



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. 17/Tender/OBCC/2026-27

NATIONAL COMPETITIVE BIDDING

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

**Request For Proposal
towards**

**“CONSTRUCTION OF REGIONAL SPORTS HUB AT DHAMNAGAR IN
THE DISTRICT OF BHADRAK, ODISHA ON TURNKEY BASIS”**

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

No: 5404

Date: 14/07/2026

File: OBCC-CIRIII-MISC-0095-2026

CORRIGENDUM NO. 01 to NIT

Bid Identification No.

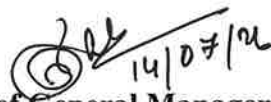
17/Tender/OBCC/2026-27

Name of the Work:

Construction of Regional Sports Hub at Dhamnagar in the District of Bhadrak, Odisha on Turnkey basis

Sl. No.	Reference	As per NIT	As modified
1.	NIT Sl. No. 01	The Bid documents will be available on the website: www.tendersodisha.gov.in from Dt. 12.06.2026 to Dt. 02.07.2026 till 05:30 PM for online bidding.	The Bid documents will be available on the website: www.tendersodisha.gov.in from Dt. 14.07.2026 to Dt. 04.08.2026 till 05:30 PM for online bidding.
2.	NIT Sl. No. 03	The pre-bid queries from the bidders shall be received through e-mail on queries@obcc.in , circle3@obcc.in on or before Dt. 16.06.2026 up to 5.00 PM	The pre-bid queries from the bidders shall be received through e-mail on queries@obcc.in , circle3@obcc.in on or before Dt. 18.07.2026 up to 11.30 AM
3.	NIT Sl. No. 04	The pre-bid meeting will be held on 17.06.2026 at 12.30 PM through video conferencing in the links https://meet.google.com/hbn-dehb-nay	The pre-bid meeting will be held on 18.07.2026 at 12.30 PM through video conferencing in the links https://meet.google.com/tpo-enwp-fts
4.	NIT Sl. No. 05	Pre-bid clarification shall be available in the e-procurement portal on Dt. 18.06.2026.	Pre-bid clarification shall be available in the e-procurement portal on Dt. 21.07.2026.
5.	NIT Sl. No. 06	Bids shall be received only on "online" on or before 05:30 PM of Dt. 02.07.2026.	Bids shall be received only on "online" on or before 05:30 PM of Dt. 04.08.2026.
6.	NIT Sl. No. 08	The technical bids received online shall be opened on Dt. 03.07.2026 at 11.30 AM in the office of the Managing Director, Odisha Bridge & Construction Corporation Ltd., Vikash Bhavan, Bhubaneswar, Odisha in the presence of 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 date of opening as specified, then the same will be opened on the next working day.	The technical bids received online shall be opened on Dt. 05.08.2026 at 11.30 AM in the office of the Managing Director, Odisha Bridge & Construction Corporation Ltd., Vikash Bhavan, Bhubaneswar, Odisha in the presence of 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 date of opening as specified, then the same will be opened on the next working day.
7.	NIT Sl. No. 09	The Design Basis Report (DBR) in Cover-III and the Original financial transaction receipts in support of Bid processing Fee and Bid Security in Cover-IV shall have to be submitted on or before 5:00 PM of 07.07.2026 in the office of EIC-cum-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 Bid processing Fee and Bid Security in Cover-IV shall have to be submitted on or before 5:00 PM of 07.08.2026 in the office of Managing Director, OB & CC Ltd failing which the bid shall not be evaluated and liable for rejection.

8. All other terms & conditions remain unchanged.


ACE (C) & Chief General Manager-III

No. ୧୩୩୭

Date: 06/06/2026

File: OBCC-CIRIII-MISC-0095-2026

NOTICE INVITING TENDER

Bid Identification: 17/Tender/OBCC/2026-27

Chief Engineer-I, Odisha Bridge & Construction Corporation Limited, Vikash Bhavan, Bhubaneswar on behalf of the Governor of Odisha, invites bids from eligible bidders for the work mentioned below.

