceable** without removal of the aluminium retainer. The complete system shall be supplied in the manufacturer's standard colour as approved by the Engineer-in-Charge. The complete corner guard system shall comply with **EN 13501-1** with a minimum **Class B-s2,d0** reaction to fire. Complete with all accessories, cutting, jointing, fixing, testing, cleaning, manufacturer's installation instructions, and a **minimum 2-year comprehensive on-site warranty**.		
	Corner Guard System: Supply, installation, testing and commissioning of a **heavy-duty healthcare Corner Guard System** comprising a **minimum 3.0 mm thick solid through-coloured high-impact engineered polymer cover** specifically manufactured for healthcare wall protection systems, mounted on a **continuous heavy-duty extruded aluminium retainer of minimum 2.0 mm thickness** with concealed mechanical fixings. The system shall incorporate **continuous energy-absorbing resilient cushions** between the impact cover and the aluminium retainer to absorb repeated impacts from hospital beds, stretchers, wheelchairs, trolleys and mobile medical equipment without permanent deformation, cracking or delamination. Corner guards shall have **equal wing dimensions of 75 mm × 75 mm** and a **minimum height of 1500 mm above finished floor level**, unless otherwise indicated in the approved drawings. The exposed surface shall be **smooth, non-porous, through-coloured, scratch-resistant, stain-resistant, UV-stable, graffiti-resistant, and resistant to repeated cleaning with hospital-grade disinfectants**, including sodium hypochlorite, hydrogen peroxide, quaternary ammonium compounds, alcohol-based disinfectants and phenolic cleaning agents, without deterioration of colour, finish or performance. The surface shall **not support microbial growth** and shall be free from sharp edges. The system shall be supplied complete with factory-manufactured end caps, transition pieces, internal and external corner accessories, joint covers and all accessories necessary for a continuous hygienic installation. The aluminium retainer shall be corrosion-resistant and securely fixed using concealed mechanical fasteners suitable for the wall substrate. The impact cover shall be **snap-fit and individually replaceable** without removal of the aluminium retainer. The complete system shall be supplied in the manufacturer's standard colour as approved by the Engineer-in-Charge. The complete corner guard system shall comply with **EN 13501-1** with a minimum **Class B-s2,d0** reaction to fire. Complete with all	As per design	Mtr.

Curtain Track & I.V. Hanger System			
S.No	**Description**	**Qty**	**Unit**
	accessories, cutting, jointing, fixing, testing, cleaning, manufacturer's installation instructions, and a **minimum 2-year comprehensive on-site warranty**.		

Integrated Sterilizer with Shredder			
S.no.	**Particulars**	**Qty**	**Unit**
1	**Supply, installation, testing and commissioning of an Integrated Steam Sterilizer with Shredder Unit**, **minimum 150-litre usable chamber capacity**, suitable for on-site treatment of infectious bio-medical waste, complete with **integrated oil-free silent air compressor**, integrated electric steam generator, RO water treatment unit, automatic PLC-based control system, minimum **7-inch colour touch-screen HMI**, impact printer, stainless steel loading trolley, condensate collection system, automatic door locking arrangement, pressure and temperature sensors, biological and chemical indicator ports, integrated shredder, safety devices and all accessories required for complete operation. The sterilizer chamber shall be fabricated from **minimum SS316L**, with outer jacket and cladding in **minimum SS304**, insulated with **minimum 50 mm mineral wool**. The chamber shall be designed for **minimum 3 bar working pressure** and hydrostatically tested at **1.5 times the design pressure**, complete with safety relief valve, pressure gauge, temperature transmitter, automatic air removal, condensate drain and vacuum breaker. The sterilization process shall be fully automatic and programmable with **pre-vacuum, sterilization, holding, exhaust and drying cycles**, achieving **minimum sterilization conditions of 121°C, 15 psi and 30 minutes holding time**, or an equivalent validated cycle complying with the **Bio-Medical Waste Management Rules, 2016 (as amended)**. The sterilization cycle shall be validated using **Geobacillus stearothermophilus** biological indicators containing **minimum 1×10^6 spores**, with automatic electronic recording of cycle number, date, time, temperature, pressure, holding time, operator identification and alarm history. The integrated shredder shall operate **only after successful completion of the sterilization cycle**, be interlocked with the sterilizer control system, reduce treated waste to particles **not exceeding 50 mm**, and render the waste **unrecognisable and non-reusable**. The shredder shall be provided with a **minimum 5 kW IE3 motor**, hardened alloy-steel cutters, overload protection, reverse-jog facility, jam detection, emergency stop and automatic shutdown under abnormal operating conditions. The **integrated oil-free silent air compressor** shall be suitable for **continuous duty (Duty Type S1) in accordance with IEC 60034-1**,	1	Nos.

Integrated Sterilizer with Shredder			
S.no.	**Particulars**	**Qty**	**Unit**
	capable of delivering the air pressure and flow required for all pneumatic functions of the unit, with **minimum 8 bar working pressure**, **minimum 150 LPM Free Air Delivery (FAD)**, **minimum 50-litre air receiver**, integrated refrigerant air dryer, pre-filter, coalescing filter, automatic condensate drain, pressure regulator, safety relief valve and anti-vibration mounts. The compressed-air quality shall comply with **ISO 8573-1 Class 2:4:2 or better**, the motor shall conform to **IEC 60034-30-1 (minimum IE3 efficiency)**, and the compressor shall have a **maximum noise level of 65 dB(A) measured at 1 m** in accordance with **ISO 3744**. Where the air receiver falls within the statutory scope, it shall comply with the **Indian Boiler Regulations, 1950**, or **ASME BPVC Section VIII Division 1**, as applicable. The integrated steam generator shall be fully automatic with automatic water level control, low-water protection, pressure control, safety relief valve and blowdown arrangement, designed and certified in accordance with the **Indian Boiler Regulations, 1950**, wherever applicable. The integrated RO system shall have a **minimum permeate capacity of 250 LPH**, automatic flushing, conductivity monitoring and low-water protection, suitable for the steam generator demand. The control system shall comprise PLC-based automation with password-protected user access, cycle data storage for **minimum 10,000 cycles**, USB/Ethernet data export, remote diagnostics, alarm logging, trend recording and provision for integration with the Hospital Building Management System (BMS) through open communication protocols. Electrical equipment shall comply with **IEC 60204-1**, control panels with **IEC 61439-1/2**, enclosure protection shall be **minimum IP54** in accordance with **IEC 60529**, and motors shall comply with **IEC 60034-1** and **IEC 60034-30-1 (minimum IE3 efficiency)**. The installation shall comply with the requirements for utility rooms and mechanical services under **NBCS 2026, Part D (Building Services), Section D-5**, and the fire protection requirements for utility rooms under **NBCS 2026, Part F (Fire and Life Safety), Section F-4**. The scope shall include Factory Acceptance Test (FAT), Site Acceptance Test (SAT), biological validation, installation, testing, commissioning, calibration, operator training, O&M manuals, as-built documentation and a **minimum 2-year comprehensive warranty**, including all consumables required for routine operation and validation during the warranty period.		



DENTAL CHAIRS:

DENTAL CHAIRS – 190 NOS.		
Supply, installation, testing and commissioning of 190 dental chairs complete with dental treatment unit, clinical instruments, accessories, utilities/interfaces and clinical support equipment as specified. Each chair shall be supplied as a complete ready-to-use clinical treatment system, including the specified handpieces, scaler, curing light, syringes, suction accessories, controls and associated connections. Components shall be fully compatible and the supplier shall be responsible for complete system integration, testing and performance.		
S.No	**Descriptions**	**Specifications**
1	System Configuration	Integrated dental treatment unit comprising electrically operated patient chair, dentist delivery unit, assistant unit, cuspidor/cup-fill and bowl-rinse assembly, LED operating light, foot control and dentist stool. The system shall be supplied, installed, tested and commissioned as one complete functional package. The principal dental-equipment OEM shall assume single-point responsibility for system compatibility, integration, installation, commissioning, performance and warranty. The patient chair, dentist delivery unit, assistant unit, cuspidor assembly and foot control — the core engineered dental chair platform — shall be manufactured by the principal OEM as its own product; these shall not be sourced from a third party. The operating light, dentist stool, clinical instruments, imaging devices, displays and accessories may, at the OEM's option, be

DENTAL CHAIRS – 190 NOS.		
		manufactured by the principal OEM or by an OEM-authorised/integrated partner manufacturer, provided each such component is factory-approved or validated for use with the offered dental unit and is supplied, installed, tested and warranted as part of the complete package. Regardless of the source of any individual component, entire responsibility and liability for the complete dental chair system — including compatibility, integration, installation, commissioning, performance, safety, regulatory compliance and warranty — shall rest solely with the principal OEM, who shall be the purchaser's single point of contact and accountability in all respects.
2	Patient Chair	Electrically operated dental patient chair with upholstered seat/backrest, adjustable headrest and patient-support arrangement. Minimum safe working patient load: 150 kg. Upholstery and patient-contact surfaces shall withstand repeated clinical cleaning and disinfection.
3	Chair Design	Ergonomic slim-profile backrest providing unobstructed clinical access. Minimum 4 programmable treatment positions with auto-return/zero and/or last-position recall. Smooth and quiet movement, adjustable headrest, mechanical/electronic anti-crush protection and travel-limit protection. Minimum patient weight capacity: 150 kg.
4	Chair Motor	Motorised chair movement with independent or coordinated seat/base and backrest movement, smooth start/stop and obstruction protection. Minimum lifting capacity: 150 kg. Powered height adjustment shall provide a clinically usable range of not less than 350–750 mm, or the OEM's standard range where the minimum lower and upper clinical positions are demonstrated.
5	Operating Light	LED dental operating light conforming to ISO 9680:2026, or ISO 9680:2021 with the OEM's written declaration of transition to ISO 9680:2026, with central illuminance adjustable from approximately 8,000 lux up to not less than 30,000 lux at the specified operating distance, across minimum 3 intensity levels, CRI Ra ≥90, and colour temperature within 4,000–6,500 K, adjustable. The light shall provide a uniform, clinically suitable and shadow-controlled illumination field and comply with the applicable requirements of the edition of ISO 9680 conformed to above for light field, glare and shadow performance. A low-intensity/composite-safe mode suitable for light-cured restorative procedures shall be provided. Controls shall be readily accessible to the clinician and shall permit adjustment during treatment. The operating light may be manufactured by the principal OEM or by an OEM-authorised/integrated partner, provided it is factory-approved or validated for use with the offered dental unit and is supplied, installed, tested and warranted as part of the complete package; the principal OEM shall remain solely liable for its integration, performance and warranty.
6	Light Control	Integrated clinician-accessible light controls for illumination intensity and operating modes. Controls shall permit normal operation without interrupting treatment. Touch, touchless, foot-control or other OEM-integrated control shall be acceptable.
7	Cuspidor Box	Integrated dentist/assistant cuspidor support assembly with removable or cleanable bowl, disinfectant-resistant surfaces and cup-fill/bowl-rinse functions. All wetted components shall be suitable for dental-unit water quality and routine disinfection.
8	Spittoon	Spittoon/cuspidor bowl of durable, smooth, non-porous and disinfectant-

DENTAL CHAIRS – 190 NOS.		
		resistant construction. Minimum internal bowl capacity: 1.0 litre. Bowl shall be easily removable or cleanable and provided with controlled rinse/drain arrangement.
9	Dentist Delivery Unit	Dentist-side delivery unit with minimum 4 instrument positions, including provision for air/water syringe and at least 3 powered/air-driven dental instruments as applicable to the offered configuration. Handpiece activation and water/air controls shall be provided. Instrument flushing/purging shall be available in accordance with the OEM infection-control procedure. The delivery architecture may be continental, rear, side, cart or other OEM-standard configuration, provided the specified clinical functions and working access are achieved.
10	Assistant Unit	Assistant-side unit with minimum 3 instrument positions and dedicated access to high-volume evacuation and saliva-ejector suction. The arrangement shall permit unrestricted assistant access during treatment and shall include appropriate suction controls and holders.
11	Water System	OEM-integrated clean-water supply system suitable for the dental unit and compliant with ISO 7494-2:2022. The dental unit shall connect to the treated water point provided at each chair location, fed from the centralised dental water treatment plant under the Dental MGPS/utility package, complete with backflow protection conforming to EN 1717. The OEM shall state the required water quality, pressure and flow at the chair-side connection point. The offered architecture shall be OEM-validated for the complete treatment unit.
12	Disinfection System	OEM-integrated waterline infection-control system, factory-fitted as part of the offered dental unit, capable of automated and user-initiated flushing/purging of all water-bearing instrument lines and periodic/intensive disinfection of dental-unit waterlines. The system shall provide automated end-of-day and extended-shutdown waterline treatment. Only the OEM's own validated disinfectants/agents and procedures shall be used. The OEM shall provide IFU, concentrations/contact times, flushing sequences and maintenance requirements in accordance with ISO 17664-1. Continuous treatment, scheduled chemical treatment or an equivalent validated waterline infection-control technology may be used, provided dental unit output water quality does not exceed 500 CFU/mL of heterotrophic bacteria, consistent with CDC/EPA drinking-water standards, as verified by water-quality testing.
13	Instrument Tubing	Medical-grade flexible instrument tubing and handpiece hoses with secure connections, smooth internal surfaces and adequate flexibility/length for unrestricted clinical movement. Tubing shall withstand the OEM-specified pressure, water quality and cleaning/disinfection process. Minimum working pressure shall be not less than the dental unit's specified operating pressure.
14	Foot Control	Multifunctional wired or wireless foot control for applicable chair movement, handpiece activation and air/water functions. Minimum ingress protection: IPX1. Controls shall be suitable for cleaning/disinfection and normal clinical wet-area use.
15	Syringe	Minimum 2 three-way air/water syringes, one for dentist and one for assistant, with independently controlled air and water. Tips shall be autoclavable or disposable. Each syringe shall include the required OEM

DENTAL CHAIRS – 190 NOS.		
		connection and holder.
16	Handpiece Hose & Clinical Instruments Package	Minimum 3 powered instrument hose/connection positions shall be provided. The following clinical instruments shall be supplied as part of the complete package: (a) 1 high-speed air-turbine handpiece with compatible coupling; (b) 1 electric micromotor complete with compatible contra-angle/straight handpiece as applicable to the offered system; (c) 1 ultrasonic scaler handpiece with minimum required working tips; (d) 1 LED curing light complete with light guide; (e) 2 three-way air/water syringes, one for dentist and one for assistant; and (f) 1 HVE suction handpiece/cannula and 1 saliva-ejector/low-volume suction handpiece. Instruments may be manufactured by the principal OEM or an OEM-authorised/integrated partner and shall be factory-approved or validated for use with the offered dental unit. Each connection shall provide the required air, water, electrical/control and illumination services applicable to the connected instrument. All hoses, tubing, couplings and connections shall be supplied with the system and shall be compatible with the manufacturer's validated cleaning/disinfection procedures. The principal OEM shall guarantee complete compatibility and performance. The complete instrument package listed above shall be supplied, fitted (whether at factory or on site as part of installation) and functionally tested and verified at each individual chair as part of installation and commissioning, such that every dental chair is left fully assembled and ready for immediate clinical use upon handover, without requiring separate procurement, fitting or commissioning of any instrument by the purchaser.
16A	High-Speed Handpiece	High-speed air-turbine handpiece conforming to ISO 14457 (Dentistry — Handpieces and motors) where applicable, with minimum no-load rotational speed of 300,000 rpm, integrated water/air spray for bur cooling, and ball-bearing or equivalent OEM-validated bearing system. Compatible with standard friction-grip (FG) bur shanks conforming to ISO 1797. Head and body shall be autoclavable in accordance with the OEM's validated instructions.
16B	Electric Micromotor	Brushless electric micromotor conforming to ISO 14457 (Dentistry — Handpieces and motors) where applicable, with stepless/variable speed control across a range of not less than 1,000–40,000 rpm at the motor, minimum torque of 2.5 Ncm, and compatible with OEM-standard contra-angle/straight handpiece attachments, including speed-increasing or reduction ratios as offered. Integrated water spray for cooling. Motor and compatible attachments shall be autoclavable in accordance with the OEM's validated instructions.
17	Dental Scaler	Integrated ultrasonic dental scaler, preferably piezoelectric or magnetostrictive technology, with adjustable power/output. Minimum frequency: 25 kHz. Supplied tips and patient-contact components shall be autoclavable or otherwise processed strictly in accordance with the OEM's validated instructions.
18	LED Curing Light	LED dental curing light integrated with or supplied for the dental unit. Wavelength/output shall be suitable for commonly used light-cured restorative materials. Minimum curing intensity: 1,000 mW/cm², with visible output/intensity indication and curing timer. Light guide shall be autoclavable or disposable as applicable.

DENTAL CHAIRS – 190 NOS.		
19	Dentist Stool	Height-adjustable dentist stool with ergonomic seat and back support, stable five-point base/castors and disinfectant-resistant upholstery. Minimum height adjustment range: 450–650 mm, or sufficient range to suit the offered dental chair's clinical positions.
20	Clinical Application	Suitable for general dental examination, restorative, periodontal, endodontic and minor oral-surgical procedures within the manufacturer's intended use. Paediatric treatment shall be supported through supplied or specified OEM paediatric accessories.
20A	Intraoral Camera + Display System	For 20 chairs: provide a Full-HD intraoral/clinical camera with minimum 1920 × 1080 resolution, autofocus, live image/video capture and digital output, together with a minimum 21.5-inch Full-HD display mounted on an adjustable arm or OEM-approved location visible to operator, patient and students. The camera/display system may be manufactured by the principal dental-equipment OEM or by an OEM-authorised/integrated partner, but shall be supplied, installed, tested and warranted as part of the complete dental-chair package. Include all mounting, cables, interfaces and required software/drivers. For remaining 170 chairs: provide structural mounting, power, data/interface and concealed cabling provisions for future camera/display installation without modification of the chair or room infrastructure.
20B	OEM Qualification & Service	The principal offered dental treatment unit shall be from an established dental-equipment OEM with authorised service and support in India. The principal OEM shall assume single-point responsibility for the complete supplied package, including any OEM-authorised/integrated partner components. Genuine replacement parts, preventive maintenance, technical support and operator/service training shall be available in India. The bidder shall submit documentary evidence of authorised service support for the offered principal OEM and the proposed integrated components.
21	Standards & Regulatory Compliance	The dental chair/dental unit shall conform to ISO 7494-1:2018 and ISO 7494-2:2022, as applicable; the dental operating light shall conform to ISO 9680:2026, or ISO 9680:2021 with the OEM's written declaration of transition to ISO 9680:2026; and associated electrical equipment shall comply with applicable IEC 60601-1 and IEC 60601-1-2 requirements. The principal OEM shall maintain a current ISO 13485-certified quality management system. The offered dental chair/dental unit and integrated medical devices shall comply with all applicable provisions of the Medical Devices Rules, 2017 and other applicable Indian statutory requirements according to their classification and regulatory status. The bidder/OEM shall submit applicable CDSCO registration, licence, import authorisation or other regulatory evidence. CE marking or US FDA clearance may be submitted as additional evidence where available.
22	Warranty, CMC & Spares	Minimum 2-year comprehensive on-site warranty from the date of handover covering the complete supplied dental chair/dental unit package, including chair mechanisms and controls, delivery unit, operating light, supplied clinical instruments, camera/display equipment and supplied accessories, irrespective of whether individual components are manufactured by the principal OEM or its authorised/integrated partners. Warranty shall include labour, service-call charges, replacement of defective parts, preventive maintenance visits and technical support.

DENTAL CHAIRS – 190 NOS.		
		Genuine replacement parts and authorised service support shall be available in India throughout the warranty period. Warranty service response shall commence within 48 hours of notification of a failure.
23	Installation, Training & Commissioning	Complete installation, testing and commissioning at site, integration with room MEP and Dental MGPS/utility services, on-site training, O&M manuals, service documentation and warranty support. The principal OEM shall be responsible for integration and performance of all authorised/integrated partner components. Provide chair-side interfaces for central dental compressed air, dental vacuum/suction and treated water supply, with separate clearly identified connections, local isolation where required, flexible connection hoses and OEM-standard terminal/adaptors. The OEM shall state required air pressure, air flow, vacuum level, vacuum flow, water pressure, water flow, connection type and utility quality. Central compressed-air generation, dental-vacuum generation and water treatment plants, distribution piping, zone isolation and service terminal outlets shall be provided separately under the Dental MGPS/utility package unless specifically included elsewhere. Test all chair-side utility interfaces after connection to central services.
23A	Centralised Water Treatment Plant	The turnkey design-and-build contractor shall design, supply, install, test and commission a centralised dental water treatment plant, as part of the Dental MGPS/utility package, with total flow-rate and pressure capacity not less than the sum of the water flow rate and pressure declared by each offered dental chair OEM (per ISO 7494-2:2022, and as required to be stated under S.No 23) across all 190 chairs — i.e., the plant shall be capable of supplying all 190 chairs simultaneously at their full declared flow rate and pressure — plus a minimum 20% design margin. The turnkey contractor shall document this calculation using the actual OEM-declared per-chair figures, and the resulting plant capacity shall be verified by measurement during commissioning. The plant shall treat incoming water through multi-stage filtration and disinfection (e.g., UV, ozone or equivalent validated chemical dosing) to achieve output water quality not exceeding 500 CFU/mL of heterotrophic bacteria, consistent with CDC/EPA drinking-water standards, at every chair-side outlet. The plant shall include standby/redundant treatment capacity, sized to independently meet the full calculated demand, to maintain continuity of supply during maintenance or component failure. Distribution piping shall be Chlorinated Polyvinyl Chloride (CPVC) conforming to IS 15778, which is smooth-bore and non-corroding to minimise biofilm adhesion. No other piping material shall be used. Pressure-boosting arrangements and backflow protection conforming to EN 1717 shall be provided from the plant to each chair-side outlet. The turnkey contractor shall establish a defined water-quality testing and monitoring protocol, with periodic testing records maintained and made available for inspection.
23B	Drainage Provision	The turnkey design-and-build contractor shall provide a dedicated waste-water drainage connection at each of the 190 dental chair locations, connecting the cuspidor/bowl-rinse discharge and any incidental dental-unit water discharge to the facility's sanitary drainage system. Each drainage connection shall include a trap and shall be sized to handle the discharge rate of the connected dental unit without backflow, overflow or odour ingress. Drainage design and installation

DENTAL CHAIRS – 190 NOS.		
		shall comply with the applicable provisions of the National Building Code of India (Part 9 – Plumbing Services) or equivalent applicable local plumbing code. The turnkey contractor shall test each chair-side drainage connection for correct flow and absence of leaks prior to handover.

NOTE (General)

Items / specifications to be provided at any location even though left out in the above provisions but is required as per functional requirements and as per approved drawings shall be provided as per direction of Engineer-in-Charge and the rates for same shall be deemed to be inclusive in quoted rates of contractor. Nothing extra on this account shall be payable.

BED HEAD PANEL / MEDICAL SUPPLY UNIT AND PATIENT BED LIGHTING

1. Type-wise Minimum BHP / MSU Service Requirements

Bed type	O_2	Medical Air 4 bar	Vacuum	Normal 230 V sockets	UPS/Essential 230 V sockets	RJ45 data	Nurse call	Lighting / accessory interface	Minimum BHP/MSU configuration
Trauma / Resuscitation	2	1	2	4	6	3	Emergency/ code	Controls/provision for separate examination/observation light + rail + monitor provision	High-acuity BHP/MSU or pendant;
Casualty / Emergency	2	1	2	4	4	2	Call + emergency	Controls/provision for separate examination/observation light + rail	High-acuity emergency BHP/MSU.
Triage	1	1	1	2	2	1	Call + emergency	Controls/provision for separate examination/observation light	Rapid-assessment BHP/MSU;
Critical Care	2	1	2	4	6	3	Emergency/ code	Controls/provision for separate examination/observation light + rails + monitor	ICU-grade BHP/MSU or pendant
Burn Ward	1	1	1	2	2	2	Call + reset	Controls/provision for separate reading/examination light + rail	Cleanable sealed BHP; accessories compatible with burn care.
Burn ICU	2	1	2	4	6	3	Emergency/ code	Controls/provision for separate examination/observation light + rails + monitor	ICU-grade BHP/MSU or pendant.
ICU	2	1	2	4	6	3	Emergency/ code	Controls/provision for separate examination/observation light + rails + monitor	ICU-grade BHP/MSU or pendant.
Post-Op / Recovery	1	1	2	3	3	2	Call + emergency	Controls/provision for separate examination/observation light +	Post-operative recovery BHP/MSU.

Bed type	O_2	Medical Air 4 bar	Vacuum	Normal 230 V sockets	UPS/Essential 230 V sockets	RJ45 data	Nurse call	Lighting / accessory interface	Minimum BHP/MSU configuration
								monitor provision	
Pre-Op	1	1	1	2	2	1	Call + reset	Controls/provision for separate examination/observation light	Pre-operative holding-area BHP/MSU.
HDU	2	1	2	4	4	2	Call + emergency	Controls/provision for separate examination/observation light + rail	High-dependency BHP/MSU.
Dialysis	1	1	1	2	3	2	Call + reset	Controls/provision for separate examination/observation light; equipment rail	Coordinate additional electrical/data requirements with dialysis-machine OEM.
General Ward	1	1	1	2	1	1	Call + reset	Controls/provision for separate patient bed light + IV/accessory rail	Standard ward BHP/MSU.
Private Room	1	1	1	3	2	1	Call + reset	Controls/provision for separate reading/examination light; rail	Enhanced room BHP/MSU.
Dental Observation	1	–	1	2	2			Controls/provision for separate examination/observation light	Observation BHP/MSU.
Dental Pre-observation	1	–	1	2	2			Controls/provision for separate examination/observation light	Short-stay/pre-op BHP/MSU.
Dental Post-op / Recovery	2	1	2	3	3	2		Controls/provision for separate examination/observation light + monitor provision	Five medical-gas outlets per bed: 2 O_2 + 1 Air + 2 Vacuum, consistent with dental

Bed type	O_2	Medical Air 4 bar	Vacuum	Normal 230 V sockets	UPS/Essential 230 V sockets	RJ45 data	Nurse call	Lighting / accessory interface	Minimum BHP/MSU configuration
									MGPS matrix.
Dental Male Ward	1	1	1	2	1			Controls/provision for separate patient bed light + rail	Ward BHP/MSU.
Dental Female Ward	1	1	1	2	1			Controls/provision for separate patient bed light + rail	Ward BHP/MSU.
Dental Patient Cabin	1	1	1	3	2			Controls/provision for separate reading/examination light; rail	Cabin BHP/MSU.

Notes: (a) Figures are minimum service points per bed. (b) Higher requirements in the approved medical-equipment, MGPS, electrical, ICT or nurse-call schedules shall govern. (c) Trauma/critical-care locations may use a ceiling pendant/service bridge instead of a wall BHP/MSU where required by the approved clinical layout. (d) Patient-bed luminaires are separate items; the BHP/MSU shall provide only the scheduled control/interface provisions.

2. BHP / MSU Material and Construction Specification

Component	Minimum material/construction requirement	Codal / specification reference
BHP/MSU body	Factory-assembled extruded aluminium medical supply unit; minimum nominal extrusion wall thickness 1.5 mm, with local reinforcement where required for accessory rails/equipment loads. Smooth radiused profiles; no sharp exposed edges.	IS/ISO 11197:2019 (Medical supply units); CPWD MGPS specification for extruded-aluminium BHP construction.
Finish	Anodised aluminium or durable polyester/epoxy-polyester powder coating, minimum 60 µm dry film thickness where powder coated; smooth, non-porous, disinfectant-resistant and suitable for repeated hospital cleaning.	IS/ISO 11197:2019; approved hospital infection-control requirements.
Service segregation	Minimum three segregated service zones/channels for medical gases, LV power and ELV/data. Removable individual fascia/service covers; gas and electrical compartments shall not share an unsegregated void.	IS/ISO 11197:2019; CPWD MGPS BHP provisions.

Component	Minimum material/construction requirement	Codal / specification reference
Medical-gas terminal units	Gas-specific, non-interchangeable terminal units, mechanically secure and identified for each service. Terminal type shall be uniform across the project. Gas identification colour-coding for all medical-gas terminal units, pipework and outlet labelling shall conform to IS 18466 (Part 1):2024 / ISO 7396-1:2016 (Medical Gas Pipeline Systems — Part 1: Pipeline Systems for Compressed Medical Gases and Vacuum), applied uniformly across the Hospital Block and Dental Block: Oxygen — white; Nitrous Oxide — blue; Medical Air — black and white (quartered); Medical Vacuum — yellow; Carbon Dioxide — grey; and Oxygen/Nitrous Oxide mixtures — white and blue (quartered), with any additional gas or service identified and colour-coded per the same standard. The BHP/MSU contractor shall obtain the project MGPS design consultant's written confirmation of the exact colour convention before terminal-unit manufacture, and shall apply it without exception to every terminal unit, pipe marking and area valve service unit on the project, given the direct patient-safety consequence of an inconsistently or incorrectly identified gas outlet.	ISO 9170-1:2017 / applicable adopted IS/ISO 9170-1; IS 18466 (Part 1):2024 / ISO 7396-1:2016 for MGPS.
Internal medical-gas pipework	Seamless/deoxidised copper tube specifically suitable and cleaned for medical-gas service; joints by approved brazing procedure using oxygen-free nitrogen purge; pipe ends capped until installation.	IS 18466 (Part 1):2024 / ISO 7396-1:2016; CPWD MGPS specification; applicable medical-gas copper-tube standard.
Electrical sockets	Hospital-grade modular switched socket outlets, 230 V, 6/16 A or project-standard rating, shuttered and securely fixed. Permanently differentiate normal and UPS/essential sockets by colour and engraved/printed identification. Sockets and internal electrical	SP 30:2023 National Electrical Code; IS 732:2019; CPWD General Specifications for Electrical Works Part I (Internal), 2023.

Component	Minimum material/construction requirement	Codal / specification reference
	compartments in Dialysis, Burn Ward/Burn ICU and any BHP/MSU location identified as a wet or washdown-cleaned area by the approved room-finish schedule shall be rated minimum IP44, or higher where required by the electrical design for that room classification.	
Internal wiring	FRLS/FRLSH copper conductor wiring sized for connected load; separate circuits for normal and essential/UPS power; protective conductor bonded to common protective/equipotential earthing system.	SP 30:2023; IS 732:2019; IS 3043:2018; project medical-location electrical design.
Data outlets	Minimum Cat 6A RJ45 information outlets, factory-fitted/flush-mounted in ELV compartment, complete with faceplate, identification and structured-cabling termination.	ISO/IEC 11801 series and project ICT structured-cabling specification.
Nurse call	Call/reset/reassurance indication as applicable; emergency/code call at trauma/ICU/high-acuity beds. BHP shall provide factory-cut mounting/interface and wiring segregation for the selected nurse-call system.	Project Nurse Call System specification; IS/ISO 11197:2019 interface/medical supply unit requirements.
Accessory rail	Integrated or securely attached medical equipment rail, mechanically reinforced for IV pole, suction jar holder, monitor shelf/basket and approved accessories. Rail profile shall be compatible with commonly available hospital accessories and the offered accessory ecosystem; proprietary rail geometry shall not be mandated. The manufacturer shall declare and demonstrate the safe working load and fixing method.	IS/ISO 11197:2019; CPWD MGPS BHP specification.
Lighting	LED reading/examination lighting where scheduled; independently switched, low-glare, cleanable and serviceable without disturbing gas pipework.	IS/ISO 11197:2019; applicable electrical/lighting standards.
Earthing/equipotential bonding	Bond all exposed conductive parts and protective conductors to the	IS 3043:2018; SP 30:2023 / applicable medical-location

Component	Minimum material/construction requirement	Codal / specification reference
	medical-location equipotential earthing system; do not use isolated/dedicated earth electrodes for individual equipment unless specifically permitted by the approved electrical design.	provisions.

3. Patient Bed Light - Type-wise Requirements

Bed category	Minimum lighting functions	Controls	Minimum functional requirement
General Ward / Burn Ward / Dental Ward	Patient reading + night/orientation light	Reading/comfort light control from BHP or corded nurse-call handset; staff examination/observation control from BHP/local staff control where applicable	Reading light shall illuminate the patient's reading/task zone without disturbing adjacent beds. Night/orientation mode shall provide low-level guidance without glare.
Private / Cabin / Isolation	Indirect ambient + reading + night/orientation + examination/observation mode	Reading/comfort light control from BHP or corded nurse-call handset; staff examination/observation control from BHP/local staff control where applicable	Enhanced individual-bed lighting with independent scenes.
Trauma / Casualty / ICU / Burn ICU / HDU / Recovery	high-output examination/observation mode + night/orientation	comfort light control from BHP or corded nurse-call handset; staff examination/observation control from BHP/local staff control where applicable	Examination mode shall provide uniform high-quality light over the bed/patient working area with glare control. Ceiling/pendant examination lighting to supplement the BHP where required.
Dialysis	reading + examination/observation + night/orientation	Reading/comfort light control from BHP or corded nurse-call handset; staff examination/observation control from BHP/local staff control where applicable	Coordinate with dialysis chair/bed position and equipment layout.
Dental Observation / Pre-observation / Post-op	comfort + examination/observation + night/orientation	Reading/comfort light control from BHP or corded nurse-call handset; staff examination/observation control from BHP/local staff control where applicable	This is patient-bed lighting and is separate from the dental-chair operating light.

4. Separate Patient Bed Light - Minimum Technical Specification

Parameter	Minimum specification
Construction	Separate purpose-designed healthcare/patient-bed LED luminaire, wall-mounted above/adjacent to the BHP or otherwise positioned in accordance with the approved room layout. It shall be independently removable and replaceable without dismantling the BHP/MSU or disturbing medical-gas services. Housing shall be robust, smooth, easy to clean, resistant to routine hospital disinfectants and free from exposed sharp edges or dirt traps.
Lighting functions	The separate luminaire shall provide patient reading/comfort lighting and, where scheduled for the bed category, examination/observation lighting. system. General room/ambient lighting shall remain part of the room lighting package and shall not be included in the patient-bed luminaire unless specifically scheduled.
Optical performance	Direct light shall be low-glare and directed to the patient/task zone to minimise disturbance to adjacent beds. Indirect light shall provide soft ceiling/room illumination. Examination/observation light shall provide uniform illumination of the patient working area and good visual discrimination.
Colour quality	3000-4000 K for comfort/reading scenes. Minimum CRI Ra 90 for examination/observation mode and Ra 80 for ambient/reading modes; a common Ra 90 system is acceptable and preferred.
Dimming/control	Reading and ambient/examination functions shall be independently switchable; dimming shall be provided for patient comfort functions. Controls may be hard-wired, DALI or another open/standardised building-lighting interface. Proprietary controls shall not prevent local manual operation.
Patient controls	Patient reading/comfort light shall be switched and dimmed, either from a dedicated control on the BHP or from the corded nurse-call handset. Where handset control is used, the nurse-call system shall provide the required hard-wired/digital lighting interface and the complete function shall be demonstrated during commissioning.
Staff controls	Examination/observation mode, where required, shall be operated by a clearly identified staff control on the BHP or adjacent local control point and shall not depend solely on the patient handset.
Night/orientation mode	Low-level LED night/orientation lighting shall permit safe observation and movement without creating excessive glare to the patient or adjacent beds.
Electrical	The separate luminaire shall receive its power supply from the emergency lighting circuit as defined by the electrical design. The BHP shall provide only the

Parameter	Minimum specification
	coordinated control/interface point where specified. LED driver/control gear shall remain accessible for maintenance without disturbing medical-gas pipework.
Safety	Luminaire and control gear shall comply with applicable IS/IEC 60598 requirements; electrical installation shall comply with SP 30:2023, IS 732:2019 and project medical-location electrical requirements. BHP/MSU integration shall comply with IS/ISO 11197:2019. LED driver/control gear shall comply, as applicable, with CISPR 15 / IEC 55015 for emissions, IEC 61547 for lighting-equipment immunity and IEC 61000-3-2/-3-3 for harmonics/flicker, or adopted IS/IEC equivalents, so that switching noise does not interfere with adjacent patient-monitoring or nurse-call electronics.
Life and maintainability	The LED system shall have a declared rated life of a minimum of 50,000 hours at L80 or better, or the manufacturer's higher published rating. LED modules/drivers shall be replaceable without replacing the complete BHP/MSU.
Documentation	Contractor shall submit product datasheet, photometric data/IES or LDT file, declared lumen output, wattage, CCT, CRI, driver/control details, rated life, cleaning instructions, installation detail and applicable test/compliance certificates.

5. Warranty, CMC, Spares and Service

Requirement	Provision
Comprehensive warranty	BHP/MSU: minimum 2-year comprehensive warranty from handover covering the panel body, medical-gas terminal units and internal pipework, electrical sockets/internal wiring, data outlets, nurse-call interfaces, accessory rails and controls. Separate patient-bed luminaire: minimum 2-year comprehensive warranty covering luminaire body, LED modules, drivers, switching/dimming controls and interfaces.
Single-point responsibility	Each item shall have a clearly identified OEM/supplier warranty responsibility. The BHP/MSU contractor shall coordinate the lighting and nurse-call interfaces and shall be responsible for the BHP-side power/control provisions. The patient-bed lighting supplier shall be responsible for the complete separate luminaire and its operation through the specified interface.
Lighting OEM warranty	A 5-year luminaire/LED-driver warranty is mandatory.
Warranty coverage	All labour, travel, service-call charges, testing, dismantling/reinstallation and replacement of defective parts/components shall be included, excluding only consumables and damage demonstrably caused by misuse or external causes.

Requirement	Provision
Response time	Service complaint acknowledgement within 24 hours; on-site attendance within 48 hours for functional failures affecting medical gases, electrical supply, nurse call or critical patient lighting. Make critical safety defects safe immediately upon notification. , or an OEM-authorised Indian service partner. The OEM or an OEM-authorised Indian service partner may deliver service.
Preventive maintenance	Minimum two preventive-maintenance visits per year during warranty, including inspection of terminal units, socket integrity, earthing/bonding, rail fixings, luminaire/driver operation, controls, cleaning condition and labels.
Spares support	OEM shall ensure availability of functional spares, terminal-unit service kits, electrical accessories, LED modules/drivers, and control components for a minimum of 10 years from handover. Equivalent successor components may be offered where original parts are discontinued, provided fit, function, safety and regulatory compliance are maintained. The OEM or its authorised Indian service/channel partner may fulfil the undertaking.
Training & manuals	Provide operator/maintenance training, O&M manuals, as-built drawings, circuit diagrams, gas schematics, spare-parts list, cleaning/disinfection instructions and warranty certificates at handover.
Handover testing	Warranty shall commence only after successful installation and handover along with documented acceptance testing of medical-gas terminal function/leakage, electrical safety/earthing, socket operation, data certification, nurse-call interface and all lighting scenes/controls.

6. Applicable Codes and References

Reference	Application
IS/ISO 11197:2019	Medical supply units – principal product/construction standard for BHP/MSU.
IS 18466 (Part 1):2024 / ISO 7396-1:2016	Medical gas pipeline systems – compressed medical gases and vacuum; design, installation, testing, commissioning and documentation.
ISO 9170-1:2017 / applicable adopted IS/ISO edition	Terminal units for compressed medical gases and vacuum; gas specificity, non-interchangeability, flow/leakage/pressure-drop performance.
SP 30:2023	National Electrical Code of India – medical-location electrical design and safety basis.
IS 732:2019	Code of practice for electrical wiring installations.
IS 3043:2018	Code of practice for earthing and equipotential bonding.
CPWD General Specifications for Electrical Works	Internal wiring, copper conductors, socket outlets and

Reference	Application
Part I (Internal), 2023	electrical installation workmanship.
CPWD MGPS specification / Chapter 18 (current applicable issue)	Government-work benchmark for BHP construction, service segregation, gas outlets, sockets, RJ45, rails and MGPS workmanship.
ISO/IEC 11801 series	Structured cabling / RJ45 data infrastructure, read with project ICT specifications.
IS/IEC 60598 series	Luminaire safety and construction, as applicable to the offered patient-bed luminaire.
ISO 9170-1:2017 / applicable adopted IS/ISO	Medical-gas terminal units.
SP 30:2023; IS 732:2019; IS 3043:2018	Electrical installation, wiring, earthing and equipotential bonding.
Project electrical/lighting design	Final maintained illumination in patient rooms, emergency/critical-care areas and examination tasks shall be demonstrated by the lighting design and coordinated with ceiling/general lighting.

7. Tender Coordination and Acceptance

- BHP/MSU and patient-bed luminaires shall be separate items. BHP/MSU shall include the BHP-side power/control interface, conduit/cabling provision and control devices scheduled for the bed type.
- Patient reading/comfort light shall be controllable from a dedicated BHP control and/or the corded nurse-call handset where supported by the selected nurse-call system. Examination/observation mode, where required, shall have a clearly identified staff control.
- The BHP/MSU contractor shall submit coordinated shop drawings showing outlet sequence, segregation, mounting, gas pipework, electrical circuits, data, nurse-call and lighting interfaces before manufacture.
- All medical-gas terminal units, electrical circuits, earthing/bonding, data outlets, nurse-call interfaces and lighting controls shall be tested and documented before handover.
- Minimum 2-year comprehensive warranty shall apply to the respective BHP/MSU and patient-bed-light items; any longer standard OEM warranty shall be passed to the Employer.

P. List of Approved Makes

Comprehensive “List of Approved Make” is provided in the Contract. Makes specified in the ‘List of Approved Make’s is preferred; however, a higher or equivalent make could be utilized after obtaining prior approval of Engineer-In-Charge in writing. Approval of the alternate make is at the risk and time of the Contractor, and no extension of time shall be provided for the same.

Refer **Annexure- F** for List of Approved Makes.

Annexures

- **Annexure-A:** MOU for Design Consultant.
- **Annexure-B:** BIM Implementation Plan.
- **Annexure-C:** 3D Renderings/ Design Intent.
- **Annexure-D:** Geotechnical Investigation Report.
- **Annexure-E:** Statutory Approval List.
- **Annexure-F:** List of Approved Maked.

ANNEXURE –A

MEMORANDUM OF UNDERSTANDING

FOR THE PRE-TENDER TIE-UP WITH DESIGN CONSULTANT TO BE ENGAGED FOR THE **<INSERT PROJECT NAME>.**

(To be notarized on Stamp Paper with appropriate value)

This Pre-Tender Memorandum of Understanding is made at …….. on DD/MM/YYYY

BY AND BETWEEN

M/s……(Name of the agency), an existing company under the provisions of Companies Act 2013, having its registered office at ……. (hereinafter referred to as "First Party") which expression shall, unless repugnant to the context or meaning thereof, include its successors and permitted assigns) of the **FIRST PART**.

AND

(*Name of Design Consultant*), a Proprietorship Firm / Partnership Firm / Company having its office at _____a, Pin Code - _____, being represented by its Authorized Representative – **Mr.** , aged about _____years, Son of – _____, residing at _____, P.O. _____, P.S. _____, District – _____, Pin Code - _____, (Hereinafter referred to as the 'Design Consultant') which expression shall, unless repugnant to the context or meaning thereof, include its successors and permitted assigns of the **OTHER PART**.

The Expression 'First Party' and 'Design Consultant' shall, wherever the context admits, mean and include their successors-in-interest and assigns and shall collectively be referred to as "the Parties" and individually as "the Party".

PREAMBLE

1. **WHEREAS "Name of the First Party"** intends to participate by submitting the Turnkey tender to Odisha Bridge and Construction Corporation Limited (hereinafter called "Employer") for "<***Insert Name of Work***> in the State of Odisha on Turnkey mode, eTender No…….. (hereinafter referred to as the "said Project")

2. In the event **"Name of the First Party"** being the successful bidder in getting the contract for the said Project, **"Name of the First Party"** intends to engage a Design consultant for the said Project and they will be engaged from Concept to As-built stage for the said work.

3. As **"Name of the First Party"** will be the Bidder for the said Project of Odisha Bridge and Construction Corporation Limited. For the said purpose of submission of the Bid by **"Name of the First Party"**, the Design Consultant agrees to submit all the required Design, Drawing and Planning, other related documents, Methodology Statements, Construction Schedule, etc. for the said Project and subsequent clarifications, if any, to **"Name of the First Party"** within the specified time frame fixed by **"Name of the First Party"** .

4. And, whereas, the "First Party" agrees to engage reputed Design consultant to showcase the Design expertise in response to the terms and conditions of the RFP issued by Odisha Bridge and Construction corporation Limited (OB&CC), herein referred to as the "Employer" which states the following criteria for engagement with Design consultants:

*"**Design consultants must have experience as mentioned in Clause No. 4.4 (A) b of the RFP and subsequent corrigendum, failing which their bid is liable for rejection"***

The parties (First & Second) hereby confirm the following details which is subject to verification from the Employer, if found necessary

Sl. No	Name of the Project	Name of the Client	Stage (Ongoing/Completion)	Height	Value of Work undertaken (Project cost)	Capacity (beds)	Salient Features of Work done
1							
2							
3							
4							

5. **NOW THIS MEMORANDUM** witnesseth and it is hereby agreed by and between the parties hereto as follows:

A. The scope and responsibility and participation of the Design Consultant in this MOU shall generally be as follows:

i) The Design Consultant shall prepare and provide the required Design, Drawing and Planning, Survey, Engineering, etc, as applicable for the said work.

ii) The Design Consultant has agreed that the tendered BOQ Items and quantities are tentative and may change after detail investigation, design and final acceptance of the authority during execution of the said Project.

iii) The Design Consultant shall bear their own expenses to submit necessary documents for Expression of Interest and Bidding.

iv) For the execution of the scope of work, the Design Consultant shall make own arrangements to bring in the required finance, plant and equipment, materials, manpower and other resources as per the written direction given by the "First Party".

v) The Design Consultant shall co-operate with "**Name of the First Party**" throughout the entire period of this MOU on the basis of exclusivity and shall not make arrangement or enter into agreement either directly or indirectly with any other Party or Group of Parties on matters relating to the Project except with the prior written consent of "**Name of the First**

Party”.

vi) The Design Consultant shall not assign or transfer its interest specified in this MOU to any other party without the prior written consent of **Name of the First Party”** and the “**Employer**”

B. The scope and responsibility of both the parties in this MOU shall generally be as follows:

i) Details scope of work……...

6. Jurisdiction:

This MOU shall be governed by the laws of India and both the parties shall obtain all necessary approval from appropriate authorities etc. as and when required for smooth execution of projects. The Courts in Bhubaneswar will have exclusive jurisdiction in respect to any disputes arising out of this MOU or relation thereto.

7. Validity:

This MOU shall expire upon happening of the earliest occurrence of any of the following events:

a) “**Name of the first party**” does not become eligible to bid for the project or
b) Having become eligible to bid **Name of the first party** submits a tender which is unsuccessful or
c) Having been awarded the contract, on completion of the defect liability period of the contract or
d) On the signing of a detailed Agreement by the Parties, setting out therein detailed terms of the said agreement.

8. Confidentiality:

All information acquired/obtained from one party by the other shall be treated as confidential by the recipient and shall not be used other than for the purpose meant for without the consent in writing of the party providing the information.

9. Settlement of Disputes/ Arbitration:

In case a dispute or difference of any kind whatsoever, arises out of or relates to the present MOU or ancillary / incidental as to the terms and conditions of it or relates to any matter for execution and/or performance, it is a term of the agreement by and between the parties herein that before invoking arbitration, the aggrieved party shall first & foremost refer the matter to the Competent Authority of “**Name of the first party”** and the decision / recommendation / interpretation made by the said Competent Authority of “**Name of the first party”** shall be final & binding upon both the parties.

If a party is dissatisfied with the decisions / recommendations aforesaid, and notwithstanding anything else contained elsewhere, the aggrieved party may by a notice in writing to the Competent Authority of "**Name of the first party"** clearly evince the intention to refer the disputes and differences that have arisen between the parties to Arbitration by constitution of an Arbitral Tribunal. The Arbitral Tribunal shall consist of three Arbitrators, one each to be nominated by the respective parties and the third to be appointed by the nominated arbitrators.

Pending submission of and/or decision on a dispute or difference as aforesaid or until the Arbitral Award is published, the parties (if the Contract is not terminated / cancelled) shall continue to perform all of their obligations under this present MOU, without prejudice to a final adjustment in accordance with such award.

The decision of the Arbitral Tribunal arrived at after hearing the parties shall be final and binding upon the parties. The Arbitration Proceedings shall be conducted in accordance with the Arbitration and Conciliation Act, 1996 or any statutory modifications or re-enactments thereof.

It is also agreed by the parties that the Arbitration Proceedings shall be conducted in English language. The venue of Arbitration shall be Bhubaneswar only and any proceedings arising out of this Agreement / Contract shall be subject to the jurisdiction of Courts at Bhubaneswar.**"**

10. General:

    a. All notices which are required to be given hereunder shall be in writing and shall be sent to the address of Registered Office of the Company or to the addresses as set out in this MOU or such other address in India as the recipient may designate by notice given in accordance with the provisions of this clause. Any such notice may be delivered personally or by Speed Post or facsimile transmission and shall be deemed to have been served if by hand when delivered, if by Speed Post, after five working days from the date of posting and if by facsimile transmission when dispatched.

    b. 'Project Specific Agreement', prepared in line with the present MOU, shall be signed between the parties for construction of Projects over each land after reaching consensus of the parties herein.

    c. Neither party shall be entitled to have any claim for damages against the other party in respect of non-performance or delay in performance of this MOU caused by reason of any event beyond the reasonable control of other party, including but not limited to government action, war, hostilities act of the public enemy, civil commotion, any imminent threat of the proceeding, sabotage, fire, flood explosion, epidemics, acts of God, quarantine restrictions, strike or lockout, orders/directions of any statutory/judicial authority etc.

    d. Other matters not stipulated in this MOU shall be discussed and decided later between the Parties.

    e. This MOU is being executed in duplicate.

11. By signing this MOU, the Parties acknowledge that it correctly records the understanding

the parties have reached with regard to the mutual co-operation in their common interest.

THIS MOU IS MADE BETWEEN "Name of the first party" AND DESIGN CONSULTANT WITH THE APPROVAL OF THEIR RESPECTIVE BOARD OF DIRECTORS OF THE COMPANY AND IS SIGNED BY THE DULY AUTHORIZED REPRESENTATIVE OF BOTH THE PARTIES, IN PRESENCE OF THE FOLLOWING WITNESSES: -

……..	……...……
FOR AND ON BEHALF OF DESIGN CONSULTANT	FOR AND ON BEHALF OF DESIGN **Name of the Agency**
Witnesses	Witnesses
1.	1.
2.	2.

Annexure-B

OBCC BUILDING INFORMATION MODELLING (BIM) Protocol

Version.1.0



Appendix 3: BIM Execution Plan Template

V.1.0

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Revision	Date	Originator	Approver	Description of Updates
1.0	Apr. 2024	OBCC Senior BIM Manager	Principal Consultant	Version 1.0

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d from the party which commissioned it.

1.2 Scope

To effectively integrate BIM into the project delivery process, it is important for the team to develop a detailed execution plan for BIM implementation. A BIM Project Execution Plan (hereinafter referred to as the 'BIM Plan') outlines the overall vision along with implementation details for the team to follow throughout the project. The BIM Plan should be developed in the early stages of a project; *The full detailed Post-contract BIM Execution Plan should be submitted in 2 weeks-time from the date of signing the contract with the awarded contractor;* continually developed as additional participants are added to the project;and monitored, updated, and revised as needed throughout the implementation phase of the project. The plan should define the scope of BIM implementation on the project, identify the process flow for BIM tasks, define the information exchanges between parties, and describe the required project and company infrastructure needed to support the implementation. By developing a BIM Plan, the project and project team members can achieve the following value:

1. All parties will clearly understand and communicate the strategic goals for implementing BIM on the project.
2. Organizations will understand their roles and responsibilities in the implementation
3. The team will be able to design an execution process which is well suited for each team member's business practices and typical organizational workflows
4. The plan will outline additional resources, training, or other competencies necessary to successfully implement BIM for the intended uses.
5. The plan will provide a benchmark for describing the process to future participants who join the project.
6. The purchasing divisions will be able to define contract language to ensure that all project participants fulfil their obligations.
7. The baseline plan will provide a goal for measuring progress throughout the project.

1.3 Purpose of the document

The document is not considered as final and is expected to be updated as the project progresses. The contents of this document don't supersede or replace any liability for the delivery of the information on the project, as defined in separate appointments, contracts, and specifications.

2. General information.

This section defines basic project reference information.

2.1 Project general information.

S/N	Item	Description
1	Employer	
2	Project Title	
3	Project Code	
4	Architect	
5	Structure	
6	Civil Engineer	
7	MEP	
8	Landscape	
9	ID	
10	PMC	
11	Total Built up Area	
12	Planned start date	
13	Planned finish date	

2.2 Project location.

Project Address	
Project Coordinates	



2.3 Project brief

Insert project brief, type of the project and its purpose, some information about what the project in the future will be (project uses).

2.4 Proposed project team

S/N	Project Team Member	Count	Deployment	Exact period within the project
1	BIM Project Manager	TBA	Full/Part time - On/Off site	
2	BIM Coordinator	TBA	Full/Part time - On/Off site	
3	BIM Engineers	TBA	Full/Part time - On/Off site	
4	BIM Modelers	TBA	Full/Part time - On/Off site	

5	BIM Specialist	TBA	Full/Part time - On/Off site	

2.5 Project Schedule, Phasing & Milestones

Consultant/Contractor to insert main project milestones and phases here. Additionally, the BIM activities to be inserted in the project's baseline program and these activities should be aligned with the other related construction/ handover activities.

S/N	Project BIM Phase/Milestones	Planned Start Date	Planned Finished Date	Stakeholders Involvement
1	MS 1	TBA	TBA	Delivery, Development, Assets, Technical, Commercial
2	MS 2	TBA	TBA	Delivery, Development, Assets, Technical, Commercial

2.6 Key Project Contact

Consultant/Contractor to nominate their key projects contacts including their sub-contractors if any.

S/N	Roles	Company	Name	Phone#	Email
1	Client Rep	TBA	TBA	TBA	TBA
2	PMC	TBA	TBA	TBA	TBA
3	Project Director	TBA	TBA	TBA	TBA
4	Subcontractor 1	TBA	TBA	TBA	TBA
5	Subcontractor 2	TBA	TBA	TBA	TBA
6	Subcontractor 3	TBA	TBA	TBA	TBA
7	BIM Manager	TBA	TBA	TBA	TBA

3.1 BIM uses

Selected BIM uses in project xxx should be highlighted here according to EIR BIM uses.