Sl. No.	Name of the Work	Concerned Nodal Officer with Headquarters	Bid Security Fee/ EMD (In Shape of BG)	Bid Processing Fee (In Shape of Demand Draft)	Class of Contractor	Time for completion
1	2	3	4	5	6	7
1	Construction of Regional Sports Hub at Dhamnagar in the District of Bhadrak, Odisha on Turnkey basis.	ACE (C) & Chief General Manager-III, Bhubaneswar	₹ 1,05,00,000/-	₹ 1,05,000 /- (Including GST)	'Super' Class	24 (Twenty-Four) Calendar Months

- The Bid document shall be available in the website <https://tendersodisha.gov.in>, from Dt. 12.06.2026 to 5:30 PM of Dt. 02.07.2026 for online bidding.
- The bidder must possess compatible Digital Signature Certificate (DSC) of Class – II or Class-III. The online bidding procedure is indicated in the document.
- Pre-bid queries will be received up to 5.00 P.M of 16.06.2026 through email queries@obcc.in and circle3@obcc.in
- The Pre-bid meeting will be held on 17.06.2026 at 12.30 P.M through video conferencing in the following link: <https://meet.google.com/hbn-dehb-nay>
- Pre-bid clarification shall be available in the e-procurement portal on 18.06.2026.
- The bids shall be received only on “online mode” on or before 05.30 P.M. of Dt. 02.07.2026.
- The bidder must submit the Bid Security / EMD of required amount in shape of Bank Guarantee as stated in the above table at column no 4. Scanned copy of Bank Guarantee shall have to be uploaded along with the Technical Bid failing which bid shall be summarily rejected.

8. The technical bids received online shall be opened on Dt. **03.07.2026 at 11.30 AM** in the office of the Managing Director, Odisha Bridge & Construction Corporation Ltd., Vikash Bhavan, Bhubaneswar, Odisha in the presence of 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 date of opening as specified, then the same will be opened on the next working day.
9. The Design Basis Report (DBR) in Cover-III and the Original Demand Draft and Bank Guarantee in support of Bid processing Fee and Bid Security fees respectively in Cover-IV shall have to be submitted on or before **5:00 PM of 07.07.2026** in the office of Managing Director, OB & CC Ltd failing which the bid shall not be evaluated and liable for rejection.
10. Bids submitted other than e-procurement platform shall not be considered.
11. The authority reserves the right to cancel any or all bids without assigning any reason thereof.
12. Further details with any addendum, corrigendum, cancellation can be seen from the website <https://tendersodisha.gov.in>.



Chief Engineer-I

C.C to: -

- i. The PS to the Principal Secretary to Government of Odisha, Works Department, Bhubaneswar for kind information of the Principal Secretary.
- ii. The PS to the Managing Director, OB&CC Ltd for kind information of Managing Director
- iii. The Collector and District Magistrate, Bhadrak.
- iv. The Addl. Secretary to Government, Sports & Youth Service Department, Odisha, Bhubaneswar
- v. The Engineer-in-chief (Civil-cum-Roads), Nirman Soudha, Odisha, Bhubaneswar.
- vi. The Chief Engineer (DPI & Roads), Odisha/Chief Engineer (Building), Odisha/ Chief Engineer (NHs), Odisha/ Chief Manager (Technical), State e-Procurement Cell, / Chief Engineer, NIC Office, Bhubaneswar.
- vii. The Chief Engineer-I/ The Chief Engineer-II/ Chief Finance Officer, OB &CC Ltd, Bhubaneswar.
- viii. The General Manager, Infrastructure Division, OB & CC Ltd., Cuttack
- ix. M/s SM Consultants Pvt. Ltd., SM Tower, Plot No-130, Mancheswar, Rasulgarh, 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 & EXECUTION)****KEY DATES**