Initiation	DESIGN	CONSTRUCT	OPERATE
PROGRAMMING	MODEL AUTHORING	SITE UTILIZATION PLANNING	BUILDING MAINTENANCE SCHEDULING
SITE ANALYSIS	MODEL REVIEWS	CONSTRUCTION SYSTEM DESIGN	BUILDING SYSTEM ANALYSIS
	3D COORDINATION	3D COORDINATION	ASSET MANAGEMENT
	STRUCTURAL ANALYSIS	DIGITAL FABRICATION	SPACE MANAGEMENT / TRACKING
	LIGHTING ANALYSIS	3D CONTROL AND PLANNING	DISASTER PLANNING
	ENERGY ANALYSIS	AS BUILT MODELING	RECORD MODELING
	MECHANICAL ANALYSIS		
	OTHER ENG. ANALYSIS		
	SUSTAINABLITY (LEED) EVALUATION		
	CODE VALIDATION		
COST ESTIMATION	COST ESTIMATION	BOQ EXTRACTION	COST ESTIMATION
EXISTING CONDITIONS MODELING	EXISTING CONDITIONS MODELING	EXISTING CONDITIONS MODELING	EXISTING CONDITIONS MODELING

3.2 Main objectives

Contractor/Consultant will add main objectives for BIM uses in Project xxx.

S/N	Objective	Description	BIM Process/use mapped
1	Ob 1	TBA	TBA
2	Ob 2	TBA	TBA
3	Ob 3	TBA	TBA
4	Ob 4	TBA	TBA
5	Ob 5	TBA	TBA

4.1 BIM roles and responsibilities.

4.1.1 BIM Project Manager:

- Prepare the BXP
- Pre-model Setup
- Establish standards and methodology
- Develop server requirements and resolve conflicts to ensure successful integration for all BIM Model contributors
- Verify BIM capabilities of the Contractor's team
- Develop processes for transferring and accessing Model files
- Establish access rights
- Negotiating, developing and enforcing the Project Protocol
- Prepare BIM protocols, establish Standards and BIM procedures for Contractor, Employer, Employers Representative and Assistant contribution and access to models, their security & stability and getting revisions incorporated
- Create BIM file set-up and management
- Provide template Files
- Clearly define a protocol for file transfer and handling
- Establish and maintain a process for change documentation and communicating the change
- Provide a method and format for identifying clashes, documenting, resolving and revisions to the BIM model
- Establish standards for, coordinate and ensure the quality of contributions to the BIM models by other parties, including by the Employers Representative and the Contractor

4.1.2 BIM Coordinator:

- Enforce the BXP
- Create, maintain and manage a single point central database that hosts all models and their content in direct control of the BIM Management
- Receive and manage the construction phase information provided by the contractor's BIM models
- Enforce reliability of the BIM Model's information so that it is an accurate representation of as built construction
- Regularly audit, integration and validate information to ensure BIM model is robust
- Manage quality and quantity model information
- Manage model updates
- Provide clash detection
- Ensure the Contractor delivered models have standardized properties.
- Manage the health of the files and provide periodic file stability and integrity checks
- Maintain a data base of all BIM elements, standards, families and 2D / 3D content
- Coordinate submission and exchange of Models
- Manage access rights
- Facilitate extracts & exports

- Create components not provided by others
- Provide content, families & annotations as required for each Level of Development
- Provide 2D drafting details
- Establish, create and maintain drawing sheets & visibility settings
- After review and approval incorporate all updates, change, revisions, clash detections and BIM requests for information into the models.
- Integrate Contractor models into the BIM model
- Maintain model storage and security
- Regularly back up Model and maintain back up in a secure and independent location from the model storage
- Collect incoming Models
- Log incoming Models
- Validate that files are complete and usable and in compliance with applicable protocols
- Maintain record copy of each file received
- Collect Model files and make available for viewing
- Perform clash detection in accordance with established protocols and issue periodic clash detection reports
- Maintain Model archives and backups

4.1.4 BIM Production Team (Sr./BIM Engineer) Role:

- Suggest and Nominate Coding, Naming, Numbering for BIM Platforms and Work sets
- Develop shared data and relationships between models e.g. grids, floor levels, shared project coordinates
- Ensure that all the procedures for Information Exchange are defined and implemented
- Confirm that all the project team members are following BIM Execution Plan
- Arranging QC/QA meetings and agendas
- Pre-Planning each BIM creation considering model content, level of details, format and party responsible for updates plus the distribution of the model and data to various parties
- Participating in all major BIM activities as required by the team
- Certify that the project is based on a company Protocols & Standards

4.2 Organization chart

Consultant/Contractor organizational chart to be inserted here.

4.3 Organizational Roles & Staffing

S/N	DESIGN PHASE MODEL USE	ORGANIZATION	LOCATION(S)	LEAD CONTACT
1	DESIGN AUTHORING	TBA	TBA	TBA
2	PROGRESS REVIEWS	TBA	TBA	TBA
3	DESIGN 3D COORDINATION	TBA	TBA	TBA
4	[CONTRACTOR ELECTIVE]	TBA	TBA	TBA

5.1 Analysis & Control tools

All agreed analysis & quality control tools and software's to be mentioned in this section.

5.2 3D coordination & collaboration

Describe how the project team will collaborate in development and execution of modeling for the project. Include items such as electronic communication requirements and procedures, digital mock-up delivery, document management, transfer, and updating, and record storage, etc.

5.3 Workflows & procedures

Any important or applicable workflows/procedures should be mentioned in this section.

5.4 Interoperability

Any chances for interoperability tools, software, ideas, or integrations should be mentioned in this section, the integration process with other platforms, information exchange procedures, workflow, & procedure with the software's/ tools of next OPEX phase "asset management, spatial, …etc." to be added here

5.5 Training requirements

Training and awareness sessions strategy should be mentioned in this section.

5.6 Research & development

Lessons learned gathering and any ideas that can benefit the BIM Project aspects and escalate the work should be mentioned in this section.

MIRAL BIM Processes should be agreed by Consultant/Contractor, Enhanced or same BIM processes mapped from EIR should be presented in this section.

6.1.1 Overview process map
6.1.2 Model authoring
6.1.3 Design review
6.1.4 Coordination - 3D
6.1.5 Quantity extraction - BoQ
6.1.6 Field management - RFIs & Issues
6.1.7 Field changes capturing - As-Built

6.2 Common Data Environment – CDE

Mailing lists, naming conventions, folders structures, gates approval personnel, specifications, etc., should be mentioned by Consultant/Contractor in this section.

6.3 Communication flow

Communication correspondences should be stated here by Consultant/Contractor.

6.4 Client e-viewing/e-reviewing

Consultant/Contractor shall provide a platform that enables viewing/reviewing models and BIM uses.

6.5 Meetings & workshops

BIM initiation Meetings: Meeting to establish the principles of BIM adoption, scope and ambition on the proposed project and to setup the post contract-award BXP. Establish when and where future meetings will be held. The purpose of the meeting is to:

- Determine the BIM goals and aspiration of the project
- Define the project-wide BIM Execution Plan

Agenda: The agenda for the BIM kick-off meeting can be based on the headings covered in the Project BIM Execution Plan as a basic measure.

- Purpose of meeting
- Introductions
- Project Information
- Project team
- Project goals / BIM objectives
- Model standards
- Software & Compatibility
- Meetings
- Model organization
- Spatial coordination
- Project KPI
- Supporting documentation
- Any other business
- Next Meeting schedule

BIM Execution Plan Demonstration: After the initial kick-off meeting, the organizations should clearly understand who will be responsible for the defined tasks, and in what sequences the BIM Uses will be executed. The responsible party for the Level One map should clearly document and distribute it to the project team for

prior to the following meeting. Each responsible party for the specified BIM Uses should also draft their workflow prior to the Design BIM Project Execution Process meeting.

BIM Workgroup Meeting: Meeting to track the progress of BIM implementation on the project in the context of the BXP. This meeting should be used as a mechanism to identify forthcoming challenges and agree a proactive solution. Agenda:

- BIM process
- Data requirements within the project model requirements within the project CDE requirements
- Models
- Common Data Environment
- Next Meeting

BIM Coordination Meeting: After the Design BIM Project Execution Process meeting, the team must focus on developing the information exchanges. Each responsible party for an exchange should take the lead in developing the information exchanges. The authors of the information exchange will need to coordinate with the information receivers to ensure that they have developed consistent information exchanges with minimal inconsistencies to discuss. The team members should also prepare for the discussions regarding infrastructure requirements which will occur in Meeting Three. Team members should compile examples of typical methods that they have used or wish to use on the project to share with the team. Once the meetings are complete, the BIM Project Execution Plan should be distributed to all parties and approved as appropriate for the project and contracting structure. Team members should ensure that the plan monitoring and updating procedure is implemented into the project controls system.

BIM Coordination Meeting: Meeting to review and allocate responsibility to clashes found during clash detection process undertaken by the BIM Validator. Agenda:

- BIM process so far…
- Clash investigation
- Next meeting

BIM Validation Meeting: Meeting to review and discuss deficiencies in model geometry and data identified during the model validation checks undertaken by the BIM Validator.
Agenda:

- Modelling progress, where everyone is and what they have been doing in terms of modelling
- Go through outstanding actions from previous minutes
- Collaboration, things we are working on together as a team
- Technical, dealing with any technical issues the team are experiencing
- Scopes and contracts, finalizing and reviewing progress against the BXP
- Validation, go through checks and assign responsibility and timescales to resolve issues
- Ascertaining whether the design teams needs any additional support going forward to help them compete required tasks
- Next Meeting

chain capabilities and experience.

7.2 Responsibility matrix.

Project responsibility matrix should be attached to this section highlighting roles for each company/ organization in each project phase with respect to BIM uses mapped from EIR.

7.3 MIDP

Master Information Delivery Plan to be attached with this section, template to be provided along with OBCC Welcome Pack.

7.4 TIDP

Task Information Delivery Plan example to be attached in this section and to be implemented in BIM models, a sample of TIDP segregation to be provided with OBCC Welcome Pack.

7.5 Level of development

LOD matrix for all modeled elements should be mentioned in this section with highlighting Level of Details/Information for each element.

Sr. no	Submittal title	Stage	Formats	Remarks
1	List of all submitted files (Excel spreadsheet preferred)	TBA	TBA	TBA
2	Advanced Modeling Submittal Review Checklist (CHX)	TBA	TBA	TBA
3	BIM Files	TBA	TBA	TBA
4	CAD Files	TBA	TBA	TBA
5	PDF Files	TBA	TBA	TBA

8.2 Project Information Model PIM delivery strategy

Delivery strategy and model handling in construction phase should be stated in this section.

8.3 Assets Information Model AIM delivery strategy

Delivery strategy and model handling in handing-over phase should be stated in this section, assets information tagging and integration with model should be highlighted in this section with strategy and workflows.

9 Standard Methods & Procedures SMP

9.1 Volume strategy

9.2 PIM origin & orientation

Describe the measurement system (Imperial or Metric) and coordinate system (geo-referenced) used

Project Coordinate System:

a. Coordinate System: [State Plane] [UTM]
b. Zone: [_____]
c. Horizontal Units of Measure: [Meters] [US Survey Feet] [International Feet]
d. Vertical Units of Measure: [Meters] [Feet]
e. Horizontal Datum: [NAD 83/2011] [_____]
f. Vertical Datum: [NAVD 88] [_____]

9.3 Naming conventions

As applicable in each category below, list examples of proposed file names by discipline, e.g. Civil, Structural, Architectural, etc.

a. BIM FILE NAMING CONVENTION:

[Provide File naming convention and samples here]

b. CAD FILE NAMING CONVENTION:

[Must comply with A/E/C CAD Standard file naming convention. Insert samples here]

Construction tolerances which will be highlighted within BIM models should be mentioned here.

9.5 Drawing sheet template

Drawing sheet template to be provided to Consultant/Contractor.

9.6 Data attributes & parameters

Any shared parameters or attributes are to be uses in the project should be mentioned here with their category and use.

10 IT Solutions

10.1 Hardware

10.2 Software versions

10.3 Exchange format

10.4 Process and data management system.

11 Quality Control

11.1 Overall strategy for Quality Control

Describe the strategy to control the quality of the model and clarify how the manual & the automated quality control procedures will be performed.

11.2 Quality Control checks

The following checks is the minimum that should be performed to assure quality.

CHECKS	DEFINITION	RESPONSIBLE PARTY	SOFTWARE PROGRAM(S)	FREQUENCY
ADVANCED MODELING SUBMITTAL CHECKLIST	Refer to Contract requirements, Paragraph titled *Advanced Modeling Submittal Checklist.*			AT EVERY SUBMITTAL
MODEL Visual Check	Ensure there is no unintended model components, and the design intent has been followed			AT EVERY SUBMITTAL
Model - Integrity check	Provide evidence for the manual “checklist” & automated “software” QAQC validation to confirm the model quality, such as: The Asset Data set is well-defined, the elements are correctly defined with no duplication & with correct tags/ codes. Certify geometry suitability spatial compatibility between all disciplines & operational impacts. Check the status of all BIM deliverables. Monitor, response, & update all the BIM Issues raised by the employer and the supply chain. Check the naming Convention of all BIM files, objects...etc."			AT EVERY SUBMITTAL
MODEL STANDARDS	Refer to Contract requirements, Paragraph titled *Model Standards Checks and Reports.*			AT EVERY SUBMITTAL
GRAPHICS STANDARD	Refer to Contract requirements, Paragraph titled *Graphic Standards Checks and Report.*			AT EVERY SUBMITTAL
CAD STANDARD	Refer to Contract requirements, Paragraph titled *CAD Standards Checks and Report*			AT EVERY SUBMITTAL
INTERFERNCE MANAGEMENT (3D COORDINATION)	Refer to Contract requirements, Paragraph titled *Interference Management (3D Coordination) Checks and Report.*			AT EVERY SUBMITTAL

QC Validation	Monitor and validate the manual and automated QA/QC checks provided by the sub-contractors within their BIM deliverables			AT EVERY SUBMITTAL
Construction Sequence Review	Review that the ongoing development of the models is aligned with the construction progress as per the baseline program			As agreed
ADDITIONAL PARAMETERS	Refer to Contract requirements, Paragraph titled *Additional Parameters*			As agreed

OBCC BUILDING INFORMATION MODELLING (BIM) Protocol

Version 2.5



Exchange Information Requirements

V.2.5

Preface

This document represents OBCC BIM Information requirements that should be followed by all project team members. This document is part of OBCC BIM Protocol which aims to digitize all OBCC requirements, processes and procedures.

This document contains set of information that addresses all OBCC requirements, these requirements are to be distributed to all project team members and their supply chain. Information included in this document is about OBCC VDC Goals, IT Infrastructure, Data Management, Model Management and Resource Management.

OBCC BIM Protocol is ultimately based on previous practical experiences and potential future applications that could be beneficial for construction industry, some of the information that is found here had been cited from some of standards and practical documents; all reference that had been used are mentioned in the last section in this document.

This protocol had been created in line with OBCC VDC (Virtual Design & Construction) vision, OBCC VDC vision is to be the 1st in a region to develop an intensive BIM Protocol that addresses all project needs and requirements to LCECs (Lead Content Development & Experience Design Consultants), CDC (Concept Design Consultants), LDCs (Lead Design Consultants), CCs (Cost Consultants), PMCs (Project Management Consultants), GCs (General Contractors) and their supply chain.

OBCC requirements had been tested carefully in their projects which gives this protocol more reality and practicality than others in the market. All OBCC stakeholders were involved to develop this BIM Protocol and its requirements.

Document Control and Revisions

Date	Doc/Version	Author	Description	Title
Oct. 2021	OBCC/2.5	OBCC Senior BIM Manager	OBCC BIM Protocol	OBCC Information Requirements

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Abbreviations & Terminologies

Abbreviation	Description
2D	Two-dimensional
3D	Three-dimensional
3DC	3D Coordination
4D	Construction sequencing information
5D	Cost information
6D	Project lifecycle information (O&M information)
7D	Information from sensors and building analytics
AB	As-Built in OBCC
ADQ	Actual Digital Questions
AEC	Architecture, Engineering and Construction
AIM	Asset Information Model
AIR	Asset Information Requirements
ARG	Asset Registry
BC	BIM Coordinator
BC	BIM Consultant in OBCC
BCF	BIM Collaboration Format
BCIS	Building Cost Information Services of RICS
BEP	BIM Execution Plan
BIM	Building Information Modelling
BMO	BIM Management Office
BOM	Bills of Materials
BOQ	Bills of Quantities
BS	British Standards
BSDD	Building SMART Data Dictionary
BUA	Build-up Area
CAD	Computer Aided Design
CAFM	Computer-Aided Facility Management
CAPEX	Capital Expenditure
CC	Cost Consultant
CD	Concept Design
CDE	Common Data Environment

Abbreviation	Description
CIC	UK Construction Industry Council
CIC BIM Protocol	The Construction Industry Council Building Information Modelling Protocol
CMMS	Computerized Maintenance Management System
COBie	Construction Operations Building Information Exchange
CPI	Construction Project Information
CPIC	Construction Project Information Committee (UK)
CPIc	Construction Project Information Committee
CPIx	Construction Project Information Xchange
CR	Clash Rendition
CS	Construction Stage
CSG	Constructive Solid Geometry
DD	Design Development
DGN	MicroStation and Intergraph file format
DR	Design Review
DWF	AutoCAD Design Web Format
DWG	AutoCAD file format
DXF	Interchange file format
EIR	Employer's Information Requirements
ERC	Employer Representative Consultant
eS	Electronic Snagging in OBCC
FAR	Floor Area Ratio
FF&E	Furniture Fixture and Equipment
FM	Facility Management
GC	General Contractor - Main Contractor
GIS	Geographic Information System
GSL	Government Soft Landings
H&S	Health and Safety
HVAC	Heating, Ventilation, and Air Conditioning
iBIM	Integrated Building Information Model, or Level 3 BIM
ICT	Information and communications technology
IDM	Information Delivery Manual
IDP	Information Delivery Plan
IFC	Issued for Construction

Abbreviation	Description
IFC	Industry Foundation Classes
IFC2x	Industry Foundation Class version 2x
IFD	International Framework for Dictionaries
IFT	Issued for Tender
IMP	Information management process
IT*	Issue Tracking in OBCC
IT	Information Technology
ITP	Inspection Test Plan
LCEC	Lead Content Development & Experience Design Consultant
LDC	Lead Design Consultant
LOD	Level of Development
LOD	Level of model detail
LOI	Level of model information
LOIN	Level of Information Need
MA	Model Authoring
MC	Main Contractor
MEP	Mechanical, Electric, Plumbing Engineering
MIDI	Master Information Document Index
MIDP	Master Information Delivery Plan
OIR	OBCC Information Requirements
N/A	Not Applicable
NCR	Non-Conformance Reports
NLA	Net Leasable Area
NPV	Net Present Value
NRM	New Rules of Measurement
NSA	Net Sales Area
O&M	Operation and Maintenance
OIR	Organizational Information Requirements
OPEX	Operating Expenditure
PAS	Publicly Available Specification
PCM	Project Control & Monitor
PEP	Project execution plan
PIM	Project information model

Abbreviation	Description
PIMS	Project Information Management System
PIP	Project Implementation Plan
PIP	Project implementation plan
PLQ	Plain Language Questions
PM	Project Manager
PMC	Project Management Consultant
PMO	Project Management Office
POMI	Principals of Measurement (International)
PQ	Pre-Qualification
QA/QC	Quality Assurance, Quality Control
QCC	Quantity Crosscheck in OBCC
QTO	Quantity Takeoff
RIBA	Royal Institute of British Architects
RFI	Request for Information
RFI	Request for Inspection
RFP	Request for Proposal
RICS	Royal Institute of Chartered Surveyors
SC	Sub-Contractor
SCCS	Supply Chain Capability Summary
SD	Schematic Design
SFCA	Standard Form of Cost Analysis
SMP	Standard Method and Procedure
SW	Software
TBD	To Be Determined
TIDP	Task Information Delivery Plan
VDC	Virtual Design & Construction
VO	Variation Order
VPCM	Virtual Project Control & Monitor
WBS	Work Breakdown Structure
WI	Work Inspection
WIP	Work in progress
WIR	Work Inspection Report
WO	Work Order

Abbreviation	Description
XML	Extensible Markup Language

Terminology	Definition
2D CAD Model File	CAD file containing CAD data in two dimensions X and Y coordinates
3D CAD Model File	CAD file containing CAD data in three dimensions X, Y and Z coordinates
BEP	A document used to capture all project specific standards, workflows and procedures.
BIM Author	A term used to define a person within a specific discipline responsible for authoring the project using the nominated BIM authoring software.
BIM Coordinator	A term used to describe the nominated person within a specific discipline who is responsible for maintaining the BIM health and coordination of that discipline.
BIM Manager	A term used to describe a person within a specific organization tasked with maintaining the health, vision implementation and maintenance of BIM within that organization.
CAD File/s	A collective name for files created utilizing CAD software; CAD model, CAD container, CAD drawing file/s
Common Data Environment	A collective name for a system or, systems that are connected or, utilized to manage and govern control of data and information while provided accessibility and collaboration functionality
Consultant(s) or Contractor(s)	Organizations contracted to the Employer/Appointing Party to deliver project contract/Appointment requirements required to satisfy Project Stage deliverables.
Data Files	File consisting purely of coded information i.e. Binary for the use in a device or physical machine. Also defined as an 'Information container'.
Deliverable	A document or asset required, in a format stated in the EIR or contract/Appointment documentation to satisfy the completion of the requirements of the Employer's/ Appointing Party's project.
Digital Asset	A graphical/geometrical representation of a physical asset also referred to within Autodesk Revit as a Family or a Type of a Family.
Discipline	A term used to identify a group of individuals that are specialists in their field of work. For example, architects, interior designers, mechanical engineers, structural engineers, etc.
Document	The common name given to a file that is not recognized as CAD file format. Also defined as an 'Information container'.
Drawing	A CAD or PDF rendition file containing multiple spaces where referenced 2D CAD model file(s) are required to produce a project drawing deliverable. Reference file(s) are scaled and positioned within the Employer's/ Appointing Party's approved border inclusive of title block information pertaining to the CAD or PDF rendition drawing file
Level of Asset Definition (LOAD)	Definition of the stages contained within the lifecycle of the Employer's project(s) inclusive of the associated digital asset Level of Development (LOD) and Level of Information (LOI) required to satisfy and inform the delivery of the relevant project stage digital assets.
Level of Development (LOD)	Definition of the graphical/geometrical detail of digital assets at a level appropriate to the current Project Stage.

1 Introduction:

OBCC requires all CCs/GCs/LDCs to work to the principals of BIM (Building Information Modelling) as defined by the British Standard which is the UK implementation of EN ISO 19650-1:2018 together with BS EN ISO 19650-2:2018. (It supersedes BS 1192:2007+A2:2016 and PAS 1192-2:2013, which are withdrawn).

• The intent of this document is to provide an outline definition of Exchange Information Requirements (OIRs) to support the implementation of Building Information Modelling (BIM) on [Project Name] Project.

• This document outlines the following to support collaborative processes and produce the information required by OBCC during design, construction, and handover:

1) Responsibilities
2) Requirements and Processes
3) Best Practices
4) Supporting Software Requirements
5) BIM Uses & Data Requirements
6) Project Deliverables

1.1 Scope

This document describes which BIM uses are implemented on ***the project*** and what methods, tools and standards the BIM uses require. A BIM use is a method of applying building information modelling during a facility's lifecycle to achieve one or more specific objectives (NBIMS 2012) (10). This document specifies the technology and process requirements for the BIM uses, as well as the model content requirements on ***the project***. It introduces how model data shall be delivered, specifies the model and data management solution and defines how project teams shall collaborate by means of BIM. Finally, the BIM organization of the project including expected roles and responsibilities is outlined.

The following BIM design disciplines shall provide models of their design and follow the EIR and the design scope/intent:

- Infrastructure and Civil
- Landscape, Earth works, & Roads
- Architectural
- Structures
- Mechanical
- Electrical
- Plumbing
- Fire Fighting
- Power and Utilities
- Audio Visual Systems
- Interior Design
- Lighting
- Vertical Transportation
- Kitchen Laundry and Waste
- Theming
- Special Systems "i.e., Security System…etc."

This list is not limited and disciplines can be added/removed depending on each project.

1.2 Statement of Purpose

This document outlines the following to support collaborative processes and produce the information required by OBCC during all project stages.

The EIR (or OIR – same meaning) is an important element of Project BIM Implementation and is used to set out clearly the required information within the Project Information Models (PIMs).

The Exchange's Information Requirements shall be embedded within the Employer's Project Contractual documentation issued to a Project Consultant(s) and, or Contractor(s).

Consultant(s) and, or Contractor(s) contractually engaged by OBCC shall develop in response to the EIR a contractually binding BIM Execution Plan. Amendments to the EIR shall be reflected in the Deviation from Standards and EIRs section of the document, after being reviewed and approved by the Programme BIM Manager appointed by OBCC.

1.3 Document Authority

This document will define the requirements of different stakeholders that will become part of the project delivery team at different stages of the development of the project. The acceptance of this document by the Consultant(s) and or Contractor(s), confirms that the relevant supply chains personnel have read and understood its requirements.

The document will provide a structure and specification for the development of the BIM Execution Plan and associated documents and the delivery of the Project Information Model (PIM) in accordance with the Employer's requirements and subsequent hand back of Information to the Employer's team.

The EIRs are applicable to the entire project team and all project-related data. Project data should be stored in a secure manner and managed in a consistent and structured framework. Data must be protected against unauthorized access, alteration, disclosure, and modification and managed with relevant procedures.

1.4 BIM Intent

Building Information Model (BIM) or "Model" is a parametric, computable representation of the project design developed by the LDC and the LCEC and the construction model will be developed by the contractor (in this case only – for Project XXXX and for specific zones). As used in this BIM specification, references to Building Information Model, BIM, or the Model, include the primary design model or models and all linked, related, affiliated or subsidiary models developed for design, analysis, estimating, detailing, fabrication, construction, operation or maintenance of the project, or any portion or element of the project.

1.5 Right of Reliance

The BIM Model produced by the project stakeholders associated with the Lead Content Development & Experience Design Consultant (LCEC) will serve as the basis of design and is considered a Design Model. The model prepared by the LDC/LCEC shall be used by [Contractor] to prepare a Construction model. This Right of Reliance pertains to all models and applications associated with the model and associated applications.
The [Contractor] may rely on the accuracy of the model(s) prepared by the LDC/LCEC in accordance with traditional Standard of Care provisions that apply and govern the design and construction of comparable buildings in two (2)-dimensional design formats and methods.

Conversely, the LDC/LCEC may rely on the accuracy of the model(s) prepared by the [Contractor] in accordance with traditional Standard of Care provisions that apply and govern the preparation of shop drawings, fabrication drawings, sequencing and other instruments used to convey the means and methods under the control of [Contractor], its subcontractors, consultants and other agents working on this project.

1.6 Ownership and Use of BIM Model and Database

The BIM Model is an instrument of service and is considered to be a component of Design and Construction Documents. The [Appointing Party (Employer)] has ownership of and to all CAD files, BIM Models, and Facility Data developed for the project, the data contained within it and all copyrights. The [Appointing Party] may make use of this data following any deliverable. Each Model Element Author (MEA) contributing to the BIM model(s) and database agrees to provide all project stakeholders and [Appointing Party] a non-recoverable, exclusive license to utilize any and all intellectual property provided by each MEA contained within this BIM for the sole purpose of completing the design, construction, and other uses as stipulated and/or implied by the executed Appointing Party/Design Consultant Agreement.

1.7 Deviations from Standards and EIRs

Any deviations from the Standards, Classifications, Specifications and EIRs must be clearly highlighted in the Request for Proposal (RFP) and agreed on by all project stakeholders and Programme BIM Manager.

1.8 Relationship of BIM Requirements to other Requirements

To the greatest extent practicable, the BIM should describe the project as it will be designed and constructed, except for elements that cannot be practicably modelled because of software limitations or that are smaller than elements normally modelled on similar projects. All limitations to the extent of modeling must be identified in the BIM Execution Plan and agreed in writing by OBCC. Those project elements that are not modelled must be constructed in accordance with supplementary design information prepared by the Contractor that has been fully coordinated with the modelled information.

1.9 Standards, Classifications and Specifications

A BIM execution philosophy is mandated for all portfolios under the OBCC's Programme. To produce information to the same form and quality, the below Standards and Codes associated with BIM will, therefore, form the basis of the OBCC execution strategy. Consultants and Contractors should utilize the below standards to develop their BIM execution plans as applicable and required.

BS EN ISO 19650:2018 sets out a method for managing the production, distribution, and quality of construction information. This method includes construction information produced using CAD systems.

Uni-class is a unified classification system developed for the UK construction industry covering all sectors of the industry. Uni-class is used for the naming of all components (content) on the OBCC Programme. Modelled elements will be populated with accurate Uniformat information through-out the design phase of the project and fully complete for all elements at the close-out of the final design stage. This will allow for the successful export and identification of modelled elements. E.g. in Revit authoring tool, the assembly code for all family types will be populated with Uniformat information.

COBie (Construction Operations Building Information Exchange) is an international standard for building data exchange. Its most common use is in product data handover from construction to operations AM/FM (Asset Management and Facilities Management). The COBie specifications and guidelines capture industry knowledge and best practices "used version to be agreed with the Employer in each project".

Geographic Information System (GIS) ISO 19115:2014 extends the value of BIM data through visualization and analysis by importing BIM information into GIS tools. To ensure this, optimal integration and standardization of metadata must be in place. The ISO 19115 standard is a metadata standard and defines how to describe geographical information and associated services, including contents, spatial-temporal purchases, data quality, access, and rights to use. GIS applications should use data format standards to store geospatial as this will enable the transfer of data between systems through integration. The below identifies the information exchange gates:

Work in progress

The "WIP" section of the CDE is used to store unapproved information such as non-verified design data for each organizational role such as architecture. To pass through the Approval Gate (Gate 1) a check, review and approval process shall be carried out before being issued to the Shared area.

Shared

The "Shared" section of the CDE is used to store Information which has been approved for sharing with other organizations to use as reference material for their own design development. When the design has been completed, the information shall be placed for authorization in the Appointing Party (Employer) Shared Area. To pass through the Authorized Gate (Gate 2) in the information in the Appointing Party (Employer) Shared Area, shall be authorized by OBCC or their representative.

Published

The "Published Documentation" section of the CDE shall be used to hold published information such as co-ordination and validated design outputs for use by the total project team, e.g. production information suitable for tender or construction. This section concludes with the Verified Gate 3 which represents the transition to "archive".

Archived

The "Archive" section of the CDE shall store a record of the project history including all transaction and change orders.

1.10 Approach

The approach used for establishing the EIR is based on RIBA plan of work 2013 & the British Standard which is the UK implementation of EN ISO 19650-1:2018 together with BS EN ISO 19650-2:2018.

The EIR are issued as part of the Request for Proposal (RFP) and a response from prospective bidders is required through the means of a BIM Execution Plan (BEP) that describes how the specifications and requirements are to be implemented.

OBCCS requires a BEP of all awarded bidders along with their Project Implementation Plan (i.e. a Post-Contract BEP) as part of their proposal, regardless of their scope of work and the design phase they are involved, setting out the suppliers proposed approach, capability, capacity and competence to meet the EIR.

The selected bidder is to submit Post-Contract BEP in two weeks' time after the award of the appointment (contract), detailing the agreed processes and procedures.

1.11 Applied Standards and Documents

Name	Category	Year
ISO 19650-1: 2018	Standards (BSI & ISO)	2018
ISO 19650-2: 2018		2018
RIBA Plan of work	Practicing Standards	2020

NBS BIM Object Standards		2014

Table 1 - Standards

1.12 List of Appendices with Employers Responsibilities

No.	Title	LCEC	PMC	LDC	CC	GC
Appendix 2	LDC BIM Requirements	Responsible	Manage	Responsible	Consulted	Informed
Appendix 2a	LCEC BIM Requirements	Responsible	Manage	Responsible	Consulted	Informed
Appendix 4	CC BIM Requirements	Informed	Manage	Informed	Responsible	Informed
Appendix 5	GC BIM Requirements	Consulted	Manage	Consulted	Consulted	Responsible
Appendix 6	PMC BIM Requirements	N/A	Responsible	N/A	N/A	N/A
Appendix 7	Level of Information Need	Responsible	Manage	Responsible	Informed	Responsible
Appendix 10	BIM Competence Assessment	Responsible	Responsible	Responsible	Responsible	Responsible

Table 2 - Appendices with Employers Responsibilities

1.13 RIBA POW 2020 with Employers Responsibilities

RIBA POW 2020	LCEC	PMC	LDC	CC	GC
Stage 0: Strategic Definition	N/A	N/A	N/A	N/A	N/A
Stage 1: Preparation and Brief	N/A	Manage	N/A	N/A	N/A
Stage 2: Concept Design	Responsible	Manage	Informed	Consulted	Informed
Stage 3: Spatial Coordination	Responsible	Manage	Responsible	Consulted	Informed
Stage 4: Technical Design	Responsible	Manage	Responsible	Consulted	Consulted
Stage 5: Manufacturing and Construction	Consulted	Manage	Consulted	Consulted	Responsible
Stage 6: Handover	Consulted	Manage	Consulted	Consulted	Responsible
Stage 7: Use	Informed	Informed	Informed	Informed	Consulted

Table 3 - RIBA POW 2020 with Employers Responsibilities

KEY:

Manage: Responsible for managing all tasks to ensure the compliance of requirements.
Responsible: Responsible for undertaking all tasks to ensure compliance of requirements.
Consulted: Consulted to provide input and assistance.
Informed: Informed with no need for input.
NA: Not Applicable.
***:** As defined in the Scope of Services agreement.

1.14 BIM INFORMATION CONFIDENTIALITY AND NON-DISCLOSURE

Reference is made based on the confidentially clauses of the Professional Services Agreement signed by the Consultant/ Contractor and the non-disclosure agreement (NDA) signed by the Consultant/ Contractor for a OBCC project, the BIM design data and documentations "BIM Information" for the project including but not limited to; all BIM related deliverables, 3d models, non-graphical data, renders, drawings, reports, and diagrams in any stage of OBCC project will be considered as a Confidential Information, where OBCC is the sole authorized entity to the ownership of these information. Any rights (including but not limited to the copyright or the intellectual property rights or design rights) subsisting in the material and any proprietary work contained in the material shall vest in OBCC.
For the duration of the project, OBCC will grant to the consultant/ contractor an access to the project's BIM information for the permitted project purposes. Additionally, All the involved parties under the consultant/ contractor "affiliates" shall use BIM Information solely to the limited extent necessary for the purpose, the consultant/ contractor and their affiliates shall prevent and not allow any BIM Information to be disclosed.
The consultant/ contractor will maintain in strict confidentiality and not to present, share with, and/or disclose to any third party or in any event any BIM information generated by the consultant/ contractor and its affiliates, or by its representatives that contains and/or reflects the project's BIM Information.

the consultant/ contractor shall not, at any time during the term of their scope in this project and after its completion, disclose or use any BIM deliverable **"i.e.** BIM deliverables, 3d models, non-graphical data, renders, drawings, reports, and diagrams".
Subject to the restrictions contained in the above clauses, the consultant/ contractor agrees to preserve as Confidential Information any information learned by their teams as a result of their involvement in the BIM implementation process in this project.
the consultant/ contractor agrees to transmit the BIM Information only to such of its representatives who need to know the BIM Information for the sole purpose of assisting the implementation or carrying out the assignment and who are made aware of the obligations of BIM information confidentiality.

2 OBCC BIM Goals & Objectives

2.1 Introduction

OBCC aims to digitize all the design & construction work through the project life cycle, also to become leader in paperless collaboration and work environment. OBCC vision is to minimize project impacts for all parties by depending on VDC and its tools.
OBCC general objectives of the VDC process is to:

- Ensure the success of construction project delivery through the use of integrated digital technologies that provide scheduling and project management capabilities for the dynamic construction operations environment.
- Real time visualization that adds new and exciting ways for project participants to plan - by enabling all participants the ability to see into the future, to understand the past and to know current conditions as they happen.
- Contribute to a clear communications and shared understanding amongst the entire project delivery team.
- Enable performance on a much higher level across all aspects of the delivery process, from safety, workspace utilization and productivity, quality, and reliability, to project cost competitiveness.
- Assure on performance improvement without compromise and the typical constraining trade-offs between time, cost, and quality.

2.2 OBCC BIM Objectives

Objectives	Priority	Project Phase
Use BIM to inform the design & construction programme and to review the design at key project phases to ensure compliance to programme.	High	RIBA Stage 2>>6
Vendor information to be present in BIM, subject to vendor contractual obligations.	High	RIBA Stage 2>>6
Management of all project information, procedures and correspondences to be through BIM environment using models and CDE.	High	RIBA Stage 2>>6
QA/QC to ensure data integrity throughout all project phases.	High	RIBA Stage 2>>6
Ensure integrity of design data and value through BIM processes.	High	RIBA Stage 2>>6
BIM to remain as single source of truth – information to derive from BIM.	High	RIBA Stage 2>>6
BIM is kept up to date throughout project duration.	High	RIBA Stage 2>>6
Use appropriate tools and methods to address clash control and omitting it.	High	RIBA Stage 2>>6
To have LOD 300 at the end of IFC – project handover to contractor.	High	RIBA Stage 4
Information exchanges shall be in BIM.	High	RIBA Stage 2>>6
BIM to inform design & construction progress.	High	RIBA Stage 2>>6
To verify quantities for costing purposes.	High	RIBA Stage 3>>6
Digital site management and controlling to de conducted using BIM and CDE.	High	RIBA Stage 5>>6
Fabrication and drawings to be approved using BIM extractions and CDE gates.	High	RIBA Stage 5>>6
To have LOD 500 at the end of project – Project handover to FM.	High	RIBA Stage 6

Table 4 - OBCC BIM Goals (Corporate)

2.3 Project BIM Objectives

Objectives	Priority	Project Phase
Project tasks and procedures should be managed through BIM environment and design BIM models & progress to be totally utilized on a daily basis.	High	RIBA Stage 2>>6
Facilitate decision making process for any changes or major issues.	Medium	RIBA Stage 2>>6
Clash renditions and discrepancies to be fast highlighted and resolved.	High	RIBA Stage 2>>6

Objectives	Priority	Project Phase
Facilitate quantity extraction/validation and drawings production.	High	RIBA Stage 2>>6
To have virtual models for all project disciplines and facilities.	High	RIBA Stage 2>>6
To enable the transfer of project data into data management during operation.	High	RIBA Stage 2>>6
Utilize building project data during building operations and facility management activities.	High	RIBA Stage 2>>6
To have better collaboration and communication using CDE among all project stakeholders.	High	RIBA Stage 2>>6
To have better quality for extracted data which facilitate all project works & activities.	High	RIBA Stage 2>>6
To have change management for all project aspects.	High	RIBA Stage 2>>6
To have energy analysis and sustainability consideration for better facility management and preventive maintenance.	High	RIBA Stage 3>>4
To have better visualization for all required data like analysis and constructability.	High	RIBA Stage 2>>6
Use VR for a better understanding of project spaces and for constructability review.	Medium	RIBA Stage 3>>6

Table 5 - OBCC BIM Goals (Project)

3 General Information

3.1 Project General Information

No.	Item	Description
1	Employer	OBCC
2	Project Title	TBA
3	Project Code	TBA
4	Architect	TBA
5	Civil Engineer	TBA
6	MEP	TBA
7	Landscape	TBA
8	ID	TBA
9	PMC	TBA
10	Total Built Up Area	TBA
11	Planned Start Date	TBA
12	Planned Finish Date	TBA

Table 6 - Project Information

3.2 Project Location

Project Address	TBA
Project Coordinates	TBA

Table 7 - Project Location

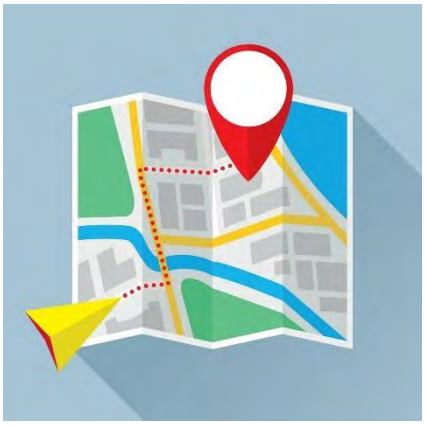


Figure 1 - Project Map

3.3 3.3 Project Brief

As per Request for Proposal (RFPs) main document.

4 IT Infrastructure

This section clarifies in detail all OBCC hardware and software requirements to assure flowing and work integrity, also it gives the freedom for the project teams to propose any compatible solutions in which final product and OBCC VDC goals should be achieved.

a. Hardware Requirements

OBCC requires proper hardware specs to achieve its VDC goals, all bidders should propose their workstations that shall be used in their work within OBCC projects.

i. Model Authoring (MA):

Code	Description	Specifications
G.1	General	Hardware shall support all model authoring processes, synchronization and collaboration.
HR.1.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 32 GB RAMs.
HR.1.2	Display	2 screens with a minimum of 24.3”.

Table 8 - MA Hardware Requirement

ii. Design Review (DR):

Code	Description	Specifications
G.1	General	Hardware shall support all design review processes, synchronization and collaboration.
HR.2.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 32 GB RAMs.
HR.2.2	Display	2 screens with a minimum of 24.3”.

Table 9 - DR Hardware Requirement

iii. 3D Coordination (3DC):

Code	Description	Specifications
G.1	General	Hardware shall support all 3d coordination processes, clash detection & discrepancies resolution.
HR.3.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 32 GB RAMs.
HR.3.2	Display	2 screens with a minimum of 24.3”.

Table 10 - 3DC Hardware Requirement

iv. Quantity & Cost:

Code	Description	Specifications
G.1	General	Hardware shall support all quantity crosscheck processes & validation.
HR.4.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 32 GB RAMs.
HR.4.2	Display	2 screens with a minimum of 24.3”.

Table 11 - QCC Hardware Requirement

v. Project Control & Monitor (PCM):

Code	Description	Specifications
G.1	General	Hardware shall support all project control and monitor processes, animations, simulations, analysis and collaboration.
HR.5.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 64 GB RAMs.
HR.5.2	Display	2 screens with a minimum of 24.3”.

HR.5.3	VGA Card	NVIDIA GTX Titanium or Quadro Tesla/P5000 VGA Card, 8 GB.

Table 12 - PCM Hardware Requirement

vi. Build & Commissioning (BC):

Code	Description	Specifications
G.1	General	Hardware shall support all build & commissioning processes.
HR.6.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 32 GB RAMs.
HR.6.2	Display	2 screens with a minimum of 24.3”.
HR.6.3	Tablet	A proper Tablet/iPad with a minimum of 32 GB memory and 8 GB RAMs or equivalent with a durable case for site circumstances, this is for use of comparing models with as-built, crosscheck with MEP & handing over and snagging lists.

Table 13 - BC Hardware Requirement

vii. Facility Management (FM):

Code	Description	Specifications
G.1	General	Hardware shall support all facility management processes.
HR.7.1	Workstation	Strong workstation (i.e. HP Z series, Dell T series, equivalent) with a minimum of Core i7 7740x (x299) – 32 GB RAMs.
HR.7.2	Display	2 screens with a minimum of 24.3”.
HR.7.3	Tablet	A proper Tablet/iPad with a minimum of 32 GB memory and 8 GB RAMs or equivalent with a durable case for site circumstances, this is for use of checking defects, periodical checks & incidents.

Table 14 - FM Hardware Requirement

viii. General Requirements (GR):

Code	Description	Specifications
G.1	General	Hardware shall support all build & commissioning processes.
HR.8.1	Smart screen	SMART Board, Projector with white sheet, Smart TV Touch, for the use of workshop meeting & collaboration.
HR.8.2	Printers/copy machines	Adequate number of printers should be provided only for the most-paper users like secretaries & DCs, central printers & copy machines also to be provided.
HR.8.3	Plotters	A minimum of 1 color plotter to be provided to support colored printouts in case of coordinated MEP drawings and sophisticated drawings.

Table 15 - GR Hardware Requirement

b. Hardware Platforms and Benchmarking

This section highlights on the hardware platforms that should be used in general to support the work collaboration and communication between OBCC & CC/GC/LDC/LCEC.

Code	Description	Specifications
HP.1.1	Server	A powerful server should be fixed at the project office with a capability of download/upload data in a maximum speed from the shared folder.
HP.1.2	Internet	A high-speed internet should be provided to OBCC & project team to facilitate work collaboration.

Table 16 - Hardware Platforms

c. Software Requirements

This section is about all software that will be used during whole project life cycle and about which platforms should be utilized. All bidders should propose their IT infrastructure plan and propose for any equivalent/alternative software with illustrations.

i. Model Authoring (MA):

Code	Tool as example	Description
SR.1.1	Autodesk AutoCAD	Used for preliminary sketches, single line diagrams, export CAD from Revit for printouts.
SR.1.2	Autodesk Revit	Used as a modelling tool in the project, Landscape add-in should be installed for purpose of Landscape modelling.
SR.1.3	Autodesk 3D Civil	Used as a modelling tool for infrastructure utilities, roads & bridges.
SR.1.4	Trimble Tekla	Used as a modelling tool for steel structure or any steel buildings.
SR.1.5	Trimble Sketchup	Used as a sketching tool for concept designs and illustrations.
SR.1.6	Autodesk BIM 360 Design	Used for Revit collaboration along the teams. Is accessible from mobile devices and tablets. Work sharing should be through it within project teams. OBCC should have access anytime to all the WIP models.
SR.1.7	General requirements	• The software used for model authoring shall provide all the 3D modelling capability, adding new attributes, linking different models and formats, exporting/importing IFC formats and assuring on achieving all needed model management requirements. • Distributed teams need to be able to access models created by the software for model authoring over the internet. • The software shall support most of publicly add-ins to help/facilitate model authoring. • The software shall support multi-location work (cloud-based) and not be attached to a specific server in a specific location.

Table 17 - MA Software Requirement

ii. Design Review (DR):

Code	Tool as example	Description
SR.2.1	Autodesk Revit	Provide visual checks and review.
SR.2.2	Autodesk 3D Civil	Provide visual checks and review.
SR.2.3	Autodesk Navisworks	Used as a clash detection tool, provide tabulated reports about the clashes locations and their attributes and support intensive visual checks.
SR.2.4	Autodesk BIM 360 Design	Used for Revit collaboration along the teams. Is accessible from mobile devices and tablets. Work sharing should be through it within project teams. OBCC should have access anytime to all the WIP models.
SR.2.5	General Requirements	• The software shall provide viewing capability on mobile devices as specified. • Distributed teams need to be able to access models created by the software for design review over the internet. • The software for design review can save comments and markups in the 3D model that were collected through the design review. • The software shall provide capability to communicate the issues registered in the software. The software for design review provides functionality that can be used to distribute comments. This can either be done through a file that can be distributed, or by uploading it on a web-based platform. • A desirable feature is that the status, (e.g. issued, approved, rejected), can be tracked within the software for design review. • The software for design review provides functionality that can measure distance on screen in the model that is being reviewed by snapping to elements in it. • The software shall provide capability to access object properties when clicking on an object. • The software shall provide secure and authenticated access to up-to-date, multidisciplinary BIM projects.

Code	Tool as example	Description
		• If the software is standalone, this requirement can be handled by authentication of the operation system and the data management solution. If the software is cloud-based, authentication needs to be provided and access rights are granted dependent on the role.

Table 18 - DR Software Requirement

iii. 3D Coordination (3DC):

Code	Tool as example	Description
SR.3.1	Autodesk Navisworks Manage	Used as a coordination software to view, comment & markup the clashes and coordination issues.
SR.3.2	Solibri Model Checker	Should be used with a predefined rule set to highlight on design compliance, codes, and regulations.
SR.3.3	Autodesk BIM 360 Design	• Used for Revit collaboration along the teams. • Is accessible from mobile devices and tablets. • Work sharing should be through it within project teams. • OBCC should have access anytime to all the WIP models. • Collaboration between all stakeholders should be under this platform.
SR.3.4	General requirements	• The software shall be able to detect, identify and manage clashes. The software can automatically detect clashes between elements in different 3D models. Identifying clashes is achieved by highlighting them in the 3D model. Clashes are managed by saving them in the model and being able to track their status. • The software shall provide capability to create clash reports. The software can create a report which gives the opportunity to explore details of the clash results or to share that data with others. It shall be able to include an image and the status of the clash, (e.g. new, active, reviewed, approved and resolved) and export the report in XML, HTML and TXT format. • The software shall provide capability to import and export clash tests. The software shall be able to import and export clash tests in XML format that contains the settings, names and selected items to save time setting up clashes across projects. • When clicking on an object in the software for 3D coordination it shows the properties attached to it. • Distributed teams need to be able to access models created by the software for 3D coordination remotely over the internet. • The software shall integrate multiple 3D models and multi-format data and aggregate it into one model, a single model to be published as a distributable file. This can either be done through a file that can be distributed, or by uploading it on a web-based platform. • The software shall provide capability to group objects, (e.g. based on properties or naming convention) to clash-test subsets of the model. The software can be set up to filter and group for certain objects.

Table 19 - 3DC Software Requirement

iv. Quantity & Cost

Code	Tool as example	Description
SR.4.1	General requirements	• Provides a simple interface for the extraction of dimensions from BIM files. • Can be tied with a costing library to provide instant budget or valuation of buildings. • Provide cost planning options. • Ability to work on building projects separately and merge the work into one building project.

Code	Tool as example	Description
SR 4.2	Quantification requirements	• Supports standard drawing formats (DWG, DXF and DWF). • Supports (PDF., cBIM, IFC, etc.) formats. • Supports electronic dimension extraction from paper drawings using scanning technology. • Ability to add views and import dimension information from BIM Models. • Full measurement capability including area, length and count modes. • Dimensions can be broken down into zones (representing functional areas/levels/units etc. or stages of construction). • Fully supports scaled drawings (including separate X and Y scales) and allows calibration of scanned drawings. • Ability to add measurements during session. • Quick and easy measurements of reinforced steel using measurements from standard reinforced steel drawings. • Export of measurements to Microsoft Excel. • Overlay comparisons between two drawings/models in a building, (e.g. electrical and lighting drawings). • Revisioning system for drawings/models. • Tied in with the revisioning capability of BIM Models, drawing comparison mode graphically shows the changes between the models' revisions.
SR 4.3	Costing requirements	• Provide automatic cost plan generation from dimension information. • Provide full data import capability from systems such as enterprise resource planning (ERPs). • Ability to 'tweak' cost plan elements, rates, quantities etc. • Backwards linking and display. (For a quantity in a workbook cell, the option exists to display the referenced dimension on the drawing). • Provide free form hierarchical spreadsheet capability (workbooks). • Provide full workbook templates capability with live links to dimension groups and rate libraries. • Rate libraries and price lists can be manually entered or imported. • Standard reports such as Elemental Summary, Bill of Quantities, and Trade Breakup amongst others can be created for cost plans. • Export of costing information to Excel. • Enhanced revisioning system for workbooks including ability to create a new workbook based on the previous revision. • Rates can be broken down using a spreadsheet per rate which can link back to other rate libraries/price lists. • Offer the possibility of fully customizable reports. • Ability to do a workbook reorder (sort) based on code. For example, convert from Elemental to Trade etc. • Offer automatic synchronization with BIM models.

Table 20 - QCC Software Requirement

v. Project Control & Monitor (PCM)

Code	Tool as example	Description
SR.5.1	Synchro	• Daily, weekly & monthly report should be extracted and to be in line with Synchro data.
SR.5.2	Fuzor	• To be used for safety simulations, erections simulation, Logistics and planning.
SR.5.3	CostX	• Can be used also for Cost estimation/control along with its capability of quantity extraction.

Code	Tool as example	Description
SR.5.4	General requirements	• Cash flow should be demonstrated and integrated with software used for VPCM. • Payment validation should be linked with the software and integrated with the electronic WIR. • Any plan mitigations, updates and modifications should be applied on VPCM software pack. • Cost comparison between versions and submission should be carried out on VPCM software pack. • The software shall provide the ability to integrate or import Primavera P6, MS Project or to import a project schedule in csv-format. • The software shall provide capability to group objects, (e.g. based on properties or naming convention). The software shall provide ability to filter and group certain objects to enable easier selection of objects in the model. • The software shall provide ability to assign an activity with different task types, (e.g. construct, demolish or temporary). • The software should provide ability to run a simulation of a workflow or sequence.

Table 21 - PCM Software Requirement

vi. Build & Commissioning (BC)

Code	Description
SR.6.1	The software shall enable the user to record issues that could affect project quality, health and safety, environment, or scheduled delivery. The software shall enable the user to record the following information: • A description of the issue. • A responsible organization for resolution or the issue. • A location of the recorded issue. • The issue type: • NCR (Non-conformance report). • Site observation notice. • Safety non-conformance. • Safety Incident. • Material inspection non-conformance. • Design query. • Housekeeping.
SR.6.2	The software shall enable the user to manage issues. The software shall: • Display the resolution status of the issue, (e.g. open, work complete, closed). • Enable the user to update the status of an issue which will automatically notify the responsible organization. • Enable the user to filter issues based on: resolution status, location, company, issue type as well as text-based search on issue description.
SR.6.3	The software shall be able to add photographic evidence to an issue or inspection. The software shall enable the user to add a photograph or other file document to the issue or inspection record in order to provide a better understanding and visual context to an issue or inspection.
SR.6.4	The software shall enable the user to record and manage quality, and health and safety inspection checklists. The software shall enable the user to record the following information on a checklist: • A record of Pass, Fail, or Not Applicable, against each check point test on the checklist. • Location of the check that has been conducted. • Additional descriptive information. • Assign an issue to a responsible organization when a check point test registers as a fail. • Photographic evidence.
SR.6.5	The software shall enable the user to add markups. The software shall enable the user to add markups to a picture or document attached to an issue or inspection. Markups shall include the ability to add lines, arrows, shapes and textual graphics or user selected color to the picture of document. The user shall also be able to take measurements by snapping to a surface or point in the model.

Code	Description
SR.6.6	The software shall enable 3D model viewing capability. The software shall enable the mobile field tablet user to navigate a 3D model.
SR.6.7	The software shall enable viewing of 2D drawings and documents. The software shall enable the user to view 2D drawings and documents in the following file formats: PDF, DOCX, and XLSX via an Apple iPad tablet.
SR.6.8	The software shall enable the user to modify and add object properties as specified. The Site management application shall support the update of the following 'as-built' properties for objects required for operational management of the building: • Manufacturer. • Manufacturer Contact. • Model. • Serial number. • Installation date. • Warranty start date. • Expected life. • Location.
SR.6.9	The software shall provide email notification of new issues and status change on existing issues to the relevant parties. Immediate email notification is valuable in reducing time to resolve an issue so that it doesn't affect project delivery quality and schedule.
SR.6.10	The software shall provide an administrative interface to enable configuration of the system. The software shall provide an administrative interface to enable the following: • Management of users and responsible organizations. • Roll based access to the system and its functional capability. • Configuration of issue types and root causes. • Configuration of Quality Assessment/Quality Control-QA/QC safety checklists.
SR.6.11	The software shall provide role-based access to the Site management tool. The specified roles to include: • Contractor. • Subcontractor. • Architect. • Engineer. • Owner. • Inspector. Role-based access shall be provided to enable/restrict functional access to the system based on user role.
SR.6.12	The software shall provide reporting capability. The software shall enable users to create reports as follows: • A list of issues including description, location, responsible company and status which can be grouped by company, location or issue type. This list shall allow for an option to include photos, documents, and markups. • A summary of issue status including average time to close and overall project trend. • A list of QA/QC checklists with responses, comments and any issues generated as a result of the inspection. This list shall allow for an option to include drawings or documents. • A summary of safety activities including number of inspections conducted and their conformance. The reporting function shall enable the user to create filtered reports based on resolution status, location, company, and issue/checklist type.
SR.6.13	The software shall enable the user to create automated scheduled, (e.g. daily, weekly, monthly) reports. The software shall enable scheduled reports in PDF or XLS format to be sent to recipients via email.
SR.6.14	The software shall provide an iPad tablet interface to the Site management tool. The software shall enable Site management via an iPad that does not require network connectivity to function. The software shall enable work to be uploaded and synchronized when a WIFI is in range or a 3G/4G Mobile connection is available.
SR.6.15	The software shall provide a desktop web-based interface to the Site management tool. The software shall enable site management via a web portal for office-based staff and any user not using an iPad.

Table 22 - BC Software Requirement

vii. Computer Aided Facility Management (CAFM)

Code	Description
SR.7.1	• Manual entry of data from drawings, manufacturers documents, and so on into computerized maintenance management system (CMMS) files. This is tedious, error prone, and significantly delays the use of CMMS systems after turnover of the building. It cannot be seriously considered for modern buildings of moderate and larger size. • Transfer of data from a BIM model to a CMMS system using some standard format such as COBie. • Direct integration of the BIM and the facility management system. • Use of a middleware system that integrates with both the BIM authoring system and the CMMS.
SR.7.2	Ability of full BIM integration with any platform (Autodesk, Bentley, Trimble, etc.).
SR.7.3	Operation & Maintenance (O&M) and all related elements/equipment data should be embedded inside the software and to be available offline.
SR.7.4	Software should enable the following: • General inspections scheduler. • Room inspections scheduler. • Facility scheduler. • Integration with Building Management System (BMS) and sensor control. • Event scheduler. • GIS solutions for infrastructure assets. • BIM interface. • Mobile capability. • Asset management. • Maintenance schedule. • Move & space management. • Real estate & leasing management.

Table 23 - CAFM Software Requirement

d. Technology Compatibility

Any compatible software/hardware that could meet OBCC requirements should be communicated with the responsible team (TBD) and to arrange Proof of Concept (POC) for the project team.

e. Training Requirements

Any software shall be used in OBCC project. All the bidders should detail their training plan in case of awarding to satisfy and achieve all OBCC BIM needs and requirements.

OBCC may call for a training for any software used in the project, Consultant/Contractor shall ensure on the training commencement not more than two weeks from the training request.

OBCC is not responsible for any training requirements or technology providing for external parties in the project.

Find below the main training fields needed:

- Software trainings
- Any technology requirements
- Any other/s TBD according to OBCC needs

5 Data Management

a. Collaboration Process

The purpose of this section is to define how, where and when project information will be shared. It will highlight also on how the project team should communicate with each other.

The consultant, contractor or subcontractor should identify in detailed processes and procedures how project data and information will be exchanged and shared in each project stage/phase. All collaboration processes should be created and carried out through an approved CDE which will be addressed in section 5.2.

i. Meetings Methodology:

Meetings are to be conducted periodically and whenever needed, below are some mandatory meetings and not limited to:

Meeting Name	Occurrence	Participants	Location
BIM Initiation Meeting (Kick Off)	Once	TBA	TBA
BEP Demonstration	As requested	TBA	TBA
BIM Workshop Meeting	As requested	TBA	TBA
BIM Coordination Meeting	Bi-monthly	TBA	TBA
BIM Validation Meeting	As requested	TBA	TBA

Table 24 - Required Meetings

1. BIM Initiation Meeting

Meeting to establish the principles of BIM adoption, scope and ambition on the proposed project and to setup the post contract-award BXP. Establish when and where future meetings will be held. The purpose of the meeting is to:

a. Determine the BIM goals and aspiration of the project
b. Define the BIM Execution Plan

Agenda: The agenda for the BIM kick-off meeting can be based on the headings covered in the Project BIM Execution Plan as a basic measure.

c. Purpose of meeting
d. Introductions
e. Project Information
f. Project team
g. Project goals / BIM objectives
h. Model standards
i. Software & Compatibility
j. Meetings
k. Model organization
l. Spatial coordination
m. Project Key Performance indicator (KPI)
n. Supporting documentation
o. Any other business
p. Next Meeting schedule

2. BIM Execution Plan Demonstration

After the initial kick-off meeting, the organizations should clearly understand who will be responsible for the defined tasks, and in what sequences the BIM Uses will be executed. The responsible party for the Level One map should clearly document and distribute it to the project team for review prior to the following meeting. Each responsible party for the specified BIM Uses should also draft their workflow prior to the Design Project BIM Execution Process meeting.

3. BIM Workshop Meeting

Meeting to track the progress of BIM implementation on the project in the context of the BXP. This meeting should be used as a mechanism to identify forthcoming challenges and agree a proactive solution. Agenda:

a. BIM processes
b. Data requirements within the project model requirements within the project CDE requirements
c. Models
d. Common Data Environment
e. Next Meeting

4. BIM Coordination Meeting

a. After the Design Project BIM Execution Process meeting, the team must focus on developing the information exchanges. Each responsible party for an exchange should take the lead in developing the information exchanges.
b. The authors of the information exchange will need to coordinate with the information receivers to ensure that they have developed consistent information exchanges with minimal inconsistencies to discuss.
c. The team members should also prepare for the discussions regarding infrastructure requirements which will occur in Meeting Three. Team members should compile examples of typical methods that they have used or wish to use on the project to share with the team. Once the meetings are complete, the Project BIM Execution Plan should be distributed to all parties and approved as appropriate for the project and contracting structure.
d. Team members should ensure that the plan monitoring and updating procedure is implemented into the project controls system.
e. Meeting to review and allocate responsibility to clashes found during clash detection process undertaken by the BIM Validator. Agenda:

i. Clash investigation
ii. Next meeting

5. BIM Validation Meeting

Meeting to review and discuss deficiencies in model geometry and data identified during the model validation checks undertaken by the BIM Validator. Agenda:

a. Modelling progress, where everyone is and what they have been doing in terms of modelling
b. Go through outstanding actions from previous minutes
c. Collaboration
d. Technical, dealing with any technical issues the team are experiencing
e. Scopes and contracts, finalizing and reviewing progress against the BXP (BIM Execution Plan)
f. Validation, go through checks and assign responsibility and timescales to resolve issues
g. Ascertaining whether the design teams need any additional support going forward to help them compete required tasks
h. Next Meeting

b. Common Data Environment – CDE

i. Introduction

OBCC will provide the CDE (BIM 360/ACC) to its project team members as needed, all project team members shall be obliged with OBCC CDE and its specifications and requirements.

The Common Data Environment (CDE) is the place where to hold all project information, data, processes & procedures. It has access rights for all CC/GC/LDC/LCEC, it acts as a single source of truth at any time of project, it enables to control and monitor data changes, history and revisions.
The CDE should contain:

- Graphical Data (models, drawings, PDF's, IFC, photographs, renders, videos, …etc.)
- Non-Graphical Data (Schedules, data-bases, COBie, …etc.)
- Documents (Contracts, minutes, correspondance, request for information (RFI's), brief, Specifications, reports, BOQ, Inspection Plans & Reports, Commissioning Certificates, Product data Sheets, user O&M Manuals, …etc.).

ii. Audit Trial

An audit trial is a standard requirement for all documentation regardless of whether external quality assurance systems require it. All files that are shared with third parties should have a record of when, who and what reason they were shared. Any subsequent revisions should be tracked also ensuring that all recipients of the previous version understand that the previous version is superseded.

Any requirements that were mentioned in Appendices 2,3,4,5 & 6 BIM Requirement should have a trial procedure with start and end point, this should be carried out to assure on the process/task flow without any interference or discrepancies.

iii. CDE Gates

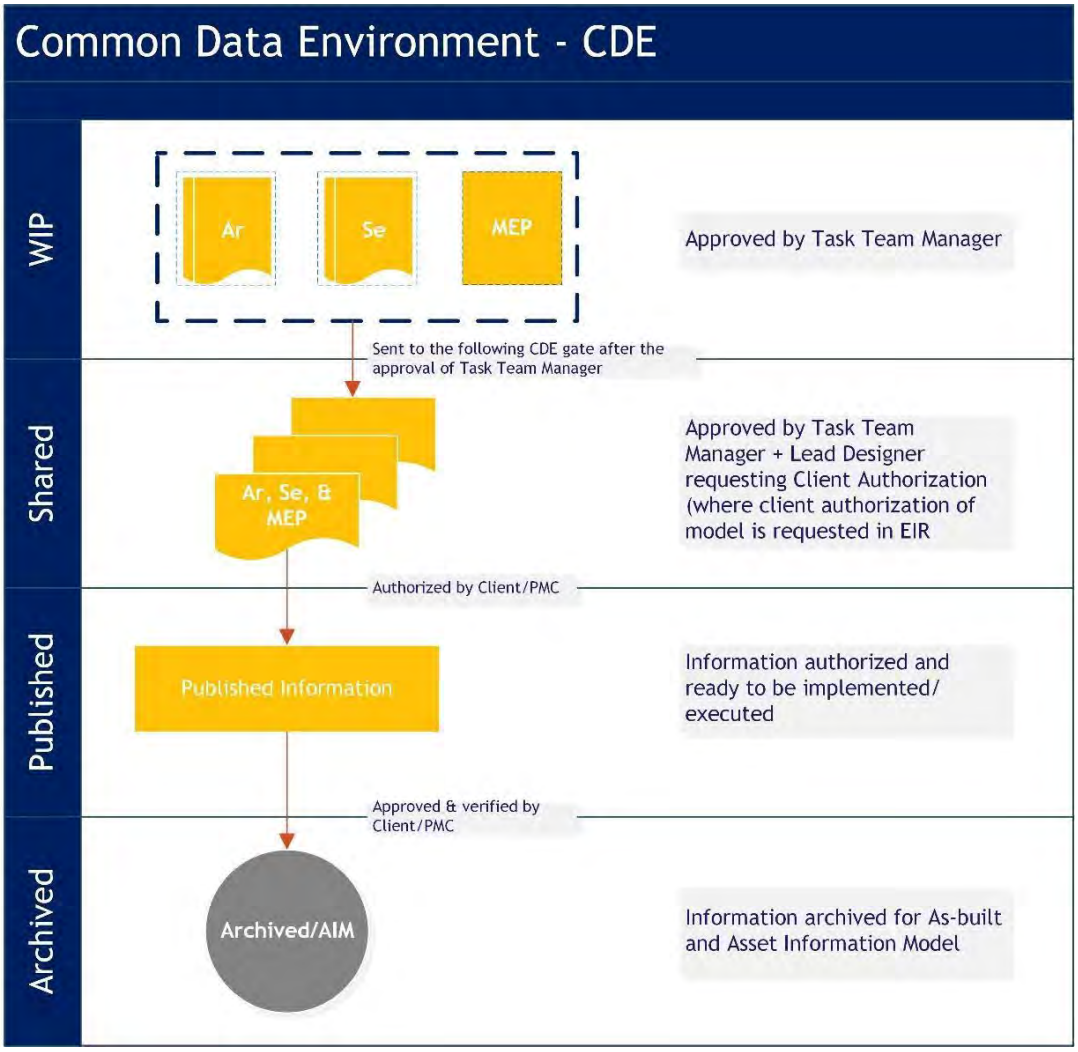


Figure 2 - CDE Illustration

Work in Progress

The "WIP" section of the CDE is used to store unapproved information such as non-verified design data for each organizational role such as architecture. To pass through the Approval Gate (Gate 1) a check, review and approval process shall be carried out before being issue to the Shared area.

Shared

The "Shared" section of the CDE is used to store Information which has been approved for sharing with other organizations to use as reference material for their own design development. When the design has been completed, the information shall be placed for authorization in the Appointing Party (Employer) Shared Area. To pass through the Authorized Gate (Gate 2) in the information in the Appointing Party Shared Area, shall be authorized by OBCC or their representative.

Published

The "Published Documentation" section of the CDE shall be used to hold published information such as co-ordination and validated design outputs for use by the total project team, e.g. production information suitable for tender or construction. This section concludes with the Verified Gate 3 which represents the transition to "archive".

Archived

The "Archive" section of the CDE shall store a record of the project history including all transaction and change orders.

c. Information Delivery Plan

i. Master Information Delivery Plan (MIDP)

The Master Information Delivery Plan (MIDP) is a primary plan which is used to manage the delivery of information during the project lifecycle. It should be developed by the project delivery manager in collaboration with the task team managers and then used by the project delivery manager to assist in the delivery of project information during the project. It should be addressed on Post-contract BIM Execution Plan.

Information deliverables which may be listed in the MIDP include (but are not limited to):

- Models
- Drawings or renditions
- Specifications
- Equipment schedules
- Room data sheets
- Procurement packages
- Reports
- Schedules

ii. Task Information Delivery Plan (TIDP)

The Task Information Delivery Plan (TIDP), is a federated list of information about deliverables by each task, including format, date and responsibilities.

It is the responsibility of each task team manager to compile their own TIDP which then assist in the development of the MIDP. Each task shall have a corresponding milestone that aligns to the overall design and construction programme, taking into consideration any sequencing requirements to produce information.

Each task shall also detail the responsibility of each appointed party (supplier)'s information and show how responsibility for the preparation of project documents transfer from one team to another.

d. Folder Structure

The defined structure shall follow the principles of British Standard which is the UK implementation of EN ISO 19650-1:2018 together with BS EN ISO 19650-2:2018: 'Work In Progress (WIP)', 'Shared', 'Published' and 'Archived' segregation of data within a designated set of folders.

When a project comprises of several separate elements such as multiple buildings, zones or areas, the BIM structure shall be maintained within a set of designated sub-folders representing the various project elements.

All project data shall be held within the standard project folder structure located on central network servers or appropriate Document Management technology. This includes all WIP components or assemblies.

All bidders shall submit their folder structure and highlight how the data will be segregated within it, also to be highlighted on the main 4 gates for CDE as per EN ISO 19650-1/2:2018.

e. File Formats and Sizes

All BIM models should be divided and segregated in a proper way with alignment of project site zones and levels.
The maximum file size that should be used is 300 MB, also it depends on LOD & LOI embedded within the models.

Type	Examples	Format	Version	Size
Documents	BEP	Docx, Pdf.	TBA	N/A
	Reports	Docx, Pdf, Xlsx		N/A
2D drawings	Design drawings	Native file format, Pdf, DWFx	TBA	10 mb
	Shop drawings			10 mb
	Illustrations & sketches			10mb
3D Models	Design model	Native file format, DWFx, IFC	TBA	250 mb
	Construction model			250 mb

Type	Examples	Format	Version	Size
	Asset model			300 mb
	Federated model	Native file format, DWFx, IFC		500 mb
	Coordination model	Native file format, DWFx, IFC		400 mb
Quantity takeoff	Design Qty model	Native file format, TBA	TBA	250 mb
	Construction Qty model	Native file format, TBA		250 mb
	Schedules	Xlxs		N/A
Project Control	5D model	Native file format, TBA	TBA	250 mb
Site management model	Logistics planning	Native file format, TBA	TBA	100 mb
	Crane movement	Native file format, TBA		100 mb

Table 25 - File Formats & Sizes

f. Exchange of Information – Timings & Procedures

This should be specific for each project and to be addressed in Post-contract BIM Execution Plan.

Information Exchange	File Sender	File Receiver	Frequency	Due Date or Start Date	Model/ File/ Document	Software	Format	File Exchange Type
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Table 26 - Information Exchange Log

Contractor/Consultant shall document all the information exchange and file transfers that will occur on the project.
The schedule of deliverables is subjected to change and shall be updated based on coordination. Validation meetings which shall be agreed by Project BIM Manager.

g. Quality Control Strategy

Contractor/Consultant are requested to submit/attach their Quality Control Plan/Strategy along with their BIM Execution Plan to show their process of how the manual & the automated quality control procedures “checklists & compliance Model checker” will be performed.

h. Ownership of Data

Please refer to the main RFP document.

i. Level of Information Need

According to BS EN 17412:2020 Level of Information Need LOIN is used to determine both the level of geometry detail, level of Information and the documentation for any given model element at an agreed project work stage, it is structured to:

- **Geometrical Information** that is responsible for the graphical representation of the modeled element in which the following will be taken into consideration:
  - Details: from simple to detailed.
  - Dimensionality: 1D, 2D and/or 3D
  - Location: Absolute or relative
  - Appearance: Monochromatic, Materialistic, Realistic, etc.
  - Parametric Behavior: Explicit, Constructive and/or Parametric
- **Alphanumerical Information** that is responsible for the information and data that shall be associated with modeled elements, the following shall be taken into consideration:

- The identification of the element: name, type, classification, index, etc.
- Information content that shall contain all the data which will be shared from suppliers and project parties.

- **Documentations** that shall be embedded within the modeled elements during the handover phase for the sake of the facility management and operation, these documents are and not limited to:
  - Reports.
  - Manuals.
  - Data Sheets
  - Schedules
  - Photos.
  - Catalogues.
  - Etc.

All project team members Consultants/Contractors shall follow Appendix 7, Level of Information Need during their BIM Execution.

j. BIM Audits

The Project Manager and/or Agent of Record (AOR) may, at any time during the Appointment period and without notice, perform audits on the Project BIM models and associated processes to determine the accuracy of the Project BIM information and adherence to the Contractor's approved/current BIM Plan.

The Contractor is obliged to facilitate these reviews and resolve any issues which the Project Manager or Agent of Record (AOR) find to be non-compliant.

6 Model Management

a. Introduction

The Model Management formalizes the level of information need (level of development-LOD) required at each project stage / data drop and defines which discipline is responsible to produce what project output and when. Model Management establishes an overall design level of maturity that does not apply to individual design elements but to the delivery.

Information mentioned below is to be used as a minimum, all bidders should submit their modelling strategy, model handing-over and model management plan.

b. Modelling Strategy and Data Segregation

The main purpose of segregating models is driven by performance. (Models shall be split by building, levels and disciplines) and according to project size and complexity.
Models shall consist of objects that resemble the building elements they represent at the given level of detail.
Rooms and spaces shall be modelled as objects.
The Lead Consultant/Contractor shall account for the model strategy and data segregation in the Contract BEP taking the MIDP and TIDP into account as well as requirements of the design team, (e.g. software to analyze a MEP system might require an unbroken system).

i. Starting View

A starting view/splash screen should be created for all WIP BIM models. The starting view should state the following:

- Project Information (location, name, title, built up area (BUA), etc.)
- Consultant/Contractor name
- Model discipline
- Project/sheet browser definitions
- Message center for updates and publishing dates
- Any notes that could be important and crucial

Consultant/Contractor should submit a sample of starting view with Post-contract BIM Execution Plan.

ii. Project Browser

Project browser shall be segregated according to the project phases and CDE gates, at the same coordination views should be created for the purpose of disciplines coordination and collaboration. Consultant and Contractor shall provide their browser categorization structure in BEP.

iii. Sheet Browser

Sheet browser shall follow MIDP & TIDP that will be submitted with BEP.

iv. Naming Conventions

Object and attribute naming conventions ensure that data can be reused for different applications in different software platforms. Consistent naming of attributes ensures reuse of data, automation of tasks, rule-based data extraction and the identification of the same object in different applications. All spaces shall be named consistently in all discipline models.

1. General Naming Conventions

a. Use only letters A-Z, hyphen, underscore and numbers 0-9 for all fields.
b. All fields shall be separated by a hyphen character "-". Do NOT use spaces.
c. Within a field, either Camel Case or an underscore "_" shall be used instead of a space to separate words.
d. A single period character "." shall be used to separate the file name from the extension. This character should not be used anywhere else in the file name.
e. The file extension shall not be amended or deleted.
f. An "XX" shall be used if the file does not refer a single specific zone or level.
g. The scheme for zone and level sub-division shall be agreed with the other project professionals at the outset and defined in the Project BIM Execution Plan document.
h. Elements where a naming convention is not explicitly defined by this Standard shall adopt the naming convention of existing elements and prefix with a 3-character abbreviation to identify corporate author.

2. Model File Naming (Example)

Naming of model files shall be based on EN ISO 19650:2018. For full compliance, recommended character restrictions should be adopted.
For a more accessible and simpler naming convention, all fields are optional. To maintain compliance, any variations should be clearly stated in the Project BIM Execution Plan.

1	2	3	4	5	6	7
Project	**Originator**	**Zone/System**	**Level**	**Type**	**Role**	**Revision**
WBH	SPML	CZ1	L02	3DC	AR	R00

Table 27 - File Naming (ex)

a. Field 1: **Project**
An abbreviated code or number identifying the project.
b. Field 2: **Originator Code** (Recommended 3 characters)
An abbreviated code identifying the originating stakeholder.
c. Field 3: **Zone/System** (Recommended 2 characters)
Identifier of which building, area, phase or zone of the project the model file relates to if the project is sub-divided by zones.
d. Field 4: **Level** (Recommended 2 characters)
Identifier of which level, or group of levels, the model file relates to if the project is sub-divided by levels.
e. Field 5: **Type** (Recommended 2 characters)
Document type, which will be M3 for 3D model files.
f. Field 6: **Role** (Recommended 2 characters)
2-character discipline identifier code
g. Field 7: **Revision** (Recommended 3 characters)

EN ISO 19650:2018 Examples:

Model File Name	Description
FTR-ACM-XX-XX-M3-S-School_Stage_E.rvt	Acme structures model for School project at Stage E – no zones or segregation of floors.
102-ACM-Z1-XX-M3-ME-School.dgn	Acme Building Services model for job 102, Zone 1 all levels.
G322-DoorInternal-826-P	Internal door of 826mm wide, intended for plan use at up to 1:50 scale.

Table 28 - Ex.

3. Objects (Example)

The naming of spaces and objects shall follow the NBS BIM Object Standard: Section 5 (1), or similar equivalent standard. The consultant/contractor shall provide their naming conventions matrix for all model elements to facilitate work categorization and filtering. All BIM model elements should follow the implemented matrix during all project stages and phases.

1	2	3	4	5	6
Role	Classification	Description	Originator	Size/item code	Type
WBH	SPML	CZ1	L02	3DC	AR

Table 29 - Object Naming (ex)

a. Field 1: Role *(Optional)*

Identifies the owner of the object. Normally this would be omitted as objects are generic; ownership is inferred by file/layer containing the object.

b. Field 2: Classification

Uniclass code to classify the object. This is positioned at the start of the name to allow easier listing of all specific object types. E.g. all furniture regardless of manufacturer.

Note: where the classification is applied as a property of an object, it can be omitted from the object name. However, the ability to search and organize objects should be carefully considered before dropping this field. The classification must be included in either the object name or its metadata.

c. Field 3: Description

Camel Case description based on Uniclass/AEC descriptions, e.g. ExternalFinishCladdingConcrete.

d. Field 4: Originator/Manufacturer *(Optional)*

Used if a proprietary object is required to represent specific manufacturer.

e. Field 5: Size / Originator item code *(Optional)*

Used to further define the object type by specifying dimensions or the manufacturer's item code. The latter can be used to help link objects directly to a specification, brochure or procurement.

f. Field 6: **Type**

This field uses a code to describe the intended "view" of the object.

Examples:

Object File Name	Description
G25-WallBrick-102.5-M3	Brick wall, 102.5mm wide, 3-dimensional, grade suitable for up to 1:50 models, (e.g. no brick bond defined or wall ties).
DoorInternal-M3	Generic internal door, not specifically sized, 3-dimensional, grade for schematic modelling purposes of ~1:200. Classification included as a property of the object.
G322-DoorInternal-826-P	Internal door of 826mm wide, intended for plan use at up to 1:50 scale.

Table 30 - Ex.

4. Parameters and Attributes

The naming of attributes shall follow the NBS BIM Object Standard: Section 2.4 and 5.1, or similar equivalent standard. Accordingly, the bidder is to provide a list of attributes with their agreed naming as part of the Post-Contract BEP. Parameters, or object properties, should be named in a consistent and logical manner to aid clarity and usability. Unique names should always be used.

5. Model Contents

All model contents as and not limited to (worksets, views, levels, filters, system families, loadable families, nominations, etc.) should follow a proper nomination structure such as The NBS to have a better categorization and filtering options.

6. Sheet Naming

Sheet naming shall be based on the document and drawing numbering protocols established for the project. These names automatically match the text as it appears in the title block and any schedules.

c. Family/Element Creation and Contents

For a proper file management and family creation, important steps and conditions should be followed while creating families and loaded to BIM models:

- Have no warnings or exceptions
- Have intuitive and neat parameters
- Include standard types or type catalogs
- Contain Uniform Resource Locator (URL) parameters
- Have the right amount of data
- Have data with thoughtful organization
- Include materials
- Differentiate appropriately between Type and Instance Parameters
- Be of minimal file size
- Appropriately consider the Level of Detail (LOD) – as per the model will be loaded into
- Include shared parameters
- Include helpful options specific to the scenario
- Be modelled in a version of Revit from a few years ago
- Be placed under an appropriate category
- Not some other file type dropped into Revit
- Can be complex, but not complicated
- Contain all appropriate parameters as per appendix 7, Level of Information Need

d. Classification Systems

Classification systems are to be mapped/implemented with all applicable project elements and all international and OBCC codes:

No.	Project BIM Uses	Standards/codes
1	Construction Schedules	OBCC WBS Activity ID
2	Cost Information	OBCC CBS NRM – RICS code POMI
3	Quantifications	NRM – RICS code POMI Standards POMI
4	Elements Coding – Design Phase	Uniformat Class CSI code NBS Code
5	Elements Coding – Construction Phase	Uniformat Class CSI code NBS code
6	Elements Coding – Assets	COBie OBCC Assets code
7	Design Stages Information	Uniformat OBCC Asset code

Table 31 - Classification Systems

e. Geospatial Information, Origin & Survey Point

The purpose of this section is to define requirements for the common coordinate system for all BIM data. A coordinate origin/system of 3 dimensions (X, Y, Z) is to be used to place graphical models, for example Ordnance Survey locators, with respect to an agreed origin. Using the same coordinate system, avoids having to move and transpose models when federating them, e.g. for 3D Coordination.

OBCC requires that all models use an agreed coordinate system. All models shall overlay one another without having to apply any additional relocation or conversion activities. The coordinate system shall be agreed upon and documented in the BEP.

7 Resources Management

This section describes the roles and responsibilities in relation to BIM. Bidders must provide a proposed Organizational Chart for their BIM Teams along with CVs and roles and responsibilities in their BEP.

In case that Consultant/Contractor outsourced some/all of their BIM work, this shall be mentioned clearly in the BIM Execution Plan, compliance assessment should be carried out also for the outsourced BIM companies.

a. Overview

Information Requirements specify the minimum requirements and specifications for BIM. The requirements are authorized by OBCC BIM lead, supported by the OBCC BIM Committee which will review/support the implementation of BIM on the project.
The Lead Consultant and later the Main Contractor will lead the BIM application by conducting and leading the BIM uses, and update the Post-Contract BEP and MIDP/TIDPs. The Lead Consultant, Cost Consultant, Main Contractor, as well as the tier 3 suppliers, all need to participate in BIM by contributing to the Post-Contract BEP, providing models and conducting BIM use related activities as specified in this EIR document.

b. Roles & Responsibilities (Organizational)

Bidders must include their BIM team in an organizational level, Bidders are requested to provide their expected BIM team and to define the role s and responsibilities for each team member.

c. BIM Awareness Sessions – Project Team

Awareness sessions are to be conducted and to be separated from BIM Meetings (section 5.1.1), awareness sessions will be conducted by Contractor, Consultant and/or third party if needed.

Awareness Session	Occurrence	Participants	Demonstrator	Location
General BIM Awareness	Once	TBA	TBA	TBA
BIM uses across the project	Once	TBA	TBA	TBA
BIM Common Data Environment	Once	TBA	TBA	TBA
Site Management Platform	As requested,	TBA	TBA	TBA
Collaboration Platform	As requested,	TBA	TBA	TBA
VR/AR	As requested,	TBA	TBA	TBA
iPad usage for BIM collaboration/site manage	As requested,	TBA	TBA	TBA

Table 32 - Awareness Sessions

d. BIM Specific Competence Assessment (Appendix 10)

The bidder's submission shall account for their organizations' as well as their Consultants' competences and experiences related to:

- BIM capability and experience
- Evidence of BIM execution planning
- Confirmation of BIM applications used
- Details of BIM workload and resourcing
- Total number of BIM resources (details and curriculum vitae)

Assessment forms will be sent with bidding documents at time of bidding (Appendix 10).

e. Project Deliverables

Each (LCEC, LDC, CC, GC & PMC) are responsible for their project deliverables that were mentioned in appendences attached with EIR/OIR.

All project deliverables for Master Information and Task Information shall be filled in Appendix 8, Information Delivery Plan.

f. Compliance Plan

i. Post-Contract BIM Execution Plan

In case of award Consultants/Contractors should submit a full detailed Post-contract BEP in which all EIR should be addressed and highlighted accordingly in 2 weeks-time from the date of signing the contract.

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Redevelopment of

Maharaja Krushna Chandra Gajapati (M.K.C.G.)

Medical College & Hospital as an

AIIMS Plus Institute (2000 + Beds Strength),

Brahmapur, Ganjam (Odisha).

MKCG PROPOSED SITE PLAN



BUILDINGS:

1.Hospital Block (450 Beds) B+G+10
2.Ess-01 (B+G+2)
3.Indoor Stadium (B+G+1)
4.Surgeon Gents Hostel (150 Units) + Guest House (25 Units)
5.Surgeon Ladies Hostel (150 Unit)
6.Ug Girls Hostel (300 Capacity)
7.Residence – Type –IVA & IVB (52 Units)
8.Residence – Type -IIA & IIB(52 Units)
9.Club House
10.Pharmacy College (180 Admissions Annually) B+G+5
11.Boys Hostel (Pharmacy) (288 Capacity) B+S+13
12.Girls Hostel (Pharmacy) (192 Capacity) B+S+9
13.Dental College (77 Admissions Annually) B+G+7
14.Boys Hostel (Dental) (152 Capacity) B+S+11
15.Girls Hostel (Dental) (152 Capacity) B+S+11
16.Ess – (G+2)

MKCG AERIAL VIEW



CLUB HOUSE



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

DENTAL BOYS HOSTEL



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

DENTAL GIRLS HOSTEL



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

HOSPITAL BLOCK



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

INDOOR STADIUM



PHARMACY GIRLS HOSTEL



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

RESIDENCE TYPE -2



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

RESIDENCE TYPE -4



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

SURGEON FEMALE HOSTEL



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

SURGEON MALE HOSTEL



MAHARAJA KRUSHNA CHANDRA GAJAPATI MEDICAL COLLEGE & HOSPITAL, BRAHMAPUR, ODISHA

DDF Consultants
Private Limited

DATE: - 30/01/2024

Annexure-D

A REPORT

ON

SUBSOIL INVESTIGATION FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) M E D I C A L COLLEGE & H O S P I T A L AT BRAHMAPUR, GANJAM (ODISHA)

Submitted to:

M/S. DDF CONSULTANTS PVT. LTD.

NEW DELHI

Executed by:

SUVADRA CONSULTANTS

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PREFACE:-

Before design the foundation for a proposed structure the designer requires the subsoil exploration test result to know the engineering properties of the subsoil strata as well as the SBC of the foundation soil met at different depths. The designer confirms the type of foundation as well as the dimension of the footing perfectly and economically ascertaining the subsoil properties and the SBC of the foundation soil evaluated at different depths. In view of this during execution the site in charge decided to explore the subsoil strata at the proposed site for the **GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA).**With an instruction to make the three Boreholes in order to the Sub Soil Strata met at different depths.

Accordingly the geotechnical investigation were carried out both in the field and laboratory to know the Sub-soil character and different Engineering properties of the Sub-soil strata met at different depths. SPT samples collected at different depths were brought to the laboratory to determine its physical properties, as per its relevant IS codes.

Test result of all the soil samples collected at different depths have been presented in the Sub-soil investigation test result. Soil samples collected at different depths with its graphical representation have also been presented in the test report.

CONTENTS

Sl no	Particulars
1	**Introduction**
2	**Field Operations**
3	**Information about Laboratory Tests**
4	**Bore Logs**
5	**Laboratory Test Result**
6	**Calculation of Safe Bearing Capacity**
7	**Settlement calculation**
8	**Allowable bearing pressure of rock**
8	**Analysis of the Sub Surface Investigation**
9	**Abstract of Safe Bearing Capacity soil & rock**
10	**Recommendation**

M/s.Suvadra Consultants.

1.0 Introduction

Sub-surface exploration plays an important role in the design for the construction of buildings. Before design, it is essential to study the behavior as well as the engineering properties of the sub-surface strata, which promotes the design more economic and perfect. It also enables to take precaution in the design for the structural safety. **GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA).**Was decided to be designed on the basis of the sub-surface investigation test results. As such **DDF Consultants Private Limited.**Entrusted the sub-surface investigation work to**M/s Suvadra Consultants.** The scope of work comprised of boring three boreholes at site. The fieldwork included making of borehole by Rotary drilling method. The scope also included conducting Standard Penetration Tests at regular intervals and collecting soil samples for identification and logging purposes, and the collected soil samples were tested in the Base Laboratory and the data were analyzed.

Based on the above, this report presents the Bore Logs, Laboratory & Field Test results. On the basis of field & laboratory test results and their analysis, suitable foundations have been suggested.

2.0 Field Operations

2.1 General:

In an attempt for optimization in the design of foundation for the proposed structure to be constructed at this site, Geo-technical Investigation was done. The entire investigation work had been divided mainly into two parts. (i) Field works & (ii) Laboratory tests.

- Field works determine the types of sub-soil deposit and their characteristics.
- Laboratory tests help in determining the relevant geo-technical properties of the sub-surface deposits leading to finalization of foundation depth of the structure basing on Bearing Capacities of the foundation strata as well as the influence zone.

Final depths of boring and observation of water table for each borehole are given below.

2.2 Boring & In-Situ Tests:

Wash boring method was adopted to bore holes to the required depth. UDS & SPT were conducted at regular intervals and the soil samples were brought to the laboratory with proper identification and labeling. Standard split spoon sampler was used for conducting Standard Penetration Test. The number of blows required to drive the sampler for the 1st, 2nd & 3rd 15cm depths were recorded. The total number of blows required to drive the split spoon sampler due to the free fall of a 63.5kg hammer through a distance of 75 cm for the 2nd and 3rd 15cm penetration were taken together as the field 'N' value or the standard penetration test (resistance) of the soil.

After the penetration to full depth, the sampler was carefully pulled out. The cutting shoe and the head were removed. The soil samples were then sealed in polythene bags and labeled properly by indicating the depth of bore hole mark, reference no. etc for visual inspection and identification of soil samples for logging of the bore holes.

The field 'N' values recorded at various depths have been reported in the summarized data sheet. Test results of soil samples & their bore logs were presented separately in the sub-soil report.

Based on the above, this report presents the Bore Logs, Laboratory & Field Test results.

Undisturbed soil samples were carefully extracted in such a manner that the moisture content and structure of soil did not get altered. Standard open tube sampler was used for the collection of undisturbed soil samples. Each end of the sampling tube was carefully sealed with wax, the bore hole number and depth were indicated on the tube for proper identification.

2.3 Sampling:

Representative soil samples were collected from the borehole confirming to IS: 1892-1979. Collected samples were properly sealed in polythene bags and labeled for proper identification during testing. The disturbed samples were used for classification of soils as per IS: 1498-1970.

2.4 Ground Water Table:

Observation of ground water table is important since it influences the bearing capacity of soil in different seasons. When the foundation remains submerged under water the bearing capacity is to be calculated considering the water table correction factor. Therefore while conducting tests during rainy season, it is always necessary to enquire about the ground water table level.

Bore Hole No./Location		Termination Depth in m.	R.L in (m)	Co-ordinate		Water Table from the G.L. in m.
				E	N	
BH-01	Brahmapur	15.0	38.702	----	----	2.0m
BH-02		15.0	40.788	----	----	2.3m
BH-03		15.0	38.664	----	---	1.3m

3.0 Laboratory Tests

Laboratory test conforming to relevant Indian Standard specifications were conducted on the soil samples collected from both the boreholes as detailed below. All laboratory tests were conducted as per SP: 36 Part-1 1987 of BIS.

3.1 Grain Size Analysis:

To obtain information concerning the type of soil met at various depths and to classify each soil strata, grain size analysis were carried out as per IS: 2720 (Part-IV). The results have been presented in the summarized data sheet.

3.2 Index Properties:

Soil consistency refers to the resistance of the soil offered against forces that tend to deform or rupture the soil aggregate. Consistency limits indicate the soil moisture content limits for various states of consistency. The consistency limits include Liquid Limit (L.L) and Plastic Limit (P.L). The difference between the numerical values of liquid limit and plastic limit of the soil is called the Plasticity Index (P.I). It indicates the range of moisture content over which the soil exhibits plasticity. It is determined as per the procedure laid down in IS: 2720 (Part-IV). Plasticity index was computed. Results of liquid limit and plasticity index have been reported in the summarized data sheets.

3.3 Specific Gravity:

The specific gravity of the soil sample is the ratio of the mass of a given volume of soil sample in air to the mass of an equal volume of water at 270C. Specific gravity of soil sample was determined as per the provisions of IS: 2720 (Part –III). Specific gravity of soil sample obtained during the test has been reported in the summarized data sheet.

3.4 Void Ratio:

Void ratio of different soil samples were determined in through appropriate formula.

3.5 DFS:

Differential free swell index of different soil samples were determined in the laboratory and are mentioned in the laboratory test result sheet.

3.6 Final Logging:

The logging of the boreholes as obtained during field work were checked with the disturbed and undisturbed soil samples and scrutinized with the findings of laboratory tests to avoid discrepancies, if any. The bore logs have been reported in the summarized data sheets.

3.7 Results of Test:

The findings of various in-situ and laboratory tests conducted on disturbed /SPT samples have been reported in the summarized data sheet. The soil has been classified into different categories base on their Engineering properties. A careful study of the sub soil strata was made in accordance with the provisions of IS: 1498-1970 to find out their suitability as foundation materials.

4.0 .BORELOG DATA SHEET

NAME OF THE CONSULTANT: M/s.SUVADRA CONSULTANT.
NAME OF CLIENT:DDF CONSULTANTS PRIVATE LIMITED.
NAME OF THE WORK: GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA) .
LOCATION: BRAHMAPUR.
TYPE OF BORING:WASH BORING
DIAMETER OF BORING :150MM
INCLINATION: VERTICAL
GROUND WATER TABLE: 2.0M WITH BELOW OGL.

BH No:01
Date of Commencement-18/01/2024
Date of Completion-21/01/2024

Sl. No	Thickness of soil strata in m.	R.L. in mt. (R.L. = 38.702m)	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in cm.	Core Recovery IN %	RQD IN %	Remarks
01	0.5	38.202m		0.5	Field up soil	DS	----	----	----	----	----	----	----	DS Sample Collected
02		37.202m		1.5m	Clay mixed with gravels & sand	SPT	10	15	17	32	45cm	----	----	SPT Sample Collected
03	5.5	35.702m		3.0m		SPT	15	16	20	36	45cm	----	----	SPT Sample Collected
04		34.202m		4.5m		SPT	18	22	27	49	45cm	----	----	SPT Sample Collected
05		32.702m		6.0m		SPT	20	25	30	55	45cm	----	----	SPT Sample Collected
06	1.5	31.202m		7.5m	Weather Rock	SPT/DS	35	>50	>50	>50	16cm	----	----	SPT Sample Collected
07		29.702m		7.5m to 9.0m	Fracture Rock	F.Rock	Fracture Rock Sample collected.					2%	Nil	7.5m to 13.0m depth is Fracture rock strata which core sample collected, but RQD percent NIL
08	5.5	28.202m		9.0m to 10.5m		F.Rock	Fracture Rock Sample collected.					3%	Nil	
09		26.702m		10.5m to 12.0m		F.Rock	Fracture Rock Sample collected.					5%	Nil	
10		25.702m		12.0m to 13.0m		F.Rock	Fracture Rock Sample collected.					3%	Nil	
11		24.702m		13.0m to 14.0m	Hard Rock	Rock	Rock Sample collected					39%	32%	----
12		23.702m		14.0m to 15.0m		Rock	Rock Sample collected					45%	35%	----
13		22.702m		15.0m to 16.0m		Rock	Rock Sample collected					49%	39%	----
14	7.0	21.702m		16.0m to 17.0m		Rock	Rock Sample collected					52%	43%	----
15		20.702m		17.0m to 18.0m		Rock	Rock Sample collected					55%	47%	----
16		19.702m		18.0m to 19.0m		Rock	Rock Sample collected					63%	51%	----
17		18.702m		19.0m to 20.0m		Rock	Rock Sample collected					65%	52%	----

NAME OF THE CONSULTANT: M/s.SUVADRA CONSULTANT.
NAME OF CLIENT:DDF CONSULTANTS PRIVATE LIMITED.
NAME OF THE WORK: GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA) .
LOCATION: BRAHMAPUR.
TYPE OF BORING:WASH BORING
DIAMETER OF BORING :150MM
INCLINATION: VERTICAL
GROUND WATER TABLE: 2.30M WITH BELOW OGL.

BH No:02
Date of Commencement-22/01/2024
Date of Completion-23/01/2024

Sl. No	Thickness of soil strata in m.	R.L. in mt. (R.L. = 40.788m)	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in cm.	Core Recovery IN %	RQD IN %	Remarks
01	0.5	40.288m		0.5	Field up soil	DS	---	---	---	---	---	---	---	DS Sample Collected
02	5.5	39.288m		1.5m	Clay mixed with gravels & sand	SPT	7	8	10	18	45cm	---	---	SPT Sample Collected
03		37.788m		3.0m		SPT	9	11	13	24	45cm	---	---	SPT Sample Collected
04		36.288m		4.5m		SPT	13	14	19	33	45cm	---	---	SPT Sample Collected
05		34.788m		6.0m		SPT	17	19	20	39	45cm	---	---	SPT Sample Collected
06	1.5	33.288m		7.5m	Weather Rock	SPT	35	>50	>50	>50	17cm	---	---	SPT Sample Collected
07	5.5	31.788m		7.5m to 9.0m	Fracture Rock	F.Rock	Fracture Rock Sample Collected.					2%	Nil	7.5m to 13.0m depth is Fracture rock strata which core sample collected,but RQD percent NIL.
08		30.288m		9.0m to 10.5m		F.Rock	Fracture Rock Sample Collected.					3%	Nil	
09		28.788m		10.5m to 12.0m		F.Rock	Fracture Rock Sample Collected.					Nil	Nil	
10		27.788m		12.0m to 13.0m		F.Rock	Fracture Rock Sample Collected.					2%	Nil	
11	7.0	26.788m		13.0m to 14.0m	Hard Rock	Rock	Rock Sample collected					35%	29%	---
12		25.788m		14.0m to 15.0m		Rock	Rock Sample collected					39%	30%	---
13		24.788m		15.0m to 16.0m		Rock	Rock Sample collected					43%	39%	---
14		23.788m		16.0m to 17.0m		Rock	Rock Sample collected					49%	45%	---
15		22.788m		17.0m to 18.0m		Rock	Rock Sample collected					55%	51%	---
16		21.788m		18.0m to 19.0m		Rock	Rock Sample collected					57%	53%	---
17		20.788m		19.0m to 20.0m		Rock	Rock Sample collected					59%	57%	---

NAME OF THE CONSULTANT: M/s.SUVADRA CONSULTANT.
NAME OF CLIENT:DDF CONSULTANTS PRIVATE LIMITED.
NAME OF THE WORK: GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA) .
LOCATION: BRAHMAPUR.
TYPE OF BORING:WASH BORING
DIAMETER OF BORING :150MM
INCLINATION: VERTICAL
GROUND WATER TABLE:1.30M WITH BELOW OGL.

BH No:03
Date of Commencement-24/01/2024
Date of Completion-26/01/2024

Sl. No	Thickness of soil strata in m.	R.L. in mt. (R.L. = 38.664m)	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in cm.	Core Recovery IN %	RQD IN %	Remarks
01	1.5	38.164m		0.5	Sand mixed with silty clay	DS	---	---	---	---	---	---	---	DS Sample Collected
02		37.164m		1.5m		SPT	10	15	20	35	45cm	---	---	SPT Sample Collected
03	4.5	35.664m		3.0m	Weather Rock	SPT	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							1.5m to 6.0m depth is Weather rock strata which core sample not collected only washout sample (DS) collected
04		34.164m		4.5m		SPT	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
05		32.664m		6.0m		SPT	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
06	4.5	31.164m		6.0m to 7.5m	Fracture Rock		Fracture Rock Sample collected.					Nil	Nil	6.0m to 10.5m depth is Fracture rock strata which core sample collected,but RQD percent NIL.
07		29.664m		7.5m to 9.0m		F.Rock	Fracture Rock Sample collected.					Nil	Nil	
08		28.164m		9.0m to 10.5m		F.Rock	Fracture Rock Sample collected.					2%	Nil	
09	9.5	26.664m		10.5m to 12.0m	Rock	Rock	Rock Sample Collected					29%	20%	---
10		25.664m		12.0m to 13.0m		Rock	Rock Sample Collected					30%	23%	---
11		24.664m		13.0m to 14.0m		Rock	Rock Sample Collected					35%	29%	---
12		23.664m		14.0m to 15.0m		Rock	Rock Sample Collected					41%	33%	---
13		22.664m		15.0m to 16.0m		Rock	Rock Sample Collected					45%	38%	---
14		21.664m		16.0m to 17.0m		Rock	Rock Sample Collected					50%	42%	---
15		20.664m		17.0m to 18.0m		Rock	Rock Sample Collected					53%	47%	---
15		19.664m		18.0m to 19.0m		Rock	Rock Sample Collected					59%	51%	---
15		18.664m		19.0m to 20.0m		Rock	Rock Sample Collected					63%	58%	---

5.0 Result sheet

SUVADRA CONSULTANTS																				
BORE HOLE -01																				
Soil Clasification	Sample Collected at Depth in Mtrs.	Type of Sample Collected	SPT (N) VALUE	SOIL ENGINEERING PROPERTIES															ROCK ENGINEERING PROPERTIES	
				Grain Size					ATERBERG LIMIT IN %			Bulk Density in g/cc(ASSUMED)	Dry Density in g/cc	Specific Gravity	Natural Moisture Content (%)	Void Ratio (e)	Free swelling index in %	SHEAR TEST		Core Recovery (%)	RQD (%)
				Gravel %(10mm to 4.75mm)	Coarse Sand % (4.75 mm to 2.0mm)	Medium Sand % (2.00mm to 0.425mm)	Fine Sand % (0.425mm to 0.075mm)	Silt & Clay % (0.075mm to 0.001mm)	Liquid Limit in %	Plastic Limit in %	Plastic Index in %							Cohesion (C) (Kg/Cm^2)	Angle of Internal Friction (Φ) (Degree)		
SC	0.5	DS	-	14.25	16.87	14.03	19.01	35.84	28.0	18.0	10.0	1.845	1.630	2.68	13.2	0.64	10	-	-	-	-
SC	1.5	SPT	32	17.01	18.06	15.08	17.03	32.82	28.0	18.0	10.0	1.846	1.626	2.68	13.5	0.65	10	-	-	-	-
SC	3.0	SPT	36	18.09	20.03	13.88	14.03	33.97	27.0	17.0	10.0	1.852	1.640	2.68	12.9	0.63	10	-	-	-	-
SC	4.5	SPT	49	20.07	19.69	14.08	17.02	29.14	27.0	17.5	9.5	-	-	2.67	13.2	-	0	-	-	-	-
SC	6.0	SPT	55	22.05	20.05	15.68	18.96	23.26	27.0	18.0	9.0	-	-	2.67	13.4	-	0	-	-	-	-
---	7.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	7.5m to 9.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	2%	NIL
---	9.0m to 10.5m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	3%	NIL
---	10.5m to 12.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	5%	NIL
---	12.0m to 13.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	3%	NIL
---	13.0m to 14.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	39%	32%
---	14.0m to 15.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	45%	35%
---	15.0m to 16.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	49%	39%
---	16.0m to 17.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	52%	43%
---	17.0m to 18.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	55%	47%
---	18.0m to 19.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	63%	51%
---	19.0m to 20.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	65%	52%

SUVADRA CONSULTANTS

BORE HOLE -02

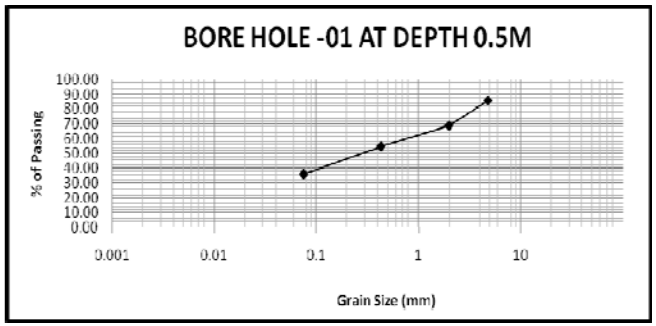
Soil Clasification	Sample Collected at Depth in Mtrs.	Type of Sample Collected	SPT (N) VALUE	SOIL ENGINEERING PROPERTIES																ROCK ENGINEERING PROPERTIES	
				Grain Size					ATERBERG LIMIT IN %			Bulk Density in g/cc(ASSUMED)	DryDensity in g/cc	Specific Gravity	Natural Moisture Content (%)	Void Ratio (e)	Free swelling index in %	SHEAR TEST			
				Gravel % (10mm to 4.75mm)	Coarse Sand % (4.75 mm to 2.0mm)	MediumSand % (2.00mm to 0.425mm)	Fine Sand % (0.425mm to 0.075mm)	Silt & Clay % (0.075mm to 0.001mm)	Liquid Limit in %	Plastic Limit in %	Plastic Index in %							Cohesion (C) (Kg/Cm^2)	Angle of Internal Friction(Ø) (Degree)	Core Recovery (%)	R.Q.D (%)
SC	0.5	DS	-	13.02	16.01	15.13	18.69	37.15	29.0	18.5	10.5	1.835	1.627	2.67	12.8	0.64	10	-	-	-	-
SC	1.5	SPT	18	17.85	18.36	16.45	18.02	29.32	28.0	18.0	10.0	1.842	1.629	2.67	13.1	0.64	10	-	-	-	-
SC	3.0	SPT	24	17.96	19.02	16.52	19.38	27.12	28.0	17.3	10.7	1.849	1.638	2.67	12.9	0.63	10	-	-	-	-
SC	4.5	SPT	33	18.34	18.96	14.98	18.91	28.81	27.0	17.5	9.5	-	-	2.67	12.8	-	0	-	-	-	-
SC	6.0	SPT	39	23.02	16.25	15.03	16.02	29.68	26.0	17.5	8.5	-	-	2.67	13.0	-	0	-	-	-	-
---	7.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	7.5m to 9.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	2%	NIL
---	9.0m to 10.5m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	3%	NIL
---	10.5m to 12.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	NIL	NIL
---	12.0m to 13.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	2%	NIL
---	13.0m to 14.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	35%	29%
---	14.0m to 15.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	39%	33%
---	15.0m to 16.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	43%	39%
---	16.0m to 17.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	49%	45%
---	17.0m to 18.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	55%	51%
---	18.0m to 19.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	57%	53%
---	19.0m to 20.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	59%	57%

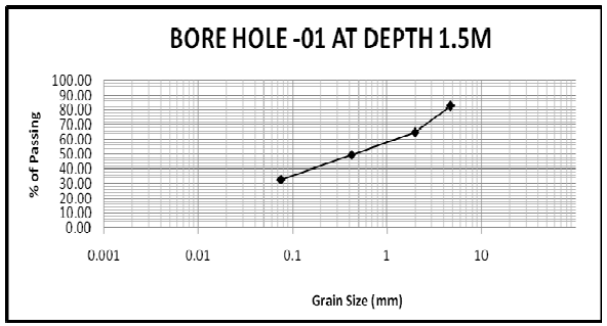
SUVADRA CONSULTANTS

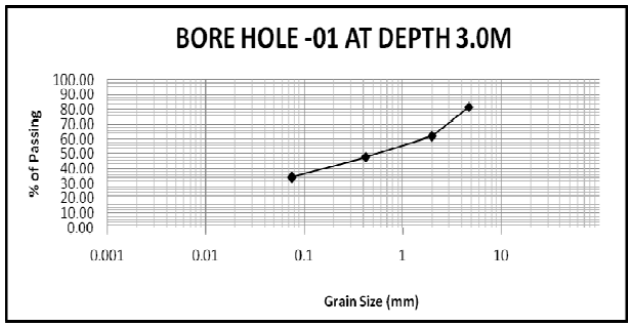
BORE HOLE -03

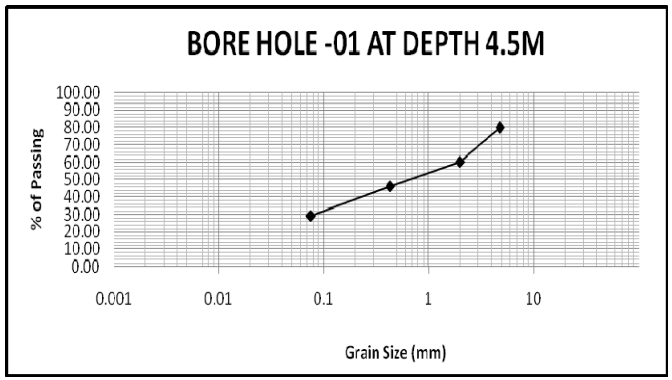
Soil Classification	Sample Collected at Depth in Mtrs.	Type of Sample Collected	SPT (N) VALUE	SOIL ENGINEERING PROPERTIES																ROCK ENGINEERING PROPERTIES	
				Grain Size					ATERBERG LIMIT IN %			Bulk Density in g/cc(ASSUMED)	Dry Density in g/cc	Specific Gravity	Natural Moisture Content (%)	Void Ratio (e)	Free swelling index in %	SHEAR TEST		Core Recovery (%)	RQD (%)
				Gravel % (10mm to 4.75mm)	Coarse Sand % (4.75 mm to 2.0mm)	Medium Sand % (2.00mm to 0.425mm)	Fine Sand % (0.425mm to 0.075mm)	Silt & Clay % (0.075mm to 0.001mm)	Liquid Limit in %	Plastic Limit in %	Plastic Index in %							Cohesion (C) (Kg/Cm^2)	Angle of Internal Friction(Ø) (Degree)		
SC	0.5	DS	-	10.23	14.25	17.02	18.69	39.81	29.0	18.0	11.0	1.849	1.638	2.68	12.9	0.64	10	-	-	-	-
SC	1.5	SPT	35	16.14	15.02	18.96	19.05	30.83	28.0	18.0	10.0	1.854	1.644	2.66	12.8	0.62	10	-	-	-	-
---	3.0	SPT	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	4.5	SPT	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	6.0	SPT	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	6.0m to 7.5m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	NIL	NIL
---	7.5m to 9.0m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	NIL	NIL
---	9.0m to 10.5m	F.Rock	Fracture Rock Strata. were collected during boring. Total Core Recovery																	2%	NIL
---	10.5m to 12.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	29%	20%
---	12.0m to 13.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	30%	23%
---	13.0m to 14.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	35%	29%
---	14.0m to 15.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	41%	33%
---	15.0m to 16.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	45%	38%
---	16.0m to 17.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	50%	42%
---	17.0m to 18.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	53%	47%
---	18.0m to 19.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	59%	51%
---	19.0m to 20.0m	Rock	Rock Strata. were collected during boring. Total Core Recovery																	63%	58%