1.	NAME OF WORK	:	“CONSTRUCTION OF REGIONAL SPORTS HUB AT DHAMNAGAR IN THE DISTRICT OF BHADRAK, ODISHA ON TURNKEY BASIS”
2.	PERIOD OF AVAILABILITY OF BIDDING DOCUMENT	:	From 14.07.2026 to Dt.04.08.2026 upto 5.30 PM.
3.	LAST DATE OF RECEIPT OF PRE-BID QUERY	:	Dt.18.07.2026 up to 11.30 AM
4.	DATE and TIME OF PRE-BID MEETING	:	18.07.2026, 12.30 P.M via VC https://meet.google.com/tpo-enwp-fts
5.	ISSUE OF PRE-BID CLARIFICATION	:	Dt.21.07.2026
6.	LAST DATE AND TIME FOR RECEIPT OF BIDS	:	Dt.04.08.2026, 5.30 PM
7.	DATE AND TIME OF OPENING OF TECHNICAL BIDS	:	Dt.05.08.2026, 11.30 AM
8.	DATE AND TIME OF PRESENTATION	:	TO BE ANNOUNCED
9.	DATE AND TIME OF OPENING OF FINANCIAL BIDS		TO BE ANNOUNCED
10.	PLACE OF OPENING OF BIDS		Office of the Managing Director, OB & CC Ltd., Vikash Bhavan, Nayapalli, Bhubaneshwar-751012.
11.	OFFICER INVITING BIDS		Chief Engineer-I, 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, tenderer, 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 District Mineral Foundation Fund, Keonjhar, 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 Road, Bridge & Building work 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 programme 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 If the Employer has not undertaken prequalification of potential bidders, 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 construction works during last five financial years ending 31.03.2024.[As mentioned in Bid Data Sheet at the end of Section-1]
 - (c) Experience in similar works [As mentioned in Bid Data Sheet at the end of Section-1] and size for each of the last five financial years preceding the NIT, 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, arbitration, debarment, termination, notice for recession of contract, abandonment of work, etc. resulting from contracts executed or under execution by the bidder within the last five years of bid submission due date of this tender. The information shall include the name of the employer with contact details, description of work, agreement no., status and matter of dispute and/or issues, contact details of employer;
- (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]
- (l) Deleted
- (m) Deleted
- (n) Deleted
- (o) Deleted

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 turnover¹ from civil construction works 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 sector projects, completion certificate with TDS shall be submitted.

¹ Financial turnover from construction works 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 up to the year of bid invitation.

(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

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 of Section-1].	Requirement ² [As mentioned in Bid Data Sheet at the end of 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 fund based credit facilities/ overdraft 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.

4.5 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:

$$\text{Assessed Available Bid Capacity} = (A \times N \times 2) - B$$

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

² Based on the preliminary studies carried out by the department, an indicative list of major equipment and their quantity to attain the completion of works are shown in the Bid Data Sheet.

B = Value (updated to the price level on the financial year in which bids are received) of existing commitments and on-going works³ to be completed during the next[As mentioned in Bid Data Sheet at the end of Section-1]

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

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

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

(c) 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:

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

6. Cost of Bidding:

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:

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 storage of 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 within 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

³ The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the Engineer-in - charge, not below the rank of an Executive Engineer or equivalent or certified by registered Chartered Accountant.

- (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 of 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	
9	Payment Schedule	
10	Documents to be furnished by bidder	V

- 8.2. The Bidder shall download the above listed documents and shall submit his bid 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. Copies of the Employer's response will be posted in e-procurement portal, including a description of the enquiry but without identifying its source.
- 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 posted in e-procurement portal.
- 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 shall 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 in official website [As mentioned in Bid Data Sheet at the end of Section-1].

C. PREPARATION OF BIDS

11. Language of the Bid:

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 only*): -

- (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 in 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. DBR to be given weightage in 15 marks in Technical Evaluation.