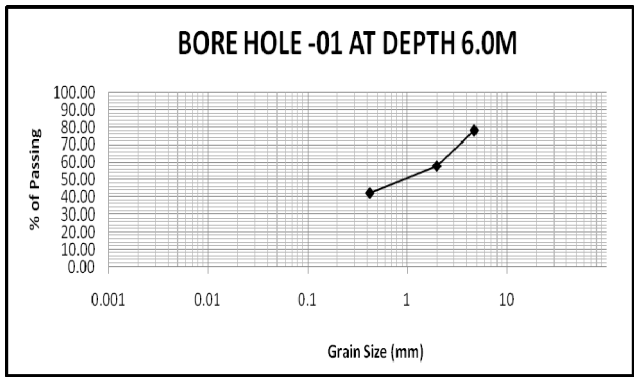
GRAIN SIZE CURVE(% FINNER)

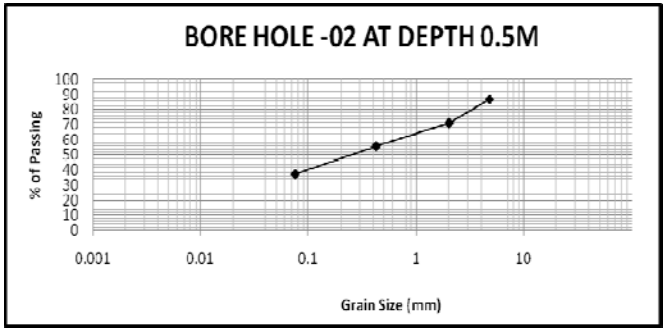


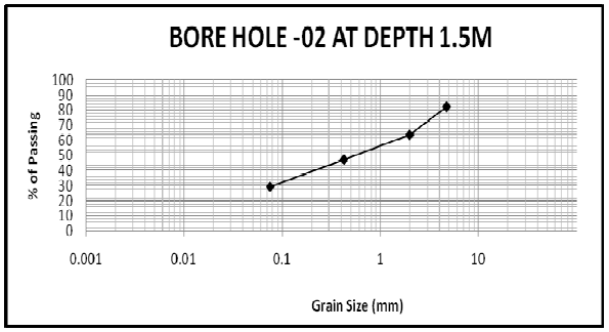


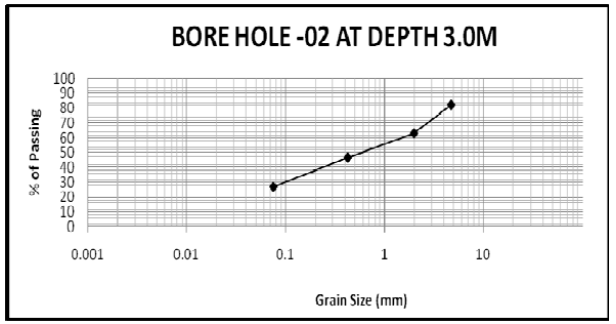


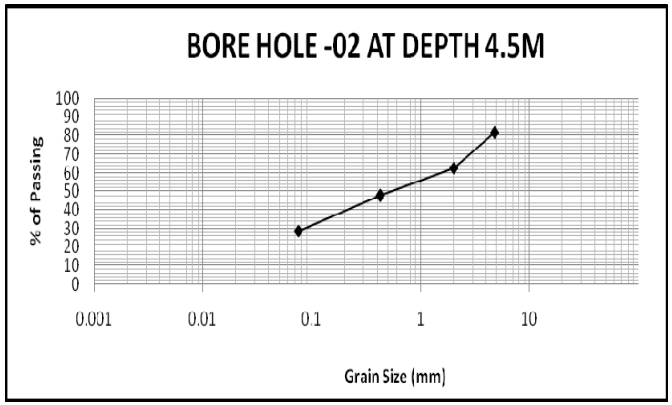


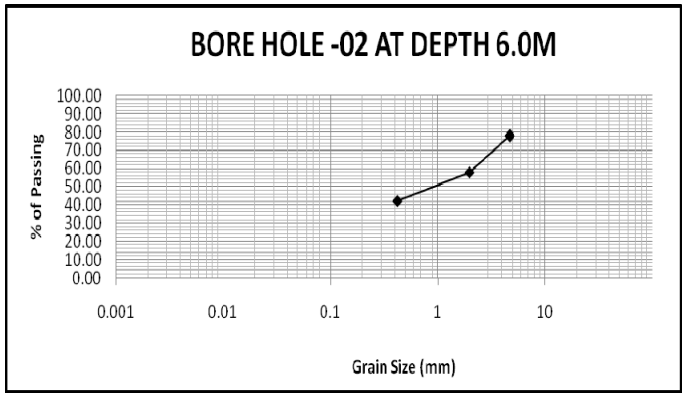


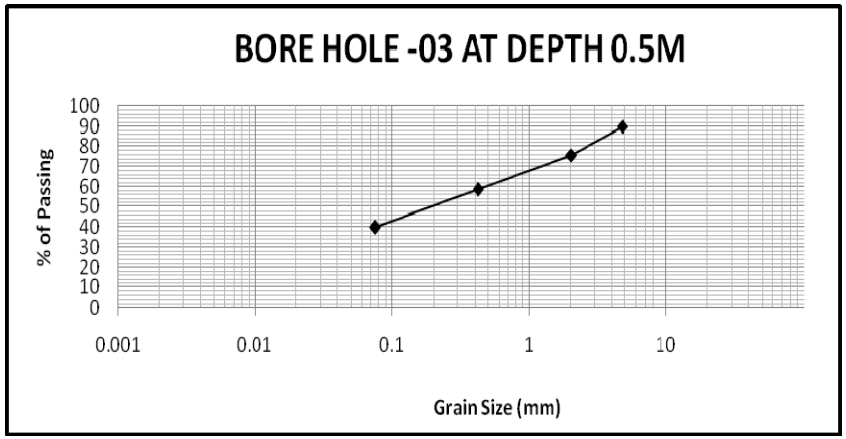

BORE HOLE -02 AT DEPTH 0.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)

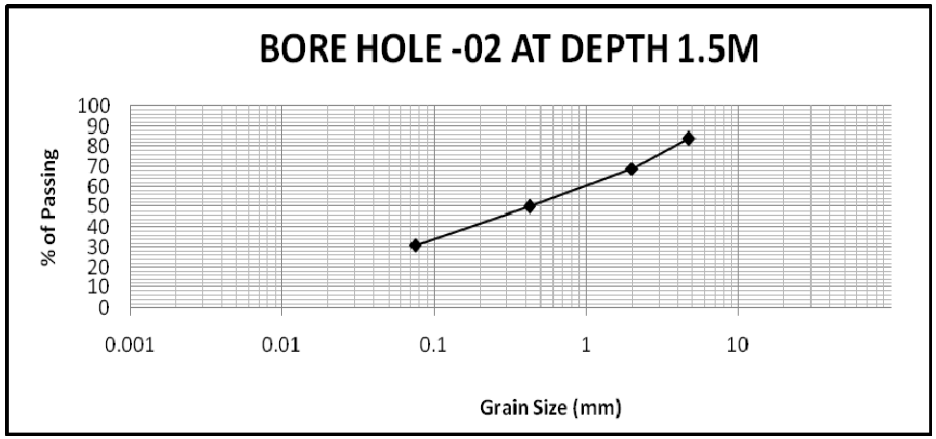

BORE HOLE -02 AT DEPTH 1.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -02 AT DEPTH 3.0M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -02 AT DEPTH 4.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -02 AT DEPTH 6.0M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -03 AT DEPTH 0.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -02 AT DEPTH 1.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)

6.0 SAFE BEARING CAPACITY.

SUVADRA CONSULTANTS

GEO - TECHNICAL INVESTIGATION &

FOUNDATION ENGINEERING.

SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :						
Bore Hole No.	:	1				
Field SPT (N) Value	:	32				
Depth (Df)	:	1.5	m			
Depth of water table	:	2.0	m			
2.As per the Lab report :						
Specific gravity		2.68				
Submersible weight (γ_{sub})		10.00	KN/m^3			
Correction factor for cohessionless soil		1	Strata below water table			
Correction for overburden (N')		32	contains fine sands and		**YES**	
Due to Dilatancy (N'')		23.5	silts			
Angle of shearing resistance (ϕ)		34.4	Degree			
ϕ'		24.6	Degree			
3. Assumptions						
Width of Foundation (B)		2	m			
Length of foundation (L)		2	m			
Type of footing	:	Square				
4. Calculation						
Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated						
As per IS: 6403 Clause-5.2.2.1						
Over burdern pressure (q)		15	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	31.51			
		N_y =	44.95			
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	10.32			
	:	N'_y =	10.44			
Shape Factors	:	S_q =	1.2			
	:	S_y =	0.8			
Depth Factors	:	d_q =	1.14			
	:	d_y =	1.14			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	1.0				
Difference in Nq	:	21.19				
Difference in Ny	:	34.51				
From interpolation Nq	:	27.27				
From interpolation Ny	:	38.05				
$qd = q(Nq -1)\ sq\ dq\ iq + 1/2\ B\gamma\ N_y\ s\gamma\ d\gamma\ i\gamma\ W'$	:	539.06	+	347.02	=	886.08 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	295.36	KN/m^2	=	30.1	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	1		
Field SPT (N) Value	:	36		
Depth (Df)	:	3.0	m	
Depth of water table	:	2.0	m	

2.As per the Lab report :

Specific gravity	2.68		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1		
Correction for overburden (N')	36	Strata below water table contains fine sands and silts	**YES**
Due to Dilatancy (N'')	25.5		
Angle of shearing resistance (ϕ)	35.1	Degree	
ϕ'	25.2	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		30	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	33.92			
		N_y =	49.26			
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	10.97			
	:	N'_y =	11.34			
Shape Factors	:	S_q =	1.2			
	:	S_y =	0.8			
Depth Factors	:	d_q =	1.29			
	:	d_y =	1.29			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	22.95				
Difference in Ny	:	37.92				
From interpolation Nq	:	31.34				
From interpolation Ny	:	44.99				
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	1408.99	+	232.15	=	1641.14 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	547.05	KN/m^2	=	55.8	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	3			
Field SPT (N) Value	:	49			
Depth (Df)	:	4.5	m		
Depth of water table	:	2.0	m		

2.As per the Lab report :

Specific gravity	2.67		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1	Strata below water table	
Correction for overburden (N')	49	contains fine sands and	**YES**
Due to Dilatancy (N'')	32	silts	
Angle of shearing resistance (ϕ)	36.4	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

3. Calculation

Since $\phi > 36$, General is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		45	KN/m^2				
Bearing Capacity Factors (Based on φ value)	:	$N_q =$	41.95				
		$N_y =$	65.22				
Shape Factors	:	$S_q =$	1.2				
	:	$S_y =$	0.8				
Depth Factors	:	$d_q =$	1.45				
	:	$d_y =$	1.45				
Inclination of load to the vertical	:	0	Degree				
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:	0.5					
$qd = q(Nq -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	3206.39	+	378.28	=	3584.67	KN/m^2
Considering factor of safety	:	3					
Net Safe Bearing Capacity (NSBC)	:	1194.89	KN/m^2	=	121.8	**T/m^2**	

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	2				
Field SPT (N) Value	:	18				
Depth (Df)	:	1.5	m			
Depth of water table	:	2.3	m			

2.As per the Lab report :

Specific gravity		2.67				
Submersible weight (γ_{sub})		10.00	KN/m^3			
Correction factor for cohessionless soil		1	Strata below water table			
Correction for overburden (N')		18	contains fine sands and			**YES**
Due to Dilatancy (N'')		16.5	silts			
Angle of shearing resistance (ϕ)		32.0	Degree			
ϕ'		22.7	Degree			

3. Assumptions

Width of Foundation (B)		2	m			
Length of foundation (L)		2	m			
Type of footing	:	Square				

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		15	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	24.36			
		N_y =	32.65			
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	8.7			
	:	N'_y =	8.35			
Shape Factors	:	S_q =	1.2			
	:	S_y =	0.8			
Depth Factors	:	d_q =	1.14			
	:	d_y =	1.14			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	1.0				
Difference in Nq	:	15.66				
Difference in Ny	:	24.30				
From interpolation Nq	:	16.53				
From interpolation Ny	:	20.50				
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	318.68	+	186.96	=	505.64 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	168.55	KN/m^2	=	17.2	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	2				
Field SPT (N) Value	:	24				
Depth (Df)	:	3.0	m			
Depth of water table	:	2.3	m			

2.As per the Lab report :

Specific gravity	2.67			
Submersible weight (γ_{sub})	10.00	KN/m^3		
Correction factor for cohessionless soil	1	Strata below water table		
Correction for overburden (N')	24	contains fine sands and		**YES**
Due to Dilatancy (N'')	19.5	silts		
Angle of shearing resistance (ϕ)	32.9	Degree		
ϕ'	23.4	Degree		

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		30	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	27.04			
		N_y =	37.27			
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	9.3			
	:	N'_y =	9.12			
Shape Factors	:	S_q =	1.2			
	:	S_y =	0.8			
Depth Factors	:	d_q =	1.28			
	:	d_y =	1.28			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	17.74				
Difference in Ny	:	28.15				
From interpolation Nq	:	20.17				
From interpolation Ny	:	26.36				
$qd = q(Nq -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	883.35	+	134.96	=	1018.31 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	339.44	KN/m^2	=	34.6	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	2				
Field SPT (N) Value	:	33				
Depth (Df)	:	4.5	m			
Depth of water table	:	2.3	m			

2.As per the Lab report :

Specific gravity	2.67			
Submersible weight (γ_{sub})	10.00	KN/m^3		
Correction factor for cohessionless soil	1	Strata below water table		
Correction for overburden (N')	33	contains fine sands and	**YES**	
Due to Dilatancy (N'')	24	silts		
Angle of shearing resistance (ϕ)	34.6	Degree		
ϕ'	24.8	Degree		

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		45	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	$N_{q=}$	32.11			
		$N_{y=}$	45.98			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	10.49			
	:	$N'_{y=}$	10.66			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.43			
	:	$d_{y=}$	1.43			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	21.62				
Difference in Ny	:	35.32				
From interpolation Nq	:	28.33				
From interpolation Ny	:	39.80				
$qd = q(Nq -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	2110.42	+ 227.66	=	2338.08	KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	779.36	KN/m^2	=	79.5	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	2		
Field SPT (N) Value	:	39		
Depth (Df)	:	6.0	m	
Depth of water table	:	2.3	m	

2.As per the Lab report :

Specific gravity	2.67		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1	Strata below water table	
Correction for overburden (N')	39	contains fine sands and	**YES**
Due to Dilatancy (N'')	27	silts	
Angle of shearing resistance (ϕ)	35.4	Degree	
ϕ'	25.5	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		60	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	$N_{q=}$	35.77			
		$N_{y=}$	52.94			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	11.43			
	:	$N'_{y=}$	12.03			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.58			
	:	$d_{y=}$	1.58			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	24.34				
Difference in Ny	:	40.91				
From interpolation Nq	:	33.94				
From interpolation Ny	:	49.87				
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	3747.25	+	315.18	=	4062.43 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	1354.14	KN/m^2	=	138.0	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	3		
Field SPT (N) Value	:	35		
Depth (Df)	:	1.5	m	
Depth of water table	:	1.3	m	

2.As per the Lab report :

Specific gravity	2.66		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1	Strata below water table	
Correction for overburden (N')	35	contains fine sands and	**YES**
Due to Dilatancy (N'')	25	silts	
Angle of shearing resistance (ϕ)	35.0	Degree	
ϕ'	25.1	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		15	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	$N_{q=}$	33.3			
		$N_{y=}$	48.03			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	10.81			
	:	$N'_{y=}$	11.11			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.14			
	:	$d_{y=}$	1.14			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	22.49				
Difference in Ny	:	36.92				
From interpolation Nq	:	30.49				
From interpolation Ny	:	43.42				
$qd = q(Nq -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	605.13	+	198.00	=	803.13 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	267.71	KN/m^2	=	27.3	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	3			
Field SPT (N) Value	:	50			
Depth (Df)	:	3.0	m		
Depth of water table	:	1.3	m		

2.As per the Lab report :

Specific gravity		2.69			
Submersible weight (γ_{sub})		10.00	KN/m^3		
Correction factor for cohessionless soil		1	Strata below water table		
Correction for overburden (N')		50	contains fine sands and		**YES**
Due to Dilatancy (N'')		32.5	silts		
Angle of shearing resistance (ϕ)		36.5	Degree		

3. Assumptions

Width of Foundation (B)		2	m
Length of foundation (L)		2	m
Type of footing	:	Square	

3. Calculation

Since $\phi > 36$, General is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)			30	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	42.57				
		N_y =	66.44				
Shape Factors	:	S_q =	1.2				
	:	S_y =	0.8				
Depth Factors	:	d_q =	1.30				
	:	d_y =	1.30				
Inclination of load to the vertical	:	0	Degree				
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:	0.5					
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	1945.48	+	345.49	=	2290.97	KN/m^2
Considering factor of safety	:	3					
Net Safe Bearing Capacity (NSBC)	:	763.66	KN/m^2	=	77.85	**T/m^2**	

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	3			
Field SPT (N) Value	:	50			
Depth (Df)	:	4.5	m		
Depth of water table	:	1.3	m		

2.As per the Lab report :

Specific gravity	2.7			
Submersible weight (γ_{sub})	10.00	KN/m^3		
Correction factor for cohessionless soil	1	Strata below water table		
Correction for overburden (N')	50	contains fine sands and	**YES**	
Due to Dilatancy (N'')	32.5	silts		
Angle of shearing resistance (ϕ)	36.5	Degree		

3. Assumptions

Width of Foundation (B)	2	m
Length of foundation (L)	2	m
Type of footing	: Square	

3. Calculation

Since $\phi > 36$, General is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		45	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	$N_q =$	42.57			
		$N_y =$	66.44			
Shape Factors	:	$S_q =$	1.2			
	:	$S_y =$	0.8			
Depth Factors	:	$d_q =$	1.45			
	:	$d_y =$	1.45			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
$qd = q(Nq -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	3254.93	+	385.35	=	3640.28 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	1213.43	KN/m^2	=	123.7	**T/m^2**

7.0 SETTLEMENT CALCULATION

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-1

Depth of footing (Df)	:	1.5	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	30.10	t/m^2
Ground water table	:	2.00	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	32	
Corrected N value	=	23.5	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	11.5	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	23	mm
So, Settlement (S_i)		69.23	mm
Depth factor	=	0.785	
Correceted total settlement (S)	=	54.35	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-01

Depth of footing (Df)	:	3.00	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	55.80	t/m^2
Ground water table	:	**2.0m**	

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	36	
Corrected N value	=	26.0	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	9.5	mm
Effect of water table	=	1	
Settlement after water table correction	=	19	mm
So, Settlement (S_i)		106.02	mm
Depth factor	=	0.66	
Correceted total settlement (S)	=	69.97	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-01

Depth of footing (Df)	:	4.50	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	121.80	t/m^2
Ground water table	:	**Not found**	

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	49	
Corrected N value	=	32.0	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	7.7	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	15.4	mm
So, Settlement (S_i)		187.57	mm
Depth factor	=	0.61	
Correceted total settlement (S)	=	114.42	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-2

Depth of footing (Df)	:	1.5	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	17.20	t/m^2
Ground water table	:	2.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	18	
Corrected N value	=	17	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	16	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	32	mm
So, Settlement (S_i)		55.04	mm
Depth factor	=	0.785	
Correceted total settlement (S)	=	43.21	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-2

Depth of footing (Df)	:	3.0	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	34.60	t/m^2
Ground water table	:	2.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	24	
Corrected N value	=	20	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	14	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	28	mm
So, Settlement (S_i)		96.88	mm
Depth factor	=	0.66	
Correceted total settlement (S)	=	63.94	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-2

Depth of footing (Df)	:	4.5	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	79.50	t/m^2
Ground water table	:	2.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	33	
Corrected N value	=	24	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	11	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	22	mm
So, Settlement (S_i)		174.9	mm
Depth factor	=	0.61	
Correceted total settlement (S)	=	106.69	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-2

Depth of footing (Df)	:	6.0	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	123.70	t/m^2
Ground water table	:	2.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	39	
Corrected N value	=	27	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	9	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	18	mm
So, Settlement (S_i)		222.66	mm
Depth factor	=	0.58	
Correceted total settlement (S)	=	129.14	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-3

Depth of footing (Df)	:	1.5	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	27.30	t/m^2
Ground water table	:	1.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	35	
Corrected N value	=	25	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	10	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	20	mm
So, Settlement (S_i)		54.6	mm
Depth factor	=	0.785	
Correceted total settlement (S)	=	42.86	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-3

Depth of footing (Df)	:	3.0	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	77.85	t/m^2
Ground water table	:	1.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	50	
Corrected N value	=	32.5	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	7.5	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	15	mm
So, Settlement (S_i)		116.78	mm
Depth factor	=	0.66	
Correceted total settlement (S)	=	77.07	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

Bore Hole No:-3

Depth of footing (Df)	:	4.5	m
Width of footing (B)	:	2.0	m
Length of footing (L)	:	2.0	m
Estimate Load (q_o) (NSBC)	:	123.70	t/m^2
Ground water table	:	1.30	m

IMMEDIATE SETTLEMENT FROM SPT (N) VALUE

Field SPT N Value	=	50	
Corrected N value	=	32.5	
As per IS: 8009-1976 of Fig.9 Settlement in mm per unit pressure ($1kg/cm^2$)	=	7.5	mm
Effect of water table	=	0.5	
Settlement after water table correction	=	15	mm
So, Settlement (S_i)		185.55	mm
Depth factor	=	0.61	
Correceted total settlement (S)	=	113.19	mm

ALLOWABLE BEARING PRESSURE (ABP) OF ROCK CORE SPECIMENS COLLECTED DURING THE BORING

TEST WAS CONDUCTED AS PER IS: 9143 – 1979 & IRC: 78 - 2014

Sample Reference	Bore hole reference	Sample collected from depth	Test Condition (Soaked/Un soaked)	Size of specimens		Length: Dia ratio of specimen	Water absorption	Specific gravity	Correction factor for size Length:Dia	Cross-sectional area of the specimen in mm^2	Compressive Load in KN	Compressive strength in N/mm^2	Ave. corrected Compressive strength in N/mm^2	ABP	
				Length in mm	Diameter in mm									in N/mm^2 or in Mpa (F.S = 8)	in T/m^2
1	1	10.5-12.0	Soaked	108	54	2:1	0.33	2.74	1	2290.2	26	11.35	11.57	1.45	145
2			Unsoaked	108	54	2:1	0.32	2.73	1	2290.2	27	11.79			
3		12.0-13.0	Soaked	108	54	2:1	0.33	2.75	1	2290.2	30	13.10	13.76	1.72	172
4			Unsoaked	108	54	2:1	0.31	2.76	1	2290.2	33	14.41			
5		13.0-14.0	Soaked	108	54	2:1	0.32	2.76	1	2290.2	34	14.85	15.51	1.94	194
6			Unsoaked	108	54	2:1	0.29	2.75	1	2290.2	37	16.16			
7		14.0-15.0	Soaked	108	54	2:1	0.3	2.74	1	2290.2	38	16.59	17.03	2.13	213
8			Unsoaked	108	54	2:1	0.31	2.76	1	2290.2	40	17.47			
9		15.0-16.0	Soaked	108	54	2:1	0.34	2.75	1	2290.2	39	17.03	17.25	2.16	216
10			Unsoaked	108	54	2:1	0.33	2.73	1	2290.2	40	17.47			
11		16.0-17.0	Soaked	108	54	2:1	0.34	2.75	1	2290.2	39	17.03	17.69	2.21	221
12			Unsoaked	108	54	2:1	0.32	2.74	1	2290.2	42	18.34			
13		17.0-18.0	Soaked	108	54	2:1	0.35	2.73	1	2290.2	41	17.90	18.34	2.29	229
14			Unsoaked	108	54	2:1	0.34	2.75	1	2290.2	43	18.78			
15		18.0-19.0	Soaked	108	54	2:1	0.33	2.74	1	2290.2	42	18.34	18.78	2.35	235
16			Unsoaked	108	54	2:1	0.32	2.75	1	2290.2	44	19.21			
17		19.0-20.0	Soaked	108	54	2:1	0.32	2.74	1	2290.2	42	18.34	19.00	2.37	237
18			Unsoaked	108	54	2:1	0.33	2.76	1	2290.2	45	19.65			

Note:ABP of the rock specimen have been calculeted by considering a factor of seafty of 8 as per IRC:78-2014

ALLOWABLE BEARING PRESSURE (ABP) OF ROCK CORE SPECIMENS COLLECTED DURING THE BORING

TEST WAS CONDUCTED AS PER IS: 9143 – 1979 & IRC: 78 - 2014

Sample Reference	Bore hole reference	Sample collected from depth	Test Condition (Soaked/Un soaked)	Size of specimens		Length: Dia ratio of specimen	Water absorption	Specific gravity	Correction factor for size Length:Dia	Cross-sectional area of the specimen in mm^2	Compressive Load in KN	Compressive strength in N/mm^2	Ave. corrected Compressive strength in N/mm^2	ABP	
				Length in mm	Diameter in mm									in N/mm^2 or in Mpa (F.S = 8)	in T/m^2
1	2	13.0-14.0	Soaked	108	54	2:1	0.29	2.75	1	2290.2	28	12.23	12.45	1.56	156
2			Unsoaked	108	54	2:1	0.28	2.75	1	2290.2	29	12.66			
3		14.0-15.0	Soaked	108	54	2:1	0.30	2.76	1	2290.2	30	13.10	13.76	1.72	172
4			Unsoaked	108	54	2:1	0.31	2.75	1	2290.2	33	14.41			
5		15.0-16.0	Soaked	108	54	2:1	0.32	2.76	1	2290.2	33	14.41	14.63	1.83	183
6			Unsoaked	108	54	2:1	0.31	2.77	1	2290.2	34	14.85			
7		16.0-17.0	Soaked	108	54	2:1	0.3	2.78	1	2290.2	37	16.16	16.82	2.10	210
8			Unsoaked	108	54	2:1	0.29	2.76	1	2290.2	40	17.47			
9		17.0-18.0	Soaked	108	54	2:1	0.31	2.77	1	2290.2	41	17.90	18.12	2.27	227
10			Unsoaked	108	54	2:1	0.3	2.80	1	2290.2	42	18.34			
11		18.0-19.0	Soaked	108	54	2:1	0.33	2.77	1	2290.2	43	18.78	19.22	2.40	240
12			Unsoaked	108	54	2:1	0.28	2.76	1	2290.2	45	19.65			
13		19.0-20.0	Soaked	108	54	2:1	0.3	2.76	1	2290.2	44	19.21	19.65	2.46	246
14			Unsoaked	108	54	2:1	0.3	2.75	1	2290.2	46	20.09			

Note:ABP of the rock specimen have been calculeted by considering a factor of seafty of 8 as per IRC:78-2014

ALLOWABLE BEARING PRESSURE (ABP) OF ROCK CORE SPECIMENS COLLECTED DURING THE BORING

TEST WAS CONDUCTED AS PER IS: 9143 – 1979 & IRC: 78 - 2014

Sample Reference	Bore hole reference	Sample collected from depth	Test Condition (Soaked/Un soaked)	Size of specimens		Length: Dia ratio of specimen	Water absorption	Specific gravity	Correction factor for size Length:Dia	Cross-sectional area of the specimen in mm^2	Compressive Load in KN	Compressive strength in N/mm^2	Ave. corrected Compressive strength in N/mm^2	ABP	
				Length in mm	Diameter in mm									in N/mm^2 or in Mpa (F.S = 8)	in T/m^2
1	3	10.5-12.0	Soaked	108	54	2:1	0.29	2.75	1	2290.2	22	9.61	10.27	1.28	128
2			Unsoaked	108	54	2:1	0.28	2.76	1	2290.2	25	10.92			
1		12.0-13.0	Soaked	108	54	2:1	0.30	2.74	1	2290.2	23	10.04	10.70	1.34	134
2			Unsoaked	108	54	2:1	0.30	2.77	1	2290.2	26	11.35			
1		13.0-14.0	Soaked	108	54	2:1	0.27	2.72	1	2290.2	30	13.10	13.32	1.67	167
2			Unsoaked	108	54	2:1	0.28	2.73	1	2290.2	31	13.54			
3		14.0-15.0	Soaked	108	54	2:1	0.29	2.74	1	2290.2	34	14.85	15.29	1.91	191
4			Unsoaked	108	54	2:1	0.30	2.75	1	2290.2	36	15.72			
5		15.0-16.0	Soaked	108	54	2:1	0.31	2.75	1	2290.2	35	15.28	15.94	1.99	199
6			Unsoaked	108	54	2:1	0.29	2.76	1	2290.2	38	16.59			
7		16.0-17.0	Soaked	108	54	2:1	0.32	2.77	1	2290.2	42	18.34	18.78	2.35	235
8			Unsoaked	108	54	2:1	0.32	2.75	1	2290.2	44	19.21			
9		17.0-18.0	Soaked	108	54	2:1	0.31	2.74	1	2290.2	41	17.90	18.78	2.35	235
10			Unsoaked	108	54	2:1	0.3	2.79	1	2290.2	45	19.65			
11		18.0-19.0	Soaked	108	54	2:1	0.32	2.76	1	2290.2	43	18.78	19.44	2.43	243
12			Unsoaked	108	54	2:1	0.31	2.75	1	2290.2	46	20.09			
13		19.0-20.0	Soaked	108	54	2:1	0.30	2.74	1	2290.2	46	20.09	20.53	2.57	257
14			Unsoaked	108	54	2:1	0.29	2.75	1	2290.2	48	20.96			

Note:ABP of the rock specimen have been calculeted by considering a factor of seafty of 8 as per IRC:78-2014

8.0 ANALYSIS OF THE SUB SOIL INVESTIGATION

BH: 01

1. It is seen that,0.0m to 0.5m depth is field up soil.
2. From0.5m to 6.0m It is seen that, low plasticity, low expansive clay mixed with gravels & sand strata is existing up to 6.0m depth. Wherein one no of DS collected at 0.5m depth, four nos of SPT collected at 1.5m to 6.0m depth. The field N values from SPT are found to be 32 to 55 at respectively depth.

3. From 6.0m to 7.5m depth, it is seen that, non coaring weather rock strata is existing. Whose core recovery & RQD were found to be NIL & Nil.

4. From 7.5m to 13.0m depth, it is seen that, Fracture rock strata is existing. Whose core recovery & RQD were found to be 2 to 5% & Nil.

5. From 13.0m to 20.0m depth, it is seen that, rock strata is existing. Whose core recovery & RQD were found to be 39% to 65% & 32 to 52%.

BH: 02

1. It is seen that,0.0m to 0.5m depth is field up soil.
2. From0.5m to 6.0m It is seen that, low plasticity, low expansive clay mixed with gravels & sand strata is existing up to 6.0m depth. Wherein one no of DS collected at 0.5m depth, four nos of SPT collected at 1.5m to 6.0m depth. The field N values from SPT are found to be 18 to 39 at respectively depth.

3. From 6.0m to 7.5m depth, it is seen that, non coaring weather rock strata is existing. Whose core recovery & RQD were found to be NIL & Nil.

4. From 7.5m to 13.0m depth, it is seen that, Fracture rock strata is existing. Whose core recovery & RQD were found to be 2 to 5% & Nil.

5. From 13.0m to 20.0m depth, it is seen that, rock strata is existing. Whose core recovery & RQD were found to be 35% to59% & 29to 57%.

BH: 02

1. It is seen that,0.0m to 0.5m depth is field up soil.
2. From0.5m to 6.0m It is seen that, low plasticity, low expansive clay mixed with gravels & sand strata is existing up to 6.0m depth. Wherein one no of DS collected at 0.5m depth, four nos of SPT collected at 1.5m to 6.0m depth. The field N values from SPT are found to be 18 to 39 at respectively depth.

3. From 6.0m to 7.5m depth, it is seen that, non coaring weather rock strata is existing. Whose core recovery & RQD were found to be NIL & Nil.

4. From 7.5m to 13.0m depth, it is seen that, Fracture rock strata is existing. Whose core recovery & RQD were found to be 2 to 5% & Nil.

5. From 13.0m to 20.0m depth, it is seen that, rock strata is existing. Whose core recovery & RQD were found to be 35% to59% & 29to 57%.

BH: 03

1. It is seen that, From0.0m to 1.5m It is seen that, low plasticity, low expansive sand mixed with silt clay strata is existing up to 6.0m depth. Wherein one no of DS collected at 0.5m depth,one no of SPT collected at 1.5m depth. The field N values from SPT are found to be 35 at respectively depth.

2. From 1.5m to 6.0m depth, it is seen that, non coaring weather rock strata is existing. Whose core recovery & RQD were found to be NIL & Nil.

3. From 6.0m to 10.5m depth, it is seen that, Fracture rock strata is existing. Whose core recovery & RQD were found to be 2 % & Nil.

4. From 10.5m to 20.0m depth, it is seen that, rock strata is existing. Whose core recovery & RQD were found to be 29% to63% & 20to 58%.

9.0 Abstract of Safe Bearing Pressure Soil

BH NO	Depth in m	Type of sample collected	NSBC t/m^2	Settlement in mm	ABP T/M^2		Ground water table
					25MM	40MM	
BH.01	1.5	SC	30.10	54.35	13.84	22.15	2.0m
	3.0	SC	55.80	69.97	19.93	31.89	
	4.5	SC	121.80	114.42	26.61	42.58	
BH.02	1.5	SC	17.20	43.21	9.95	15.92	
	3.0	SC	34.60	63.94	13.52	21.64	2.3m
	4.5	SC	79.50	106.69	18.62	29.80	
	6.0	SC	138.0	129.14	23.94	38.31	
BH.03	1.5	SC	27.3	42.86	15.92	25.47	
	3.0	W.Rock	77.85	77.07	25.25	40.40	1.3m
	4.5	W.Rock	123.70	113.19	27.32	43.71	

Abstract of Safe Bearing Pressure (Rock)

BH Location	Depth in mt.	ABP in Mpa	ABP in T/m²	Type of Rock
BH NO.01	10.5-12.0	1.45	1.45	Moderately Strong
	12.0-13.0	1.72	1.72	Moderately Strong
	13.0-14.0	1.94	1.94	Moderately Strong
	14.0-15.0	2.13	2.13	Moderately Strong
	15.0-16.0	2.16	2.16	Moderately Strong
	16.0-17.0	2.21	2.21	Moderately Strong
	17.0-18.0	2.29	2.29	Moderately Strong
	18.0-19.0	2.35	2.35	Moderately Strong
	19.0-20.0	2.37	2.37	Moderately Strong
BH NO.02	13.0-14.0	1.56	156	Moderately Strong
	14.0-15.0	1.72	172	Moderately Strong
	15.0-16.0	1.83	183	Moderately Strong
	16.0-17.0	2.10	210	Moderately Strong
	17.0-18.0	2.27	227	Moderately Strong
	18.0-19.0	2.40	240	Moderately Strong
	19.0-20.0	2.46	246	Moderately Strong
BH NO.03	10.5-12.0	1.28	128	Moderately Strong
	12.0-13.0	1.34	134	Moderately Strong
	13.0-14.0	1.67	167	Moderately Strong
	14.0-15.0	1.91	191	Moderately Strong
	15.0-16.0	1.99	199	Moderately Strong
	16.0-17.0	2.35	235	Moderately Strong
	17.0-18.0	2.35	235	Moderately Strong
	18.0-19.0	2.43	243	Moderately Strong
	19.0-20.0	2.57	257	Moderately Strong

AS PER TABLE -2 OF IRC:78-2014		
Sl. No.	Rock type	Unconfined Compressive Strength (UCS) in MPa
1	Extremely Strong	> 200
2	Very Strong	100 to 200
3	Strong	50 to 100
4	Moderately Strong	12.5 to 50
5	Moderately Weak	5 to12.5
6	Weak	1.25 to 5
7	Very Weak	< 1.25

10.0 Foundation & Recommendation

- Considering the bore hole and after studying the engineering properties it has been decided that depth of foundation can be taken at suitable depth as per the decision of designer from the original ground level both for economical point of view and for good structural stability. But however the structural designer can adopt higher depth to take advantage of higher SBC depending upon the load. The soil strata of foundation layer were observed medium to dense strata.

The designer can study the SBC table and take his own decision as per structural load and position of structure at the site. Therefore, special care is not required for footing.

1. All R.C.C works should be designed as per IS –456-2000
2. Shallow foundation will be designed as per IS: 6403-1981.
3. The groundwater table were encountered and tabulated in bore holes data sheet.

M/S.SUVADRA CONSULTANTS.





PREFACE:-

Before design the foundation for a proposed structure the designer requires the subsoil exploration test result to know the engineering properties of the subsoil strata as well as the SBC of the foundation soil met at different depths. The designer confirms the type of foundation as well as the dimension of the footing perfectly and economically ascertaining the subsoil properties and the SBC of the foundation soil evaluated at different depths. In view of this during execution the site in charge decided to explore the subsoil strata at the proposed site for the **GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA).**With an instruction to make the three Boreholes in order to the Sub Soil Strata met at different depths.

Accordingly the geotechnical investigation were carried out both in the field and laboratory to know the Sub-soil character and different Engineering properties of the Sub-soil strata met at different depths. SPT samples collected at different depths were brought to the laboratory to determine its physical properties, as per its relevant IS codes.

Test result of all the soil samples collected at different depths have been presented in the Sub-soil investigation test result. Soil samples collected at different depths with its graphical representation have also been presented in the test report.

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Sl no	Particulars
1	**Introduction**
2	**Field Operations**
3	**Information about Laboratory Tests**
4	**Bore Logs**
5	**Laboratory Test Result**
6	**Calculation of Safe Bearing Capacity**
7	**Settlement calculation**
8	**Analysis of the Sub Surface Investigation**
9	**Abstract of Safe Bearing Capacity soil**
10	**Recommendation**

M/s.Suvadra Consultants.

1.0 Introduction

Sub-surface exploration plays an important role in the design for the construction of buildings. Before design, it is essential to study the behavior as well as the engineering properties of the sub-surface strata, which promotes the design more economic and perfect. It also enables to take precaution in the design for the structural safety. **GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA).**Was decided to be designed on the basis of the sub-surface investigation test results. As such **DDF Consultants Private Limited.**Entrusted the sub-surface investigation work to**M/s Suvadra Consultants.** The scope of work comprised of boring three boreholes at site. The fieldwork included making of borehole by Rotary drilling method. The scope also included conducting Standard Penetration Tests at regular intervals and collecting soil samples for identification and logging purposes, and the collected soil samples were tested in the Base Laboratory and the data were analyzed.

Based on the above, this report presents the Bore Logs, Laboratory & Field Test results. On the basis of field & laboratory test results and their analysis, suitable foundations have been suggested.

2.0 Field Operations

2.1 General:

In an attempt for optimization in the design of foundation for the proposed structure to be constructed at this site, Geo-technical Investigation was done. The entire investigation work had been divided mainly into two parts. (i) Field works & (ii) Laboratory tests.

- Field works determine the types of sub-soil deposit and their characteristics.
- Laboratory tests help in determining the relevant geo-technical properties of the sub-surface deposits leading to finalization of foundation depth of the structure basing on Bearing Capacities of the foundation strata as well as the influence zone.

Final depths of boring and observation of water table for each borehole are given below.

2.2 Boring & In-Situ Tests:

Wash boring method was adopted to bore holes to the required depth. UDS & SPT were conducted at regular intervals and the soil samples were brought to the laboratory with proper identification and labeling. Standard split spoon sampler was used for conducting Standard Penetration Test. The number of blows required to drive the sampler for the 1st, 2nd & 3rd 15cm depths were recorded. The total number of blows required to drive the split spoon sampler due to the free fall of a 63.5kg hammer through a distance of 75 cm for the 2nd and 3rd 15cm penetration were taken together as the field 'N' value or the standard penetration test (resistance) of the soil.

After the penetration to full depth, the sampler was carefully pulled out. The cutting shoe and the head were removed. The soil samples were then sealed in polythene bags and labeled properly by indicating the depth of bore hole mark, reference no. etc for visual inspection and identification of soil samples for logging of the bore holes.

The field 'N' values recorded at various depths have been reported in the summarized data sheet. Test results of soil samples & their bore logs were presented separately in the sub-soil report.

Based on the above, this report presents the Bore Logs, Laboratory & Field Test results.

Undisturbed soil samples were carefully extracted in such a manner that the moisture content and structure of soil did not get altered. Standard open tube sampler was used for the collection of undisturbed soil samples. Each end of the sampling tube was carefully sealed with wax, the bore hole number and depth were indicated on the tube for proper identification.

2.3 Sampling:

Representative soil samples were collected from the borehole confirming to IS: 1892-1979. Collected samples were properly sealed in polythene bags and labeled for proper identification during testing. The disturbed samples were used for classification of soils as per IS: 1498-1970.

2.4 Ground Water Table:

Observation of ground water table is important since it influences the bearing capacity of soil in different seasons. When the foundation remains submerged under water the bearing capacity is to be calculated considering the water table correction factor. Therefore while conducting tests during rainy season, it is always necessary to enquire about the ground water table level.

Bore Hole No./Location		Termination Depth in m.	R.L in (m)	Co-ordinate		Water Table from the G.L. in m.
				E	N	
BH-04	Brahmapur	15.0	---	----	----	1.0m
BH-05		15.0	---	----	----	1.3m
BH-06		15.0	----	----	---	1.2m

3.0 Laboratory Tests

Laboratory test conforming to relevant Indian Standard specifications were conducted on the soil samples collected from both the boreholes as detailed below. All laboratory tests were conducted as per SP: 36 Part-1 1987 of BIS.

3.1 Grain Size Analysis:

To obtain information concerning the type of soil met at various depths and to classify each soil strata, grain size analysis were carried out as per IS: 2720 (Part-IV). The results have been presented in the summarized data sheet.

3.2 Index Properties:

Soil consistency refers to the resistance of the soil offered against forces that tend to deform or rupture the soil aggregate. Consistency limits indicate the soil moisture content limits for various states of consistency. The consistency limits include Liquid Limit (L.L) and Plastic Limit (P.L). The difference between the numerical values of liquid limit and plastic limit of the soil is called the Plasticity Index (P.I). It indicates the range of moisture content over which the soil exhibits plasticity. It is determined as per the procedure laid down in IS: 2720 (Part-IV). Plasticity index was computed. Results of liquid limit and plasticity index have been reported in the summarized data sheets.

3.3 Specific Gravity:

The specific gravity of the soil sample is the ratio of the mass of a given volume of soil sample in air to the mass of an equal volume of water at 270C. Specific gravity of soil sample was determined as per the provisions of IS: 2720 (Part –III). Specific gravity of soil sample obtained during the test has been reported in the summarized data sheet.

3.4 Void Ratio:

Void ratio of different soil samples were determined in through appropriate formula.

3.5 DFS:

Differential free swell index of different soil samples were determined in the laboratory and are mentioned in the laboratory test result sheet.

3.6 Final Logging:

The logging of the boreholes as obtained during field work were checked with the disturbed and undisturbed soil samples and scrutinized with the findings of laboratory tests to avoid discrepancies, if any. The bore logs have been reported in the summarized data sheets.

3.7 Results of Test:

The findings of various in-situ and laboratory tests conducted on disturbed /SPT samples have been reported in the summarized data sheet. The soil has been classified into different categories base on their Engineering properties. A careful study of the sub soil strata was made in accordance with the provisions of IS: 1498-1970 to find out their suitability as foundation materials.

4.0 .BORELOG DATA SHEET

NAME OF THE CONSULTANT: M/s.SUVADRA CONSULTANT.
NAME OF CLIENT:DDF CONSULTANTS PRIVATE LIMITED.
NAME OF THE WORK: GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA) .
LOCATION: BRAHMAPUR.
TYPE OF BORING:WASH BORING
DIAMETER OF BORING :150MM
INCLINATION: VERTICAL
GROUND WATER TABLE:1.0M WITH BELOW OGL.

BH No:04
Date of Commencement-14/01/2024
Date of Completion-15/01/2024

Sl. No	Thickness of soil strata in m.	R.L. in mt. R.L. =	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in cm.	Core Recovery IN %	RQD IN %	Remarks
01	0.5	—		0.5	Field up soil	DS	---	---	---	---	---	---	---	DS Sample Collected
02	1.5	—		1.5m	Clay mixed with little amount of fine gravels	SPT	2	3	3	6	45cm	---	---	SPT Sample Collected
03	2.0	—		3.0m	Clay soil	SPT	2	3	4	7	45cm	---	---	SPT Sample Collected
04	2.0	—		4.5m	Clay mixed with little amount of fine gravels	SPT	3	4	5	9	45cm	---	---	SPT Sample Collected
05		—		6.0m		SPT	2	2	3	5	45cm	---	---	SPT Sample Collected
06	9.0	—		7.5m	Weather Rock	SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							6.0m to 15.0m depth is Weather rock strata which core sample not collected only washout sample (DS) collected
07		—		9.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
08		—		10.5m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
09		—		12.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
10		—		13.5m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
11		—		15.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							

NAME OF THE CONSULTANT: M/s.SUVADRA CONSULTANT.
NAME OF CLIENT: DDF CONSULTANTS PRIVATE LIMITED.
NAME OF THE WORK: GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA) .
LOCATION: BRAHMAPUR.
TYPE OF BORING:WASH BORING
DIAMETER OF BORING :150MM
INCLINATION: VERTICAL
GROUND WATER TABLE:1.30M WITH BELOW OGL.

BH No:05
Date of Commencement-15/01/2024
Date of Completion-16/01/2024

Sl. No	Thickness of soil strata in m.	R.L. in mt. R.L. =	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in cm.	Core Recovery IN %	RQD IN %	Remarks
01	0.5	—		0.5	Field up soil	DS	---	---	---	---	---	---	---	DS Sample Collected
02	5.5	—		1.5m	Clay mixed with little amount of sand	SPT	3	3	4	7	45cm	---	---	SPT Sample Collected
03		—		3.0m		SPT	6	7	9	16	45cm	---	---	SPT Sample Collected
04		—		4.5m		SPT	6	7	7	14	45cm	---	---	SPT Sample Collected
05		—		6.0m		SPT	9	8	9	17	45cm	---	---	SPT Sample Collected
06	9.0	—		7.5m	Weather Rock	SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							6.0m to 15.0m depth is Weather rock strata which core sample not collected only washout sample (DS) collected
07		—		9.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
08		—		10.5m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
09		—		12.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
10		—		13.5m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
11		—		15.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							

NAME OF THE CONSULTANT: M/s.SUVADRA CONSULTANT.
NAME OF CLIENT:DDF CONSULTANTS PRIVATE LIMITED.
NAME OF THE WORK: GEO-TECHNICAL INVESTIGATION WORK FOR MAHARAJA KRUSHNA CHANDRA GAJAPATI (MKCG) MEDICAL COLLEGE & HOSPITAL AT BRAHMAPUR,GANJAM (ODISHA) .
LOCATION: BRAHMAPUR.
TYPE OF BORING:WASH BORING
DIAMETER OF BORING :150MM
INCLINATION: VERTICAL
GROUND WATER TABLE:1.20M WITH BELOW OGL.

BH No:06
Date of Commencement-16/01/2024
Date of Completion-17/01/2024

Sl. No	Thickness of soil strata in m.	R.L. in mt. R.L. =	Graphical representation of soil strata	Depth from ground level in m.	Type of soil strata	Type of sample collected	No. of blows for 1st 15 cm penetration (1)	No. of blows for 2nd 15 cm penetration (2)	No. of blows for 3rd 15 cm penetration (3)	S.P.T. value = 2+3 =N	Penetration of soil strata in cm.	Core Recovery IN %	RQD IN %	Remarks
01	6.5	---		0.5	Blackish colure clay	DS	---	---	---	---	---	---	---	DS Sample Collected
02		---		1.5m		SPT	2	2	3	5	45cm	---	---	SPT Sample Collected
03		---		3.0m		SPT	3	3	5	8	45cm	---	---	SPT Sample Collected
04		---		4.5m		SPT	4	5	8	13	45cm	---	---	SPT Sample Collected
05		---		6.0m		SPT	6	8	11	19	45cm	---	---	SPT Sample Collected
06	8.5	---		7.5m	Weather Rock	SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							6.5m to 15.0m depth is Weather rock strata which core sample not collected only washout sample (DS) collected
07		---		9.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
08		---		10.5m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
09		---		12.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
10		---		13.5m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							
11		---		15.0m		SPT/DS	Weather Rock, Non coring sample Collected during Boring. Whose N Value is >50.							