Cover-IV (both in 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 Price Bid submitted by the Bidder.

- 13.2 The bidder shall fill the total bid price as **Lump Sum Price** (both in figures and words) for execution of work on Lumpsum / Turnkey basis including all items of works as specified in the Bid document.
- 13.3 The prices tendered shall except 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 except GST & 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:

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 in online mode/ in the form of Bank Guarantee as per the format provided in Section-6: Securities and other Forms.
- 16.2 Any bid not accompanied by an acceptable Bid Security and not secured as indicated in sub-clauses 16.1 shall be rejected by the Employer as non-responsive.
- 16.2 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 Super Class contractor with Government of Odisha within 15 (fifteen) days of issue of Letter of Acceptance of Bid.

17. Alternative Proposals by Bidders:

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 MoRT&H, IRC, IS Codes & NBC.

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

18. Format and Signing of Bid: Refer e-Procurement procedure as 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. Employer will not be responsible for non-submission of bids due to technical glitch (like slow net speed, crash of portal) in e-procurement portal.
- 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. Refer e-Procurement procedure as annexed
- 23.2 The Employer shall prepare minutes of the Bid opening.

24. Process to be Confidential:

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:

- 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 Bid 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 tender document. 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 (LoA)**") 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 detail work programme 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 programme / 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 award along with the Letter of Acceptance
- 31.4 Upon the 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 shall constitute sufficient grounds for cancellation of the award and suitable action under provision of Bid Security or suspension from further bidding for a period of three years from bid due date.

- 33. Advance Payment and Security** - 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 (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 any time 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.

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 relevant information 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 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 bidder can participated in the online bidding process.

Contractor not registered with Government of Odisha, can participate in the e-procurement after necessary enrolment 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.

- 1.1 To log on to the portal the Contractor/Bidder is required to type his/her username and password. 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.
- 1.2 The tender documents uploaded by the Tender Inviting Officer in the website <https://tendersodisha.gov.in> will appear on 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.
- 1.3 Contractor exempted from payment of EMD will be able to participate in the tender directly by uploading documentary evidences towards his eligibility for such exemption.
- 1.4 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.
- 1.5 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. It is mandatory that the DSC issued in the name of the authorized signatory is used in the portal.
- 1.6 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 breakdowns other than in those systems strictly within their own control.
- 1.7 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.

- 1.8 For submission of Bids through the E-Procurement Portal, the bidder shall up load the scanned copy/copies of document in prescribed format wherever warranted in support of eligibility criteria and qualification information. The on-line 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.
- 1.9 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.
- 1.10 The bidder may ask question 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 in tender call notice/Bid. The Officer inviting the Bid/ Procurement Officer-Publisher will clarify queries related to the tender.
- 1.11 The details of drawings and documents pertaining to the works available with the officer inviting the Bid as well as in the office of the Superintending Engineer and Executive Engineer as mentioned in the Contract Data will be open for inspection by the bidders. The bidder is required to down load 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 up load 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 for not 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 shall be forfeited.
- 1.12 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.
- 1.13 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 check 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 up load 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 down loaded for the work in designated Cell and up loads the same in designated locations of Financial 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 document 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 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 The EMD or Bid Security payable along with the bid as mentioned in the bid document.

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 as 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 Contractor 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 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 up load the completed Bid document well 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 store in 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 in to the portal for any bid and the time of entering in to the portal.

3.5 The Bidder should ensure clarity of the document up loaded 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, 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 is valid 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 rates in figure only in the rate column of respective items(s) without any blank cell in the rate column in case of item rate tender and type percentage excess or less up to two decimal places 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 up loading 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 summary of submission to confirm successful uploading of 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 statement's 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 / opened by 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 opener's 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 on-line bidding can witness opening of the bid from any 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 time is 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 alters the 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 up 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 finalized 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 authorised 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 up load the summery and declare the process as complete.
- 13.4 If the L1 bidder does not turn up for agreement after finalisation of the tender then he shall be debarred from participation in bidding for three years and action will be taken to blacklist the contractor. 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 recommend 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.