5.0 Result sheet

SUVADRA CONSULTANTS																				
BORE HOLE -04																				
Soil Clasification	Sample Collected at Depth in Mtrs.	Type of Sample Collected	SPT (N) VALUE	SOIL ENGINEERING PROPERTIES															ROCK ENGINEERING PROPERTIES	
				Grain Size					ATERBERG LIMIT IN %			Bulk Density in g/cc(ASSUMED)	DryDensity in g/cc	Specific Gravity	Natural Moisture Content (%)	Void Ratio (e)	Free swelling index in %	SHEAR TEST		Core Recovery (%)	R.Q.D (%)
				Gravel % (10mm to 4.75mm)	Coarse Sand % (4.75 mm to 2.0mm)	MediumSand % (2.00mm to 0.425mm)	Fine Sand % (0.425mm to 0.075mm)	Silt & Clay % (0.075mm to 0.001mm)	Liquid Limit in %	Plastic Limit in %	Plastic Index in %							Cohesion (C) (Kg/Cm^2)	Angle of Internal Friction(Ø) (Degree)		
CI	0.5	DS	-	0.00	1.36	3.05	15.01	80.58	36.0	18.9	17.1	1.805	1.535	2.69	17.6	0.75	30	-	-	-	-
CI	1.5	SPT	6	0.86	1.69	3.85	16.03	77.57	35.0	17.9	17.1	1.813	1.540	2.69	17.7	0.75	30	-	-	-	-
CI	3.0	SPT	7	0.00	0.76	2.04	14.03	83.17	36.5	18.6	17.9	1.818	1.547	2.70	17.5	0.75	30	-	-	-	-
CI	4.5	SPT	9	1.68	2.45	6.35	16.89	72.63	34.4	17.5	16.9	-	-	2.70	17.2	-	25	-	-	-	-
CI	6.0	SPT	5	0.96	1.88	5.34	12.08	79.74	35.9	18.5	17.4	-	-	2.70	16.8	-	25	-	-	-	-
---	7.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	9.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	10.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	12.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	13.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	15.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-

SUVADRA CONSULTANTS

BORE HOLE -05

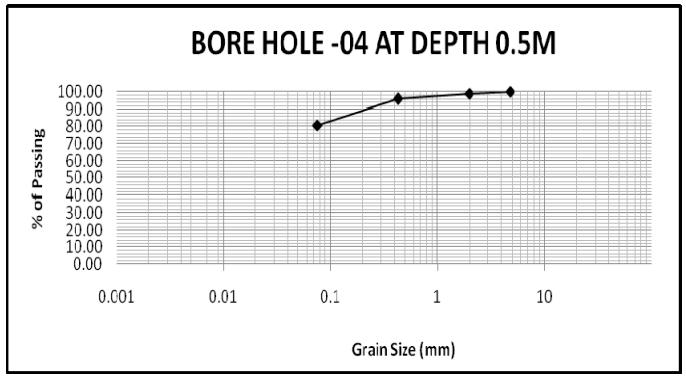
Soil Clasification	Sample Collected at Depth in Mtrs.	Type of Sample Collected	SPT (N) VALUE	SOIL ENGINEERING PROPERTIES																ROCK ENGINEERING PROPERTIES	
				Grain Size					ATERBERG LIMIT IN %			Bulk Density in g/cc(ASSUMED)	DryDensity in g/cc	Specific Gravity	Natural Moisture Content (%)	Void Ratio (e)	Free swelling index in %	SHEAR TEST		Core Recovery (%)	R.Q.D (%)
				Gravel % (10mm to 4.75mm)	Coarse Sand % (4.75 mm to 2.0mm)	MediumSand % (2.00mm to 0.425mm)	Fine Sand % (0.425mm to 0.075mm)	Silt & Clay % (0.075mm to 0.001mm)	Liquid Limit in %	Plastic limit in %	Plastic Index in %							Cohesion (C) (Kg/Cm^2)	Angle of Internal Friction(Ø) (Degree)		
CI	0.5	DS	-	0.00	2.02	3.69	10.25	84.04	36.8	18.7	18.1	1.812	1.542	2.70	17.5	0.75	35	-	-	-	-
CI	1.5	SPT	7	0.00	2.63	3.85	12.36	81.16	36.5	18.2	18.3	1.819	1.548	2.71	17.5	0.75	35	-	-	-	-
CI	3.0	SPT	16	0.65	3.02	4.32	11.02	80.99	36.0	18.5	17.5	1.820	1.540	2.69	18.2	0.75	30	-	-	-	-
CI	4.5	SPT	14	1.52	2.07	5.01	11.38	80.02	36.0	18.3	17.7	-	-	2.69	17.9	-	30	-	-	-	-
CI	6.0	SPT	17	2.03	3.52	5.86	13.01	75.58	35.2	17.9	17.3	-	-	2.68	18.0	-	30	-	-	-	-
---	7.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	9.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	10.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	12.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	13.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	15.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-

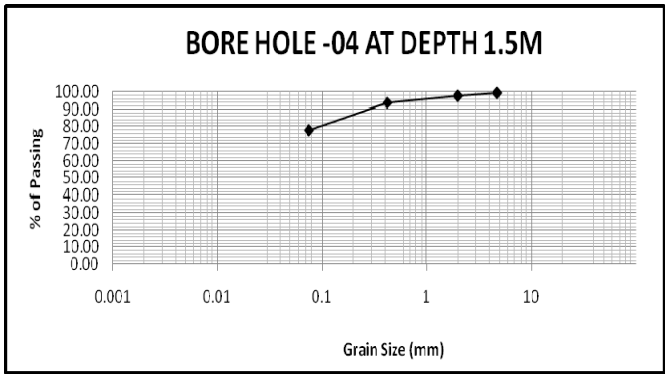
SUVADRA CONSULTANTS

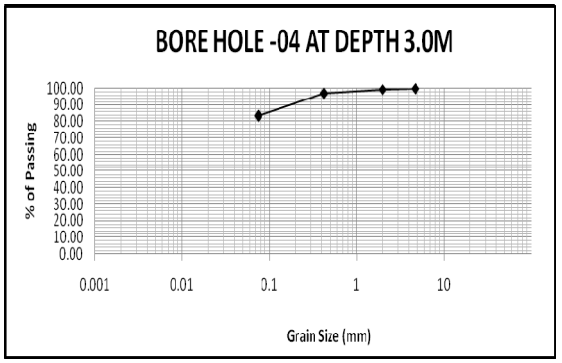
BORE HOLE -06

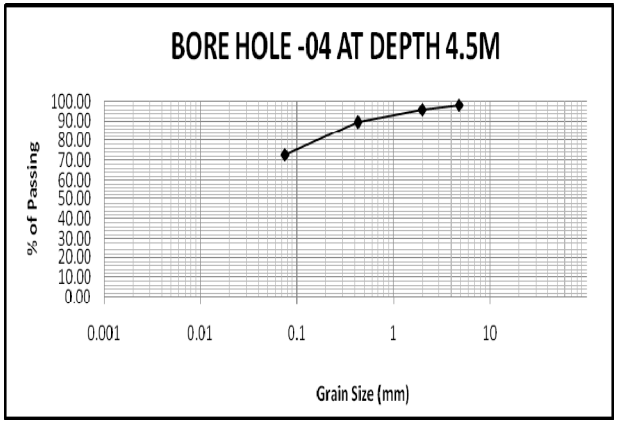
Soil Clasification	Sample Collected at Depth in Mtrs.	Type of Sample Collected	SPT (N) VALUE	SOIL ENGINEERING PROPERTIES															ROCK ENGINEERING PROPERTIES	
				Grain Size					ATERBERG LIMIT IN %			Bulk Density in g/cc(ASSUMED)	DryDensity in g/cc	Specific Gravity	Natural Moisture Content (%)	Void Ratio (e)	Free swelling index in %	SHEAR TEST		Core Recovery (%)	R.Q.D (%)
				Gravel % (10mm to 4.75mm)	Coarse Sand % (4.75 mm to 2.0mm)	MediumSand % (2.00mm to 0.425mm)	Fine Sand % (0.425mm to 0.075mm)	Silt & Clay % (0.075mm to 0.001mm)	Liquid Limit in %	Plastic Limit in %	Plastic Index in %							Cohesion (C) (Kg/Cm^2)	Angle of Internal Friction(Ø) (Degree)		
CI	0.5	DS	-	0.00	0.00	1.89	8.70	89.41	37.0	19.0	18.0	1.805	1.530	2.69	18.0	0.76	35	-	-	-	-
CI	1.5	SPT	5	0.00	0.00	2.01	10.03	87.96	37.0	19.0	18.0	1.809	1.530	2.70	18.2	0.76	35	-	-	-	-
CI	3.0	SPT	8	0.00	0.25	2.35	9.65	87.75	36.5	18.4	18.1	1.812	1.537	2.69	17.9	0.75	30	-	-	-	-
CI	4.5	SPT	13	0.00	0.00	3.01	10.52	86.47	36.0	18.5	17.5	1.816	1.534	2.71	18.4	-	30	-	-	-	-
CI	6.0	SPT	19	0.00	0.45	3.25	11.44	84.86	36.0	18.5	17.5	-	-	2.70	18.2	-	30	-	-	-	-
---	7.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	9.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	10.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	12.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	13.5	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-
---	15.0	W.Rock	Weather Rock, Which core sample not collected only washout sample (DS)collected																	-	-

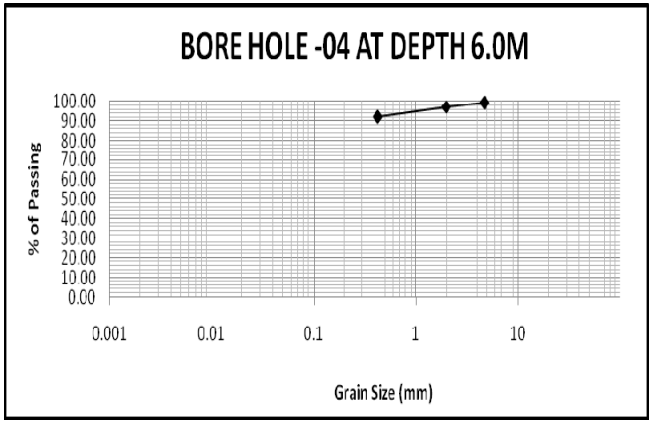
GRAIN SIZE CURVE(% FINNER)

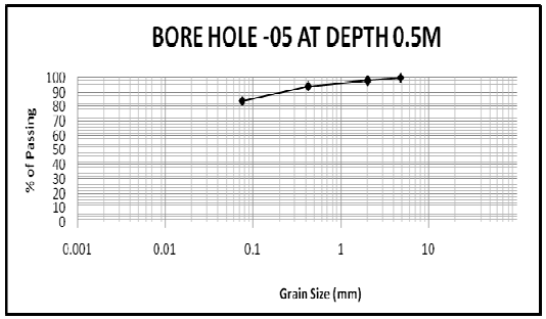


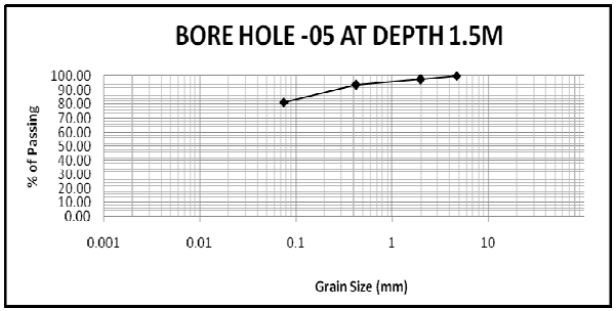


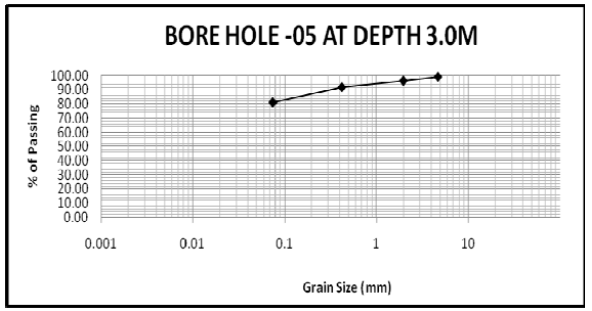


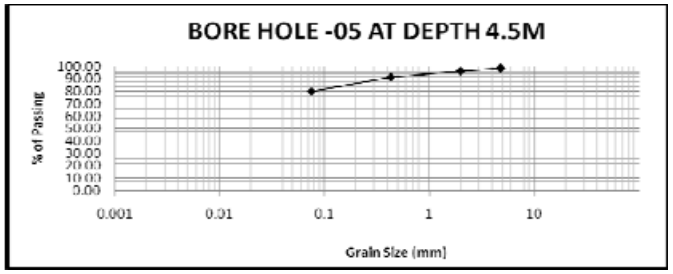


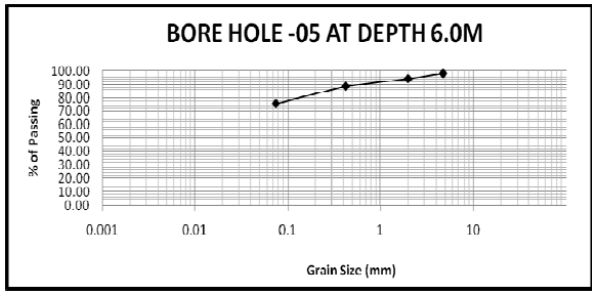


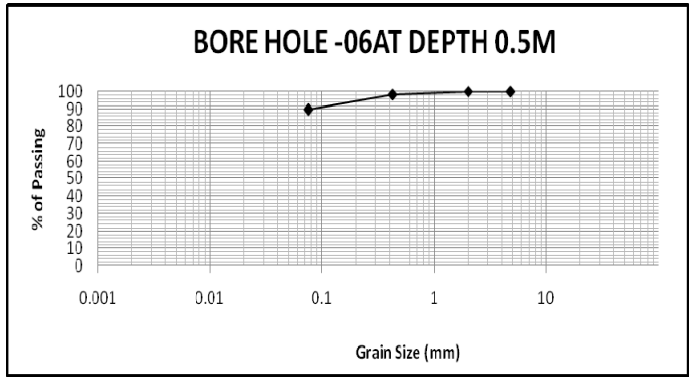

BORE HOLE -05 AT DEPTH 0.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)

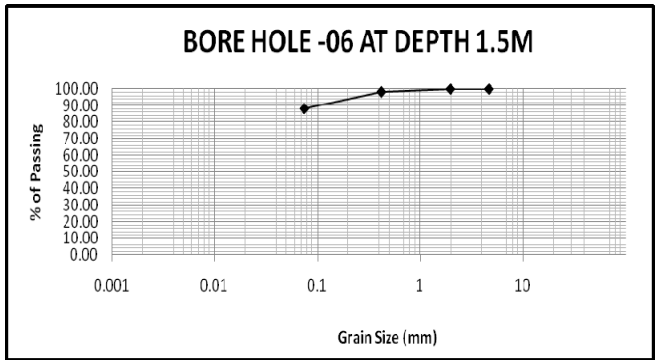

BORE HOLE -05 AT DEPTH 1.5M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)

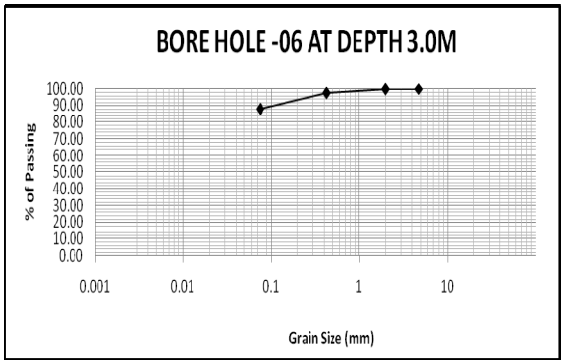

BORE HOLE -05 AT DEPTH 3.0M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)

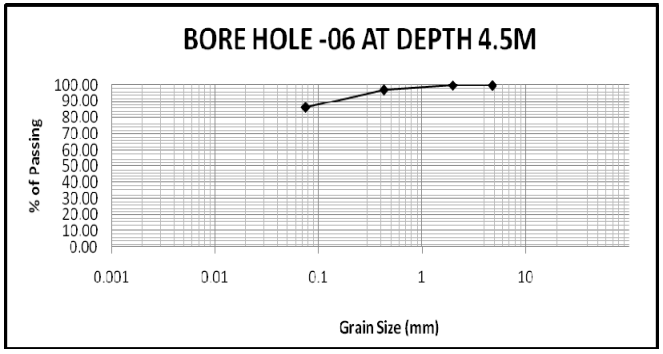

BORE HOLE -05 AT DEPTH 4.5M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)

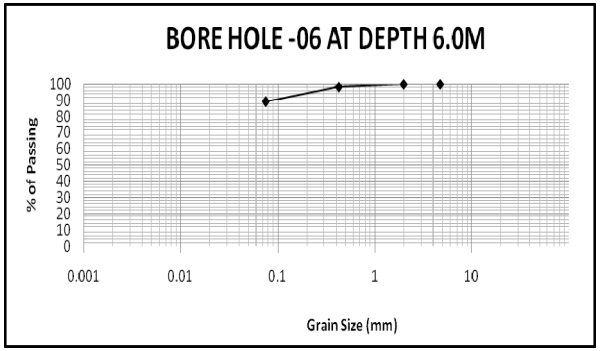

BORE HOLE -05 AT DEPTH 6.0M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -06AT DEPTH 0.5M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -06 AT DEPTH 1.5M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -06 AT DEPTH 3.0M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -06 AT DEPTH 4.5M
% of Passing
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.001
0.01
0.1
1
10
Grain Size (mm)


BORE HOLE -06 AT DEPTH 6.0M
% of Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
Grain Size (mm)

6.0 SAFE BEARING CAPACITY.

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :						
Bore Hole No.	:	4				
Field SPT (N) Value	:	6				
Depth (Df)	:	1.5	m			
Depth of water table	:	1	m			
2.As per the Lab report :						
Specific gravity		2.69				
Submersible weight (γ_{sub})		10.00	KN/m^3			
Correction factor for cohessionless soil		1	Strata below water table			
Correction for overburden (N')		6	contains fine sands and		**YES**	
Due to Dilatancy (N'')		6	silts			
Angle of shearing resistance (ϕ)		28.4	Degree			
ϕ'		19.9	Degree			
3. Assumptions						
Width of Foundation (B)		2	m			
Length of foundation (L)		2	m			
Type of footing	:	Square				
4. Calculation						
Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated						
As per IS: 6403 Clause-5.2.2.1						
Over burdern pressure (q)		15	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	6.35			
	:	$N'_{y=}$	5.34			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.13			
	:	$d_{y=}$	1.13			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
$q'd = q(N'q -1)\ sq\ dq\ iq + 1/2\ B\gamma\ N'_y\ s\gamma\ d\gamma\ i\gamma\ W'$	:	108.82	+	24.14	=	132.96 KN/m^2
Considering factor of safety	:	2.5				
Net Safe Bearing Capacity (NSBC)	:	53.18	KN/m^2	=	5.42 **T/m^2**	

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	4			
Field SPT (N) Value	:	7			
Depth (Df)	:	3	m		
Depth of water table	:	1	m		

2.As per the Lab report :

Specific gravity		2.7		
Submersible weight (γ_{sub})		10.00	KN/m^3	
Correction factor for cohessionless soil		1	Strata below water table	
Correction for overburden (N')		7	contains fine sands and	**YES**
Due to Dilatancy (N'')		7	silts	
Angle of shearing resistance (ϕ)		28.8	Degree	
ϕ'		20.2	Degree	

3. Assumptions

Width of Foundation (B)		2	m
Length of foundation (L)		2	m
Type of footing	:	Square	

4. Calculation

Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)			30	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	6.57				
	:	$N'_{y=}$	5.61				
Shape Factors	:	$S_{q=}$	1.2				
	:	$S_{y=}$	0.8				
Depth Factors	:	$d_{q=}$	1.25				
	:	$d_{y=}$	1.25				
Inclination of load to the vertical	:		0	Degree			
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:		0.5				
$q'd = q(N'q -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N'_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:		250.65	+	28.05	=	278.7 KN/m^2
Considering factor of safety	:		2.5				
Net Safe Bearing Capacity (NSBC)	:		111.48	KN/m^2	=	11.36	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	4			
Field SPT (N) Value	:	9			
Depth (Df)	:	4.5	m		
Depth of water table	:	1	m		

2.As per the Lab report :

Specific gravity		2.7		
Submersible weight (γ_{sub})		10.00	KN/m^3	
Correction factor for cohessionless soil		1	Strata below water table	
Correction for overburden (N')		9	contains fine sands and	**YES**
Due to Dilatancy (N'')		9	silts	
Angle of shearing resistance (ϕ)		29.6	Degree	
ϕ'		20.8	Degree	

3. Assumptions

Width of Foundation (B)		2	m
Length of foundation (L)		2	m
Type of footing	:	Square	

4. Calculation

Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)			45	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	7.08				
	:	$N'_{y=}$	6.27				
Shape Factors	:	$S_{q=}$	1.2				
	:	$S_{y=}$	0.8				
Depth Factors	:	$d_{q=}$	1.39				
	:	$d_{y=}$	1.39				
Inclination of load to the vertical	:		0	Degree			
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:		0.5				
$q'd = q(N'q -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N'_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:		456.36	+	34.86	=	491.22 KN/m^2
Considering factor of safety	:		3				
Net Safe Bearing Capacity (NSBC)	:		163.74	KN/m^2	=	16.69	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	4				
Field SPT (N) Value	:	5				
Depth (Df)	:	6	m			
Depth of water table	:	1	m			
2.As per the Lab report :						
Specific gravity		2.7				
Submersible weight (γ_{sub})		10.00	KN/m^3			
Correction factor for cohessionless soil		1	Strata below water table			
Correction for overburden (N')		5	contains fine sands and			**YES**
Due to Dilatancy (N'')		5	silts			
Angle of shearing resistance (ϕ)		28.0	Degree			
ϕ'		19.6	Degree			
3. Assumptions						
Width of Foundation (B)		2	m			
Length of foundation (L)		2	m			
Type of footing	:	Square				
4. Calculation						
Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated						
As per IS: 6403 Clause-5.2.2.1						
Over burdern pressure (q)		60	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	6.2			
	:	$N'_{y=}$	5.17			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.50			
	:	$d_{y=}$	1.50			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
q'd = q(N'q -1) sq dq iq + 1/2 Bγ N'$_y$ sγ dγ iγ W'	:	561.60	+	31.02	=	592.62 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	197.54	KN/m^2	=	20.14	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	5		
Field SPT (N) Value	:	7		
Depth (Df)	:	1.5	m	
Depth of water table	:	1.3	m	

2.As per the Lab report :

Specific gravity	2.71		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1	Strata below water table	
Correction for overburden (N')	7	contains fine sands and	**YES**
Due to Dilatancy (N'')	7	silts	
Angle of shearing resistance (ϕ)	28.8	Degree	
ϕ'	20.2	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		15	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	6.57			
	:	$N'_{y=}$	5.61			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.13			
	:	$d_{y=}$	1.13			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
$q'd = q(N'q -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N'_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	113.29	+	25.36	=	138.65 KN/m^2
Considering factor of safety	:	2.5				
Net Safe Bearing Capacity (NSBC)	:	55.46	KN/m^2	=	5.65	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	5				
Field SPT (N) Value	:	16				
Depth (Df)	:	3.0	m			
Depth of water table	:	1.3	m			
2.As per the Lab report :						
Specific gravity		2.69				
Submersible weight (γ_{sub})		10.00	KN/m^3			
Correction factor for cohessionless soil		1	Strata below water table			
Correction for overburden (N')		16	contains fine sands and			**YES**
Due to Dilatancy (N'')		15.5	silts			
Angle of shearing resistance (ϕ)		31.7	Degree			
ϕ'		22.5	Degree			
3. Assumptions						
Width of Foundation (B)		2	m			
Length of foundation (L)		2	m			
Type of footing	:	Square				
4. Calculation						
Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated						
As per IS: 6403 Clause-5.2.2.1						
Over burdern pressure (q)		30	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	23.47			
		N_y =	31.11			
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	8.53			
	:	N'_y =	8.14			
Shape Factors	:	S_q =	1.2			
	:	S_y =	0.8			
Depth Factors	:	d_q =	1.27			
	:	d_y =	1.27			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	14.94				
Difference in Ny	:	22.97				
From interpolation Nq	:	15.44				
From interpolation Ny	:	18.76				
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	660.20	+	95.30	=	755.5 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	251.83	KN/m^2	=	25.7	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	5				
Field SPT (N) Value	:	14				
Depth (Df)	:	4.5	m			
Depth of water table	:	1.3	m			

2.As per the Lab report :

Specific gravity		2.69			
Submersible weight (γ_{sub})		10.00	KN/m^3		
Correction factor for cohessionless soil		1			
Correction for overburden (N')		14		Strata below water table contains fine sands and silts	**YES**
Due to Dilatancy (N'')		14			
Angle of shearing resistance (ϕ)		31.2	Degree		
ϕ'		22.1	Degree		

3. Assumptions

Width of Foundation (B)		2	m
Length of foundation (L)		2	m
Type of footing	:	Square	

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)			45	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	21.98				
		N_y =	28.55				
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	8.19				
	:	N'_y =	7.7				
Shape Factors	:	S_q =	1.2				
	:	S_y =	0.8				
Depth Factors	:	d_q =	1.40				
	:	d_y =	1.40				
Inclination of load to the vertical	:		0	Degree			
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:		0.5				
Difference in Nq	:		13.79				
Difference in Ny	:		20.85				
From interpolation Nq	:		13.71				
From interpolation Ny	:		16.04				
$qd = q(Nq -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:		960.88	+	89.82	=	1050.7 KN/m^2
Considering factor of safety	:		3				
Net Safe Bearing Capacity (NSBC)	:		350.23	KN/m^2	=	35.7	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	5		
Field SPT (N) Value	:	17		
Depth (Df)	:	6.0	m	
Depth of water table	:	1.3	m	

2.As per the Lab report :

Specific gravity	2.69		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1		
Correction for overburden (N')	17	Strata below water table contains fine sands and silts	**YES**
Due to Dilatancy (N'')	16		
Angle of shearing resistance (ϕ)	31.8	Degree	
ϕ'	22.6	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		60	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	23.76			
		N_y =	31.63			
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	8.62			
	:	N'_y =	8.24			
Shape Factors	:	S_q =	1.2			
	:	S_y =	0.8			
Depth Factors	:	d_q =	1.54			
	:	d_y =	1.54			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
Difference in Nq	:	15.14				
Difference in Ny	:	23.39				
From interpolation Nq	:	15.81				
From interpolation Ny	:	19.35				
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	1642.13	+	119.20	=	1761.33 KN/m^2
Considering factor of safety	:	3				
Net Safe Bearing Capacity (NSBC)	:	587.11	KN/m^2	=	59.9	**T/m^2**

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FOUNDATION ENGINEERING.

SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	6			
Field SPT (N) Value	:	5			
Depth (Df)	:	1.5	m		
Depth of water table	:	1.2	m		

2.As per the Lab report :

Specific gravity	2.7		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1	Strata below water table	
Correction for overburden (N')	5	contains fine sands and	**YES**
Due to Dilatancy (N'')	5	silts	
Angle of shearing resistance (ϕ)	28.0	Degree	
ϕ'	19.6	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		15	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	6.2			
	:	$N'_{y=}$	5.17			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.12			
	:	$d_{y=}$	1.12			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
$q'd = q(N'q -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N'_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	104.83	+	23.16	=	127.99 KN/m^2
Considering factor of safety	:	2.5				
Net Safe Bearing Capacity (NSBC)	:	51.2	KN/m^2	=	5.22	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	6		
Field SPT (N) Value	:	8		
Depth (Df)	:	3	m	
Depth of water table	:	1.2	m	

2.As per the Lab report :

Specific gravity	2.69		
Submersible weight (γ_{sub})	10.00	KN/m^3	
Correction factor for cohessionless soil	1	Strata below water table	
Correction for overburden (N')	8	contains fine sands and	**YES**
Due to Dilatancy (N'')	8	silts	
Angle of shearing resistance (ϕ)	29.2	Degree	
ϕ'	20.5	Degree	

3. Assumptions

Width of Foundation (B)	2	m	
Length of foundation (L)	2	m	
Type of footing	: Square		

4. Calculation

Since ϕ <30 , Local shear is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		30	KN/m^2			
Bearing Capacity Factors (Based on φ' value)	:	$N'_{q=}$	6.83			
	:	$N'_{y=}$	5.94			
Shape Factors	:	$S_{q=}$	1.2			
	:	$S_{y=}$	0.8			
Depth Factors	:	$d_{q=}$	1.26			
	:	$d_{y=}$	1.26			
Inclination of load to the vertical	:	0	Degree			
Inclination Factors	:	iq=	1.0			
		iy=	1.0			
Effect of Water Table = **W'**	:	0.5				
$q'd = q(N'q -1)\, sq\, dq\, iq + 1/2\, B\gamma\, N'_y\, s\gamma\, d\gamma\, i\gamma\, W'$	:	264.45	+	29.94	=	294.39 KN/m^2
Considering factor of safety	:	2.5				
Net Safe Bearing Capacity (NSBC)	:	117.76	KN/m^2	=	12.00	**T/m^2**

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	5				
Field SPT (N) Value	:	13				
Depth (Df)	:	4.5	m			
Depth of water table	:	1.2	m			

2.As per the Lab report :

Specific gravity		2.71				
Submersible weight (γ_{sub})		10.00	KN/m^3			
Correction factor for cohessionless soil		1				
Correction for overburden (N')		13	Strata below water table contains fine sands and silts			**YES**
Due to Dilatancy (N'')		13				
Angle of shearing resistance (ϕ)		30.9	Degree			
ϕ'		21.9	Degree			

3. Assumptions

Width of Foundation (B)		2	m
Length of foundation (L)		2	m
Type of footing	:	Square	

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated
As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)		45	KN/m^2				
Bearing Capacity Factors (Based on φ value)	:	N_q =	21.08				
		N_y =	27.01				
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	8.02				
	:	N'_y =	7.48				
Shape Factors	:	S_q =	1.2				
	:	S_y =	0.8				
Depth Factors	:	d_q =	1.40				
	:	d_y =	1.40				
Inclination of load to the vertical	:	0	Degree				
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:	0.5					
Difference in Nq	:	13.06					
Difference in Ny	:	19.53					
From interpolation Nq	:	12.75					
From interpolation Ny	:	14.56					
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	888.30	+	81.54	=	969.84	KN/m^2
Considering factor of safety	:	3					
Net Safe Bearing Capacity (NSBC)	:	323.28	KN/m^2	=	33.0	**T/m^2**	

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SAFE BEARING CAPACITY FOR SHEAR FAILURE CRITERIA FROM SPT N-VALUE.

1.As per the Field report :

Bore Hole No.	:	6				
Field SPT (N) Value	:	19				
Depth (Df)	:	6.0	m			
Depth of water table	:	1.2	m			

2.As per the Lab report :

Specific gravity		2.7			
Submersible weight (γ_{sub})		10.00	KN/m^3		
Correction factor for cohessionless soil		1			
Correction for overburden (N')		19		Strata below water table contains fine sands and silts	**YES**
Due to Dilatancy (N'')		17			
Angle of shearing resistance (ϕ)		32.1	Degree		
ϕ'		22.8	Degree		

3. Assumptions

Width of Foundation (B)		2	m
Length of foundation (L)		2	m
Type of footing	:	Square	

4. Calculation

Since ϕ Between 30 to 36 , Interpolate is considered. The ultimate bearing capacity is calculated As per IS: 6403 Clause-5.2.2.1

Over burdern pressure (q)			60	KN/m^2			
Bearing Capacity Factors (Based on φ value)	:	N_q =	24.66				
		N_y =	33.16				
Bearing Capacity Factors (Based on φ' value)	:	N'_q =	8.79				
	:	N'_y =	8.46				
Shape Factors	:	S_q =	1.2				
	:	S_y =	0.8				
Depth Factors	:	d_q =	1.54				
	:	d_y =	1.54				
Inclination of load to the vertical	:	0	Degree				
Inclination Factors	:	iq=	1.0				
		iy=	1.0				
Effect of Water Table = **W'**	:	0.5					
Difference in Nq	:	15.87					
Difference in Ny	:	24.70					
From interpolation Nq	:	16.92					
From interpolation Ny	:	21.12					
qd = q(Nq -1) sq dq iq + 1/2 Bγ N_y sγ dγ iγ W'	:	1765.21	+	130.10	=	1895.31	KN/m^2
Considering factor of safety	:	3					
Net Safe Bearing Capacity (NSBC)	:	631.77	KN/m^2	=	64.4	**T/m^2**	

7.0 SETTLEMENT CALCULATION

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.4

Depth of footing (Df)	:	1.50	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	5.50	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	5.42	t/m^2
Compression Index (Cc)	:	0.225	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.69	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.00	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 3.40 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{21.68}{16}$ = 1.4 t/m^2

Sc = 75.15 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 63.88 mm

Depth factor = 0.785

Corrected total settlement (S) = 50.15 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.4

Depth of footing (Df)	:	3.00	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	7.00	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	11.36	t/m^2
Compression Index (Cc)	:	0.239	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.70	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.00	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 4.85 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{45.44}{16}$ = 2.8 t/m^2

Sc = 109.36 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 92.96 mm

Depth factor = 0.660

Corrected total settlement (S) = 61.35 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.4

Depth of footing (Df)	:	4.50	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	8.50	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	16.69	t/m^2
Compression Index (Cc)	:	0.234	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.70	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.00	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 6.31 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{66.76}{16} =$ 4.2 t/m^2

Sc = 117.85 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 100.17 mm

Depth factor = 0.61

Corrected total settlement (S) = 61.1 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.4

Depth of footing (Df)	:	6.00	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	10.00	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	20.14	t/m^2
Compression Index (Cc)	:	0.243	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.70	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.00	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 7.76 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{80.56}{16}$ = 5.0 t/m^2

Sc = 120.72 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 102.61 mm

Depth factor = 0.58

Corrected total settlement (S) = 59.51 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.5

Depth of footing (Df)	:	1.50	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	5.50	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	5.65	t/m^2
Compression Index (Cc)	:	0.239	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.71	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.30	m
Submerged density (ysub)	:	0.98	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 3.43 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{22.6}{16} =$ 1.4 t/m^2

Sc	=	81.7	mm
Avg. value of λ, for normally	=	0.85	
Corrected settlement (S_c)	=	69.45	mm
Depth factor	=	0.785	
Corrected total settlement (S)	=	54.52	mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.5

Depth of footing (Df)	:	3.00	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	7.00	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	25.70	t/m^2
Compression Index (Cc)	:	0.225	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.69	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.30	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 4.85 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{102.8}{16} =$ 6.4 t/m^2

Sc = 188.52 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 160.24 mm

Depth factor = 0.660

Corrected total settlement (S) = 105.76 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.5

Depth of footing (Df)	:	4.50 m
Width of footing (B)	:	2.00 m
Length of footing (L)	:	2.00 m
Depth Considered below EGL	=	8.50 m
Height of Compressible layer (Ht)	=	4.00 m
Consider,Estimate Load (q_o)	:	35.70 t/m^2
Compression Index (Cc)	:	0.234
Void ratio e_0	:	0.75
Specificgravity(G)	:	2.69
Using the 2:1 method, z	=	2.00 m
Ground water table	:	1.30 m
Submerged density (ysub)	:	0.97 g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 6.31 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{142.8}{16} =$ 8.9 t/m^2

Sc = 204.83 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 174.11 mm

Depth factor = 0.61

Corrected total settlement (S) = 106.21 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.5

Depth of footing (Df)	:	6.00	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	10.00	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	59.90	t/m^2
Compression Index (Cc)	:	0.207	
Void ratio e_0	:	0.74	
Specificgravity(G)	:	2.68	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.30	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 7.76 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{239.6}{16} =$ 15.0 t/m^2

Sc = 222.19 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 188.86 mm

Depth factor = 0.58

Corrected total settlement (S) = 109.54 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.6

Depth of footing (Df)	:	1.50 m
Width of footing (B)	:	2.00 m
Length of footing (L)	:	2.00 m
Depth Considered below EGL	=	5.50 m
Height of Compressible layer (Ht)	=	4.00 m
Consider,Estimate Load (q_o)	:	5.22 t/m^2
Compression Index (Cc)	:	0.243
Void ratio e_0	:	0.76
Specificgravity(G)	:	2.70
Using the 2:1 method, z	=	2.00 m
Ground water table	:	1.20 m
Submerged density (ysub)	:	0.97 g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 3.40 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{20.88}{16} =$ 1.3 t/m^2

Sc	=	78.17 mm
Avg. value of λ, for normally	=	0.85
Corrected settlement (S_c)	=	66.44 mm
Depth factor	=	0.785
Corrected total settlement (S)	=	52.16 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.6

Depth of footing (Df)	:	3.00	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	7.00	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	12.00	t/m^2
Compression Index (Cc)	:	0.239	
Void ratio e_0	:	0.75	
Specificgravity(G)	:	2.69	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.20	m
Submerged density (ysub)	:	0.97	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 4.85 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{48}{16}$ = 3.0 t/m^2

Sc = 114.24 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 97.1 mm

Depth factor = 0.660

Corrected total settlement (S) = 64.09 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.6

Depth of footing (Df)	:	4.50 m
Width of footing (B)	:	2.00 m
Length of footing (L)	:	2.00 m
Depth Considered below EGL	=	8.50 m
Height of Compressible layer (Ht)	=	4.00 m
Consider,Estimate Load (q_o)	:	33.00 t/m^2
Compression Index (Cc)	:	0.234
Void ratio e_0	:	0.75
Specificgravity(G)	:	2.71
Using the 2:1 method, z	=	2.00 m
Ground water table	:	1.20 m
Submerged density (ysub)	:	0.98 g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \frac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 6.37 t/m^2

Using the 2:1 method, $\Delta_p = \frac{q_o \times B \times L}{(B+z)^2} = \frac{132}{16} =$ 8.3 t/m^2

Sc = 192.98 mm

Avg. value of λ, for normally = 0.85

Corrected settlement (S_c) = 164.03 mm

Depth factor = 0.61

Corrected total settlement (S) = 100.06 mm

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CALCULATION OF SETTLEMENT OF FOOTING

AS PER IS:8009 (Part -I)-1976

BH NO.6

Depth of footing (Df)	:	6.00	m
Width of footing (B)	:	2.00	m
Length of footing (L)	:	2.00	m
Depth Considered below EGL	=	10.00	m
Height of Compressible layer (Ht)	=	4.00	m
Consider,Estimate Load (q_o)	:	64.40	t/m^2
Compression Index (Cc)	:	0.207	
Void ratio e_0	:	0.74	
Specificgravity(G)	:	2.70	
Using the 2:1 method, z	=	2.00	m
Ground water table	:	1.20	m
Submerged density (ysub)	:	0.98	g/cc

CALCULATION OF PRIMARY CONSOLIDATION SETTLEMENT OF CLAY STRATA

The clay is normally consolidated.

Thus Sc $= \dfrac{H_t}{(1+e_0)} X\ C_c\ [\log_{10} (P_0 + \Delta_P)/P_0]$

Initial Pressure P_0 = 7.84 t/m^2

Using the 2:1 method, $\Delta_p = \dfrac{q_o \times B \times L}{(B+z)^2} = \dfrac{257.6}{16} =$ 16.1 t/m^2

Sc	=	230.7	mm
Avg. value of λ, for normally	=	0.85	
Corrected settlement (S_c)	=	196.1	mm
Depth factor	=	0.58	
Corrected total settlement (S)	=	113.74	mm

8.0 ANALYSIS OF THE SUB SOIL INVESTIGATION

BH: 04

1. It is seen that,0.0m to 0.5m depth is field up soil.
2. From0.5m to 2.0m It is seen that, medium to high plasticity, moderate expansive clay mixed with little amount of gravels strata is existing up to 2.0m depth. Wherein one no of DS collected at 0.5m depth, one no of SPT collected at 1.5m depth. The field N values from SPT are found to be 6 at respectively depth.
3. From2.0m to 4.0m It is seen that, high plasticity, moderate expansive clay strata is existing up to 4.0m depth. Wherein one no of SPT collected at 3.0m depth. The field N values from SPT are found to be 7 at respectively depth.
4. From4.0m to 6.0m It is seen that, medium to high plasticity, moderate expansive clay mixed with little amount of gravels strata is existing up to 6.0m depth. Wherein two nos of SPT collected at 4.5m & 6.0m depth. The field N values from SPT are found to be 9 & 5 at respectively depth.
5. From 6.0m to 15.0m depth, it is seen that, non coaring weather rock.

BH: 05

1. It is seen that,0.0m to 0.5m depth is field up soil.
2. From0.5m to 6.0m It is seen that, medium to high plasticity, moderate expansive clay mixed with little amount of sand strata is existing up to 6.0m depth. Wherein one no of DS collected at 0.5m depth, four nos of SPT collected at 1.5m to 6.0m depth. The field N values from SPT are found to be 7 to 17 at respectively depth.
3. From 6.0m to 15.0m depth, it is seen that, non coaring weather rock.

BH: 06

1. It is seen that, medium to high plasticity, moderate expansive clay mixed with little amount of sand strata is existing up to 6.5m depth. Wherein one no of DS collected at 0.5m depth, four nos of SPT collected at 1.5m to 6.0m depth. The field N values from SPT are found to be 5 to 19 at respectively depth.
2. From 6.0m to 15.0m depth, it is seen that, non coaring weather rock.

9.0 Abstract of Safe Bearing Pressure

BH NO	Depth in m	Type of sample collected	NSBC t/m^2	Settlement in mm	ABP T/M^2		Ground water table
					25MM	40MM	
BH.04	1.5	CI	5.42	50.15	2.70	4.32	1.0m
	3.0	CI	11.36	61.35	4.63	7.41	
	4.5	CI	16.69	61.10	6.83	10.93	
	6.0	CI	20.14	59.51	8.46	13.54	
BH.05	1.5	CI	5.65	54.52	2.59	4.15	1.3m
	3.0	CI	25.7	105.76	6.08	9.72	
	4.5	CI	35.7	106.20	8.40	13.45	
	6.0	CI	41.7	98.12	10.62	17.00	
BH.06	1.5	CI	5.22	52.16	2.50	4.0	1.2m
	3.0	CI	12.0	64.09	4.68	7.49	
	4.5	CI	33.0	100.1	8.25	13.19	
	6.0	CI	64.4	113.7	113.7	14.16	

10.0 Foundation & Recommendation

- Considering the bore hole and after studying the engineering properties it has been decided that depth of foundation can be taken at suitable depth as per the decision of designer from the original ground level both for economical point of view and for good structural stability. But however the structural designer can adopt higher depth to take advantage of higher SBC depending upon the load. The soil strata of foundation layer were observed stiff to medium strata.

The designer can study the SBC table and take his own decision as per structural load and position of structure at the site. Therefore, special care is not required for footing.

1. All R.C.C works should be designed as per IS –456-2000
2. Shallow foundation will be designed as per IS: 6403-1981.
3. The groundwater table were encountered and tabulated in bore holes data sheet.

M/S.SUVADRA CONSULTANTS.

Annexure- E

STATUTORY APPROVAL AND PERMITS

SL#	Statutory Approval	Responsible Agency for taking approval (Consultant/OBCC/Turnkey Contractor)	When approval is required (Stage) (Master Planning/Design/Construction/post-Construction)	Institution / Authority	Validity		Remarks
					From	To	
1	Environment Clearance	Consultant	Master Planning	Environment state authority			
2	Approval of Master Plan	Consultant	Master Planning	Respective Development Authority			
3	No Objection Certificate for Height Clearance	Consultant	Master Planning	Airport Authority of India			
4	Fire safety Certificate for Height Clearance	Turnkey Contractor	Design	Fire Service department			
5	Permission for abstraction of ground water / Use of Surface water	Turnkey Contractor	Design	CGWB/ State Ground Water board/ Department of Water Resource/ Irrigation Dept, Odisha			
6	Tree cutting/transplant permission	Turnkey Contractor	Design	Department of environment and forest			
7	Structural safety clearance	Turnkey Contractor	Design	Respective Development Authority			
8	Permission from Central Ground Water Board for Rainwater Harvesting Network Layout	Turnkey Contractor	Design	CGWB			
9	Approval of Storm water Layout Plan	Turnkey Contractor	Design	Respective Development Authority			
10	Approval of Sewer Layout Plan	Turnkey Contractor	Design	Respective Development Authority			
11	Building Plan Approval	Turnkey Contractor	Design	Respective Development Authority			
12	Lift License	Turnkey Contractor	Design	Lift Inspector			
13	Water Connection	Turnkey Contractor	Design	Respective Development Authority			
14	AERB Approval	Turnkey Contractor	Design	AERB			
15	Liquid Oxygen	Turnkey Contractor	Design	Chief Controller of Explosives			
16	Mining (if any)	Turnkey Contractor	Design	TBD			
17	CTE (Consent to Establish) and CTO (Consent to Operate) under Air and Water Act	Turnkey Contractor	Construction	OSPCB			

SL#	Statutory Approval	Responsible Agency for taking approval (Consultant/OBCC/Turnkey Contractor)	When approval is required (Stage) (Master Planning/Design/Construction/post-Construction)	Institution / Authority	Validity		Remarks
					From	To	
18	Explosive License	Turnkey Contractor	Construction	Chief Controller of Explosives			
19	Fire Approval	Turnkey Contractor	Construction	Chief fire officer			
20	Construction Power	Turnkey Contractor	Construction	State Electricity Board			
21	Electrical Connection	Turnkey Contractor	Construction	State Electricity Board			

Or any other required for the project shall be deemed to be included in the cost of the project.

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
A.	**CIVIL AND INTERIOR WORKS**	
1	CEMENT	ULTRATECH/ACC/RAMCO/NUVOCO/SHREE CEMENT/JSW CEMENT/DALMIA/ EQUIVALENT
2	WHITE CEMENT/PUTTY	J.K.BIRLA/BERGER/NEROLAC/AMBUJA/DALMIA/ULTRATECH/EQUIVALENT
3	REINFORCEMENT STEEL (TMT BARS/CRS)	VIZAG/SAIL/ TATA /RINL/JINDAL/SHYAM/EQUIVALENT
4	STRUCTURAL STEEL SECTIONS /TUBES	VIZAG/SAIL/ TATA /RINL/JINDAL/EQUIVALENT
5	SS REINFORCEMENT (STAINLESS STEEL)	JSL/EQUIVALENT
6	CONCRETE ADDITIVES	FOSROC/ SIKA/ TREMCO/BASF/PIDILITE/ASIAN PAINTS/FERROUS CRETE/EQUIVALENT
7	ANTI TERMITE	AS APPROVED BY ENGR-IN- CHARGE IN COMPLIANCE WITH THE SPECIFICATIONS
8	TILE ADHESIVE & EPOXY GROUTS	TREMCO/KERAKOLL/FERROUS CRETE/ WEBER/PIDILITE/MYK/ROFF/ FOSROC/ EQUIVALENT
9	POLYSULPHIDE SEALANT	WEBER/TREMCO/KERAKOLL/FOSROC/PIDILITESIKA/3M/EQUIVALENT
10	SILICONE SEALANT	GE SILICON/ BASF/ALSTONE/PIDILITE/FOSROC/DrFIXIT/DOW/EQUIVALENT
11	WATER PROOFING MEMBRANE /COMPOUND (To be applied through authorised applicator only)	FOSROC/ SIKA/BASF/DrFIXIT/FERROUS CRETE/ASIAN PAINTS/EQUIVALENT
12	CRYSTALLINE WATERPROOFING (To be applied through authorised applicator only)	FOSROC/ SIKA/BASF/DrFIXIT/FERROUS CRETE/PENETRON/EQUIVALENT
13	ADMIXTURE	FOSROC/ SIKA/ TREMCO/CICO/BASF/PIDILITE/PENETRON/ASIAN PAINTS/BERGER/FERROUS CRETE/EQUIVALENT
14	FORMWORK RELEASE AGENT	FOSROC/ SIKA/ TREMCO/CICO/BASF/PIDILITE/ASIAN PAINTS/FERROUS CRETE/EQUIVALENT
15	NON-SHRINK GROUTS	FOSROC/ SIKA/ TREMCO/CICO/BASF/PIDILITE/ASIAN PAINTS/FERROUS CRETE/EQUIVALENT
16	NON-METALLIC FLOOR HARDENERS	FOSROC/ SIKA/TREMCO/BASF/LATICRETE/MAPEI/ARDEX/EQUIVALENT
17	BITUMEN	IOCL/HPCL/BPCL/HINCOL/SHELL/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
18	SYNTHETIC ENAMEL PAINTS (MINIMUM 7 YEARS WARRENTY)	BERGER/ NEROLAC/ DULUX/ ASIAN PAINTS/EQUIVALENT
19	OIL BOUND DISTEMPER (MINIMUM 5 YEARS WARRENTY)	BERGER/ NEROLAC/ DULUX/ ASIAN PAINTS/EQUIVALENT
20	CEMENT PAINT (MINIMUM 5 YEARS WARRENTY)	BERGER/ NEROLAC/ DULUX/ ASIAN PAINTS/EQUIVALENT
21	STONE SEALER (MINIMUM 5 YEARS WARRANTY)	FOSROC/ SIKA/ TREMCO/BASF/PIDILITE/ASIAN PAINTS/FERROUS CRETE/EQUIVALENT
22	PLASTIC EMULSION PAINT (MINIMUM 7 YEARS WARRANTY)	BERGER/ NEROLAC/ ASIAN PAINTS/ DULUX/EQUIVALENT
23	OTHER PAINTS & PRIMER	BERGER/ NEROLAC/ ASIAN PAINTS/ DULUX/EQUIVALENT
24	EXTERIOR TEXTURE COATINGS/PAINTS (MINIMUM 5 YEARS WARRANTY)	BERGER/ NEROLAC/ ASIAN PAINTS/ DULUX/EQUIVALENT
25	MELAMINE (MINIMUM 5 YEARS WARRANTY)	ICI DULUX/ ASIAN PAINTS/ TIMBERSTONE MELAMINE COATING/ BERGER/ EQUIVALENT
26	POLYURETHANE PAINT	BERGER/ NEROLAC/ ASIAN PAINTS/DULUX/JOTUN/AKZONOBEL/EQUIVALENT
27	PU COATING IN PARKING AREAS	FOSROC/ SIKA/ TREMCO/BASF/JOTUN/AKZONOBEL/PIDILITE/EQUIVALENT
28	SILICON WATER REPELLENT SOLUTION	GE SILICON/ BASF/DOW/FOSROC/SIKA/PIDILITE/EQUIVALENT
29	VITRIFIED / CERAMIC TILES (5 Tiles will be tested randomly in Every Lot)	KAJARIA/JHONSON/VARMORA/RAK/APARNA VETIRO/EQUIVALENT
30	LAMINATED WOODEN FLOORING	PERGO/ BERRY/FLOOR MASTER/ ACTION TEESA/EQUIVALENT
31	PVC/VINYL FLOORING	FORBO/ TARKETT/ARMSTRONG/MAPEI/DLW/BOLLARD/GERFLOR/EQUIVALENT
32	EPOXY TERRAZZO FLOORING	FOSROC/ SIKA/ TREMCO/BASF/PIDILITE/ASIAN PAINTS/FERROUS CRETE/EQUIVALENT
33	PVC RESIN FLOORING	FOSROC/ SIKA/ TREMCO/BASF/PIDILITE/ASIAN PAINTS/FERROUS CRETE/EQUIVALENT
34	LAMINATES& VENEERS	ARCHIDPLY/ STYLAM/ DURO/ GREENLAM/ MERINO/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
35	MDF/HDF	ARCHIDPLY/ STYLAM/ DURO/ GREENLAM/ MERINO/EQUIVALENT
36	ADHESIVE FOR WOODWORK	PIDILITE/ BENSON/CHEMISOLS/ARALDITE/EQUIVALENT
37	PRE-LAMINATED PARTICLE BOARD	ARCHIDPLY/ STYLAM/ DURO PLY/GREENLAM/MERINO/EQUIVALENT
38	PLYWOOD, BLOCK BOARD, SOFT BOARD	ARCHIDPLY/ STYLAM/ DURO PLY/ CENTURY PLY/GREEN LAM/MERINO/EQUIVALENT
39	PAVING STONES/BLOCKS	AS APPROVED BY ENGR-IN- CHARGE IN COMPLIANCE WITH THE SPECIFICATIONS
40	WAX POLISH	MANSION/ RECKITT & COLMAN/UNILEVER/EQUIVALENT
41	POLYETHANE SEALANT	WEBER/TREMCO/KERAKOLL/CICO/FOSROC/SIKA/3M/PIDILITE/EQUIVALE NT
42	POLYETHELENEBOARD, BACK UP ROD	SUPREME INDUSTRIES/ SOFTEX/ SRINIDHI PLASTIC INDUSTRIES/ALSTONE/EQUIVALENT
43	WATER STOPPER	SIKA/FOSROC/CICO/ROFF/TREMCO/PIDILITE/EQUIVALENT
44	ALUMINIUM COMPOSITE PANEL	ALUCOBOND/ ALUDECOR/ ALSTONE/VIVA/EQUIVALENT
45	ASPHALT EMULSION	IOCL/HPCL/BPCL/HINCOL/SHELL/EQUIVALENT
46	SS CLAMP /EXPANSION FASTENER / DASH FASTENER /ANCHOR FASTENER, ANCHOR BOLTS	HILTI/ FISCHER/UNBRAKO/WUERTH/ KONCEPT FASTNER/EQUIVALENT
47	STAINLESS STEEL	SALEM/ JINDAL/ TATA/EQUIVALENT
48	GYPSUM PARTITION	SAINT GOBIN/ LAFARGE/ USG KNAUF/EQUIVALENT
49	GYPSUM PLASTER	FERROUS CRETE / MYK LATECRETE/GYPROC
50	READY MIX PLASTER	FERROUS CRETE / ARDEX ENDURA / MYK LATECRETE
51	EPOXY GROUT	FERROUS CRETE / ARDEX ENDURA / MYK LATECRETE
52	ELECTRODES	ADVANI-OVERLIKON/ ESAB/ DWEKAM/ VICTOR / ADOR / COSMOS/EQUIVALENT
53	H.T. BOLTS	UNBRAKO/ HILTI/ FISCHER/WUERTH/EQUIVALENT
54	STEEL DOORS /STEEL WINDOW/PRESSED STEEL DOOR FRAME /ROLLING SHUTTER/STEEL FIRE DOORS	TATA/NCL/HORMANN/NAVAIR INTERNATIONAL/EQUIVALENT
55	Fire Door Metal	NAVAIR INTERNATIONAL/REDMOND/BHAWANI FIRE/IHMS/SUKRITI DOORS/PACIFIC FIRE CONTROLS/HORMANN/EQUIVALENT
56	FIRE DOOR (WOODEN)	NAVAIR INTERNATIONAL/REDMOND/BHAWANI FIRE/IHMS/SUKRITI DOORS/PACIFIC FIRE CONTROLS/HORMANN/EQUIVALENT
57	FIRE GLAZE DOOR	SAINTGOBIN/HARMANN/IHMS/VETROTECH/RADIANT/EQUIVALENT
58	ALUMINUM SECTIONS	JINDAL/ HINDALCO/ INDALCO / BHARUKA/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
59	THERMAL INSULATION (UNDER DECK / OVER DECK/WALL)	OWENS CORNING/BASF/KNAUF/DOW/ROCKWOOL/EQUIVALENT
60	POLYCARBONATE SHEETS	GE PLASTICS/ DANPALON/ LEXAN/DPI DAY LIGHTING/MG PLASTO/SABIC INDIA/EQUIVALENT
61	SELF-DRILLING SCREWS	HILTI/ FISCHER/UNBRAKO/WUERTH/EQUIVALENT
62	FLUSH DOORS	ARCHIDPLY/REDMOND/GREEN LAM/ MERINO/EQUIVALENT
63	MS SLIDING MOTORIZED DOOR	DORMA/KONE/TORMAX/ASSA ABLOY/EQUIVALENT
64	ALUMINUM FITTINGS	DORMA/HETTICH/DORSET/EQUIVALENT
65	OUTDOOR FURNITURE (SITTING BENCH, DUSTBIN)	GODREJ/STEELCASE/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
66	MODULAR FURNITURE	GODREJ/STEELCASE/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
67	CHAIRS AND SOFAS	GODREJ/STEELCASE/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
68	MODULAR FIXED & LAB FURNITURE,etc.	GODREJ/STEELCASE/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
69	CUSTOM FURNITURE	AS PER DIRECTIONS AND APPROVAL OF THE EIC
70	ACOUSTICAL PANELING	ARMSTRONG/HUNTER DOUGLAS/LIGNOSI/BOLLARD/USG KNAUF/EQUIVALENT
71	MODULAR TOILETS	MERINO/ GREEN LAM/EQUIVALENT
72	MOSAIC TILES	KAJARIA/JHONSON/VARMORA/RAK/APARNA VETIRO/EQUIVALENT
73	ACOUSTICAL FALSE CEILING	ARMSTRONG/HUNTER DOUGLAS/LIGNOSI/BOLLARD/USG KNAUF/EQUIVALENT
74	EXTERIOR TILES	KAJARIA/JHONSON/RAK/VARMORA/APARNAVETIRO/EQUIVALENT
75	PATCH FITTING/ SPIDER FITTING	DORMA/ OZONE/ DORSET/ TAITON/EQUIVALENT
76	UPVC DOOR & WINDOW	FENESTA/ KOEMMERLING/ PROMINANCE/ VEKA /EQUIVALENT
77	ACID AND ALKALI RESISTENT TILES	KAJARIA/JHONSON/RAK/VARMORA/EQUIVALENT
78	ROLLER BLINDS	HUNTER DOUGLAS /VISTA/EQUIVALENT
79	GRC JALI	AS PER DIRECTIONS OF THE EIC
80	METAL CEILING	HUNTER DOUGLAS/ DURLUM/USG KNAUF/BOLLARD/ARMSTRONG/EQUIVALENT
81	DECKING SHEET	TATA BLUESCOPE/JSW STEEL/SAIL/JINDAL/EQUIVALENT
82	GLASS BRICKS/BLOCKS	SOLARIS/ SEVES/ SPG CORPORATION/EQUIVALENT
83	ALUMINIUM STANDING SEAM ROOFING	KALZIP/BEMO/SANKO/KINGSPAN/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
84	FOAM CONCRETE	SHALIFOAM/ SILICA GROUP/PRATIBHA/J.B INTERNATIONAL/HEMCARE/EQUIVALENT
85	EXPANSION JOINTS	EKSPAN/JOINT MASTER/TRELLEBORG/EMSEAL/SUPREME/UNISON/EQUIVALENT
86	RAISED/FALSE ACCESS FLOORING	UNITILE/ UNIFLOOR/ TATE/ALUFLOR/EQUIVALENT
87	LIFTS & Dumb Waiters	KONE/OTIS/SCHNEIDER/MITSUBISHI /EQUIVALENT
88	CALCIUM SILICATE FALSE CEILING	ARMSTRONG/ DEXUNE/USG KNUAF/USG BORAL/EQUIVALENT
89	MINERAL FIBER FALSE CEILING	ARMSTRONG/ DEXUNE/USG KNUAF/BOLLARD/USG BORAL/EQUIVALENT
90	“T” GRID FOR FALSE CEILING	HUNTER DOUGLAS/ DURLUM/USG KNAUF/BOLLARD/ARMSTRONG/EQUIVALENT
91	FIRE RATING HARDWARE	MARSHALL/DORMA/BACKER FS/ADOT/GEZE/ASSA ABLOY/EQUIVALENT
92	PHENOL BONDED BAMBOOWOOD FLOORING	EPITOME/FLOOR INDIA /ECO GREEN/EQUIVALENT
93	SIGNAGES	COSIGN/COOPER/GEVIS/LEGRAND/MK/PHILIPS/PROLITE/THORN/TEKNO WARE /EQUIVALENT
94	AUTOCLAVED AERATED CEMENT BLOCKS (AAC)	AS APPROVED BY ENGINEER-IN- CHARGE IN COMPLIANCE WITH THE SPECIFICATIONS
95	POLYMER MODIFIED ADHESIVE FOR AAC BLOCKS	TREMCO/KERAKOLL/CICO/FERROUS CRETE/SIKA/MYK/WEBER/EQUIVALENT
96	SS RAILING FITTINGS	DORMA/HETTICH/DORSET/EQUIVALENT
97	FLOOR SPRING/ DOOR CLOSER	DORMA/HETTICH/DORSET/EQUIVALENT
98	AUTOMATIC SLIDING DOOR	OZONE/ DORMA CROWN / ASSA ABLOY/EQUIVALENT
99	MODULAR KITCHEN	GODREJ INTERIO/ HAFFLE/ HACKER/ OZONE/EQUIVALENT
100	FACTORY-MADE HIGH-PERFORMANCE ALUMINIUM WINDOWS/ SYSTEM WINDOWS	REYNERS/KAWNEER/SCHUCO/HAFELE/EQUIVALENT
101	BAFFLE METAL CEILINGS	HUNTER DOUGLAS/DURLUM/BOLLARD/USG/KNAUF/ARMSTRONG/EQUIVALENT
102	FACADE SYSTEMS	SCHUCO/SAPA/ REYNERS/ KAWNEER/ALUK/EQUIVALENT
103	3D ALUMINUM JALI/ MESH	DECOGRILLE/ALSTRONG/GKD/ALUMINOUS/EQUIVALENT
104	CARPET	FLOTEX/ FORBO/BENTLEY/ MODULYSS/EQUIVALENT
105	SWIMMING POOL	HAYWARD /JANDY/STARLING /CERTIKIN /EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
106	INDOOR SPORTS FLOORING(SAI approved)	CONIPUR HG / POLYTAN /STOCKMERIER/KDF/EQUIVALENT
107	SYNTHETIC TRACK (SAI approved)	POLYTAN/CONICA AG/PORPLASTIC/STOCKMEIER URETHANES/EQUIVALENT
108	HOCKEY TURF (SAI approved)	POLYTAN/CONICA AG/PORPLASTIC/STOCKMEIER URETHANES/EQUIVALENT
109	FOOTBALL FIFA APPROVED TURF	POLYTAN/CONICA AG/PORPLASTIC/STOCKMEIER URETHANES/EQUIVALENT
110	BASKET BALL SYNTHETIC TURF (SAI approved)	CONICA / POLYTAN /STOCKMERIER/KDF/EQUIVALENT
111	TENNIS (ACRYLIC ITF APPROVED)	REBOUND ACE / FLEXITEN / LAYKOLD/KDF/EQUIVALENT
112	ATHLETIC TRACK & FIELD EQUIPMENT(WA APPROVED)	VINEX /AFN/NELCO/EQUIVALENT
113	FACADE LIGHTING	LIGHTING TECHNOLOGY/KLITE/UNILAMP/ENDO/IGUZZINI/DISANDO/ LEKSA/ EQUIVALENT
114	TENSILE FABRIC	SERGE FERRARI, MEHLER, SIOEN/EQUIVALENT
115	MIRROR	Saint-Gobain / Asahi / Gold Plus/ MODI/EQUIVALENT
116	Clear Float Glass	Saint-Gobain / Asahi /Gold Plus/ Modi/EQUIVALENT
117	Toughened Glass	Saint-Gobain / Asahi /Gold Plus/ Modi/EQUIVALENT
118	Fire Rated Glass	Saint-Gobain / Pilkington / Firelite / Glaverbel/Aashi/ Modi/ SCHOTT/ AIS/EQUIVALENT
119	Glass Processing	Saint-Gobain / Asahi/Gold Plus / Pilkington/Modi/Equivalent
120	PVB Lamination	Dupont / Saflex/Equivalent
121	Weather Sealant & Structural Sealant	DowCorning/GE/ALSTONE/Mccoy/Equivalent
122	Anchor Channels (Cast in Channel)	Halfen / Hilti / Jordhal/ Fischers/Equivalent
123	EPDM & Silicon Gasket	Schuco I SAPA Building Systems/ European/ Favade Product (EPF) / Reyners /Equivalent
124	Powder Coating	Jotun / Akzonoble/Valspar/Equivalent
125	PVDF Coating	Jotun / Akzonoble/Valspar/Equivalent
126	Powder & PVDF Processer	SP Coating / MJ Coaters / Aura International/Equivalent
127	Smoke Seal lntumescent	HAFELE/ENVIROGRAF/WEDGE/PROMAT/MANN MAGOWAN/INTUFLAME/EQUIVALENT
128	SS Spider Fittings	DORMA/HETTICH/DORSET/EQUIVALENT
129	SS Patch Fitting	DORMA/HETTICH/DORSET/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
130	SS Friction Hinges / Multipoint Locking sets/ Handle/ Rollers / Flush Lock/ Wool Pile with Silent Film/ Windows Hinges/ Door Hinges	Giesse / Cotswold/ Securistyle/ Schuco / SAPA Building Systems/ European Facade Product (EFP)/ Reyners/DORMA/ OZONE/ ASSA ABLOY/GODREJ/Equivalent
131	Mechanical Couplar	USHA MARTIN, ASCON, HERRISAN, DORMA, OZONE, ASSA ABLOY, GODREJ/EQUIVALENT
132	Precast drain cover/kerb channel	KK, NITCO, UNISTONE, MODERN TILES/EQUIVALENT
133	LACQURED GLASS	SAINT GOBAIN/ ASAHI/GOLD PLUS/ PILKINGTON/EQUIVALENT
134	GRASS PAVER	AS APPROVED BY ENGR-IN- CHARGE IN COMPLIANCE WITH THE SPECIFICATIONS
135	Fire sealant	3M/PROMAT/FISCHER/ROXTEC/EQUIVALENT
136	Nut Bolts and Washers	AS APPROVED BY ENGR-IN- CHARGE IN COMPLIANCE WITH THE SPECIFICATIONS
137	Aluminium Expension Joints (10 Years Warranty)	MAURER-Sanfield/DECG International/Bruecke Gebaeude/BALCO/UNISON/KAIZEN /EQUIVALENT
138	wood polymer composite door frames (WPC)	Alstone / Greenply / Century /EQUIVALENT
139	**ELECTRICAL WORKS**	
140	**ELECTRICAL HIGH SIDE EQUIPMENT**	
141	UPS SYSTEM	VERTIV/EMERSON/APC/ EATON/ABB/CYBER POWER/FUJI/EQUIVALENT
142	INVERTOR	LUMINOUS/ MICROTEK / SUKAM/DELTA/EXIDE/EQUIVALENT
143	**ELECTRICAL SYSTEM/ PANELS**	
144	FUSES & SWITCH FUSE UNIT	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
145	ACB / MCCB / CONTACTOR	L&T/ ABB/ Seimens/ Schneider/ Eaton/Equivalent (As per DISCOM)
146	METAL CLAD SOCKET (Industrial)	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
147	RISING MAINS / BUS DUCT	L&T/ ABB/ Seimens/ Schneider/Legrand/ Equivalent (As per DISCOM)
148	LED LIGHT-INDICATING LAMP (PANEL INDICATOR)	SIEMENS/ABB/Lauritz Knudsen/BCH/SBEE/LEGERO/GE/EQUIVALENT
149	ISOLATORS FOR MOTORS	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
150	CHANGE OVER SWITCH	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
151	CONTACTOR, TIMER, SINGLE PHASE PREVENTOR & OVER LOAD RELAY	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
152	METERS - DIGITAL TYPE (Approval taken by line Department)	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
153	PROTECTIVE & APFC RELAYS	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
154	CT'S / PT'S- DRY TYPE-EPOXY	AE/ KAPPA /GE/EQUIVALENT
155	INDICATING LAMP / PUSH BUTTON ACTUATERS - LED CLUSTER TYPE	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
156	ROTARY SWITCHES	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
157	TERMINAL BLOCK	ELEMEX/ WAGO/SCHNEIDER/EQUIVALENT
158	MAIN LT PANEL	SEIMENS-SIEPAN-PU/SCHNEIDER-BLOCKSET/ABB-ARTUK/Lauritz Knudsen-TI/EQUIVALENT (Panells shall be design verified TTA assembly and MCCB shall have Microprocessor based relay)
159	LT PANELS/CAPACITOR PANEL /SYNC PANEL /SUB PANEL/ FEEDAR PILLAR/HVAC PANEL (AS PER CERTIFIED DESIGN BY THE OEM) (Design Vertical assembly as per IEC-61439-Part 1&2)	Lauritz Knudsen/ABB/SEIMENS/SCHNEIDER/ADVANCE/SPC ELECTROTECH/VDEAL/EQUIVALENT
160	LIGHTNING ARRESTER	OBLUM/ABB/ERICO/CAPE/ Dhen/EQUIVALENT
161	ATS / STS	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
162	Solar PV Panels (RFID TO BE EMBEDDED IN THE PANEL)	Tata/RenewSys India/Adani/Waaree/EQUIVALENT
163	SCADA(Supervisory Control and Data Acquisition)	ABB/SEIMENS/SCHNEIDER/HONEYWELL/ROCKWELL/EQUIVALENT
164	DUEL FIRED STEAM BOILERS	THERMAX/CHEEMA/ROSS/HEATEX/IBL/EQUIVALENT
165	Aviation Obstruction Light (LED Type)	Actos/Bajaj/Binay/EQUIVALENT
166	HDPE Pipe for underground cable only	Reliance/Kaplan/Durolane/EQUIVALENT
167	Occupancy sensors	ABB/Anchor (Panasonic)/Schneider/ Creston/ Lutron/ MK (Honeywell)/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
168	33&11 KV Ring Main Unit (With Metering)	ABB/ Seimens/ Schneider/Eaton/C-Sec/ Parth Eletricals/ Equivalent (As per DISCOM)
169	33&11 KV Ring Main Unit (Without Metering)	ABB/ Seimens/ Schneider/Eaton/C-Sec/ Parth Eletricals/ Equivalent (As per DISCOM)
170	**CABLES/ TERMINATIONS/ACCESSORIES**	
171	LUGS	DOWELLS/ COMET/ BALIGA/JHONSON/EQUIVALENT
172	BRASS CABLE GLANDS	DOWELLS/ COMET/ BALIGA/JHONSON/EQUIVALENT
173	LT POWER CABLE (CU/AL) (Only FRLS to be used)	Dynamic/ KEI/Ravi/ Zenium/ Equivalent (As per DISCOM)
174	CONTROL CABLE (COPPER)	Dynamic/ KEI/Ravi/ Zenium/ Equivalent (As per DISCOM)
175	HT XLPE CABLE	Dynamic/ KEI/ Havells/Apar/KEC/Torrent/Polycab/ Equivalent (As per DISCOM)
176	H.T. CABLE END TERMINATION	POLYCAB/KEI/AKG/HAVELLS/3M/XYLEM/RAYCHEM/EQUIVALENT
177	**CONDUITING & WIRING ACCESSORIES**	
178	MS CONDUIT WITH ACCESSORIES / GI CONDUIT	AKG/RAMCON/PRECISION/ BEC/ NIC/STEEL CRAFT/EQUIVALENT
179	PVC/ Fire Retardent (FR) CONDUIT WITH ACCESSORIES	AKG/BEC/RAMCON/SKIPPER PIPES/ POLY PACK/ PRECISION/EQUIVALENT
180	PVC INSULATED COPPER CONDUCTOR FRLS WIRE	POLYCAB/ HAVELLS /KEI/AKG/BONTON/ FINOLEX/EQUIVALENT
181	PLATE TYPE - SWITCHES / SOCKETS / TV & TELEPHONE SOCKETS AND ALL OTHER WIRING ACCESSORIES (ONE MODEL ABOVE BASE MODEL)	LEGRAND/ PANASONIC/ABB/Crabtree/ Precision/ Northwest/EQUIVALENT
182	RACEWAYS & CABLE TRAY	BEC/ LEGRAND/ENFORTURE INFRATECH/ADVACNE/SUPER TECH CONTROL/EQUIVALENT
183	**LIGHTING DBS & MCBS**	
184	MCB/ ELCB/ ELMCB / RCCB	ABB/ LEGRAND/ SCHNIDER/SIEMENS / Lauritz Knudsen(HAGER)/EQUIVALENT
185	DISTRIBUTION BOARD	ABB/ LEGRAND/ SCHNIDER/SIEMENS / Lauritz Knudsen(HAGER)/EQUIVALENT
186	**LIGHTING FIXTURES & FANS**	