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	Maximum Marks	Evaluation
(a)	Financial strength (i) Minimum annual financial Construction Turnover 4.4 A (a) of the BID DATA SHEET	20 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 works Refer clause 4.4 A.(b) of the BID DATA SHEET	20 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: 5 Marks Specification of Works: 3 Marks Work Programme: 3 Marks Approach & Methodology: 4 Marks
(d)	Personnel and Establishment⁴ Refer 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 of adequate technical staff to execute the works is to be assessed by the bidder and deployed as per requirement. (Total marks to be prorated to 20 marks from 100 marks below)

Sl. No	Attributes	Maximum Marks	Evaluation
i	Project Manager– 1 No	4	Qualification: Min. Graduation in Civil Engineering – 2 Marks Experience in Similar Project Construction / Supervision 5-10 years– 1 Mark More than 10 years - 2 Mark
ii	Site Engineer – 2 Nos	4 (2 Each)	Qualification: Min. Graduation in Civil Engineering – 1 Mark Experience in Similar Project Construction / Supervision 3 - 5 years– 0.5 Marks More than 5 years - 1 Marks
iii	Architect – 1 No	2	Qualification Graduation in Architecture: 1 Mark Experience in Architectural Design: 3-5 Yrs. – 0.5 Mark More than 5 years - 1 Mark
iv	Agronomist / Horticulturist – 1 No	2	Qualification Diploma / Graduation in Horticulture: 1Mark Experience in Landscaping: 2- 3 Yrs. – 0.5 Mark More than 3 Yrs – 1 Mark
v	Surveyor - 1 No.	2	Qualification Min. Diploma/ Graduation in Civil Engineering: 1 Mark Experience in similar nature of works 3 - 5 years– 0.5 Mark More than 5 years - 1 Mark
vi	Quality Control Engineer - 1 No	2	Qualification Min. Diploma/ Graduation in Civil Engineering: 1 Mark Experience in similar nature of works 3 - 5 years– 0.5 Mark More than 5 years - 1 Mark
vii	Quantity Surveyor - 1 No.	2	Qualification Min. Diploma/Graduation in Civil Engineering: 1 Marks Experience in similar nature of works 3 - 5 years– 0.5 Mark More than 5 years - 1 Mark
viii	Electrical Engineer – 1 No	2	Qualification Diploma in Electrical Engineering – 0.5 Mark Graduation in Electrical Engineering – 1 Mark Experience in Electrical Design / Supervision works : 3-5 Yrs.– 0.5 Mark More than 5 Yrs – 1 Mark

Notes: - *The Key Personnels mentioned above in Personnel and Establishment head are minimum requirements for obtaining the marks for evaluation, however more nos. of key personnels may be engaged as per requirement for execution of the projects.*

Sl. No	Attributes	Maximum Marks	Evaluation
(e)	Plant & Equipment⁵ Refer clause 4.4 B (a) of ITB	(20 Marks)	
1.	Batch Mix Plant (30 Cum/Hr) – 1 No.	3 Marks	
2.	Water Tanker 10 KL – 2 Nos.	2 Marks	
3.	Vibratory Roller 8-10 ton capacity-2 No	2 Marks (1 mark each)	
4.	Excavator – 2 No	2 Marks (1 mark each)	
5.	Steel Centering & shuttering- 1500 Sqm	Minimum 1000-1500 Sqm – 1 Mark More than 1500 Sqm – 2 Marks	
6.	Transit Mixer 4.5cum – 4 Nos.	Minimum 2 nos – 2 Marks 4 nos or More. – 4 Marks	
7.	Tipper- 25 T capacity – 2 Nos	2 Marks (1 mark each)	
8.	D.G Set 125 KVA -2Nos	2 Marks (1 mark each)	
9.	Piling Rig with Bentonite Pump – 1 No	1 Mark	
	Total	20 Marks	