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
187	BULK HEAD FITTINGS	WIPRO/ PHILIPS/ BAJAJ/HAVELLS/KLITE/STURITE/EQUIVALENT
188	LIGHTING FIXTURES INTERNAL	IGUZZINI/LIGMAN/BEGA/LT/HOMEDEC/STURITE/PHILIPS/EQUIVALENT
189	FACADE LIGHTING	IGUZZINI/LIGMAN/BEGA/LT/HOMEDEC/STURITE/PHILIPS/EQUIVALENT
190	LANDSCAPE LIGHTING	IGUZZINI/LIGMAN/BEGA/LT/HOMEDEC/STURITE/REYTEK/EQUIVALENT
191	FLOOD LIGHTING	WIPRO/ PHILIPS/ BAJAJ/HAVELLS/KLITE/STURITE/EQUIVALENT
192	LIGHTING CONTROL SYSTEM	HELVAR/ CRESTRON/ ZUMTOBEL/ SIEMENS//STURITE/ LIGMAN/LIGHTING TECHNOLOGY/EQUIVALENT
193	STREET LIGHT & POLES	LIGMAN/HOMEDEC/LIGHTING TECHNOLOGY/STURITE/KLITE/ REYTEK/ TRANSRAIL/ KESELEC/EQUIVALENT
194	DECORATIVE LIGHT POLES & LIGHTS	IGUZZINI/LIGMAN/BEGA/LT/HOMEDEC/STURITE/KLITE/REYTEK/TRANSRAIL/KESELEC/ EQUIVALENT
195	EXHAUST FANS / CEILING FAN / WALL MOUNTED FAN	USHA/CROMPTON/ORIENT/WIPRO/STURITE/ PHILIPS/ BAJAJ/EQUIVALENT
196	**CCTV/ FIRE ALARM SYSTEMS**	
197	FIRE ALARM SYSTEM	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
198	SMOKE DETECTORS / MULTISENSOR	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
199	HEAT DETECTORS / CO DETECTORS	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
200	MANUAL CALL BOX	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
201	HOOTER/ SOUNDER / MODULES/ FAULT ISOLATORS	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
202	RESPONSE INDICATOR	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
203	FIRE PANEL/REPEATER PANEL	SIEMENS/ HONEYWELL-NOTIFIER/ BOSCH/ GLYPTIC/EDWARDS/JHONSON CONTROLS-SIMPLEX/EQUIVALENT
204	FIRE ALARM SYSTEM- FIRE SURVIVAL CABLE	POLYCAB/AKG/HAVELLS/KEI/EQUIVALENT
205	CAMERA WITH ALL ACCESSORIES	HONEYWELL/AXIS/BOSCH/PELCO/EQUIVALENT
206	ROAD BARRIER	NICE / MAGNETICS / GODREJ /MOTWANE/EQUIVALENT
207	PARKING MANAGEMENT SYSTEM	DESIGNA/SKIDATA/HOUSTON/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
208	LED PANEL/MONITOR/VIDEO WALL	LG/ SAMSUNG / SONY/BARCO/CHRISTIE/DELTA/EQUIVALENT
209	TELEPHONE TAG BLOCK	COMMSCOPE / SCHNEIDER / PANDUIT/KRONE/EQUIVALENT
210	TELEPHONE CABLES	KEI/ POLYCAB/ BELDEN/LEGRAND/DELTON/EQUIVALENT
211	CO-AXIAL CABLES	KEI/ POLYCAB/ HAVELLS/ BELDEN/EQUIVALENT
212	CATEGORY 6A CABLE	PANDUIT/COMMSCOPE/BELDEN/SEIMON/EQUIVALENT
213	MICC CABLE	NORDEN/KERONE/WREHAM/EQUIVALENT
214	NETWORK SWITCH	JUNIPER/CISCO/ARISTA/EQUIVALENT
215	**MISCELLANEOUS SYSTEMS**	
216	BATTERIES	EXIDE/ STANDARD/AMARON/ AMCO/EQUIVALENT
217	BATTERY CHARGER	EXIDE/ STANDARD/AMARON/ AMCO/EQUIVALENT
218	EARTHING (ALL TYPE)	NUTECH PRODUCTS/ DEHN /TRIPROTEC/ TERCEL/ PRANAV ENERGY/EQUIVALENT
219	**DG/PANEL/TRANSFORMER**	
220	ALTERNATOR	STAMFORD/ CATERPILLAR/ CROMPTON/ LEROY SOMER/ KIRLOSKAR/EQUIVALENT
221	ENGINE	CUMMINS/ CATERPILLAR/ MTU/BAUDOUIN/EQUIVALENT
222	HT PANELS	ABB / SIEMENS / SCHNIEDER /Lauritz Knudsen/EQUIVALENT
223	TRANSFORMER	ABB/ Schnieder/Raychem/TMC
224	UNITISED / COMPACT SUB-STATION	ABB/SIEMENS/ SCHNIEDER/Crompton Greaves/EQUIVALENT (Approved by Discom)
225	DG	JACKSON/KIRLOSKAR/ Cummins/ Greaves/STERLING/EQUIVALENT
226	**PLUMBING SYSTEM**	
227	VITREOUS CHINA SANITARYWARE	KOHLER/GROHE/ROCA/JAQUAR/EQUIVALENT
228	PLASTIC W.C.SEATS & COVERS	KOHLER/GROHE/ROCA/JAQUAR/EQUIVALENT
229	C.P. FITTINGS:	KOHLER/GROHE/ROCA/JAQUAR/EQUIVALENT
230	AUTOMATIC WATER TAPS, AUTOMATIC URINAL FLUSHING	KOHLER/GROHE/ROCA/JAQUAR/EQUIVALENT
231	TOWEL RING, TOWEL ROD, TOWEL RACK, COAT HOOK ETC. (304 GRADE S.S.)	KOHLER/GROHE/ROCA/JAQUAR/EQUIVALENT
232	CHROMIUM PLATED / STAINLESS STEEL / POLY VENIEL CHLORIDE GRATING	KOHLER/GROHE/ROCA/JAQUAR/CERA/EQUIVALENT
233	PH TOILET ONLY	HINDWARE/CERA/PARRYWARE/EQUIVALENT
234	STAINLESS STEEL SINK	JAYNA /NIRALI/NEELKANT/KINGSTON/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
235	G.I. & M.S. PIPES PART-I IS: 1239 UPTO 150 MM AND M.S. PIPES PART-II IS: 3589 ABOVE 150 MM	TATA STEEL (TUBE DIVISION)/JINDAL HISAR/SAIL/EQUIVALENT
236	G.I. AND M.S. FITTINGS	UNIK/ ZOLOTO / JAINSON / BHARATFORGE/EQUIVALENT
237	PVC PIPES & FITTINGS	ASTRAL/FINOLEX INDUSTRIES/AKG/SUPREME/ASHIRBAD/ORIPLAST/EQUIVALENT
238	UPVC PIPES & FITTINGS	ASTRAL/FINOLEX INDUSTRIES/AKG/SUPREME/ASHIRBAD/ORIPLAST/EQUIVALENT
239	CPVC PIPES & FITTINGS	ASTRAL/FINOLEX INDUSTRIES/AKG/SUPREME/ASHIRBAD/ORIPLAST/EQUIVALENT
240	SWR PIPES & FITTINGS	ASTRAL/FINOLEX INDUSTRIES/AKG/SUPREME/ASHIRBAD/ORIPLAST/EQUIVALENT
241	HDPE PIPE & FITTINGS (For Soil & Waste Dual Stack system)	GABERIT/ACO/EQUIVALENT
242	R.C.C. PIPES (NP2,NP3,NP4)	PRAGATI CONCRETE UDYOG/ K.K. SPUN PIPES/ J. K. SPUN PIPES/SOOD &SOOD/HUME /EQUIVALENT
243	WATER TANK (ISI MARK)	ASTRAL/FINOLEX INDUSTRIES/AKG/ SUPREME/SYNTEX/EQUIVALENT
244	FORGED BRASS BALL VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
245	F.B. MULTI UTILITY CHECK VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
246	F.B. AIR VENT	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
247	F.B.P.R.V.	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
248	FLOAT VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
249	C.I, SLUICE VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/KIRLOSKAR/Lauritz Knudsen/EQUIVALENT
250	C.I. BUTTER FLY	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/KIRLOSKAR/Lauritz Knudsen/EQUIVALENT
251	C.I.NRV REFLUX	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
252	C.I. DUAL PLATE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
253	D.I. WAFER TYPE CHECK VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
254	C.I. Y TYPE STRAINER	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
255	C.I. DOUBLE ACTING AIR VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/KIRLOSKAR/EQUIVALENT
256	FOOT VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
257	REST ALL TYPE OF VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
258	HAND DRIER (304 GRADE S.S.)	EURONICS/GROHE/KOHLAR/DURAVIT/EQUIVALENT
259	LIQUID SOAP DISPENSER (304 GRADE S.S.)	EURONICS/BOBRIC/SLOAN/PRESTIGE/NIRALI/EQUIVALENT
260	STORAGE TYPE WATER HEATER (5 STAR RATED)	RACOLD/ CROMPTON/ JAQUAR/HAVELLS/EQUIVALENT
261	INSULATION	THERMAFLEX / AEROFLEX / K FLEX/ A- FLEX/EQUIVALENT
262	SOLAR HOT WATER EQUIPMENT	TATA SOLAR/ SOLAHART/ GREENTEK/EQUIVALENT
263	PVC FOOT REST &SFRC COVERS	KGM/ Patel / Pranali Industries/EQUIVALENT
264	STAINLESS STEEL PIPES & 316L	INOX-KANTHERM/ ALFA PRESSCONEX BÄNNINGER/ VIEGA/ AQUNIOX/VSH/EQUIVALENT
265	FRP Manholes Covers	EVERLAST/THERMO SET/RX/EQUIVALENT
266	PRESSURE RELIEF VALVES	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
267	PRESSURE REDUCING VALVES	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
268	**PUMPS AND EQUIPMENTS**	
269	WATER TRANSFER PUMPS	WILO/GROUNDFOS/KIRLOSKAR/CROMPTON/EQUIVALENT
270	IRRIGATION PUMP	WILO/GROUNDFOS/KIRLOSKAR/CROMPTON/EQUIVALENT
271	SUMP PUMP	WILO/GROUNDFOS/KIRLOSKAR/CROMPTON/EQUIVALENT
272	WATER LEVEL INDICATOR	MINILEC/AUTOPUMP/TECHNIKA/Elegent Controls/EQUIVALENT
273	WATER LEVEL CONTROLLER	MINILEC/AUTOPUMP/TECHNIKA/Elegent Controls/EQUIVALENT
274	ELECTRONIC SENSING PROBE	MINILEC/AUTOPUMP/TECHNIKA/Elegent Controls/EQUIVALENT
275	WATER METER	CRESENT/ KRANTI/KENT/KAPSTAN/WIKA/EQUIVALENT
276	SOUNDER PATTERN VALVE FOR FILTER AND SOFTENER	LABLINE/ AIP (AGRICULTURE AND INDUSTRIAL PUMPS)/EQUIVALENT
277	PRESSURE GAUGE	FIEBIG/EMERALD/WIKA/EQUIVALENT
278	ELECTRICAL PANEL (TTA PANEL)	SIEMENS/SCHNEIDER/Lauritz Knudsen/ABB/SUPER TECH CONTROL/EQUIVALENT
279	NON RETURN VALVE (65MM DIA & ABOVE)	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
280	BUTTERFLY VALVE (LEVER TYPE)	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/AUDCO/DANFOS/EQUIVALENT
281	BUTTERFLY VALVE (GEAR TYPE)	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/AUDCO/DANFOS/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
282	MOTORIZED VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/AUDCO/DANFOS/EQUIVALENT
283	VIBRATION PAD	RESISTOFLEX/ EASYFLEX/DULOP/EMERALD/EQUIVALENT
284	VIBRATION ELIMINATOR	RESISTOFLEX/ EASYFLEX/DULOP/EMERALD/EQUIVALENT
285	Booster Pumps	Grundfos / Wilo-Mather & Platt/KIRLOSKAR/EQUIVALENT
286	Self Priming Pumps	WILO/GROUNDFOS/KIRLOSKAR/CROMPTON/EQUIVALENT
287	**FIRE FIGHTING SYSTEM**	
288	ELECTRIC DRIVEN MOTOR AND PUMPS	WILO/GROUNDFOS/CROMPTON/KIRLOSKAR/KSB/MATHER PLATT/EQUIVALENT
289	DIESEL ENGINE / DIESEL FIRE PUMP	ASHOK LEYLAND / CUMMINS / KOEL/ CATERPILLAR/KIRLOSKAR/EQUIVALENT
290	G.I. AND M.S. PIPES	TATA / JINDAL-HISAR / SAIL /EQUIVALENT
291	FIRE HOSE PIPES / R R.L. HOSE PIPE WITH COUPLING (GUN METAL / BRASS /SS/ ALUMINIUM)	NEWAGE / MINMAX / TYCO/ EVERSAFE/EQUIVALENT
292	FIRST AID FIRE HOSE REEL WITH BRACKET, DRUM AND SHUT OFFNOZZLE	NEWAGE / MINMAX / TYCO/ EVERSAFE/EQUIVALENT
293	G.I. AND M.S. FITTINGS	ZOLOTO/ JAINSON / BHARATFORGE/EQUIVALENT
294	C.I. DOUBLE FLANGED SLUICE / GATE VALVE / NON-RETURN VALVES	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
295	SLIM SEAL BUTTERFLY VALVES (PN- 1.6)	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
296	C. I. BODY BUTTERFLY VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
297	GUN METAL BODY BUTTERFLY VALVE	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
298	LANDING VALVE (GUN METAL / BRASS/ SS/ ALUMINIUM	ZOLOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
299	ALARM GONG	HD/TYCO/VIKING/EQUIVALENT
300	QB. SPRINKLER	TYCO / NEWAGE/ HD/EQUIVALENT
301	WRAPPING AND COATING	PYPKOTE / RUSTECH / COALTEK/EQUIVALENT
302	FABRICATED FIRE HOSE CABINET	NEWAGE / SAFEGUARD/EVERSAFE/EQUIVALENT
303	BRANCH PIPE / NOZZLES (GUN METAL/ BRASS / SS / ALUMINIUM)	NEWAGE / SAFEGUARD/EVERSAFE/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
304	FIRE EXTINGUISHERS (ALL TYPE)	MINIMAX/CEASE FIRE/KANEX/EQUIVALENT
305	FIRE BRIGADE CONNECTION	HD/TYCO/VIKING/EQUIVALENT
306	SUCTION STRAINER	AUDCO/ADVACNE/ZOLOTO/NORMEX/TYCO/EQUIVALENT
307	VIBRATION ELIMINATOR CONNECTORS	RESISTOFLEX / DUNLOP /EASYFLEX/ EMERALD/EQUIVALENT
308	SINGLE PHASING PREVENTOR (CURRENT OPERATED)	Lauritz Knudsen / SIEMENS / MINILEC/EQUIVALENT
309	FLOW METER	EMERSON/E&H/SIEMENS/JUMO/EQUIVALENT
310	ELECTRICAL SWITCHGEAR & STARTERS	SCHNEIDER/SIEMENS / Lauritz Knudsen / ABB/EQUIVALENT
311	FLOW SWITCH	HONEYWELL / SWITZER / JHONSON CONTROL/EQUIVALENT
312	MAIN CONTROL PANEL (POWDER COATED)	SPC ELECTROTECH/SUPER TECH CONTROL / HAVELLS / C&S/ ABB/ SCHNIEDER/Lauritz Knudsen/EQUIVALENT
313	PRESSURE SWITCHES	INFOSS / SWITZER/DANFOSS/ VIKING/EQUIVALENT
314	PRESSURE GAUGE	H.GURU / FIEBIG/ Emarald/EQUIVALENT
315	ANNUNCIATION PANEL FOR SPRINKLER SYSTEM	PCD / SAFEWAY / AGNI (INDIA)/EQUIVALENT
316	ALARM VALVE & HYDRAULIC ALARM MOTOR WITH COVERING	MATHER & PLATT / HD/EQUIVALENT
317	THIMBLES / FERRULES (TINNED COPPER)	DOWEL/UTKAL/LUGS INDIA/EQUIVALENT
318	POWER CAPACITOR	Lauritz Knudsen/ ASIAN / DUCATTI/ EPCOS/EQUIVALENT
319	ENERGY MEASURING METER (DIGITAL) (As per approval of the DISCOM)	Lauritz Knudsen / SIEMENS / AE / ENERCON/SECURE/HPL/EQUIVALENT
320	2-WAY INLET BREACHING	NEWAGE / MINMAX/HD/VIKING/EQUIVALENT
321	4-WAY INLET BREACHING	NEWAGE / MINMAX/HD/VIKING/EQUIVALENT
322	GAS FIRE SUPRESSION SYSTEM	AMEREX/NOHMI/FIRETRACE/KANEX/Ceasefire/ Minimax GMBH / Rotarex/EQUIVALENT
323	FIRE STOP (FIRE SEALANT)	HILTI/ FISCHER/3M/PROMAT/EQUIVALENT
324	**HVAC WORKS**	
325	WATER-COOLED Chiller(Compressor to be the same make,Double Screw)	CARRIER/ TRANE/CLIMAVENETA/YORK/DAIKIN/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
326	PUMP SETS (FOR PRIMARY / SECONDARY CHW PUMPS & CONDENSER WATER PUMPS & HOT WATER PUMPS)	ITT-XYLEM/ARMSTRONG/GRUNDFOSS/KIRLOSKAR/EQUIVALENT
327	VARIABLE SPEED PUMPING STEM.	ITT-XYLEM (e-80ITSC)/ARMSTRONG (DE4300)/GRUNDFOSS (TPE)/ABB/EQUIVALENT
328	Plate type Heat exchanger (PHE)	Alfa laval/ Armstrong/GEA / ITT-Xylem/EQUIVALENT
329	Heat Pumps	CARRIER / DAIKIN/ TRANE/CLIMAVENETA/YORK/EQUIVALENT
330	Dessicant Wheel	DRI / Flakt Woods / Ostberg(Enventus)/BRY AIR/EQUIVALENT
331	Air washer Unit	Edgetech/Humidin / Wave Aircon / Zeco/EQUIVALENT
332	MS Piping	Jindal Hissar/ Sail / Tata Steel/EQUIVALENT
333	Dedicated outdoor air unit	Edgetech/VTS/ZECO/WAVE AIRCON/EQUIVALENT
334	VARIABLE FREQUENCY DRIVE (FOR PUMPS, COOLING TOWER & AHU)	DANFOSS (FC 102) / ABB (ACH 550) / SIEMENS (SINAMICS G120P)/Lauritz Knudsen/SCHNEIDER- ALTIVAR 320/EQUIVALENT
335	PRESSURIZED EXPANSION TANK FOR CHILLED WATER & HOT WATER	Reflex/Armstrong/IIT-Xylem/Grundfoss/EQUIVALENT
336	AIR & DIRT SEPARATOR, VACUUM DEGASSER	FLAMCO / SPIROTECH/ARMSTRONG/EQUIVALENT
337	COOLING TOWER	Advance / BELL / PAHARPUR/EQUIVALENT
338	HOT WATER GENERATOR & ULTRASONIC HUMIDIFIER	KEPL / EMERALD / RAPID COOL/EQUIVALENT
339	ELECTROCHEMICAL WATER	ELGRESSY / TERRAGON / ENPAR TECHNOLOGIES/EQUIVALENT
340	AIR HANDLING UNITS	Edgetech/VTS/ZECO/WAVE AIRCON/SYSTEM AIR/FLAKTWOOD/EQUIVALENT
341	PRECISION AIR HANDLING UNITS	Climaveneta(Mitsubishi Electric)/Vertiv/Schneider /EQUIVALENT
342	HEAT / ENERGY RECOVERY WHEEL	DRI / NOVELAIR-SEVCON / OSTBERG/ BRY-AIR/EQUIVALENT
343	FAN COIL UNIT WITH AMCA CERTIFIED FAN FOR SOUND & PERFORMANCE	CARRIER/VTS/FLAKTWOOD/EQUIVALENT
344	ARI CERTIFIED COOLING / HEATING COIL (AHU & FCU)	EDGETECH / VTS/ SYSTEMAIR/FLAKTWOOD/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
345	AHU FANS (AMCA CERTIFIED FOR SOUND & PERFORMANCE) / DIDW CENTRIFUGAL FORWARD	KRUGER / SYSTEMAIR/ NICOTRA/Greenheck/EQUIVALENT
346	PLUG FANS	FLAKTWOOD/GREENHECK/KRUGER/LAU/EQUIVALENT
347	Dry Scrubber	Ryder / Trion/ Flanders Air Seal/EQUIVALENT
348	PACKAGED TYPE SCRUBBER	EDGETECH / SYSTEMAIR/FLAKTWOOD/ ZECO/EQUIVALENT
349	SCRUBBER & AIR-WASHER FANS (AMCA CERTIFIED FOR SOUND & PERFORMANCE) PLUG FAN / DIDW CENTRIFUGAL FORWARD / BACKWARD CURVE	SYSTEMAIR/ NICOTRA/GREEHECK/EQUIVALENT
350	Thermal Insulation	ALP Aeroflex / Armcell / K Flex/EQUIVALENT
351	Acoustic Insulation	ALP Aeroflex / Armcell / K Flex/EQUIVALENT
352	ACOUSTICALLY INSULATED INLINE BOX FANS	SYSTEMAIR/ NICOTRA/GREEHECK/EQUIVALENT
353	AXIAL FAN FOR VENTILATION (AMCA CERTIFIED FOR SOUND & PERFORMANCE)	Greenheck /Nictra / Systemair/EQUIVALENT
354	CENTRIFUGAL FAN FOR VENTILATION (AMCA CERTIFIED FOR SOUND & PERFORMANCE)	Greenheck /Nictra / Systemair/EQUIVALENT
355	PROPELLER FAN	Greenheck /Nictra / Systemair/EQUIVALENT
356	THREE PHASE MOTORS	ABB / CROMTON GREAVES/ SIEMENS/EQUIVALENT
357	THREE PHASE MOTORS (250°C FOR 2 HOURS)	ABB / CROMTON GREAVES/ SIEMENS/EQUIVALENT
358	Y-STRAINER / POT–STRAINER	EMERALD / LEHRY VTM/EQUIVALENT
359	Butterfly Valve with Actuator	Belimo / Honeywell / Johnson Control / Schneider/EQUIVALENT
360	Actuator for valves and Dampers	Belimo / Honeywell / Johnson Control / Schneider/EQUIVALENT
361	Balancing Valve (Manual)	Advance Valve / Danfoss / Honeywell/EQUIVALENT
362	BUTTERFLY VALVE	ADVANCE/TYCO/ Lauritz Knudsen/NEWAGE/EQUIVALENT
363	CHECK VALVE	ADVANCE/TYCO/ Lauritz Knudsen/NEWAGE/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
364	AUTOMATIC BALANCING VALVES	DANFOSS / FLOWCON / SIEMENS / ADVANCE-PETTINAROLLI/EQUIVALENT
365	BALANCING CUM 2-WAY MODULATING CONTROL VALVE (SINGLE BODY)	Belimo / Danfoss / Flowcon / Honeywell / Seimens/EQUIVALENT
366	GLOBE / BALL VALVE (WITH OR WITHOUT STRAINER)	Belimo / Danfoss / Flowcon / Honeywell / Seimens/EQUIVALENT
367	AUTO AIR VENT VALVE	RB / Rapid Control/EQUIVALENT
368	PRESSURE GAUGES	FEIBIG / EMERALD / H GURU/EQUIVALENT
369	INDUSTRIAL TYPE THERMOMETER (ALCOHAL FILLED V FORM)	Pioneer / H GURU / Taylor/EQUIVALENT
370	GSS SHEET / GI Sheet	SAIL / TATA / JINDAL/EQUIVALENT
371	ALUMINIUM SHEET	HINDALCO / BALCO / NALCO/EQUIVALENT
372	FACTORY FABRICATED DUCT	Ductofab / Radiant Air System / Rolastar / Zeco/EQUIVALENT
373	INSULATED FLEXIBLE DUCT	CARYAIRE / ATCO / Titus / Seven Star / UP Twiga/EQUIVALENT
374	DUCT / PIPE SUPPORT	HILTI/ FISCHER/UNBRAKO/WUERTH/EQUIVALENT
375	FIRE & SMOKE DAMPER	Greenheck / Ruskin / Systemair / Betec CAD/EQUIVALENT
376	FIRE DAMPER ACTUATOR	BELIMO / SIEMENS / DANFOSS/EQUIVALENT
377	EXTRUDED ALUMINUM GRILLS / DIFFUSERS	AIRFLOW / TROX / DYNACRAFT/EQUIVALENT
378	VARIABLE AIR QUANTITY / INDOOR	CONAIRE / GREENHECK / PARAGON CONTROL/EQUIVALENT
379	AIR QUANTITY UNIT (WIRELESS) VAQ/ IAQ CAV UNIT	CONAIRE / TROX / AIRFLOW/EQUIVALENT
380	FILTERS including HEPA filter plenums / Pre-filter / Micro Vee Filter/ Bag Filter	THERMODYNE / KLENZOID / PUROLATOR / SPECTRUM/ AAF Synder General/EQUIVALENT
381	UV Lamp	Aeropure UV Systems / Arklite / Sterile/EQUIVALENT
382	VIBRATION ISOLATION SPRING	Dunlop / Easy flex / Resistoflex/EQUIVALENT
383	FLEXIBLE PIPE CONNECTOR	Mapro/ Easy Flex / Resistoflex/EQUIVALENT
384	CLOSED CELL FIRE RETARDANT XPE (FOR DUCT INSULATION)	PARAMOUNT / SUPREME / TROCYLENE / A FLEX/ AEROFLEX/EQUIVALENT
385	NITRILE RUBBER INSULATION (FOR PIPE INSULATION)	ARMAFLEX / A FLEX/ AEROFLEX/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
386	EXPANDED POLYSTYRENE	METTUR BEARDSELL / STYRENE PACKING / TOSHIBA/EQUIVALENT
387	FIBRE GLASS RIGID BOARD	OWEN CORNING / KIMCO / SIPLA/ SUPREME/EQUIVALENT
388	WELDING RODS	ADVANI / ESAB / VICTOR / ADOR / COSMOS/EQUIVALENT
389	COPPER REFRIGERANT PIPING (With ISI MARK PRINT)	MANDEV/RR GLOBAL/INDIGO/RAJKO/MAXFLOW/EQUIVALENT
390	AIR-CIRCUIT BREAKER	Lauritz Knudsen / SIEMENS / SCHENIDER/ABB/EQUIVALENT
391	M.C.C.B.	Lauritz Knudsen / SIEMENS / SCHENIDER/ABB/EQUIVALENT
392	MCB	Lauritz Knudsen / SIEMENS / SCHENIDER/ABB/EQUIVALENT
393	STARTERS, CONTACTORS, PUSH BUTTONS, OVERLOAD RELAY	Lauritz Knudsen / SIEMENS / SCHENIDER/ABB/EQUIVALENT
394	SINGLE PHASE PREVENTER	Lauritz Knudsen / SIEMENS / SCHENIDER/ABB/EQUIVALENT
395	CURRENT TRANSFORMER	AE / KAPPA / PRAGATI/EQUIVALENT
396	ROTARY SWITCHES	Lauritz Knudsen / SIEMENS / BCH/EQUIVALENT
397	SELECTOR & TOGGLE SWITCH	KAYCEE / Lauritz Knudsen / ABB/EQUIVALENT
398	CHANGE OVER SWITCH	HPL/HAGER/GE/SOCOMEC/EQUIVALENT
399	HRC FUSE AND FITTINGS	ABB/Lauritz Knudsen/GE / SIEMENS/EQUIVALENT
400	VOLTMETER / AMMETER	A.E. / IMP / ELMEASURE/EQUIVALENT
401	INDICATING LAMPS	SIEMENS / Lauritz Knudsen/ ALTOS / SCHENIDER/EQUIVALENT
402	TIME DELAY DEVICE	SIEMENS / Lauritz Knudsen/ BCH/EQUIVALENT
403	UL CERTIFIED AHU UVC / COILOTRON & DUCT MOUNTED UVGI	RUKS / STERIL-AIRE / TRIMMED/ ULTRAFRESH/ ULTRAPURE/ MAGNETO/EQUIVALENT
404	AIR COOLED HI WALL SPLIT UNIT (5 STARAS PER BEE)	HITACHI /MITSHUBISHI/ O-GENERAL/ DAIKIN/ Carrier/EQUIVALENT
405	AIR COOLED PRECISION AC UNIT	VERTIV/SCHNEIDER/CLIMAVENETA/EQUIVALENT
406	JET VENTILATION FAN FOR BASEMENT CAR PARKING	FLAKTWOODS/KRUGER/NICOTRA-GEBHARDT/Greenheck/EQUIVALENT
407	Grille/dampers	Caryaire/ Ruskin/ Systemair/EQUIVALENT
408	UV Protective coating	Armacell Armachek/ Amicol/Paramount/Polybond/EQUIVALENT
409	Grooved Couplings and Fittings	Victaulic/Anvil/ Smith Cooper/Equivalent
410	**BMS SYSTEM**	
411	CENTRAL CONTROL BMS SERVER	HP/DELL/LENOVO/IBM/EQUIVALENT
412	PRINTER	HP/CANON/EPSON/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
413	BUILDING MANAGEMENT SYSTEM	SIEMENS/HONEYWELL/JOHNSON CONTROL/ENLITE/SCHNEIDER/EQUIVALENT
414	BUILDING MANAGEMENT WEB BASED SERVER SOFTWARE	SIEMENS/HONEYWELL/JOHNSON CONTROL/ENLITE/SCHNEIDER/EQUIVALENT
415	PROGRAMMABLE & APPLICATION SPECIFIER CONTROLLER (DDC)	SIEMENS/HONEYWELL/JOHNSON CONTROL/ENLITE/SCHNEIDER/EQUIVALENT
416	ENCLOSURE FOR DDC CONTROLLER	SIEMENS/HONEYWELL/JOHNSON CONTROL/ENLITE/SCHNEIDER/EQUIVALENT
417	**SENSOR & FIELD DEVICES**	
418	IMMERSION TYPE TEMPERATURE SENSORS	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
419	ULTRASONIC BTU METER/FLOW METER	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
420	OUTSIDE T+RH SENSOR	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
421	DIFFERENTIAL PRESSURE SWITCH / SENSOR/ AIR&WATER	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
422	ROOM/DUCT TEMP SENSOR / T+RH SENSOR/CO2 SENSOR	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
423	PRESSURE SENSOR WATER	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
424	IAQ MONITOR/ PM2.5&10/CO SENSOR	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
425	WATER LEVEL SWITCHES	VEKSLER/FLIPRO/DWYER/KELE/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
426	FLAME PROOF LEVEL TRANSMITTER	VEKSLER/FLIPRO/DWYER/KELE/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
427	DC VOLTAGE /CURRENT/POWER FACTOR TRANSDUCER	ABB/OMICRON/DWYER/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
428	CURRENT RELAY	Lauritz Knudsen/ABB/DWYER/MECO/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
429	PH ANAYSER/ TDS ANALYSER	HACH/ABB/OMICRON/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
430	FCU/AHUVALVES	OVENTROP/T&A/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
431	THERMOSTAT	DAIKIN/DANFOSS/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
432	COMPUTER	LENOVO/ HP / DELL/EQUIVALENT
433	COMMUNICATION CABLE	DELTON/TECHNOFLEX/LEGRAND/EQUIVALENT
434	DIGITAL THERMOSTAT / HUMIDISTAT	SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER/EQUIVALENT
435	**Q-MANAGEMENT SYSTEM (Ancillary)**	
436	TOKEN PRINTER (TABLE TOP).	As per Approved OEM of Queue Management System/EQUIVALENT
437	LAN BASED MASTER AND SLAVE SOFTWARE	As per Approved OEM of Queue Management System/EQUIVALENT
438	LED DISPLAY	As per Approved OEM of Queue Management System/EQUIVALENT
439	**PUBLIC ADDRESS SYSTEM**	
440	DIGITAL VOICE EVACUATION MASTER CONTROLLER/ROUTER	BOSCH/HEINRICH/HONEYWELL/SENNHEISER/EQUIVALENT
441	TOUCHSCREEN MICROPHONE	BOSCH/HEINRICH/HONEYWELL/SENNHEISER/EQUIVALENT
442	CLASS D AMPLIFIER	BOSCH/HEINRICH/HONEYWELL/SENNHEISER/EQUIVALENT
443	CEILING SPEAKER	BOSCH/HEINRICH/HONEYWELL/SENNHEISER/EQUIVALENT
444	HORN SPEAKER	BOSCH/HEINRICH/HONEYWELL/SENNHEISER/EQUIVALENT
445	SPEAKER CABLE	BELDEN/KRAMER/CRESTRON/EXTRON/EQUIVALENT
446	**ACCESS CONTROL SYSTEM**	
447	DOOR ACCESS CONTROLLER	HONEYWELL/ TYCO/SIEMENS/EQUIVALENT
448	SMART CARD REDAER	HID/ HONEYWELL/ LENEL/ TYCO/SIEMENS/INVIXIUM/EQUIVALENT
449	BIOMETRIC READERS	LENEL/ TYCO/INVIXIUM/SIEMENS/EQUIVALENT
450	ACCESS CONTROL SOFTWARE	BOSCH/ LENEL/ TYCO/SIEMENS/EQUIVALENT
451	RFID READER	FEIG/ TAG MASTER/ IDCUBE/SIEMENS/EQUIVALENT
452	RFID TAGS	FEIG/ TAG MASTER/ IDCUBE/SIEMENS/EQUIVALENT
453	QR CODE READER	IDCUBE/ HONEYWELL/ LENEL/ TYCO/SIEMENS/EQUIVALENT
454	DOOR PANEL ENCLOSURE	IDCUBE/ HONEYWELL/ LENEL/ TYCO/SIEMENS/EQUIVALENT
455	EXIT PUSH BUTTON	IDCUBE/ HONEYWELL/ LENEL/ TYCO/SIEMENS/EQUIVALENT
456	ELECTRO MAGNETIC LOCK	IDCUBE/ HONEYWELL/ LENEL/ TYCO/SIEMENS/EQUIVALENT
457	SMART CARD FREQUENCY EXCITATION	IDCUBE/ HONEYWELL/ LENEL/ TYCO/SIEMENS/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
458	EMERGENCY GLASS BREAK UNIT	IDCUBE/ HONEYWELL/ LENEL/ TYCO/SIEMENS/EQUIVALENT
459	**ACTIVE PASSIVE IT SYSTEM AND IPBX SYSTEM**	
460	CATEGORY 6 A CABLE/ PATCH CORD/ I/O / JACK PANEL/PATCH PANEL/ LIU	PANDUIT/COMMSCOPE/ SEIMON/BELDEN/EQUIVALENT
461	FIBER MEDIA CONVERTER/LIU/ JACK PANEL	PANDUIT/COMMSCOPE/ SEIMON/BELDEN/EQUIVALENT
462	RACK	NETRACK/ RITTAL/ PANDUIT/VALRACK/EQUIVALENT
463	MDF BOX	KRONE/DELTON/BELDEN/ COMMSCOPE/ SEIMON/EQUIVALENT
464	RISER CABLE	KRONE/DELTON/BELDEN/ COMMSCOPE/ SEIMON/EQUIVALENT
465	FIBER RUNNER	PANDUIT/ COMMSCOPE/ SEIMON/BELDEN/EQUIVALENT
466	CORE SWITCH	JUNIPER/CISCO/ARISTA/EQUIVALENT
467	DISTRIBUTION SWITCH	JUNIPER/CISCO/ARISTA/EQUIVALENT
468	MANAGEMENT PLATEFORM/ CONTROLLER	JUNIPER/CISCO/ARISTA/EQUIVALENT
469	WIRELESS INDOOR ACCESS POINT	JUNIPER/CISCO/ARISTA/EQUIVALENT
470	FIREWALL	JUNIPER/ CISCO/ PALOALTO/FORTINET/EQUIVALENT
471	INTERNET ROUTER	JUNIPER/ CISCO/HP-ARUBA/EQUIVALENT
472	WI-FI ROUTER	JUNIPER/ CISCO/HP-ARUBA/EQUIVALENT
473	WI-FI CONTROLLER	JUNIPER/ CISCO/HP-ARUBA/EQUIVALENT
474	WI-FI ACCESS POINT	JUNIPER/ CISCO/HP-ARUBA/EQUIVALENT
475	DIGITAL KEY PHONE	PANASONIC/AVAYA/TADIRAN/EQUIVALENT
476	IP PHONE	PANASONIC/AVAYA/TADIRAN
477	ANALOGUE PHONE	PANASONIC/AVAYA/ BEETEL/ PROTEL/TADIRAN
478	EPABX/IP PBX	PANASONIC/AVAYA/ BEETEL/ PROTEL/TADIRAN
479	END POINT PROTECTION	TREND MICRO/ QUICKHEAL/ NORTON/MACAFEE/EQUIVALENT
480	CLOUD SERVICE PROVIDER	MICROSOFT/AMAZON/SYNOLOGY/EQUIVALENT
481	**AUDIO VIDEO WORKS**	
482	WALL MOUNT AND CEILING LOUDSPEAKERS	BOSE/AUDAC/TOA/YAMAHA/SENNHEISER/EQUIVALENT
483	POWER AMPLIFIERS	BOSE/AUDAC/TOA/YAMAHA/SENNHEISER/EQUIVALENT
484	Digital Signal Processor with inbuilt Control System	BOSE/AUDAC/TOA/YAMAHA/SENNHEISER/EQUIVALENT
485	CEILING TILE MICROPHONE	BOSE/AUDAC/TOA/YAMAHA/SENNHEISER/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
486	WIRELESS HANDHELD/LAPEL MICROPHONE /GOOSENECK MICROPHONE	SENNHEISER/BAYERDYNAMIC/SHURE/RODE/YAMAHA/EQUIVALENT
487	CHAIRMAN UNIT	BOSCH/TELEVIC/SHURE/EQUIVALENT
488	DELEGATE UNIT	BOSCH/TELEVIC/SHURE/EQUIVALENT
489	CENTRAL CONTROLLER UNIT WITH RECORDING FACILITY	BOSCH/TELEVIC/SHURE/EQUIVALENT
490	SPEAKER CABLE	KRAMER/EXTRON/CRESTRON/ BELDEN/EQUIVALENT
491	MICROPHONE CABLE	KRAMER/EXTRON/CRESTRON/ BELDEN/EQUIVALENT
492	PROJECTORS	CHRISTIE/BARCO/SONY/PANASONIC/EQUIVALENT
493	Laser projector WUXGA 25000 Lumen (Manufacturer's Authorization & Commitment Letter to be submitted along with BID).	BARCO / CHRISTIE / PANASONIC / SONY / EQUIVALENT
494	Laser Projector 20000 Mw (Manufacturer's Authorization & Commitment Letter to be submitted along with BID).	KVANT / UNITY / IBRA/ / EQUIVALENT
495	BSW GOGO PROJECTOR 300 + WATTS (Manufacturer's Authorization & Commitment Letter to be submitted along with BID).	ARCTIC / LBT / IBRA / EQUIVALENT
496	MOTORIZED PROJECTION SCREEN	SUDPI/SUVIRA/LIBERT AV/ DALITE/EQUIVALENT
497	CABLE CUBBY	LOGIC/KRAMER/EXTRON/EQUIVALENT
498	PODIUM	AHA/TECOM/PEOPLELINK/GLOBUS/EQUIVALENT
499	IP PTZ CAMERA(FOR CONFERENCING PURPOSE)	LUMENS/VADDIO/PANASONIC/SONY/BARCO/EQUIVALENT
500	RECORDING, STREAMING & WEBCASTING DEVICE	LUMENS/VADDIO/PANASONIC/SONY/BARCO/EQUIVALENT
501	JOYSTICK	LUMENS/VADDIO/PANASONIC/SONY/BARCO/EQUIVALENT
502	VIDEO CONFERENCING SYSTEM	CISCO/BARCO/ LUMENS/POLYCOM/EQUIVALENT
503	HDMI MATRIX SWITCHER	KRAMER/EXTRON/CRESTRON/ BELDEN/EQUIVALENT

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
504	WIRELESS PRESENTATION SYSTEM	BARCO/POLYCOM/CISCO/EQUIVALENT
505	HDMI TRANSMITTER & RECEIVER	KRAMER/EXTRON/CRESTRON/BELDEN/EQUIVALENT
506	CONTROL SYSTEM	KRAMER/EXTRON/CRESTRON/APPLE/EQUIVALENT
507	TOUCH PANEL	HP/SAMSUNG/DELTA/PANASONIC/EQUIVALENT
508	HDMI CABLE.	KRAMER/EXTRON/CRESTRON/ BELDEN/EQUIVALENT
509	EQUIPMENT RACK	NETRACK/ RITTAL / VALRACK/EQUIVALENT
510	Cat6A Cables	PANDUIT/COMMSCOPE/ SEIMON/BELDEN/EQUIVALENT
	ALL MEDICAL SERVICES PACKAGES	
1	**FOR MODULAR OT & MINOR OT**	
2	WALL PANELLING SYSTEM FOR MODULAR OT	Getinge / Operamed / HT Labor / Dräger
3	CEILING PANELLING SYSTEM FOR MODULAR OT	Getinge / Operamed / HT Labor / Dräger
4	WALL PANELLING SYSTEM FOR MINOR OT	Getinge / Operamed / HT Labor / Dräger
5	CEILING PANELLING SYSTEM FOR MINOR OT	Getinge / Operamed / HT Labor / Dräger
6	ANTIBACTERIAL / ANTIFUNGAL PAINT FOR MINOR OT	Jotun / SKK / Asian Paints / Berger Paints
7	LAMINAR AIR FLOW SYSTEM	Getinge / Operamed / Dräger / TROX
8	INTERNAL HVAC DUCTING & EXHAUST SYSTEMS and PRESSURE RELIEF DAMPERS	Getinge / Operamed / HT Labor / Dräger
9	4MM THICK ANTISTATIC POLYURETHANE RESIN FLOORING	Sika / BASF / Fosroc / Tremco
10	HERMETICALLY SEALED DOORS	Getinge / Operamed / HT Labor / Dräger
11	TOUCH SCREEN CONTROL PANEL	Getinge / Operamed / Dräger / Bender
12	HATCH BOX	Getinge / Operamed / HT Labor / Dräger
13	OPERATING LIST BOARD	Getinge / Operamed / HT Labor / Dräger