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

⁵ The item & quantity of plant & machinery indicated above is minimum. However, 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	25
b	Experience in Similar Nature of work during last 5 years	20
c	DBR	15
d	Personnel and Establishment	20
e	Plant & Equipment	20
	Total Marks	100

- 1.2.1** The bidders who qualify as per Clause 1 above, securing minimum 60% marks in each category 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), 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)

Presentation will be inclusive of Questions and Answer session. The bidder will be required to give presentations on similar nature of works completed by the Agency, capacity building and success stories with respect to technology and timely completion.

Sl.No	Parameters	Maximum Marks
1	Planning: Overall Planning should take into consideration the Following a. Bidder's understanding of the Concept plan apart from the DBR provided in the RFP. b. Innovation in Preliminary detailing of the entire project and site plan c. Use of new Technology d. Use of different types of material	40
2	Approach & Methodology for timely completion of the project and to overcome challenges, if any	30
3	Past Experience & Success Stories	30
	Total marks	100

- 1.3.1 The Bidder shall score minimum 70% marks in each category of the above table and 80% in total to qualify for financial proposal opening.
- 1.3.2 Evaluation of the bid will be based on 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.

DESIGN BASIS REPORT (DBR)

The Bidder shall furnish the Design Basis Report (DBR) in Cover-III for the 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 engineerings and landscaping aspects. The individual report shall contain, but not limited to, the following:

Drawings:

- i. Site plan and layout drawings.
- ii. Rendered 3D images of the Area exterior, Landscape, Roads, Pavement.
- iii. Sections & Elevation of the building, master plan with key elements and levels.

Design Approach:

- i. Area Statement with detail break-up of site as well as building.
- ii. Design considerations vis-à-vis +Statutory Compliances.
- iii. Material details and makes proposed for different architectural, structural and non-structural members, electrical, ELV items, PHE, and all other systems.
- iv. Assumptions and Exclusions.
- v. Circulation of pedestrian and vehicular traffic.

Work Programme:

- iv. Detailed construction planning.
- v. Technology proposed e.g., Primavera / MS Projects for monitoring construction.
- vi. Equipment planning.

Quality Plan:

- i. Quality management mechanism proposed to be adopted.
- ii. Methodology of execution of the project.
- iii. Process control mechanisms.

BID DATA SHEET

Clause No.	Item	Description / Clarification
A. GENERAL INSTRUCTIONS		
1.1	Employer	The Managing Director, Odisha Bridge & Construction Corporation Ltd, State of Odisha Address: Vikash Bhawan, Nayapalli, Bhubaneswar-751012 Phone No. 0674-239-4093/6309/0043 Fax: 0674-2396326 Email: md@obcc.in Official website: https://tendersodisha.gov.in
1.1	Scope of Bid	“Construction of Regional Sports Hub at Dhamnagar in the District of Bhadrak, Odisha on Turnkey basis.”
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 <i>[It is meant for the Indian Firm having reputation in the specific area of operation for which tender is being invited]</i> 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 & Building 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 Construction Turnover from Civil Construction 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 (<i>90% of the value of the contract to be considered as substantial completion</i>) as referred in Bid Data Sheet Cl. 4.4.A(b) <i>Similar Work means the bidder must have experience in execution of Infrastructure Project in India during last Five Years</i> The bidder must furnish the list of such works in the proforma stated in Cl. 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. 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 in Cl.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 Construction Turnover	i. Shall have an annual minimum turnover of Rs 94.00 Crores in <i>Civil Construction works</i> certified by chartered accountant during any year in the last five financial years ending 31.03.2026. {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.⁴ ii. The Firm should demonstrate making profit during any three financial years, in the last five financial years ending on 31.03.2026. iii. Should have valid PAN and GSTIN

⁴ Bid invitation year 2026-27, Updation Factors:

<u>Year Before</u>	<u>Updation factor</u>
One	1.10
Two	1.21
Three	1.33
Four	1.46
Five	1.61

4.4. A (b)	Experience in similar project* works	Experience of successful completion of Work: (a) Satisfying any one of the following criteria for <i>Similar Works</i>⁵ during last 5 years prior to the bid invitation date. 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 up to the year of bid invitation.⁶ One Similar Work of minimum ₹ 75.00 Crores; or Two Similar Works of minimum ₹ 47.00 Crores each; or Three Similar Works of minimum ₹ 38.00 Crores each Special Conditions: 1. The bidder should have supplied and installed himself or entered MOU (in the appended format) with an agency having experience of executing at least 3 World Athletics (Earlier IAAF) Certified Synthetic Athletic Track cast in-situ Full PUR System in India with the same / equivalent proposed product/brand including complete subbase during the last 5 years in their individual capacity and not as a Joint Venture. 2. The proposed product should be certified by World Athletics (Earlier IAAF) for a minimum thickness of 15MM. Necessary World Athletics approval certificate to be enclosed. 3. The proposed product/brand should be of European/American/Australian/ Indian Origin only. 4. At least one competition (that is approved by Athletics Federation of India) should have been held on the Athletic Track installed by the Bidder. 5. The bidder should never ever have been blacklisted / debarred by any Central / State / Semi Government Authority or Sports Authority of India or Quasi Government / PSUs. 6. Joint ventures are not acceptable. A. <u>Selection of Expert for Synthetic Athletic Track</u> If the bidder does not meet the specific conditions and experience for the specialised scope of work with respect to construction of sports infrastructure (like synthetic athletic track, etc.) then the bidder is required to submit a binding MOU (as per the format shared in

⁵ *Similar Work means the bidder must have experience in execution of Infrastructure Project in India during last Five Year*

⁶ Bid invitation year 2026 -27, Updation Factors:

<u>Year Before</u>	<u>Updation factor</u>
One	1.10
Two	1.21
Three	1.33
Four	1.46
Five	1.61

Annexure - A) with a firm that has authorization from OEM to supply the required product and the experience credentials (as stated above) to comply with the entire requirement of this scope. Such a firm should comprehensively meet all the requirements/qualification conditions (stated above) for the respective scope independently and not as a JV. In the event the bidder is allotted the work, the construction of the sports surfaces needs to be done by this firm with whom he has made the binding MOU for execution of that particular work and has submitted along with his bid documents. This MOU with the firm shall be non-transferable, and any substitution shall be with prior approval of the employer.

Bidder should have supplied/ installed himself or entered MOU with an agency having experience in World Athletics/IAAF Certified 3 Full PUR/ Sandwich track with the same brand WA class-2 certificate as an OEM/ prime contractor.

B. Selection of FOP expert for natural Grass Football (FOP)

The bidder or its appointed firm through MOU should have successfully completed natural grass sports field in India in last 7 years having sub-surface drainage system (USGA Method) adhering to the standard specific sports concerned completion certificate is to be provided by the client in the name of the bidder or firm appointed through MOU.

If the bidder does not meet the specific conditions and experience for the specialised scope of work with respect to construction of Natural Grass Football FOP then the bidder is required to submit a binding MOU (as per the format shared in Annexure- B) with a firm that has the experience credentials (as stated above) to comply with the entire requirement of this scope. Such a firm should comprehensively meet all the requirements/qualification conditions (stated above) for the respective scope independently and not as a JV. In the event the bidder is allotted the work, the construction of the sports surfaces needs to be done by this firm with whom he has made the MOU for execution of that particular work and has submitted along with his bid documents. This MOU with the firm shall be non-transferable, and any substitution shall be with prior approval of the employer.

C. Selection of FOP expert of Cricket Field

The bidder or its appointed firm through MOU should have supplied and installed USGA method (Sub-Surface drainage system) of construction of cricket field FOP in India in last 7 years.