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
14	X-RAY FILM VIEWER	Getinge / Operamed / HT Labor / Dräger
15	SCRUB STATION	Getinge / Operamed / HT Labor / Dräger
16	STORAGE UNIT	Getinge / Operamed / HT Labor / Dräger
17	OT PENDANTS (ANESTHETIST & SURGEON)	Stryker / Getinge / Dräger / KLS Martin
18	PERIPHERAL LIGHTING	Stryker / Getinge / Dräger / KLS Martin
19	AUTOMATED WASTE DISINFECTION SYSTEM FOR OT	Celitron / CISA / Steris / Getinge
20	ELECTRICAL INSTALLATION	Getinge / Operamed / HT Labor / Dräger
21	DISTRIBUTION BOX	Getinge / Operamed / HT Labor / Dräger
22	ISOLATION PANEL SYSTEM (IPS)	Getinge / Operamed / HT Labor / Dräger
23	MEDICAL GAS PIPE LINES INSTALLATIONS	Getinge / Operamed / HT Labor / Dräger
24	OT LIGHT WITH CAMERA, MONITOR & RECORDER	Steris / KLS Martin / Getinge / Admeco
25	OT TABLE	Stryker / Steris / Getinge / Hill-Rom
26	OT INTEGRATION	Getinge / Steris / Stryker / Rein Medical
27	PRESSURE RELIEF DAMPERS	Getinge / Operamed / HT Labor / Dräger
28	**FOR MODULAR EMERGENCY/ MODULAR ICU**	
29	WALL PANEL & CEILING PANEL SYSTEM	Getinge / Operamed / HT Labor / Dräger
30	ANTIBACTERIAL PAINT	Jotun / SKK / Asian Paints / Berger Paints
31	CEILING SUSPENDED ICU PENDENT WITH BRIDGE TYPE	Getinge (Maquet) / Stryker / Dräger / KLS Martin
32	HERMETICALLY SEALED OT DOOR	Getinge / Operamed / HT Labor / Dräger

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
33	CURTAIN + CEILING IV TRACK SYSTEM	Inpro Corporation / Construction Specialties (Acrovyn) / CP Medisystems / Pawling Corporation
34	PERIPHERAL LIGHTING	Stryker / Getinge / Dräger / KLS Martin
35	Touch Screen Control Panel	Getinge / Operamed / HT Labor / Dräger
36	Hatch Box	Getinge / Operamed / HT Labor / Dräger
37	Operating List Board	Getinge / Operamed / HT Labor / Dräger
38	X-ray Film Viewer	Getinge / Operamed / HT Labor / Dräger
39	Scrub Station	Getinge / Operamed / HT Labor / Dräger
40	Storage Unit	Getinge / Operamed / HT Labor / Dräger
41	LAMINAR AIR FLOW SYSTEM	Getinge / Operamed / HT Labor / Dräger
42	ANTISTATIC Flooring	Gerflor / Forbo / Tarkett / Armstrong Flooring
43	INTERNAL HVAC DUCTING & EXHAUST SYSTEMS and PRESSURE RELIEF DAMPERS	Getinge / Operamed / HT Labor / Dräger
44	**FOR MEDICAL GAS PIPELINE SYSTEM**	
45	SECONDARY OXYGEN MANIFOLD AND EMERGENCY OXYGEN MANIFOLD	BeaconMedaes / Linde / Amico / Dräger
46	AUTOMATIC CONTROL PANELS	BeaconMedaes / Linde / Amico / Dräger
47	NITROUS OXIDE MANIFOLD AND EMERGENCY NO2 MANIFOLD	BeaconMedaes / Linde / Amico / Dräger
48	MEDICAL AIR SUPPLY SYSTEM (4 BAR & 7 BAR) COMPLETE.	Ingersoll Rand / Atlas Copco / Gardner Denver / BeaconMedaes
49	AIR RECEIVER	BeaconMedaes / Atlas Copco / Ingersoll Rand / Gardner Denver
50	MEDICAL VACUUM (SUCTION) SUPPLY SYSTEM COMPLETE.	Ingersoll Rand / Atlas Copco / Gardner Denver / BeaconMedaes
51	VACUUM RECEIVER	BeaconMedaes / Atlas Copco / Ingersoll Rand / Gardner Denver
52	DISTRIBUTION PIPING COMPLETE WITH ACCESSORIES.	Mehta Tubes / BeaconMedaes / Amico / Linde

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
53	ELECTRICAL CONTROL PANEL	BeaconMedaes / Linde / Amico / Dräger
54	AREA VALVE SERVICE SYSTEM.	BeaconMedaes / Linde / Amico / Dräger
55	AGSS SYSTEM COMPLETE	BeaconMedaes / Linde / Amico / Dräger
56	ALARM SYSTEMS (MASTER & AREA)	BeaconMedaes / Linde / Amico / Dräger
57	GAS OUTLETS WITH PROBES	BeaconMedaes / Linde / Amico / Dräger
58	BED HEAD PANELS	BeaconMedaes / Linde / Amico / Dräger
59	THEATRE SUCTION UNIT FOR OPERATION THEATRES	BeaconMedaes / Linde / Amico / Dräger
60	WARD VACUUM SYSTEM	BeaconMedaes / Linde / Amico / Dräger
61	OTHER ASSOCIATED & OPTIONAL WORKS	BeaconMedaes / Linde / Amico / Dräger
62	OXYGEN SUPPLY SYSTEM	BeaconMedaes / Linde / Amico / Dräger
63	FULLY AUTOMATIC OXYGEN CONTROL PANEL	BeaconMedaes / Linde / Amico / Dräger
64	LIQUID MEDICAL OXYGEN TANK&ALLIED SYSTEM	Linde / INOX India / Air Liquide / Chart Industries
65	Control Valve	Atlas Copco / GCE / BeaconMedaes / Dräger
66	**FOR CENTRAL STERILE SERVICES DEPARTMENT (CSSD)**	
67	STEAM STERILIZER	Getinge / Steris / Tuttnauer / Celitron
68	DOUBLE DOOR WASHER/DISINFECTOR	Getinge / Steris / Tuttnauer / Celitron
69	LTSF MACHINE	Getinge / Steris / Tuttnauer / Celitron
70	ULTRASONIC CLEANER BENCH	Getinge / Steris / Tuttnauer / Celitron
71	HEAT SEALING MACHINE	Getinge / Steris / Tuttnauer / Celitron
72	ETO MACHINE	Getinge / Steris / Tuttnauer / Celitron
73	ENDOSCOPE REPROCESSING SYSTEM (ERS)	Getinge / Steris / Tuttnauer / Celitron
74	AIR & WATER GUN	Getinge / Steris / Tuttnauer / Celitron
75	UV DISINFECTION ROBOT	Getinge / Steris / Tuttnauer / Celitron

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
76	DISINFECTION AND DECONTAMINATION DEVICE	Getinge / Steris / Tuttnauer / Celitron
77	TRACKING & BAR CODING SOFTWARE	Getinge / Steris / Tuttnauer / Celitron
78	**FOR THEATRE STERILE SUPPLY UNIT (TSSU)**	
79	TABLE TOP STERILIZER	Getinge / Steris / Tuttnauer / Celitron
80	PLASMA STERILIZER DOUBLE DOOR	Getinge / Steris / Tuttnauer / Celitron
81	**FOR NURSE CALL SYSTEM (NCS)**	
82	COMPLETE NURSE CALL SYSTEM WITH SPEECH AND WITHOUT SPEECH SYSTEM	Rauland (Ametek) / Schrack Seconet / Ackermann / Siemens
83	**FOR CURTAIN TRACK SYSTEMS AND GUARD SYSTEMS**	
84	CURTAIN TRACK SYSTEMS AND GUARD SYSTEMS	Inpro Corporation / Construction Specialties (Acrovyn) / CP Medisystems / Pawling Corporation
85	**FOR LAUNDRY EQUIPMENT**	
86	LAUNDRY EQUIPMENT	Fagor / Electrolux Professional / Girbau / Miele Professional
87	**FOR INTEGRATED STERILIZER & SHREDDER (ISS) SYSTEM**	
88	INTEGRATED STERILIZER & SHREDDER (ISS)	Celitron / CISA / Steris / Bondtech
89	**FOR MORTUARY EQUIPMENT & CHAMBER**	
90	MORTUARY EQUIPMENT & CHAMBER	Kugel Medical / Mopec / Fiocchetti / UFSK International
91	**FOR KITCHEN EQUIPMENT**	
92	KITCHEN EQUIPMENT	Electrolux Professional / Angelo Po / Hobart / Rational
93	**FOR QUEUE MANAGEMENT SYSTEM**	
94	QUEUE MANAGEMENT SYSTEM (QMS)	Qmatic / Aurionpro / Wavetec / Qless

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
95	**FOR ASSET MANAGEMENT SYSTEM**	
96	ASSET MANAGEMENT SYSTEM	Siemens / Honeywell / Johnson Controls / Schneider Electric
97	**FOR PNEUMATIC TUBE SYSTEM (PTS)**	
98	PNEUMATIC TUBE SYSTEM (PTS)	Sumetzberger / Aerocom / Pevco / Swisslog
99	**FOR PNEUMATIC WASTE & LAUNDRY COLLECTION SYSTEM (PWLCS)**	
100	PNEUMATIC TUBE SYSTEM FOR TRANSPORTATION OF LAUNDRY & WASTE BELOW ITEM: BLOWER, VELOCITY MONITOR, CONTROL PANEL, COLLECTOR, CONTAINER, FILTRATION UNIT, DIVIDER SYSTEM, AIR INTAKE VALVE SYSTEM, SOFTWARE, IBS WITH TOUCH SCREEN, MAIN ELECTRICAL CONTROL PANEL AND EXHAUST AIR PIPE	Sumetzberger / Aerocom / Pevco / Swisslog
101	COMPRESSOR	Sumetzberger / Aerocom / Pevco / Swisslog
102	HORIZONTAL AND VERTICAL PIPELINE FOR WASTE AND LAUNDRY	Sumetzberger / Aerocom / Pevco / Swisslog
103	**SMART EQUIPMENT**	
104	BMS SOFTWARE	Siemens / Honeywell / Johnson Controls /Schneider Electric
105	DDC CONTROLLERS	Siemens / Honeywell / Johnson Controls /Schneider Electric

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME
106	SYSTEM INTEGRATION UNIT	Siemens / Honeywell / Johnson Controls /Schneider Electric
107	IMMERSION TEMPERATURE SENSOR	Siemens / Honeywell / Johnson Controls /Schneider Electric
108	DUCT TEMPERATURE & HUMIDITY SENSOR	Siemens / Honeywell / Johnson Controls /Schneider Electric
109	OUTSIDE TEMPERATURE & HUMIDITY SENSOR	Siemens / Honeywell / Johnson Controls /Schneider Electric
110	SLAB/SURFACE SENSOR	Siemens / Honeywell / Johnson Controls /Schneider Electric
111	HYDROGEN DETECTOR	Siemens / Honeywell / Johnson Controls /Schneider Electric
112	PRESSURE TRANSMITTERS	Siemens / Honeywell / Johnson Controls /Schneider Electric
113	FLOW METER (ULTRA SONIC)/WATER METER	Siemens / Honeywell / Johnson Controls /Schneider Electric
114	DIFFERENTIAL PRESSURE SWITCHES	Siemens / Honeywell / Johnson Controls /Schneider Electric
115	WATER FLOW SWITCHES	Siemens / Honeywell / Johnson Controls /Schneider Electric
116	LEVEL SWITCHES	Siemens / Honeywell / Johnson Controls /Schneider Electric
117	LEVEL TRANSMITTERS	Siemens / Honeywell / Johnson Controls /Schneider Electric
118	CO SENSOR/CO2 SENSOR	Siemens / Honeywell / Johnson Controls /Schneider Electric
119	DDC CONTROLLER ENCLOSURE	Rittal / Siemens / Schneider Electric / L&T
120	COMMUNICATION CABLES/SIGNAL CABLE/CONTROL/POWER CABLE	Legrand / Delton Cables / Polycab / Havells
121	MASTER SYSTEM INTEGRATOR	
122	MASTER SYSTEM INTEGRATOR	Siemens / Honeywell / Johnson Controls / Schneider Electric

APPROVED MAKE LIST

SL.NO	ITEM	MANUFACTURER/BRAND NAME

The above list is indicative in nature; however, the contractor can propose a higher or similar make based on the Technical Specifications, Warranty Details, Servicability and Third Party material test certificates on approval of the Engineer.

Contractors must get approval from the Engineer/Employer before placing an order for any required materials from the above-mentioned Indicative makes.

In case a make is not available for the specific item under a subheading. But, the item is available under another subheading, the contractor may take reference of those makes only after approval from the Engineer.

In case If any required materials are not available in the above list, the Contractor will propose 3 alternative makes (best available in the market with proven track record based on Technical Specifications, Warranty Details and Servicability) to the Engineer, and the Engineer will choose one among the 3 alternatives. The same shall be final and binding on the contractors.

All proposed makes by the contractor will necessarily have test certificates from an Independent (authorised/ accredited) third-party labs. In case of non-availability of such certifications, the contractor would need to justify such absence; the decision of the Engineer in this regard would be final and binding on the contractor.

Not all makes may apply to the project. This list will supersede any make mentioned anywhere in the RFP document.

SECTION –9

SCHEDULE OF PAYMENT

Section 9 : Schedule of Payment

Redevelopment of MKCG Medical College Berhampur, Odisha : Allied Infrastructure

SL No	Activity			Remarks
A	**Contract Scope Works**		**100.00%**	
	Total		**100.00%**	

The percentage figures as filled in column (3) by the Employer for the apportionment of the Accepted Contract Amount for completion of the Works corresponding to the items given above are fixed and payment will be released for different major cost centres as per above percentage break-up of Accepted Contract Amount.

A) Schedule of Payments for Scope of Works (Major Cost Centre "A")				
Percentage Apportioned to Major Cost Centre **"A" = 100%** of Accepted Contract Amount				
Apportionment of Major Cost Centre "A" for Payments according to Cost Centres				
Major Cost Centre	**Description of Major Cost Centre**		**Weightage of Major Cost Centre A**	**Remarks**
A1	Investigation, Planning, Designing, Approval etc, or Entire Scope of Works		1.750%	
A2	Temporary Utilities (Employer & Engineer Site Office, Field Laboratory, Etc)		0.510%	
A3	Construction Scope of Works		96.990%	
A4	Medical Equipments Co-ordination With Infrastructural Requirements.		0.750%	
	Total		**100.00%**	

A1) Schedule of Payments for Scope of Works (Major Cost Centre "A1")				
Percentage Apportioned to Major Cost Centre **"A1" = 1.750 %** of Accepted Contract Amount				
Apportionment of Major Cost Centre "A1" for Payments according to Cost Centres				
Cost Centre	**Item of Works**		**Weightage of Cost Centre A1 as Applicable**	**Cumulative Weightage of Cost Centre A1 as Applicable**
A1.1	On Approval of Inception Report, Site Survey, Geo-Technical Investigation and Preparation of Preliminary Drawings/ Services etc.		10.50%	10.50%
	On approval of Inception report	8.00%		
	On Approval of site survey-Topo	10.00%		
	On Approval of site survey-GPR	5.00%		
	On Approval of site survey-Geo technical investigation	20.00%		
	On Approval of preparation of preliminary drawings / services (Architectural 34%, Structural 33% & MEP 33%) Architectural Drawings includes Architectural Floor Plans, Elevation and Sections, External Development,	57.00%		
A1.2	On Approval of Design & Good for Construction Drawings for Structural / Architectural / Interior by Engineer		12.00%	22.50%
	Structural Design Submission & Approval of vetting Design including Design basis Report, Modelling & Design	35%		
	Structural GFC Drawings submission & Approval of vetting Drawings,	10%		

	Architectural Design & GFC (Setting out, Floor Plans, Elevation, Section, Staitrcase and Railing etc.) drawing submission & Approval. Architectural Interior GFC Drawing (Flooring Layout, ceiling Layout, Furniture Layout,Microplanning Details, Signages etc.) submission &	55%		
A1.3	On Approval of Design & Good For Constrution Drawings for MEP by Engineer		10.50%	33.00%
	MEP Design Submission and Approval (Design Basis Report 30% & MEP Design 70%) for FPS, ELV, PHE, Eletrical, HVAC, MGPS etc.	62.50%		
	MEP GFC Drawings Submisison and Approval including but not limited to FPS, ELV, PHE, Eletrical, HVAC, MGPS etc,	37.50%		
A1.4	On Approval of Design & Good For Construction Drawings for External Development by Engineer		5.50%	38.50%
	External Developent Design (Submision and Approval)	70%		
	External Developent GFC (Submision and Approval)	30%		
A1.5	On Submission to Authorities for Approval (statutory approvals as per schedule F) Including As built drawings in BIM LOD 500		7.00%	45.50%
A1.6	On Obtaining Approval from authority (statutory approvals as per schedule F) including As built drawings in BIM LOD 500		24.50%	70.00%
A1.7	On submission of preliminary drawings/services complete on BIM Environment as per contract specification.		6.00%	76.00%
A1.8	On submission of FDD stage drawings/serviecs complete on BIM Environment as per Contract specification.		9.00%	85.00%
A1.9	On submission of GFC stage drawings/services complete on BIM Environment as per Contract specification.		15.00%	100.00%
	Total		**100.00%**	
A2) Schedule of Payments for Scope of Works (Cost Centre "A2")				
Percentage Apportioned to Cost Centre **"A2" = 0.510%** of Accepted Contract Amount				
Apportionment of Major Cost Centre "A2" for Payments according to Cost Centres				
Cost Centre	**Item of Works**		**Weightage of Cost Centre A2 as Applicable**	**Cumulative Weightage of Cost Centre A2 as Applicable**
	Temporary Utilities (Employer & Engineer Site Office, Field Laboratory, Etc)			
A2.1	**Employer & Engineer Site Office**			
A2.1.1	Upon Construction & Handing Over of Employer & Engineer Field Office-Stage 1 - All Structural & Masonry Works (Till Plastering)		35%	35.00%
A2.1.2	Upon Construction & Handing Over of Employer & Engineer Field Office-Stage 2 (All Architectural Finishing, Services & Interior Works)		10%	45.00%
A2.1.3	Maintenance of Employer & Engineer Field Office as per actual construction period. Prorated basis		10%	55.00%
A2.1.4	Testing & Commissioning of Services for Employer & Engineer Field office		5%	60.00%
A2.1.5	Issuance of 'Taking Over Certificate' For Employer & Engineer Field Office		5%	65.00%
A2.2	**Field Laboratory**			
A2.2.1	Upon Construction & Handing Over of Field Laboratory - Stage 1 - All Structural & Finishes Works		20%	85.00%
A2.2.2	Upon Construction & Handing Over of Field Laboratory & Equipment's - Stage 2 (Upon Supply of All Lab Equipment's)		10%	95.00%
A2.2.3	Testing & Commissioning of Services for Field Laboratory		3.0%	98.00%
A2.2.4	Issuance of 'Taking Over Certificate' for Field Laboratory		2.0%	100.00%

	Total		**100.00%**	

Redevelopment of MKCG Medical College Berhampur, Odisha : Allied Infrastructure			
Percentage Apportioned to Major Cost Centre **"A3" = 96.990 %** of Accepted Contract Amount			
Apportionment of Major Cost Centre "A3" for Payments according to Cost			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3 as Applicable**	**Cumulative Weightage of Cost Centre A3 as Applicable**
A3.1	Hospital Building	31.000%	**31.00%**
A3.2	Indoor stadium	3.000%	**34.00%**
A3.3	U.G. GIRL'S HOSTEL	5.000%	**39.00%**
A3.4	Club House	1.000%	**40.00%**
A3.5	SURGEON HOSTEL LADIES	2.000%	**42.00%**
A3.6	SURGEON HOSTEL GENTS cum Guest House	2.000%	**44.00%**
A3.7	TYPE - II Residency	4.000%	**48.00%**
A3.8	TYPE- IV Residency	3.000%	**51.00%**
A3.9	Electric Sub Station	1.000%	**52.00%**
A3.10	External Developments (Hospital)	2.000%	**54.00%**
A3.11	MEP Services - High Side Equipments (hospital)	6.000%	**60.00%**
A3.12	Dental College	11.000%	**71.00%**
A3.13	Boys Hostel (dental College)	3.000%	**74.00%**
A3.14	Girls Hostel (dental college)	3.000%	**77.00%**
A3.15	MEP Services - High Side Equipments (dental college)	1.000%	**78.00%**
A3.16	Site development works (dental college)	1.000%	**79.00%**
A3.17	Electrical Substation (dental college)	0.500%	**79.50%**
A3.18	Pharmacy college	6.800%	**86.30%**
A3.19	Rsidence Type-IV (Pharmacy college)	2.800%	**89.10%**
A3.20	Boys Hostel (Pharmacy college)	3.900%	**93.00%**
A3.21	Girls Hostel (Pharmacy college)	3.000%	**96.00%**
A3.22	External Developments (Pharmacy college)	1.000%	**97.00%**
A3.23	MEP Services - High Side Equipments (Pharmacy college)	1.000%	**98.00%**
A3.24	O&M 5 Years, For all ELV services	2.000%	**100.00%**
	Total	**100.000%**	

A3.1) Schedule of Payments for Scope of Works - Clinical Building Facility- Hospital Block (One Basement + Ground Floor + 10 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.1" = 31.00 %** of A3			
Apportionment of Cost Centre "A3.1" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.1.1 to A3.1.71 as Applicable**	**Cumulative Weightage of Cost Centre A3.1.1 to A3.1.71 as Applicable**
	Clinical Building Facility : (One Basement + Ground Floor + 10 Upper Floors)		
	Substructure Works		
A3.1.1	Completion of Earthwork	2.00%	2.00%
A3.1.2	Completion of Foundation (Raft/Pile or combined as per Design) including Water proofing) inclduing basement floor slab.	8.00%	10.00%
A3.1.3	Completion of Retaining Wall Works (including water proofing)	4.00%	14.00%
A3.1.4	Completion of Basement Roof Slab Works	3.00%	17.00%
	Superstructure Works		
A3.1.5	Completion of Colums, Beams and slabs of Ground Floor	1.80%	18.80%
A3.1.6	Completion of Colums, Beams and slabs of 1st Floor	1.80%	20.60%
A3.1.7	Completion of Colums, Beams and slabs of 2nd Floor	1.80%	22.40%
A3.1.8	Completion of Colums, Beams and slabs of 3rd Floor	1.80%	24.20%
A3.1.9	Completion of Colums, Beams and slabs of 4th Floor	1.80%	26.00%
A3.1.10	Completion of Colums, Beams and slabs of 5th Floor	1.80%	27.80%
A3.1.11	Completion of Colums, Beams and slabs of 6th Floor	1.80%	29.60%
A3.1.12	Completion of Colums, Beams and slabs of 7th Floor	1.80%	31.40%
A3.1.13	Completion of Colums, Beams and slabs of 8th Floor	1.80%	33.20%
A3.1.14	Completion of Colums, Beams and slabs of 9th Floor	1.80%	35.00%
A3.1.15	Completion of Colums, Beams and slabs of 10th Floor	1.80%	36.80%
A3.1.16	Completion of slabs of mumty , Over head water tanks, terrace works complete	1.40%	38.20%
A3.1.17	Completion of Block works.	7.00%	45.20%
	Architectural works		
A3.1.18	Concealed plumbing works & Plaster wherever required.	1.00%	46.20%
A3.1.19	Providing and Fixing of Door frames	0.50%	46.70%
A3.1.20	Completion of Internal Flooring including skirting	1.80%	48.50%
A3.1.21	Completion of Wall Tiling.	1.00%	49.50%
A3.1.22	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.00%	51.50%
A3.1.23	Completion of False Ceiling Works.	2.00%	53.50%

A3.1.24	Completion of SS Hand railing.	1.00%	54.50%
A3.1.25	Internal Painting	2.00%	56.50%
A3.1.26	External Plastering	1.00%	57.50%
A3.1.27	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.as per scope	3.00%	60.50%
A3.1.28	Hospital Building Waterproofing (Podium, Toilet, Water Tanks etc	0.32%	60.82%
A3.1.29	Terrace Water Proofing.	0.05%	60.87%
A3.1.30	Plumbing & Sanitary Installations.	3.00%	63.87%
A3.1.31	Internal Electric Installations	2.50%	66.37%
A3.1.32	Electrical External Services	1.00%	67.37%
A3.1.33	External Services Civil complete including plinth protection, peripheral drain etc.	0.56%	67.93%
A3.1.34	Power Wiring and Plug	1.00%	68.93%
A3.1.35	Telephone Conduits	0.11%	69.04%
A3.1.36	Lighting Arrestor	0.04%	69.08%
A3.1.37	Fire Fighting Works	1.00%	70.08%
A3.1.38	Fire Alarm System Works	0.81%	70.89%
A3.1.39	UNINTERRUPTED POWER SUPPLY	0.54%	71.43%
A3.1.40	CENTRAL AC PLANT/ HVAC complete	4.07%	75.50%
A3.1.41	CCTV SYSTEM	0.22%	75.72%
A3.1.42	ACCESS CONTROL SYSTEM	0.03%	75.75%
A3.1.43	IBMS: INTEGRATED BUILDING MANAGEMENT SYSTEM	0.22%	75.97%
A3.1.44	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.08%	76.05%
A3.1.45	LAN SYSTEM	0.47%	76.52%
A3.1.46	IP BASED EPABX SYSTEM	0.39%	76.91%
A3.1.47	Audio & Video System Works	0.50%	77.41%
A3.1.48	Mechanical Ventilation System Works.	0.54%	77.95%
A3.1.49	FAÇADE LIGHTING	0.17%	78.12%
A3.1.50	EMERGENCY LIGHT & ILLUMINATED SIGNAGES	0.15%	78.27%
A3.1.51	MSI (Master System Integrator for Complete Hospital Project) including 5 Yrs O&M	0.30%	78.57%
	Medical services		
A3.1.52	Modular Operation Theatres. (supply 60% , Installation 20%, Testing and Comissioning 20%)	2.78%	81.35%
A3.1.53	Minor Operation Theatres.	0.37%	81.72%
A3.1.54	Integration of system for OT	1.20%	82.92%

A3.1.55	Medical Gas pipeline system	1.49%	84.41%
A3.1.56	Pneumatic Tube Trasfer System.	0.95%	85.36%
A3.1.57	Nurse Call System.	0.86%	86.22%
A3.1.58	Central Sterile Supply Dept (CSSD) for Hospital Building	1.00%	87.22%
A3.1.59	Laundry Equipments	0.92%	88.14%
A3.1.60	Automated waste and Laundry transport system	1.93%	90.07%
A3.1.61	Bed Head Panels	0.43%	90.50%
A3.1.62	Curtain track & IV Tree and Guard system per Bed	0.98%	91.48%
A3.1.63	Stretcher wall guards (Wall and Corner Guard system)	0.82%	92.30%
A3.1.64	Kitchen Equipment	0.78%	93.08%
A3.1.65	Mortuary	0.21%	93.29%
A3.1.66	Integrated sterilizer and shredder (ISS)	0.79%	94.08%
A3.1.67	Lift works (supply 60% , Installation 20%, Testing and Comissioning 20%)	1.71%	95.79%
A3.1.68	Supply and installation of Non medical furnitures including Art	2.21%	98.00%
	Testing, Commissioning & Handing Over		
A3.1.69	Testing & Commissioning of Services	1.00%	99.00%
A3.1.70	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.00%	100.00%
	Total	**100.00%**	

A3.2) Schedule of Payments for Scope of Works - Indoor stadium (B+G+1)			
Percentage Apportioned to Major Cost Centre **"A3.2" = 3.00 %** of A3			
Apportionment of Cost Centre "A3.2" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.2 as Applicable**	**Cumulative Weightage of Cost Centre A3.2.as Applicable**
A.3.2	**Indoor stadium : (B+Ground Floor + 1 Upper Floors)**		
	Substructure Works		
A3.1.1	Completion of Earthwork	2.00%	2.00%
A3.1.2	Completion of Foundation (Raft/Pile or combined as per Design) including Water proofing) inclduing basement floor slab.	9.00%	11.00%
A3.1.3	Completion of Retaining Wall Works (including water proofing)	6.00%	17.00%
A3.1.4	Completion of Basement Roof Slab Works	5.00%	22.00%
	Superstructure Works		
A3.2.4	Completion of Colums, Beams and slabs of Ground Floor	8.00%	30.00%
A3.2.5	Completion of Colums, Beams and slabs of 1st Floor	8.00%	38.00%
A3.2.6	Completion of slabs of mumty , Over head water tanks, terrace works complete		
A3.2.7	Completion of Block works.	10.00%	48.00%
A3.2.8	Concealed plumbing works & Plaster wherever required.	2.50%	50.50%
A3.2.9	Providing and Fixing of Door frames	2.50%	53.00%
A3.2.10	Completion of Internal Flooring including skirting	2.50%	55.50%
A3.2.11	Completion of Wall Tiling.	2.03%	57.53%
A3.2.12	Providing and Fixing of Aluminium windows including glazing, Door shutters	3.00%	60.53%
A3.2.13	Completion of False Ceiling Works.	2.00%	62.53%
A3.2.14	Completion of SS Hand railing.	1.00%	63.53%
A3.2.15	Internal Painting	2.00%	65.53%
A3.2.16	External Plastering	2.50%	68.03%
A3.2.17	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	2.00%	70.03%
A3.2.18	Water Proofing.	1.70%	71.73%
A3.2.19	Plumbing & Sanitary Installations.	2.00%	73.73%
A3.2.20	Internal Electric Installations	6.89%	80.62%
A3.2.21	Electrical External Services	2.37%	82.99%
A3.2.22	Civil External Services	0.79%	83.78%
A3.2.23	Power Wiring and Plug	3.00%	86.78%
A3.2.24	Telephone Conduits	0.16%	86.94%
A3.2.25	Lighting Arrestor	0.04%	86.98%
A3.2.26	Fire Fighting Works	2.09%	89.07%
A3.2.27	Fire Alarm System Works	1.04%	90.11%
A3.2.28	UNINTERRUPTED POWER SUPPLY	0.23%	90.34%
A3.2.29	CCTV SYSTEM	0.19%	90.53%
A3.2.30	ACCESS CONTROL SYSTEM	0.04%	90.57%
A3.2.31	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.07%	90.64%
A3.2.32	LAN SYSTEM	0.41%	91.05%
A3.2.33	IP BASED EPABX SYSTEM	0.43%	91.48%
A3.2.34	Lift works (supply 60% , Installation 20%, Testing and	2.91%	94.39%
A3.2.35	VRV AC System	2.61%	97.00%
	Testing, Commissioning & Handing Over		
A3.2.35	Testing & Commissioning of Services	2.00%	99.00%
A3.2.36	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.00%	100.00%
	Total	**100.00%**	

A3.3) Schedule of Payments for Scope of Works - U.G. GIRL'S HOSTEL (B+S+12 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.3" =5.0 %** of A3			
Apportionment of Cost Centre "A3.3" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.3 as Applicable**	**Cumulative Weightage of Cost Centre A3.3 as Applicable**
	U.G GIRL'S HOSTEL (B+S+12 UPPER FLOOR)		
	Substructure Works		
A3.3.1	Completion of Earthwork	2.0000%	2.000%
A3.3.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	6.6000%	8.600%
A3.3.3	Completion of Retaining Wall Works (including water proofing) for basement	4.5600%	13.160%
A3.3.4	Completion of Basement Slab Works	6.4000%	19.560%
	Superstructure Works		
A3.3.5	Completion of Colums, Beams and slabs of stilt floor	2.000%	21.56%
A3.3.6	Completion of Colums, Beams and slabs of 1st Floor	2.000%	23.56%
A3.3.7	Completion of Colums, Beams and slabs of 2nd Floor	2.000%	25.56%
A3.3.8	Completion of Colums, Beams and slabs of 3rd Floor	2.000%	27.56%
A3.3.9	Completion of Colums, Beams and slabs of 4th Floor	2.000%	29.56%
A3.3.10	Completion of Colums, Beams and slabs of 5th Floor	2.000%	31.56%
A3.3.11	Completion of Colums, Beams and slabs of 6th Floor	2.000%	33.56%
A3.3.12	Completion of Colums, Beams and slabs of 7th Floor	2.000%	35.56%
A3.3.13	Completion of Colums, Beams and slabs of 8th Floor	2.000%	37.56%
A3.3.14	Completion of Colums, Beams and slabs of 9th Floor	2.000%	39.56%
A3.3.15	Completion of Colums, Beams and slabs of 10th Floor	2.000%	41.56%
A3.3.16	Completion of Colums, Beams and slabs of 11th Floor	2.000%	43.56%
A3.3.17	Completion of Colums, Beams and slabs of 12th Floor	2.000%	45.56%
A3.3.18	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	46.06%
A3.3.19	Completion of Block works.	4.000%	50.06%
A3.3.20	Concealed plumbing works & Plaster wherever required.	2.000%	52.06%
A3.3.21	Providing and Fixing of Door frames	0.750%	52.81%
A3.3.22	Completion of Internal Flooring including skirting	2.000%	54.81%
A3.3.23	Completion of Wall Tiling.	2.000%	56.81%
A3.3.24	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	58.81%
A3.3.25	Completion of False Ceiling Works.	2.200%	61.01%
A3.3.26	Completion of SS Hand railing.	1.250%	62.26%
A3.3.27	Internal Painting	2.000%	64.26%
A3.3.28	External Plastering	1.500%	65.76%
A3.3.29	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.200%	69.96%
A3.3.30	Water Proofing.	1.000%	70.96%
A3.3.31	Plumbing & Sanitary Installations.	4.000%	74.96%
A3.3.32	Internal Electric Installations	6.000%	80.96%
A3.3.33	Electrical External Services	2.200%	83.16%
A3.3.34	Civil External Services	0.800%	83.96%
A3.3.35	Power Wiring and Plug	2.300%	86.26%
A3.3.36	Telephone Conduits	0.140%	86.40%

A3.3.37	Lighting Arrestor	0.040%	86.44%
A3.3.38	Fire Fighting Works	2.000%	88.44%
A3.3.39	Fire Alarm System Works	1.600%	90.04%
A3.3.40	CCTV SYSTEM	0.350%	90.39%
A3.3.41	ACCESS CONTROL SYSTEM	0.070%	90.46%
A3.3.42	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	90.57%
A3.3.43	LAN SYSTEM	0.800%	91.37%
A3.3.44	IP BASED EPABX SYSTEM	0.730%	92.10%
A3.3.45	Lift works (supply 60% , Installation 20%, Testing and Comissioning	2.800%	94.90%
A3.3.46	VRV/ VRF AC System	2.100%	97.00%
	Testing, Commissioning & Handing Over		
A3.3.46	Testing & Commissioning of Services	2.000%	99.00%
A3.3.47	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.4) Schedule of Payments for Scope of Works - Club House (B+G+3 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.4" =1.0 %** of A3			
Apportionment of Cost Centre "A3.4" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.4 as Applicable**	**Cumulative Weightage of Cost Centre A4.5 as Applicable**
	CLUB HOUSE (B+G+3 UPPER FLOOR)		
	Substructure Works		
A3.4.1	Completion of Earthwork	2.0000%	2.000%
A3.4.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	6.6000%	8.600%
A3.4.3	Completion of work up to PL including Retaining Wall its waterproofing and Slab works	5.5000%	14.100%
	Superstructure Works		
A3.4.4	Completion of Colums, Beams and slabs of Ground Floor	5.000%	19.10%
A3.4.5	Completion of Colums, Beams and slabs of 1st Floor	5.000%	24.10%
A3.4.6	Completion of Colums, Beams and slabs of 2nd Floor	5.000%	29.10%
A3.4.7	Completion of Colums, Beams and slabs of 3rd Floor/terrace floor	5.000%	34.10%
A3.4.8	Completion of slabs of mumty , Over head water tanks, terrace works complete	1.500%	35.60%
A3.4.9	Completion of Block works.	8.000%	43.60%
A3.4.10	Concealed plumbing works & Plaster wherever required.	2.000%	45.60%
A3.4.11	Providing and Fixing of Door frames	1.000%	46.60%
A3.4.12	Completion of Internal Flooring including skirting	2.000%	48.60%
A3.4.13	Completion of Wall Tiling.	2.000%	50.60%
A3.4.14	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	52.60%
A3.4.15	Completion of False Ceiling Works.	2.200%	54.80%
A3.4.16	Completion of SS Hand railing.	1.250%	56.05%
A3.4.17	Internal Painting	2.000%	58.05%
A3.4.18	External Plastering	1.500%	59.55%
A3.4.19	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.000%	63.55%
A3.4.20	Water Proofing.	1.500%	65.05%
A3.4.21	Plumbing & Sanitary Installations.	4.410%	69.46%
A3.4.22	Internal Electric Installations	6.000%	75.46%
A3.4.23	Electrical External Services	2.200%	77.66%
A3.4.24	Civil External Services	0.800%	78.46%
A3.4.25	Power Wiring and Plug	2.300%	80.76%
A3.4.26	Telephone Conduits	0.140%	80.90%
A3.4.27	Lighting Arrestor	0.040%	80.94%
A3.4.28	Fire Fighting Works	2.000%	82.94%
A3.4.29	Fire Alarm System Works	1.600%	84.54%
A3.4.30	CCTV SYSTEM	0.350%	84.89%
A3.4.31	ACCESS CONTROL SYSTEM	0.070%	84.96%
A3.4.32	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	85.07%
A3.4.33	LAN SYSTEM	0.800%	85.87%
A3.4.34	IP BASED EPABX SYSTEM	0.730%	86.60%
A3.4.35	Lift works (supply 60% , Installation 20%, Testing and Comissioning 20%)	5.300%	91.90%
A3.4.36	VRV/ VRF AC System	5.100%	97.00%
	Testing, Commissioning & Handing Over		
A3.4.37	Testing & Commissioning of Services	2.000%	99.00%
A3.4.38	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.5 Schedule of Payments for Scope of Works - SUGEON HOSTEL LADIE'S (B+S+7 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.5" = 2.0 %** of A3			
Apportionment of Cost Centre "A3.5" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.5 as Applicable**	**Cumulative Weightage of Cost Centre A3.5 as Applicable**
	Substructure Works		
A3.5.1	Completion of Earthwork	2.0000%	2.000%
A3.5.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	6.6000%	8.600%
A3.5.3	Completion of Retaining Wall Works (including water proofing) for basement	4.5600%	13.160%
A3.5.4	Completion of Basement Slab Works	6.5000%	19.660%
	Superstructure Works		
A3.5.5	Completion of Colums, Beams and slabs of Ground floor	2.500%	22.16%
A3.5.6	Completion of Colums, Beams and slabs of 1st Floor	2.500%	24.66%
A3.5.7	Completion of Colums, Beams and slabs of 2nd Floor	2.500%	27.16%
A3.5.8	Completion of Colums, Beams and slabs of 3rd Floor	2.500%	29.66%
A3.5.9	Completion of Colums, Beams and slabs of 4th Floor	2.500%	32.16%
A3.5.10	Completion of Colums, Beams and slabs of 5th Floor	2.500%	34.66%
A3.5.11	Completion of Colums, Beams and slabs of 6th Floor	2.500%	37.16%
A3.5.12	Completion of Colums, Beams and slabs of 7th Floor	2.500%	39.66%
A3.5.13	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	40.16%
A3.5.14	Completion of Block works.	6.500%	46.66%
A3.5.15	Concealed plumbing works & Plaster wherever required.	2.000%	48.66%
A3.5.16	Providing and Fixing of Door frames	0.750%	49.41%
A3.5.17	Completion of Internal Flooring including skirting	2.000%	51.41%
A3.5.18	Completion of Wall Tiling.	2.000%	53.41%
A3.5.19	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	55.41%
A3.5.20	Completion of False Ceiling Works.	2.200%	57.61%
A3.5.21	Completion of SS Hand railing.	1.250%	58.86%
A3.5.22	Internal Painting	3.000%	61.86%
A3.5.23	External Plastering	2.000%	63.86%
A3.5.24	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.000%	67.86%
A3.5.25	Water Proofing.	1.000%	68.86%
A3.5.26	Plumbing & Sanitary Installations.	4.000%	72.86%
A3.5.27	Internal Electric Installations	6.000%	78.86%
A3.5.28	Electrical External Services	2.200%	81.06%
A3.5.29	Civil External Services	1.000%	82.06%
A3.5.30	Power Wiring and Plug	2.300%	84.36%
A3.5.31	Telephone Conduits	0.140%	84.50%
A3.5.32	Lighting Arrestor	0.040%	84.54%
A3.5.33	Fire Fighting Works	2.000%	86.54%
A3.5.34	Fire Alarm System Works	1.600%	88.14%
A3.5.35	CCTV SYSTEM	0.350%	88.49%
A3.5.36	ACCESS CONTROL SYSTEM	0.070%	88.56%
A3.5.37	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	88.67%

A3.5.38	LAN SYSTEM	0.800%	89.47%
A3.5.39	IP BASED EPABX SYSTEM	0.730%	90.20%
A3.5.40	Lift works (supply 60% , Installation 20%, Testing and Comissioning	5.700%	95.90%
A3.5.41	VRV/ VRF AC System	1.100%	97.00%
	Testing, Commissioning & Handing Over		
A3.5.42	Testing & Commissioning of Services	2.000%	99.00%
A3.5.43	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.6 Schedule of Payments for Scope of Works - SURGEON HOSTEL GENT'S cum Guest House (B+S+8 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.6" = 2.0 %** of A3			
Apportionment of Cost Centre "A3.6" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.6 as Applicable**	**Cumulative Weightage of Cost Centre A3.6 as Applicable**
	Substructure Works		
A3.6.1	Completion of Earthwork	2.0000%	2.000%
A3.6.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	6.6000%	8.600%
A3.6.3	Completion of Retaining Wall Works (including water proofing) for basement	4.5600%	13.160%
A3.6.4	Completion of Basement Slab Works	6.5000%	19.660%
	Superstructure Works		
A3.6.5	Completion of Colums, Beams and of Ground floor	2.500%	22.16%
A3.6.6	Completion of Colums, Beams and slabs of 1st Floor	2.500%	24.66%
A3.6.7	Completion of Colums, Beams and slabs of 2nd Floor	2.500%	27.16%
A3.6.8	Completion of Colums, Beams and slabs of 3rd Floor	2.500%	29.66%
A3.6.9	Completion of Colums, Beams and slabs of 4th Floor	2.500%	32.16%
A3.6.10	Completion of Colums, Beams and slabs of 5th Floor	2.500%	34.66%
A3.6.11	Completion of Colums, Beams and slabs of 6th Floor	2.500%	37.16%
A3.6.12	Completion of Colums, Beams and slabs of 7th Floor	2.500%	39.66%
A3.6.13	Completion of Colums, Beams and slabs of 8th Floor	2.500%	42.16%
A3.6.14	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	42.66%
A3.6.15	Completion of Block works.	6.000%	48.66%
A3.6.16	Concealed plumbing works & Plaster wherever required.	2.000%	50.66%
A3.6.17	Providing and Fixing of Door frames	0.750%	51.41%
A3.6.18	Completion of Internal Flooring including skirting	2.000%	53.41%
A3.6.19	Completion of Wall Tiling.	2.000%	55.41%
A3.6.20	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	57.41%
A3.6.21	Completion of False Ceiling Works.	2.200%	59.61%
A3.6.22	Completion of SS Hand railing.	1.250%	60.86%
A3.6.23	Internal Painting	2.000%	62.86%
A3.6.24	External Plastering	1.500%	64.36%
A3.6.25	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.000%	68.36%
A3.6.26	Water Proofing.	1.000%	69.36%
A3.6.27	Plumbing & Sanitary Installations.	4.000%	73.36%
A3.6.28	Internal Electric Installations	6.000%	79.36%
A3.6.29	Electrical External Services	2.200%	81.56%
A3.6.30	Civil External Services	1.000%	82.56%
A3.6.31	Power Wiring and Plug	2.300%	84.86%
A3.6.32	Telephone Conduits	0.140%	85.00%
A3.6.33	Lighting Arrestor	0.040%	85.04%
A3.6.34	Fire Fighting Works	2.000%	87.04%
A3.6.35	Fire Alarm System Works	1.600%	88.64%
A3.6.36	CCTV SYSTEM	0.350%	88.99%
A3.6.37	ACCESS CONTROL SYSTEM	0.070%	89.06%

A3.6.38	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	89.17%
A3.6.39	LAN SYSTEM	0.800%	89.97%
A3.6.40	IP BASED EPABX SYSTEM	0.730%	90.70%
A3.6.41	Lift works (supply 60% , Installation 20%, Testing and Comissioning	5.700%	96.40%
A3.6.42	VRV/ VRF AC System	0.600%	97.00%
	Testing, Commissioning & Handing Over		
A3.6.43	Testing & Commissioning of Services	2.000%	99.00%
A3.6.44	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.7) Schedule of Payments for Scope of Works - Resisential Building Facility- Type- II (104 UNITS) (Basement +Stilt Floor + 13 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.7" =4.0 %** of A3			
Apportionment of Cost Centre "A3.7" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.7 as Applicable**	**Cumulative Weightage of Cost Centre A3.7 as Applicable**
	Typical Type -II Building : (Basement + Stilt Floor + 13 Upper Floors)		
	Substructure Works		
A3.7.1	Completion of Earthwork	1.000%	1.00%
A3.7.2	Completion of Foundation (Raft including Water proofing, Including Pilling if required)	13.710%	14.71%
A3.7.3	Completion of Retaining wall (inclsuing waterproofing) and slab	6.00%	20.71%
	Superstructure Works		
A3.7.4	Completion of Colums, Beams and slabs of stilt floor	2.000%	22.71%
A3.7.5	Completion of Colums, Beams and slabs of 1st Floor	2.000%	24.71%
A3.7.6	Completion of Colums, Beams and slabs of 2nd Floor	2.000%	26.71%
A3.7.7	Completion of Colums, Beams and slabs of 3rd Floor	2.000%	28.71%
A3.7.8	Completion of Colums, Beams and slabs of 4th Floor	2.000%	30.71%
A3.7.9	Completion of Colums, Beams and slabs of 5th Floor	2.000%	32.71%
A3.7.10	Completion of Colums, Beams and slabs of 6th Floor	2.000%	34.71%
A3.7.11	Completion of Colums, Beams and slabs of 7th Floor	2.000%	36.71%
A3.7.12	Completion of Colums, Beams and slabs of 8th Floor	2.000%	38.71%
A3.7.13	Completion of Colums, Beams and slabs of 9th Floor	2.000%	40.71%
A3.7.14	Completion of Colums, Beams and slabs of 10th Floor	2.000%	42.71%
A3.7.15	Completion of Colums, Beams and slabs of 11th Floor	2.000%	44.71%
A3.7.16	Completion of Colums, Beams and slabs of 12th Floor	2.000%	46.71%
A3.7.17	Completion of Colums, Beams and slabs of 13th Floor	2.000%	48.71%
A3.7.18	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	49.21%
A3.7.19	Completion of Block works.	4.000%	53.21%
A3.7.20	Concealed plumbing works & Plaster wherever required.	2.000%	55.21%
A3.7.21	Providing and Fixing of Door frames	0.700%	55.91%
A3.7.22	Completion of Internal Flooring including skirting	2.000%	57.91%
A3.7.23	Completion of Wall Tiling.	2.000%	59.91%
A3.7.24	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	61.91%
A3.7.25	Completion of False Ceiling Works.	2.200%	64.11%
A3.7.26	Completion of SS Hand railing.	1.250%	65.36%
A3.7.27	Internal Painting	2.000%	67.36%
A3.7.28	External Plastering	2.100%	69.46%
A3.7.29	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.000%	73.46%
A3.7.30	Water Proofing.	0.500%	73.96%
A3.7.31	Plumbing & Sanitary Installations.	3.000%	76.96%
A3.7.32	Internal Electric Installations	4.000%	80.96%
A3.7.33	Electrical External Services	2.000%	82.96%
A3.7.34	Civil External Services	0.800%	83.76%
A3.7.35	Power Wiring and Plug	2.000%	85.76%
A3.7.36	Telephone Conduits	0.140%	85.90%
A3.7.37	Lighting Arrestor	0.040%	85.94%
A3.7.38	Fire Fighting Works	2.000%	87.94%
A3.7.39	Fire Alarm System Works	1.800%	89.74%
A3.7.40	CCTV SYSTEM	0.350%	90.09%
A3.7.41	ACCESS CONTROL SYSTEM	0.060%	90.15%
A3.7.42	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.150%	90.30%
A3.7.43	LAN SYSTEM	0.800%	91.10%
A3.7.44	IP BASED EPABX SYSTEM	0.800%	91.90%
A3.7.45	Lift Works (supply 60% , Installation 20%, Testing and Comissioning 20%)	5.100%	97.00%
	Testing, Commissioning & Handing Over		
A3.7.46	Testing & Commissioning of Services	2.000%	99.00%
A3.7.47	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.8) Schedule of Payments for Scope of Works - Residence building Type -IV (52 units)(Basement + Stilt Floor + 13 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.8" =3.0 %** of A3			
Apportionment of Cost Centre "A3.8" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.8 as Applicable**	**Cumulative Weightage of Cost Centre A3.8 as Applicable**
	Typical Residencial Building Type-IV Facility : (Basment + Stilt Floor + 13 Upper Floors)		
	Substructure Works		
A3.8.1	Completion of Earthwork	1.000%	1.00%
A3.8.2	Completion of Foundation (Raft including Water proofing, Including Pilling if required)	13.710%	14.71%
A3.8.3	Completion of Retaining wall (inclsuing waterproofing) and slab	6.00%	20.71%
	Superstructure Works		
A3.8.4	Completion of Colums, Beams and slabs of stilt floor	2.000%	22.71%
A3.8.5	Completion of Colums, Beams and slabs of 1st Floor	2.000%	24.71%
A3.8.6	Completion of Colums, Beams and slabs of 2nd Floor	2.000%	26.71%
A3.8.7	Completion of Colums, Beams and slabs of 3rd Floor	2.000%	28.71%
A3.8.8	Completion of Colums, Beams and slabs of 4th Floor	2.000%	30.71%
A3.8.9	Completion of Colums, Beams and slabs of 5th Floor	2.000%	32.71%
A3.8.10	Completion of Colums, Beams and slabs of 6th Floor	2.000%	34.71%
A3.8.11	Completion of Colums, Beams and slabs of 7th Floor	2.000%	36.71%
A3.8.12	Completion of Colums, Beams and slabs of 8th Floor	2.000%	38.71%
A3.8.13	Completion of Colums, Beams and slabs of 9th Floor	2.000%	40.71%
A3.8.14	Completion of Colums, Beams and slabs of 10th Floor	2.000%	42.71%
A3.8.15	Completion of Colums, Beams and slabs of 11th Floor	2.000%	44.71%
A3.8.16	Completion of Colums, Beams and slabs of 12th Floor	2.000%	46.71%
A3.8.17	Completion of Colums, Beams and slabs of 13th Floor	2.000%	48.71%
A3.8.18	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	49.21%
A3.8.19	Completion of Block works.	4.000%	53.21%
A3.8.20	Concealed plumbing works & Plaster wherever required.	2.000%	55.21%
A3.8.21	Providing and Fixing of Door frames	0.700%	55.91%
A3.8.22	Completion of Internal Flooring including skirting	2.000%	57.91%
A3.8.23	Completion of Wall Tiling.	2.000%	59.91%
A3.8.24	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	61.91%
A3.8.25	Completion of False Ceiling Works.	2.200%	64.11%
A3.8.26	Completion of SS Hand railing.	1.250%	65.36%
A3.8.27	Internal Painting	2.000%	67.36%
A3.8.28	External Plastering	2.100%	69.46%
A3.8.29	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.000%	73.46%
A3.8.30	Water Proofing.	0.500%	73.96%
A3.8.31	Plumbing & Sanitary Installations.	3.000%	76.96%
A3.8.32	Internal Electric Installations	4.000%	80.96%
A3.8.33	Electrical External Services	2.000%	82.96%
A3.8.34	Civil External Services	0.800%	83.76%
A3.8.35	Power Wiring and Plug	2.000%	85.76%
A3.8.36	Telephone Conduits	0.140%	85.90%
A3.8.37	Lighting Arrestor	0.040%	85.94%

A3.8.38	Fire Fighting Works	2.000%	87.94%
A3.8.39	Fire Alarm System Works	1.800%	89.74%
A3.8.40	CCTV SYSTEM	0.350%	90.09%
A3.8.41	ACCESS CONTROL SYSTEM	0.060%	90.15%
A3.8.42	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.150%	90.30%
A3.8.43	LAN SYSTEM	0.800%	91.10%
A3.8.44	IP BASED EPABX SYSTEM	0.800%	91.90%
A3.8.45	Lift works (supply 60% , Installation 20%, Testing and Comissioning	5.100%	97.00%
	Testing, Commissioning & Handing Over		
A3.8.46	Testing & Commissioning of Services	2.000%	99.00%
A3.8.47	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.9) Schedule of Payments for Scope of Works - Electrical Sub Station (B+G+2)			
Percentage Apportioned to Major Cost Centre **"A3.9" = 1.0 %** of A3			
Apportionment of Cost Centre "A3.9" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.9 as Applicable**	**Cumulative Weightage of Cost Centre A3.9 as Applicable**
	Substructure Works		
A3.9.1	Completion of Earthwork	2.00%	2.000%
A3.9.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	7.00%	9.000%
A3.9.3	Completion of all work uo to PL	6.00%	15.000%
	Superstructure Works		
A3.9.5	Completion of Colums, Beams and slabs of Ground Floor	9.00%	24.00%
A3.9.6	Completion of Colums, Beams and slabs of 1st Floor	9.00%	33.00%
A3.9.7	Completion of Colums, Beams and slabs of 2nd Floor	9.00%	42.00%
A3.9.8	Completion of slabs of mumty , Over head water tanks, terrace works complete	1.00%	43.00%
	Architectural Works		
A3.9.9	Completion of Block works.	8.20%	51.20%
A3.9.10	Concealed plumbing works & Plaster wherever required.	2.00%	53.20%
A3.9.11	Providing and Fixing of Door frames	2.00%	55.20%
A3.9.12	Completion of Internal Flooring including skirting	2.00%	57.20%
A3.9.13	Completion of Wall Tiling.	2.00%	59.20%
A3.9.14	Providing and Fixing of Aluminium windows including glazing, Door shutters	3.00%	62.20%
A3.9.15	Completion of False Ceiling Works.	2.00%	64.20%
A3.9.16	Completion of SS Hand railing.	1.00%	65.20%
A3.9.17	Internal Painting	2.00%	67.20%
A3.9.18	External Plastering	2.50%	69.70%
A3.9.19	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	2.00%	71.70%
A3.9.20	Water Proofing.	1.61%	73.31%
A3.9.21	Plumbing & Sanitary Installations.	2.53%	75.84%
A3.9.22	Internal Electric Installations	7.89%	83.73%
A3.9.23	Electrical External Services	2.37%	86.10%
A3.9.24	Civil External Services	0.79%	86.88%
A3.9.25	Power Wiring and Plug	4.00%	90.88%
A3.9.26	Telephone Conduits	0.16%	91.04%
A3.9.27	Lighting Arrestor	0.04%	91.08%
A3.9.28	Fire Fighting Works	2.09%	93.17%
A3.9.29	Fire Alarm System Works	1.04%	94.21%
A3.9.30	UNINTERRUPTED POWER SUPPLY	0.23%	94.44%
A3.9.31	CCTV SYSTEM	0.19%	94.63%
A3.9.32	ACCESS CONTROL SYSTEM	0.04%	94.67%
A3.9.33	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.07%	94.74%
A3.9.34	LAN SYSTEM	0.41%	95.15%
A3.9.35	IP BASED EPABX SYSTEM	0.43%	95.58%
A3.9.36	Lift works (supply 60% , Installation 20%, Testing and Comissioning 20%)	1.42%	97.00%
	Testing, Commissioning & Handing Over		
A3.9.37	Testing & Commissioning of Services	2.00%	99.00%
A3.9.38	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.00%	100.00%
	Total	**100.00%**	

A3.10) Schedule of Payments for Scope of Works - External development works, Road work, Under Gound Tank Etc for hospital

Percentage Apportioned to Major Cost Centre **"A3.10" = 2.0 %** of A3

Apportionment of Cost Centre "A3.10" for Payments according to Cost Centres

Cost Centre	Item of Works		Weightage of Cost Centre A3.10 as applicable	Cumulative Weightage of Cost Centre A3.10 as Applicable
A3.10.1	Road & Driveway Works		18.00%	18.00%
a	On completion of Base layer including Filling if any	15%		
b	On Completion of Sub Base layer	25%		
c	On Completion of Surface Layer	50%		
d	On Completion of Marking and Road Signages	10%		
A3.10.2	UG Sump Works		16.00%	34.00%
a	Excavation and Disposal	10%		
b	PCC Waterproofing & Base Slab	15%		
c	Side Walls & Waterproofing	25%		
d	Top Slab	30%		
e	All Finishes Works	18%		
f	Upon issuance of Taking over Certificate	2%		
A3.10.3	Footpath with pcc base , 60 mm thick paver Blocks and kerb stone edging		3.00%	37.00%
a	PCC Base & Base Preperation	60%		
b	Paver Block Laying	40%		
A3.16.4	External Sewerage		6.00%	43.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.10.5	Filter water supply		10.00%	53.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.10.6	Unfiltered water supply distribution lines		2.82%	55.82%

a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.10.7	Strom Water Drains on prorata rate of length executed.		15.31%	71.13%
A3.10.8	Rainwater Harvesting (RWH) System Works		4.60%	75.73%
a	Upon Completion of 50% extent of work	49.0%		
b	Upon Completion of 100% extent of work	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.10.9	RCC Trenches for services to be approved by Concerned line Department		18.64%	94.37%
a	Upon Completion of 50% extent of work including backfilling	49.0%		
b	Upon Completion of 100% extent of work including backfilling	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.10.11	Parking area development, Landscaping and its lighting and irrigation sysytem, benched, Horticulture Works as per scope of work.		3.00%	97.37%
A3.10.12	Maintenance of the Softscape during DLP on completion of 1st Year.		1.13%	98.50%
A3.10.13	Developemnt of play ground as per scope of work		1.50%	
			100.000%	

A3.11)- Schedule of Payments for Scope of Works - MEP - Highside Equipment and Specialised E& M works. (Hospital)

Percentage Apportioned to Major Cost Centre **"A3.11" =6.0 %** of A3

Apportionment of Cost Centre "A3.11" for Payments according to Cost Centres

			Weightage of Cost Centre A3.11. as Applicable	**Cumulative Weightage of Cost Centre A3.11 as Applicable**
	MEP Infrastructure Works			
A3.11.1	SUB-STATION EQUIPMENTS (Transformer), HT Panel, LT Panel, Metering Panel (supply 60% , Installation 20%, Testing and Comissioning 20%)		33.00%	33.00%
A3.11.2	GENERATING SETS Including HSD tank (supply 60% , Installation 20%, Testing and Comissioning 20%)		20.00%	53.00%
A3.11.3	SOLAR PHOTO VOLTAIC POWER GENERATION SYSTEM		7.00%	60.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.11.4	CCTV SYSTEM External		2.50%	62.50%

A3.11.5	HYDROPNEUMATIC WATER SUPPLY SYSTEM INCLUDING ALL PUMPS		1.50%	64.00%
A3.11.6	STREET LIGHTING WITH LED		1.00%	65.00%
a	Upon Completion of 50% extent of work	49.0%		
b	Upon Completion of 100% extent of work	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.11.7	STP/ETP PLANT		7.00%	72.00%
a	Supply of ETP/ STP sysytem (70% for Major Equipment Supply and 30% for Ancillary materials)	60.00%		
b	Installation	20.00%		
c	Testing & Comissioning	10.00%		
d	Upon lssuance of taklng Over certificate for this section SOP Scope of Works	10.00%		
A3.11.8	DRIVER FACE AND AUTOMATIC NUMBER PLATE RECORDING SYSTEM/RECOGNITION SYSTEM		0.31%	72.31%
A3.11.9	BOOM BARRIER		0.11%	72.42%
A3.11.10	HT (UE) cable Meter room to Substationas required including HDPE pipe, earth excavation for trench, laying of pipe in trebch, refilling of earth as per CPWD norms etc complete in all respect and providing route markers		6.64%	79.06%
A3.11.11	Additional cost of Filtration, germs irridiation, Heating and dehumidification provisions		10.00%	89.06%
A3.11.12	Heating system to cater exclusively for PHE		1.69%	90.75%
A3.11.13	Fire Sealant		1.78%	92.53%
A3.11.14	Gas Suppression System for Data Centre & Command Center (Payment at prorated basis on completion of 25%, 50%, 75% & 100%)		1.53%	94.06%
A3.11.15	Very Early Smoke Detection (Payment at prorated basis on completion of 25%, 50%, 75% & 100%)		0.70%	94.76%
A3.11.16	Water Spray System for power transformers		0.41%	95.17%
A3.11.17	Gas Suppression system for Electrical Panels		1.18%	96.35%
A3.11.18	LPG Piping for Kichen		0.71%	97.06%
A3.11.19	Copper Pipes and SS Pipes & Fittings in lieu of CPVC pipes & fittings for Hot water System		2.94%	100.00%
	Total		**100.00%**	

A3.12) Schedule of Payments for Scope of Works - Dental college			
Percentage Apportioned to Major Cost Centre **"A3.12" = 11.00 %** of A3			
Apportionment of Cost Centre "A3.12" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.12 as Applicable**	**Cumulative Weightage of Cost Centre A3.12 as Applicable**
	Dental college : (One Basement + Ground Floor + 7 Upper		
	Substructure Works		
A3.12.1	Completion of Earthwork	2.00%	2.00%
A3.12.2	Completion of Foundation (Raft/Pile or combined as per Design) including Water proofing.	8.00%	10.00%
A3.12.3	Completion of Retaining Wall Works (including water proofing)	5.00%	15.00%
A3.12.4	Completion of Basement Slab Works	4.00%	19.00%
	Superstructure Works		
A3.12.5	Completion of Colums, Beams and slabs of Ground Floor	2.00%	21.00%
A3.12.6	Completion of Colums, Beams and slabs of 1st Floor	2.00%	23.00%
A3.12.7	Completion of Colums, Beams and slabs of 2nd Floor	2.00%	25.00%
A3.12.8	Completion of Colums, Beams and slabs of 3rd Floor	2.00%	27.00%
A3.12.9	Completion of Colums, Beams and slabs of 4th Floor	2.00%	29.00%
A3.12.10	Completion of Colums, Beams and slabs of 5th Floor	2.00%	31.00%
A3.12.11	Completion of Colums, Beams and slabs of 6th Floor	2.00%	33.00%
A3.12.12	Completion of Colums, Beams and slabs of 7th Floor	2.00%	35.00%
A3.12.13	Completion of slabs of mumty , Over head water tanks, terrace works complete	1.50%	36.50%
A3.12.14	Completion of Block works.	6.00%	42.50%
	Architectural works		
A3.12.15	Concealed plumbing works & Plaster wherever required.	1.50%	44.00%
A3.12.16	Providing and Fixing of Door frames	1.00%	45.00%
A3.12.17	Completion of Internal Flooring including skirting	1.80%	46.80%
A3.12.18	Completion of Wall Tiling.	1.50%	48.30%
A3.12.19	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.69%	50.99%
A3.12.20	Completion of False Ceiling Works.	2.00%	52.99%
A3.12.21	Completion of SS Hand railing.	1.00%	53.99%
A3.12.22	Internal Painting	2.00%	55.99%
A3.12.23	External Plastering	1.50%	57.49%
A3.12.24	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.26%	61.75%
A3.12.25	Waterproofing (Podium, Toilet, Water Tanks etc	0.32%	62.07%
A3.12.26	Terrace Water Proofing.	0.05%	62.12%
A3.12.27	Plumbing & Sanitary Installations.	4.49%	66.61%
A3.12.28	Internal Electric Installations	5.61%	72.22%
A3.12.29	Electrical External Services	1.68%	73.90%
A3.12.30	External Services Civil complete including plinth protection, peripheral drain etc.	0.56%	74.46%
A3.12.31	Power Wiring and Plug	1.80%	76.26%
A3.12.32	Telephone Conduits	0.11%	76.37%
A3.12.33	Lighting Arrestor	0.04%	76.41%
A3.12.34	Fire Fighting Works	1.62%	78.03%
A3.12.35	Fire Alarm System Works	0.81%	78.84%
A3.12.36	UNINTERRUPTED POWER SUPPLY	0.54%	79.38%

A3.12.37	CENTRAL AC PLANT/ HVAC complete	4.01%	83.39%
A3.12.38	CCTV SYSTEM	0.22%	83.61%
A3.12.39	ACCESS CONTROL SYSTEM	0.03%	83.64%
A3.12.40	IBMS: INTEGRATED BUILDING MANAGEMENT SYSTEM	0.22%	83.86%
A3.12.41	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.08%	83.94%
A3.12.42	LAN SYSTEM	0.47%	84.41%
A3.12.43	IP BASED EPABX SYSTEM	0.39%	84.80%
A3.12.44	Audio & Video System Works	1.10%	85.90%
A3.12.45	Mechanical Ventilation System Works.	0.54%	86.44%
A3.12.46	FAÇADE LIGHTING(like façade)	0.17%	86.61%
A3.12.47	EMERGENCY LIGHT & ILLUMINATED SIGNAGES	0.15%	86.76%
A3.12.48	Medical services	8.70%	95.46%
A3.12.49	Lift works (supply 60% , Installation 20%, Testing and Comissioning 20%)	1.54%	97.00%
	Testing, Commissioning & Handing Over		
A3.12.50	Testing & Commissioning of Services	2.00%	99.00%
A3.12.51	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.00%	100.00%
	Total	**100.00%**	

A3.13) Schedule of Payments for Scope of Works - Boys Hostel (Dental College) (B+S+11 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.13" =3.0 %** of A3			
Apportionment of Cost Centre "A3.13" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.13 as Applicable**	**Cumulative Weightage of Cost Centre A3.13 as Applicable**
	Boys hostel Dental college		
	Substructure Works		
A3.13.1	Completion of Earthwork	2.0000%	2.000%
A3.13.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	7.0000%	9.000%
A3.13.3	Completion of Retaining Wall Works (including water proofing) for basement	5.0000%	14.000%
A3.13.4	Completion of Basement Slab Works	6.8600%	20.860%
	Superstructure Works		
A3.13.5	Completion of Colums, Beams and slabs of Ground floor	2.000%	22.86%
A3.13.6	Completion of Colums, Beams and slabs of 1st Floor	2.000%	24.86%
A3.13.7	Completion of Colums, Beams and slabs of 2nd Floor	2.000%	26.86%
A3.13.8	Completion of Colums, Beams and slabs of 3rd Floor	2.000%	28.86%
A3.13.9	Completion of Colums, Beams and slabs of 4th Floor	2.000%	30.86%
A3.13.10	Completion of Colums, Beams and slabs of 5th Floor	2.000%	32.86%
A3.13.11	Completion of Colums, Beams and slabs of 6th Floor	2.000%	34.86%
A3.13.12	Completion of Colums, Beams and slabs of 7th Floor	2.000%	36.86%
A3.13.13	Completion of Colums, Beams and slabs of 8th Floor	2.000%	38.86%
A3.13.14	Completion of Colums, Beams and slabs of 9th Floor	2.000%	40.86%
A3.13.15	Completion of Colums, Beams and slabs of 10th Floor	2.000%	42.86%
A3.13.16	Completion of Colums, Beams and slabs of 11th Floor	2.000%	44.86%
A3.13.17	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	45.36%
A3.13.18	Completion of Block works.	5.000%	50.36%
A3.13.19	Concealed plumbing works & Plaster wherever required.	2.000%	52.36%
A3.13.20	Providing and Fixing of Door frames	0.750%	53.11%
A3.13.21	Completion of Internal Flooring including skirting	3.000%	56.11%
A3.13.22	Completion of Wall Tiling.	2.000%	58.11%
A3.13.23	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	60.11%
A3.13.24	Completion of False Ceiling Works.	2.200%	62.31%
A3.13.25	Completion of SS Hand railing.	1.250%	63.56%
A3.13.26	Internal Painting	2.000%	65.56%
A3.13.27	External Plastering	1.500%	67.06%
A3.13.28	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.200%	71.26%
A3.13.29	Water Proofing.	1.000%	72.26%
A3.13.30	Plumbing & Sanitary Installations.	4.000%	76.26%
A3.13.31	Internal Electric Installations	6.000%	82.26%
A3.13.32	Electrical External Services	2.200%	84.46%
A3.13.33	Civil External Services	0.800%	85.26%
A3.13.34	Power Wiring and Plug	2.300%	87.56%
A3.13.35	Telephone Conduits	0.140%	87.70%
A3.13.36	Lighting Arrestor	0.040%	87.74%

A3.13.37	Fire Fighting Works	2.000%	89.74%
A3.13.38	Fire Alarm System Works	1.600%	91.34%
A3.13.39	CCTV SYSTEM	0.350%	91.69%
A3.13.40	ACCESS CONTROL SYSTEM	0.070%	91.76%
A3.13.41	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	91.87%
A3.13.42	LAN SYSTEM	0.800%	92.67%
A3.13.43	IP BASED EPABX SYSTEM	0.730%	93.40%
A3.13.44	Lift works (supply 60% , Installation 20%, Testing and Comissioning	2.800%	96.20%
A3.13.45	VRV/ VRF AC System	0.800%	97.00%
	Testing, Commissioning & Handing Over		
A3.13.46	Testing & Commissioning of Services	2.000%	99.00%
A3.13.47	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.14) Schedule of Payments for Scope of Works - Girls Hostel (Dental College) (B+S+11 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.14" =3.0 %** of A3			
Apportionment of Cost Centre "A3.14" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.14 as Applicable**	**Cumulative Weightage of Cost Centre A3.14 as Applicable**
	Girls hostel Dental college		
	Substructure Works		
A3.14.1	Completion of Earthwork	2.0000%	2.000%
A3.14.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	7.0000%	9.000%
A3.14.3	Completion of Retaining Wall Works (including water proofing) for basement	5.0000%	14.000%
A3.14.4	Completion of Basement Slab Works	6.8600%	20.860%
	Superstructure Works		
A3.14.5	Completion of Colums, Beams and slabs of Ground floor	2.000%	22.86%
A3.14.6	Completion of Colums, Beams and slabs of 1st Floor	2.000%	24.86%
A3.14.7	Completion of Colums, Beams and slabs of 2nd Floor	2.000%	26.86%
A3.14.8	Completion of Colums, Beams and slabs of 3rd Floor	2.000%	28.86%
A3.14.9	Completion of Colums, Beams and slabs of 4th Floor	2.000%	30.86%
A3.14.10	Completion of Colums, Beams and slabs of 5th Floor	2.000%	32.86%
A3.14.11	Completion of Colums, Beams and slabs of 6th Floor	2.000%	34.86%
A3.14.12	Completion of Colums, Beams and slabs of 7th Floor	2.000%	36.86%
A3.14.13	Completion of Colums, Beams and slabs of 8th Floor	2.000%	38.86%
A3.14.14	Completion of Colums, Beams and slabs of 9th Floor	2.000%	40.86%
A3.14.15	Completion of Colums, Beams and slabs of 10th Floor	2.000%	42.86%
A3.14.16	Completion of Colums, Beams and slabs of 11th Floor	2.000%	44.86%
A3.14.17	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	45.36%
A3.14.18	Completion of Block works.	5.000%	50.36%
A3.14.19	Concealed plumbing works & Plaster wherever required.	2.000%	52.36%
A3.14.20	Providing and Fixing of Door frames	0.750%	53.11%
A3.14.21	Completion of Internal Flooring including skirting	3.000%	56.11%
A3.14.22	Completion of Wall Tiling.	2.000%	58.11%
A3.14.23	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	60.11%
A3.14.24	Completion of False Ceiling Works.	2.200%	62.31%
A3.14.25	Completion of SS Hand railing.	1.250%	63.56%
A3.14.26	Internal Painting	2.000%	65.56%
A3.14.27	External Plastering	1.500%	67.06%
A3.14.28	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.200%	71.26%
A3.14.29	Water Proofing.	1.000%	72.26%
A3.14.30	Plumbing & Sanitary Installations.	4.000%	76.26%
A3.14.31	Internal Electric Installations	6.000%	82.26%
A3.14.32	Electrical External Services	2.200%	84.46%
A3.14.33	Civil External Services	0.800%	85.26%
A3.14.34	Power Wiring and Plug	2.300%	87.56%
A3.14.35	Telephone Conduits	0.140%	87.70%
A3.14.36	Lighting Arrestor	0.040%	87.74%

A3.14.37	Fire Fighting Works	2.000%	89.74%
A3.14.38	Fire Alarm System Works	1.600%	91.34%
A3.14.39	CCTV SYSTEM	0.350%	91.69%
A3.14.40	ACCESS CONTROL SYSTEM	0.070%	91.76%
A3.14.41	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	91.87%
A3.14.42	LAN SYSTEM	0.800%	92.67%
A3.14.43	IP BASED EPABX SYSTEM	0.730%	93.40%
A3.14.44	Lift works (supply 60% , Installation 20%, Testing and Comissioning	2.800%	96.20%
A3.14.45	VRV/ VRF AC System	0.800%	97.00%
	Testing, Commissioning & Handing Over		
A3.14.46	Testing & Commissioning of Services	2.000%	99.00%
A3.14.47	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.16) Schedule of Payments for Scope of Works - External development works, Road work, Under Gound Tank (DENTAL COLLEGE) Etc

Percentage Apportioned to Major Cost Centre **"A3.16" = 1.0 %** of A3

Apportionment of Cost Centre "A3.16" for Payments according to Cost Centres

Cost Centre	Item of Works		Weightage of Cost Centre A3.16 as applicable	Cumulative Weightage of Cost Centre A3.16 as Applicable
A3.16.1	Road & Driveway Works		18.00%	18.00%
a	On completion of Base layer including Filling if any	15%		
b	On Completion of Sub Base layer	25%		
c	On Completion of Surface Layer	50%		
d	On Completion of Marking and Road Signages	10%		
A3.16.2	UG Sump Works		16.00%	34.00%
a	Excavation and Disposal	10%		
b	PCC Waterproofing & Base Slab	15%		
c	Side Walls & Waterproofing	25%		
d	Top Slab	30%		
e	All Finishes Works	18%		
f	Upon issuance of Taking over Certificate	2%		
A3.16.3	Footpath with pcc base , 60 mm thick paver Blocks and kerb stone edging		3.00%	37.00%
a	PCC Base & Base Preperation	60%		
b	Paver Block Laying	40%		
A3.16.4	External Sewerage		6.00%	43.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.16.5	Filter water supply		10.00%	53.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.16.6	Unfiltered water supply distribution lines		2.82%	55.82%

a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.16.7	Strom Water Drains on prorata rate of length executed.		15.31%	71.13%
A3.16.8	Rainwater Harvesting (RWH) System Works		4.60%	75.73%
a	Upon Completion of 50% extent of work	49.0%		
b	Upon Completion of 100% extent of work	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.16.9	RCC Trenches for services to be approved by Concerned line Department		18.64%	94.37%
a	Upon Completion of 50% extent of work including backfilling	49.0%		
b	Upon Completion of 100% extent of work including backfilling	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.16.11	Parking area development, Landscaping and its lighting and irrigation sysytem, benched, Horticulture Works as per scope of work.		4.50%	98.87%
A3.16.12	Maintenance of the Softscape during DLP on completion of 1st Year.		1.13%	100.00%
			100.000%	

A3.15)- Schedule of Payments for Scope of Works - MEP - Highside Equipment and Specialised E& M works. (DENTLA COLLEGE)

Percentage Apportioned to Major Cost Centre **"A3.15" =1.0 %** of A3
Apportionment of Cost Centre "A3.15" for Payments according to Cost Centres

			Weightage of Cost Centre A3.15. as Applicable	**Cumulative Weightage of Cost Centre A3.15 as Applicable**
	MEP Infrastructure Works			
A3.15.1	SUB-STATION EQUIPMENTS (Transformer), HT Panel, LT Panel, Metering Panel (supply 70%, installation 30%)		33.00%	33.00%
A3.15.2	GENERATING SETS Including HSD tank (supply 70%, Installation 30%)		20.00%	53.00%
A3.15.3	SOLAR PHOTO VOLTAIC POWER GENERATION SYSTEM		7.00%	60.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		

A3.15.4	CCTV SYSTEM External		2.50%	62.50%
A3.15.5	HYDROPNEUMATIC WATER SUPPLY SYSTEM INCLUDING ALL PUMPS		1.50%	64.00%
A3.15.6	STREET LIGHTING WITH LED		1.00%	65.00%
a	Upon Completion of 50% extent of work	49.0%		
b	Upon Completion of 100% extent of work	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.15.7	STP/ETP PLANT		7.00%	72.00%
a	Supply of ETP/ STP sysytem (70% for Major Equipment Supply and 30% for Ancillary materials)	60.00%		
b	Installation	20.00%		
c	Testing & Comissioning	10.00%		
d	Upon lssuance of taklng Over certificate for this section SOP Scope of Works	10.00%		
A3.15.8	DRIVER FACE AND AUTOMATIC NUMBER PLATE RECORDING SYSTEM/RECOGNITION SYSTEM		0.31%	72.31%
A3.15.9	BOOM BARRIER		0.11%	72.42%
A3.15.10	HT (UE) cable Meter room to Substationas required including HDPE pipe, earth excavation for trench, laying of pipe in trebch, refilling of earth as per CPWD norms etc complete in all respect and providing route markers		6.64%	79.06%
A3.15.11	Additional cost of Filtration, germs irridiation, Heating and dehumidification provisions		10.00%	89.06%
A3.15.12	Heating system to cater exclusively for PHE		1.69%	90.75%
A3.15.13	Fire Sealant		1.78%	92.53%
A3.15.14	Gas Suppression System for Data Centre & Command Center (Payment at prorated basis on completion of 25%, 50%, 75% & 100%)		1.53%	94.06%
A3.15.15	Very Early Smoke Detection (Payment at prorated basis on completion of 25%, 50%, 75% & 100%)		0.70%	94.76%
A3.15.16	Water Spray System for power transformers		0.41%	95.17%
A3.15.17	Gas Suppression system for Electrical Panels		1.18%	96.35%
A3.15.18	LPG Piping for Kichen		0.71%	97.06%
A3.15.19	Copper Pipes and SS Pipes & Fittings in lieu of CPVC pipes & fittings for Hot water System		2.94%	100.00%
	Total		**100.00%**	

A3.17) Schedule of Payments for Scope of Works - Electrical Sub Station (G+2)			
Percentage Apportioned to Major Cost Centre **"A3.17" = 0.5 %** of A3			
Apportionment of Cost Centre "A3.17" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.17 as Applicable**	**Cumulative Weightage of Cost Centre A3.17 as Applicable**
	Substructure Works		
A3.17.1	Completion of Earthwork	2.00%	2.000%
A3.17.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	7.00%	9.000%
A3.17.3	Completion of all work uo to PL	6.00%	15.000%
	Superstructure Works		
A3.17.5	Completion of Colums, Beams and slabs of Ground Floor	9.00%	24.00%
A3.17.6	Completion of Colums, Beams and slabs of 1st Floor	9.00%	33.00%
A3.17.7	Completion of Colums, Beams and slabs of 2nd Floor	9.00%	42.00%
A3.17.8	Completion of slabs of mumty , Over head water tanks, terrace works complete	1.00%	43.00%
	Architectural Works		
A3.17.9	Completion of Block works.	8.20%	51.20%
A3.17.10	Concealed plumbing works & Plaster wherever required.	2.00%	53.20%
A3.17.11	Providing and Fixing of Door frames	2.00%	55.20%
A3.17.12	Completion of Internal Flooring including skirting	2.00%	57.20%
A3.17.13	Completion of Wall Tiling.	2.00%	59.20%
A3.17.14	Providing and Fixing of Aluminium windows including glazing, Door shutters	3.00%	62.20%
A3.17.15	Completion of False Ceiling Works.	2.00%	64.20%
A3.17.16	Completion of SS Hand railing.	1.00%	65.20%
A3.17.17	Internal Painting	2.00%	67.20%
A3.17.18	External Plastering	2.50%	69.70%
A3.17.19	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	2.00%	71.70%
A3.17.20	Water Proofing.	1.61%	73.31%
A3.17.21	Plumbing & Sanitary Installations.	2.53%	75.84%
A3.17.22	Internal Electric Installations	7.89%	83.73%
A3.17.23	Electrical External Services	2.37%	86.10%
A3.17.24	Civil External Services	0.79%	86.88%
A3.17.25	Power Wiring and Plug	4.00%	90.88%
A3.17.26	Telephone Conduits	0.16%	91.04%
A3.17.27	Lighting Arrestor	0.04%	91.08%
A3.17.28	Fire Fighting Works	2.09%	93.17%
A3.17.29	Fire Alarm System Works	1.04%	94.21%
A3.17.30	UNINTERRUPTED POWER SUPPLY	0.23%	94.44%
A3.17.31	CCTV SYSTEM	0.19%	94.63%
A3.17.32	ACCESS CONTROL SYSTEM	0.04%	94.67%
A3.17.33	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.07%	94.74%
A3.17.34	LAN SYSTEM	0.41%	95.15%
A3.17.35	IP BASED EPABX SYSTEM	0.43%	95.58%
A3.17.36	Lift works (supply 60% , Installation 20%, Testing and Comissioning 20%)	1.42%	97.00%
	Testing, Commissioning & Handing Over		
A3.17.37	Testing & Commissioning of Services	2.00%	99.00%
A3.17.38	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.00%	100.00%
	Total	**100.00%**	

A3.18) Schedule of Payments for Scope of Works - Pharmacy College			
Percentage Apportioned to Major Cost Centre **"A3.18" = 6.80 %** of A3			
Apportionment of Cost Centre "A3.18" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.18 as Applicable**	**Cumulative Weightage of Cost Centre A3.18 as Applicable**
	Pharmacy college college : (One Basement + Ground Floor + 5 Upper Floors)		
	Substructure Works		
A3.18.1	Completion of Earthwork	2.00%	2.00%
A3.18.2	Completion of Foundation (Raft/Pile or combined as per Design) including Water proofing.	8.00%	10.00%
A3.18.3	Completion of Retaining Wall Works (including water proofing)	5.00%	15.00%
A3.18.4	Completion of Basement Slab Works	4.00%	19.00%
	Superstructure Works		
A3.18.5	Completion of Colums, Beams and slabs of Ground Floor	3.00%	22.00%
A3.18.6	Completion of Colums, Beams and slabs of 1st Floor	3.00%	25.00%
A3.18.7	Completion of Colums, Beams and slabs of 2nd Floor	3.00%	28.00%
A3.18.8	Completion of Colums, Beams and slabs of 3rd Floor	3.00%	31.00%
A3.18.9	Completion of Colums, Beams and slabs of 4th Floor	3.00%	34.00%
A3.18.10	Completion of Colums, Beams and slabs of 5th Floor	3.00%	37.00%
A3.18.11	Completion of slabs of mumty , Over head water tanks, terrace works complete	1.50%	38.50%
A3.18.12	Completion of Block works.	8.00%	46.50%
	Architectural works		
A3.18.20	Concealed plumbing works & Plaster wherever required.	2.00%	48.50%
A3.18.21	Providing and Fixing of Door frames	1.00%	49.50%
A3.18.22	Completion of Internal Flooring including skirting	1.80%	51.30%
A3.18.23	Completion of Wall Tiling.	3.00%	54.30%
A3.18.24	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.69%	56.99%
A3.18.25	Completion of False Ceiling Works.	2.00%	58.99%
A3.18.26	Completion of SS Hand railing.	1.00%	59.99%
A3.18.27	Internal Painting	3.00%	62.99%
A3.18.28	External Plastering	2.00%	64.99%
A3.18.29	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	5.00%	69.99%
A3.18.30	Waterproofing (Podium, Toilet, Water Tanks etc	1.00%	70.99%
A3.18.31	Terrace Water Proofing.	0.25%	71.24%
A3.18.32	Plumbing & Sanitary Installations.	4.49%	75.73%
A3.18.33	Internal Electric Installations	5.61%	81.34%
A3.18.34	Electrical External Services	1.68%	83.02%
A3.18.35	External Services Civil complete including plinth protection, peripheral drain etc.	0.56%	83.58%
A3.18.36	Power Wiring and Plug	1.80%	85.38%
A3.18.37	Telephone Conduits	0.11%	85.49%
A3.18.38	Lighting Arrestor	0.04%	85.53%
A3.18.39	Fire Fighting Works	1.62%	87.15%
A3.18.40	Fire Alarm System Works	0.81%	87.96%
A3.18.41	UNINTERRUPTED POWER SUPPLY	0.54%	88.50%
A3.18.42	CENTRAL AC PLANT/ HVAC complete	4.00%	92.50%

A3.18.43	CCTV SYSTEM	0.22%	92.72%
A3.18.44	ACCESS CONTROL SYSTEM	0.03%	92.75%
A3.18.45	IBMS: INTEGRATED BUILDING MANAGEMENT SYSTEM	0.22%	92.97%
A3.18.46	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.08%	93.05%
A3.18.47	LAN SYSTEM	0.47%	93.52%
A3.18.48	IP BASED EPABX SYSTEM	0.39%	93.91%
A3.18.49	Audio & Video System Works	1.10%	95.01%
A3.18.50	Mechanical Ventilation System Works.	0.50%	95.51%
A3.18.51	FAÇADE LIGHTING(like façade)	0.17%	95.68%
A3.18.52	EMERGENCY LIGHT & ILLUMINATED SIGNAGES	0.15%	95.83%
A3.18.53	Lift works (supply 60% , Installation 20%, Testing and Comissioning 20%)	1.17%	97.00%
	Testing, Commissioning & Handing Over		
A3.18.54	Testing & Commissioning of Services	2.00%	99.00%
A3.18.55	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.00%	100.00%
	Total	**100.00%**	

A3.19) Schedule of Payments for Scope of Works - Residence building type -IV (52 units)(Basement + Stilt Floor + 13 Upper Floors) Pharmacy college			
Percentage Apportioned to Major Cost Centre **"A3.19" =2.80 %** of A3			
Apportionment of Cost Centre "A3.19" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.19 as Applicable**	**Cumulative Weightage of Cost Centre A3.19 as Applicable**
	Typical Residencial Building Type-IV Facility : (Basment + Stilt Floor + 13 Upper Floors) pharmacy college		
	Substructure Works		
A3.19.1	Completion of Earthwork	1.000%	1.00%
A3.19.2	Completion of Foundation (Raft including Water proofing, Including Pilling if required)	13.710%	14.71%
A3.19.3	Completion of Retaining wall (including waterproofing) and slab	6.00%	20.71%
	Superstructure Works		
A3.19.4	Completion of Colums, Beams and slabs of stilt floor	2.000%	22.71%
A3.19.5	Completion of Colums, Beams and slabs of 1st Floor	2.000%	24.71%
A3.19.6	Completion of Colums, Beams and slabs of 2nd Floor	2.000%	26.71%
A3.19.7	Completion of Colums, Beams and slabs of 3rd Floor	2.000%	28.71%
A3.19.8	Completion of Colums, Beams and slabs of 4th Floor	2.000%	30.71%
A3.19.9	Completion of Colums, Beams and slabs of 5th Floor	2.000%	32.71%
A3.19.10	Completion of Colums, Beams and slabs of 6th Floor	2.000%	34.71%
A3.19.11	Completion of Colums, Beams and slabs of 7th Floor	2.000%	36.71%
A3.19.12	Completion of Colums, Beams and slabs of 8th Floor	2.000%	38.71%
A3.19.13	Completion of Colums, Beams and slabs of 9th Floor	2.000%	40.71%
A3.19.14	Completion of Colums, Beams and slabs of 10th Floor	2.000%	42.71%
A3.19.15	Completion of Colums, Beams and slabs of 11th Floor	2.000%	44.71%
A3.19.16	Completion of Colums, Beams and slabs of 12th Floor	2.000%	46.71%
A3.19.17	Completion of Colums, Beams and slabs of 13th Floor	2.000%	48.71%
A3.19.18	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	49.21%
A3.19.19	Completion of Block works.	4.000%	53.21%
A3.19.20	Concealed plumbing works & Plaster wherever required.	2.000%	55.21%
A3.19.21	Providing and Fixing of Door frames	0.700%	55.91%
A3.19.22	Completion of Internal Flooring including skirting	2.000%	57.91%
A3.19.23	Completion of Wall Tiling.	2.000%	59.91%
A3.19.24	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	61.91%
A3.19.25	Completion of False Ceiling Works.	2.200%	64.11%
A3.19.26	Completion of SS Hand railing.	1.250%	65.36%
A3.19.27	Internal Painting	2.000%	67.36%
A3.19.28	External Plastering	2.100%	69.46%
A3.19.29	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.000%	73.46%
A3.19.30	Water Proofing.	0.500%	73.96%
A3.19.31	Plumbing & Sanitary Installations.	3.000%	76.96%
A3.19.32	Internal Electric Installations	4.000%	80.96%
A3.19.33	Electrical External Services	2.000%	82.96%
A3.19.34	Civil External Services	0.800%	83.76%
A3.19.35	Power Wiring and Plug	2.000%	85.76%
A3.19.36	Telephone Conduits	0.140%	85.90%
A3.19.37	Lighting Arrestor	0.040%	85.94%

A3.19.38	Fire Fighting Works	2.000%	87.94%
A3.19.39	Fire Alarm System Works	1.800%	89.74%
A3.19.40	CCTV SYSTEM	0.350%	90.09%
A3.19.41	ACCESS CONTROL SYSTEM	0.060%	90.15%
A3.19.42	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.150%	90.30%
A3.19.43	LAN SYSTEM	0.800%	91.10%
A3.19.44	IP BASED EPABX SYSTEM	0.800%	91.90%
A3.19.45	Lift works (supply 60% , Installation 20%, Testing and Comissioning	5.100%	97.00%
	Testing, Commissioning & Handing Over		
A3.19.46	Testing & Commissioning of Services	2.000%	99.00%
A3.19.47	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.20) Schedule of Payments for Scope of Works - Boys Hostel (pharmacy College) (B+S+13 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.20" =3.9 %** of A3			
Apportionment of Cost Centre "A3.20" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.20 as Applicable**	**Cumulative Weightage of Cost Centre A3.20 as Applicable**
	Boys hostel Dental college		
	Substructure Works		
A3.20.1	Completion of Earthwork	2.0000%	2.000%
A3.20.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	6.9600%	8.960%
A3.20.3	Completion of Retaining Wall Works (including water proofing) for basement	4.0000%	12.960%
A3.20.4	Completion of Basement Slab Works	6.0000%	18.960%
	Superstructure Works		
A3.20.5	Completion of Colums, Beams and slabs of Ground floor	1.850%	20.81%
A3.20.6	Completion of Colums, Beams and slabs of 1st Floor	1.850%	22.66%
A3.20.7	Completion of Colums, Beams and slabs of 2nd Floor	1.850%	24.51%
A3.20.8	Completion of Colums, Beams and slabs of 3rd Floor	1.850%	26.36%
A3.20.9	Completion of Colums, Beams and slabs of 4th Floor	1.850%	28.21%
A3.20.10	Completion of Colums, Beams and slabs of 5th Floor	1.850%	30.06%
A3.20.11	Completion of Colums, Beams and slabs of 6th Floor	1.850%	31.91%
A3.20.12	Completion of Colums, Beams and slabs of 7th Floor	1.850%	33.76%
A3.20.13	Completion of Colums, Beams and slabs of 8th Floor	1.850%	35.61%
A3.20.14	Completion of Colums, Beams and slabs of 9th Floor	1.850%	37.46%
A3.20.15	Completion of Colums, Beams and slabs of 10th Floor	1.850%	39.31%
A3.20.16	Completion of Colums, Beams and slabs of 11th Floor	1.850%	41.16%
A3.20.17	Completion of Colums, Beams and slabs of 12th Floor	1.850%	43.01%
A3.20.18	Completion of Colums, Beams and slabs of 13th Floor	1.850%	44.86%
A3.20.19	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	45.36%
A3.20.20	Completion of Block works.	5.000%	50.36%
A3.20.21	Concealed plumbing works & Plaster wherever required.	2.000%	52.36%
A3.20.22	Providing and Fixing of Door frames	0.750%	53.11%
A3.20.23	Completion of Internal Flooring including skirting	3.000%	56.11%
A3.20.24	Completion of Wall Tiling.	2.000%	58.11%
A3.20.25	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	60.11%
A3.20.26	Completion of False Ceiling Works.	2.200%	62.31%
A3.20.27	Completion of SS Hand railing.	1.250%	63.56%
A3.20.28	Internal Painting	2.000%	65.56%
A3.20.29	External Plastering	1.500%	67.06%
A3.20.30	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.200%	71.26%
A3.20.31	Water Proofing.	1.000%	72.26%
A3.20.32	Plumbing & Sanitary Installations.	4.000%	76.26%
A3.20.33	Internal Electric Installations	6.000%	82.26%
A3.20.34	Electrical External Services	2.200%	84.46%
A3.20.35	Civil External Services	0.800%	85.26%
A3.20.36	Power Wiring and Plug	2.300%	87.56%

A3.20.37	Telephone Conduits	0.140%	87.70%
A3.20.38	Lighting Arrestor	0.040%	87.74%
A3.20.39	Fire Fighting Works	2.000%	89.74%
A3.20.40	Fire Alarm System Works	1.600%	91.34%
A3.20.41	CCTV SYSTEM	0.350%	91.69%
A3.20.42	ACCESS CONTROL SYSTEM	0.070%	91.76%
A3.20.43	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	91.87%
A3.20.44	LAN SYSTEM	0.800%	92.67%
A3.20.45	IP BASED EPABX SYSTEM	0.730%	93.40%
A3.20.46	Lift works (supply 60% , Installation 20%, Testing and Comissioning	2.800%	96.20%
A3.20.47	VRV/ VRF AC System	0.800%	97.00%
	Testing, Commissioning & Handing Over		
A3.20.48	Testing & Commissioning of Services	2.000%	99.00%
A3.20.49	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.21) Schedule of Payments for Scope of Works - Girls Hostel (pharmacy College) (B+S+9 Upper Floors)			
Percentage Apportioned to Major Cost Centre **"A3.21" =3.0 %** of A3			
Apportionment of Cost Centre "A3.21" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A3.21 as Applicable**	**Cumulative Weightage of Cost Centre A3.21 as Applicable**
	Girls Hostel Pharmacy College		
	Substructure Works		
A3.21.1	Completion of Earthwork	2.0000%	2.000%
A3.21.2	Completion of Foundation (Complete Foundation (Raft/Pile or Combined as per Design) including Water proofing)	6.9600%	8.960%
A3.21.3	Completion of Retaining Wall Works (including water proofing) for basement	4.0000%	12.960%
A3.21.4	Completion of Basement Slab Works	6.0000%	18.960%
	Superstructure Works		
A3.21.5	Completion of Colums, Beams and slabs of Ground floor	2.590%	21.55%
A3.21.6	Completion of Colums, Beams and slabs of 1st Floor	2.590%	24.14%
A3.21.7	Completion of Colums, Beams and slabs of 2nd Floor	2.590%	26.73%
A3.21.8	Completion of Colums, Beams and slabs of 3rd Floor	2.590%	29.32%
A3.21.9	Completion of Colums, Beams and slabs of 4th Floor	2.590%	31.91%
A3.21.10	Completion of Colums, Beams and slabs of 5th Floor	2.590%	34.50%
A3.21.11	Completion of Colums, Beams and slabs of 6th Floor	2.590%	37.09%
A3.21.12	Completion of Colums, Beams and slabs of 7th Floor	2.590%	39.68%
A3.21.13	Completion of Colums, Beams and slabs of 8th Floor	2.590%	42.27%
A3.21.14	Completion of Colums, Beams and slabs of 9th Floor	2.590%	44.86%
A3.21.15	Completion of slabs of mumty , Over head water tanks, terrace works complete	0.500%	45.36%
A3.21.16	Completion of Block works.	5.000%	50.36%
A3.21.17	Concealed plumbing works & Plaster wherever required.	2.000%	52.36%
A3.21.18	Providing and Fixing of Door frames	0.750%	53.11%
A3.21.19	Completion of Internal Flooring including skirting	3.000%	56.11%
A3.21.20	Completion of Wall Tiling.	2.000%	58.11%
A3.21.21	Providing and Fixing of Aluminium windows including glazing, Door shutters	2.000%	60.11%
A3.21.22	Completion of False Ceiling Works.	2.200%	62.31%
A3.21.23	Completion of SS Hand railing.	1.250%	63.56%
A3.21.24	Internal Painting	2.000%	65.56%
A3.21.25	External Plastering	1.500%	67.06%
A3.21.26	Exterrnal Finishes including Painting, stone cladding, Terracota façade panels, structural glazing, high pressure laminates, external texture paint, coloured fins, GRC jali etc.	4.200%	71.26%
A3.21.27	Water Proofing.	1.000%	72.26%
A3.21.28	Plumbing & Sanitary Installations.	4.000%	76.26%
A3.21.29	Internal Electric Installations	6.000%	82.26%
A3.21.30	Electrical External Services	2.200%	84.46%
A3.21.31	Civil External Services	0.800%	85.26%
A3.21.32	Power Wiring and Plug	2.300%	87.56%
A3.21.33	Telephone Conduits	0.140%	87.70%
A3.21.34	Lighting Arrestor	0.040%	87.74%
A3.21.35	Fire Fighting Works	2.000%	89.74%
A3.21.36	Fire Alarm System Works	1.600%	91.34%

A3.21.37	CCTV SYSTEM	0.350%	91.69%
A3.21.38	ACCESS CONTROL SYSTEM	0.070%	91.76%
A3.21.39	LIGHTING AUTOMATION INCLUDING OCCUPANCY SENSORS	0.110%	91.87%
A3.21.40	LAN SYSTEM	0.800%	92.67%
A3.21.41	IP BASED EPABX SYSTEM	0.730%	93.40%
A3.21.42	Lift works (supply 60% , Installation 20%, Testing and Comissioning	2.800%	96.20%
A3.21.43	VRV/ VRF AC System	0.800%	97.00%
	Testing, Commissioning & Handing Over		
A3.21.44	Testing & Commissioning of Services	2.000%	99.00%
A3.20.45	Issuance of 'Taking Over Certificate' for this SOP Scope of Works	1.000%	100.00%
	Total	**100.000%**	

A3.22) Schedule of Payments for Scope of Works - External development works, Road work, Under Gound Tank (Pharmacy college) Etc

Percentage Apportioned to Major Cost Centre **"A3.22" = 1.0 %** of A3

Apportionment of Cost Centre "A3.22" for Payments according to Cost Centres

Cost Centre	Item of Works		Weightage of Cost Centre A3.22 as applicable	Cumulative Weightage of Cost Centre A3.22 as Applicable
A3.22.1	Road & Driveway Works		18.00%	18.00%
a	On completion of Base layer including Filling if any	15%		
b	On Completion of Sub Base layer	25%		
c	On Completion of Surface Layer	50%		
d	On Completion of Marking and Road Signages	10%		
A3.22.2	UG Sump Works		16.00%	34.00%
a	Excavation and Disposal	10%		
b	PCC Waterproofing & Base Slab	15%		
c	Side Walls & Waterproofing	25%		
d	Top Slab	30%		
e	All Finishes Works	18%		
f	Upon issuance of Taking over Certificate	2%		
A3.22.3	Footpath with pcc base , 60 mm thick paver Blocks and kerb stone edging		3.00%	37.00%
a	PCC Base & Base Preperation	60%		
b	Paver Block Laying	40%		
A3.22.4	External Sewerage		6.00%	43.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.22.5	Filter water supply		10.00%	53.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.22.6	Unfiltered water supply distribution lines		2.82%	55.82%

a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		
A3.22.7	Strom Water Drains on prorata rate of length executed.		15.31%	71.13%
A3.22.8	Rainwater Harvesting (RWH) System Works		4.60%	75.73%
a	Upon Completion of 50% extent of work	49.0%		
b	Upon Completion of 100% extent of work	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.22.9	RCC Trenches for services to be approved by Concerned line Department		18.64%	94.37%
a	Upon Completion of 50% extent of work including backfilling	49.0%		
b	Upon Completion of 100% extent of work including backfilling	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.22.11	Parking area development, Landscaping and its lighting and irrigation sysytem, benched, Horticulture Works as per scope of work.		4.50%	98.87%
A3.22.12	Maintenance of the Softscape during DLP on completion of 1st Year.		1.13%	100.00%
			100.000%	

A3.23)- Schedule of Payments for Scope of Works - MEP - Highside Equipment and Specialised E& M works. (Pharmacy COLLEGE)

Percentage Apportioned to Major Cost Centre **"A3.23" =1.0 %** of A3
Apportionment of Cost Centre "A3.15" for Payments according to Cost Centres

			Weightage of Cost Centre A3.23. as Applicable	**Cumulative Weightage of Cost Centre A3.23 as Applicable**
	MEP Infrastructure Works			
A3.23.1	SUB-STATION EQUIPMENTS (Transformer), HT Panel, LT Panel, Metering Panel (supply 70%, installation 30%)		33.00%	33.00%
A3.23.2	GENERATING SETS Including HSD including tank (supply 70%, Installation 30%)		20.00%	53.00%
A3.23.3	SOLAR PHOTO VOLTAIC POWER GENERATION SYSTEM		7.00%	60.00%
a	Upon Completion of 25% extent of work	24.50%		
b	Upon Completion of 50% extent of work	24.50%		
c	Upon Completion of 75% extent of work	24.50%		
d	Upon Completion of 100% extent of work	24.50%		
e	Upon issuance of Taking over Certificate	2.00%		

A3.23.4	CCTV SYSTEM External		2.50%	62.50%
A3.23.5	HYDROPNEUMATIC WATER SUPPLY SYSTEM INCLUDING ALL PUMPS		1.50%	64.00%
A3.23.6	STREET LIGHTING WITH LED		1.00%	65.00%
a	Upon Completion of 50% extent of work	49.0%		
b	Upon Completion of 100% extent of work	49.0%		
c	Upon issuance of Taking over Certificate	2.0%		
A3.23.7	STP/ETP PLANT		7.00%	72.00%
a	Supply of ETP/ STP sysytem (70% for Major Equipment Supply and 30% for Ancillary materials)	60.00%		
b	Installation	20.00%		
c	Testing & Comissioning	10.00%		
d	Upon lssuance of taklng Over certificate for this section SOP Scope of Works	10.00%		
A3.23.8	DRIVER FACE AND AUTOMATIC NUMBER PLATE RECORDING SYSTEM/RECOGNITION SYSTEM		0.31%	72.31%
A3.23.9	BOOM BARRIER		0.11%	72.42%
A3.23.10	HT (UE) cable Meter room to Substationas required including HDPE pipe, earth excavation for trench, laying of pipe in trebch, refilling of earth as per CPWD norms etc complete in all respect and providing route markers		6.64%	79.06%
A3.23.11	Additional cost of Filtration, germs irridiation, Heating and dehumidification provisions		10.00%	89.06%
A3.23.12	Heating system to cater exclusively for PHE		1.69%	90.75%
A3.23.13	Fire Sealant		1.78%	92.53%
A3.23.14	Gas Suppression System for Data Centre & Command Center (Payment at prorated basis on completion of 25%, 50%, 75% & 100%)		1.53%	94.06%
A3.23.15	Very Early Smoke Detection (Payment at prorated basis on completion of 25%, 50%, 75% & 100%)		0.70%	94.76%
A3.23.16	Water Spray System for power transformers		0.41%	95.17%
A3.23.17	Gas Suppression system for Electrical Panels		1.18%	96.35%
A3.23.18	LPG Piping for Kichen		0.71%	97.06%
A3.23.19	Copper Pipes and SS Pipes & Fittings in lieu of CPVC pipes & fittings for Hot water System		2.94%	100.00%
	Total		**100.00%**	

A4) Schedule of Payments for Scope of Works (Major Cost Centre "A4")			
Percentage Apportioned to Major Cost Centre **"A4" = 0.75%** of Accepted Contract Amount			
Apportionment of Major Cost Centre "A4" for Payments according to Cost Centres			
Cost Centre	**Item of Works**	**Weightage of Cost Centre A4 as Applicable**	**Cumulative Weightage of Cost Centre A4 as Applicable**
	Provide all Contract Scope As in Section F : SCC : Item 28 : Medical Equipments Co-ordination With Infrastructural Requirements		
A4.1	**For Clinical Facility - Critical Care**		
A4.4.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	46.75%
A4.4.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	49.00%
A4.2	**For Clinical Facility -General Medicine**		
A4.1.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	10.00%
A4.1.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	12.25%
A4.3	**For Clinical Facility- Geriatric**		
A4.3.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	59.00%
A4.3.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	61.25%
A4.4	**For Clinical Facility - Orthopedics**		
A4.2.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	22.25%
A4.2.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	24.50%
A4.5	**For Clinical Facility- Cardiology**		
A4.3.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	22.25%
A4.3.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	24.50%
A4.6	**For Clinical Facility- Neurology**		
A4.3.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	71.25%
A4.3.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	73.50%
A4.7	**For Clinical Facility- Nephrology**		
A4.3.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	71.25%
A4.3.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	73.50%
A4.8	**For Clinical Facility- Burn Care**		
A4.3.1	Upon Porated Completion of All Contract Co-ordination Works.	10.000%	34.50%
A4.3.2	Upon Completion of all Contract Scope related to this Clinical Facility	2.250%	36.75%
A4.9	**Upon Completion of all Contract Scope related to this SOP**	2.000%	51.00%
	Total	**100.00%**	

SECTION –10

DOCUMENTS TO BE FURNISHED BY BIDDER

1. Documents as specified in Section 1 must be submitted by the Bidder in the Formats mentioned in Section 2 along with the BID.

2. Any other document, if asked by the Employer for clarification during evaluation, shall be submitted by the bidder.

CHECKLIST OF DOCUMENTS TO BE SUBMITTED IN TECHNICAL BID

	Criteria	**Document to be submitted**	**Submitted (Yes/No)**
1	Bid Processing Fees	Scanned copy of DD	
2	EMD/ Bid Security -	Scanned copy of E-BG/ Insurance Surety Bond	
3	Written power of attorney of the signatory of the Bid to commit the Bidder	Copy of power of attorney	
4	Whether Indian firms (Y/N)	Certificate of Incorporation	
5	Class of Contractor – **Super Class (Government of Odisha** Registration) or equivalent of other State Governments / Government of India / MES / Railways for execution of Civil works in general and Road, Bridge &Building work in particular	Relevant Certificate	
6	Constitution or legal status of Bidder	Incorporation Certificate, Partnership Deed, Trade License, MoA, AoA	
7	Place of registration	Qualification Information	
8	Principal place of business	Qualification Information	
9	Major items of construction equipment proposed to carry out the Contract	Invoices of equipment / Lease agreement	
10	Qualifications and experience of key site management and technical personnel proposed for the Contract	Detailed CV	
11	Reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past five financial years	CA Certificate along with Audited Financial report for the relevant Financial Years	

12	Evidence of adequacy of working capital for this contract [access to line (s) of credit and availability of other financial resources]; Liquid assets and / or availability of credit facilities	Banker's certificate	
13	Authority to seek references from the Bidder's bankers	Bankers Details	
14	Information regarding any litigation or arbitration resulting from contracts executed by the bidder in the last five years or currently under execution	List of Litigation, if any	
15	Methodology & Programme.	To be submitted in Cover-III as DBR	
16	Bids from Joint venture - Bids from Joint ventures/ Consortiums /Association of Parties are not acceptable	To be mentioned	
17	Annual minimum turnover	Turnover from Civil Construction works certified by chartered accountant	
18	The Firm should demonstrate making profit	CA/ Statutory auditor certificate	
19	Should have valid PAN and GSTIN	Scan copy of valid PAN and GSTIN	
20	Experience of successful completion of works / substantial completion of works (90% of the value of the contract to be considered as substantial completion) as referred to in Bid Data Sheet Cl. 4.4.A(b).	Completion Certificate from Competent Authority mentioning all the details as per Bid Data Sheet/TDS Certificate for Pvt Sector Project	
21	Bid Validity Undertaking	Undertaking	
22	Affidavit	Affidavit by the bidder duly signed by the Notary Public and as specified in Section 2,	
23	Design Basis Report	As mentioned in the RFP	
24	Certificate of No Relationships	As per format given in Section-2 of the tender document	
25	Information Regarding Any Conflicting Activities and Declaration Thereof	As per format given in Section-2 of the tender document	
26	Proposal for Sub-Contract	To be mentioned	

APPROVED

Sd/-
Chief Engineer-II