The bidder or its appointed firm must furnish the successful completion certificate issued by authorised representatives of client for above work. The bidder has to furnish the agreement/work order copy in support of proof of execution with USGA method of Construction. Also the bidder has to furnish the name, designation, contact or mobile number and email address of above certificate issuing authority.

If the bidder does not meet the specific conditions and experience for the specialised scope of work with respect to construction of Cricket FOP then the bidder is required to submit MOU (as per the format shared as Annexure C) with a firm that the experience credentials (as stated above) to comply with the entire requirement of this scope. Such a firm should comprehensively meet all the requirements/qualification

		conditions (stated above) for the respective scope independently and not as a JV. In the event the bidder is allotted the work, the construction of the sports surfaces needs to be done by the firm with whom he has made the MOU for execution of that particular work and has submitted along with his bid documents. This MOU with the firm shall be non-transferable, and any substitution shall be with prior approval of the employer. <i>Please note that: -</i> (i) <i>Please note that these Special Conditions of Contract are to be treated as Eligibility Criteria as defined in Clause 3.1 of Bid Data Sheet.</i> (ii) <i>Experience of holding companies, associate companies, subsidiaries, and sister concerns shall not be considered for evaluation.</i> (iii) <i>All work orders / completion certificates submitted should be in the name of the Applicant.</i> (iv) <i>For private sector projects, completion certificate with TDS shall be submitted.</i> (v) <i>Work experiences as a Subcontractor / nominated subcontractor shall not be considered as Experiences of Similar Projects</i>										
4.4. A (c)	Minimum Quantities	Not applicable										
4.4 A (d)	Construction, Planning and Methodology	Bidder shall provide these details in the Cover - III as mentioned in Cl.12.1 of this Section-I.										
4.4B. (a)	Equipment	<table><tr><td>Batch Mix Plant (30 Cum/Hr) – 1 No.</td></tr><tr><td>Water Tanker 10 KL – 2 Nos.</td></tr><tr><td>Vibratory Roller 8-10 ton capacity-2 No</td></tr><tr><td>Excavator – 2 No</td></tr><tr><td>Steel Centering & shuttering- 1500 Sqm</td></tr><tr><td>Transit Mixer 4.5cum – 4 Nos.</td></tr><tr><td>Tipper- 25 T capacity – 2 Nos</td></tr><tr><td>D.G Set 125 KVA -2Nos</td></tr><tr><td>Piling Rig with Bentonite Pump – 1 No</td></tr><tr><td>Batch Mix Plant (30 Cum/Hr) – 1 No.</td></tr></table>	Batch Mix Plant (30 Cum/Hr) – 1 No.	Water Tanker 10 KL – 2 Nos.	Vibratory Roller 8-10 ton capacity-2 No	Excavator – 2 No	Steel Centering & shuttering- 1500 Sqm	Transit Mixer 4.5cum – 4 Nos.	Tipper- 25 T capacity – 2 Nos	D.G Set 125 KVA -2Nos	Piling Rig with Bentonite Pump – 1 No	Batch Mix Plant (30 Cum/Hr) – 1 No.
Batch Mix Plant (30 Cum/Hr) – 1 No.												
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Excavator – 2 No												
Steel Centering & shuttering- 1500 Sqm												
Transit Mixer 4.5cum – 4 Nos.												
Tipper- 25 T capacity – 2 Nos												
D.G Set 125 KVA -2Nos												
Piling Rig with Bentonite Pump – 1 No												
Batch Mix Plant (30 Cum/Hr) – 1 No.												

4.4. B. (a)	Non-Availability of Equipment	In case of non-availability of any of the plants and equipment the bidders should submit a lease letter/commitment letter/ agreement (notarized) from the rightful owner.
4.4. B. (c)	Liquid Assets	Liquid assets or availability of fund based credit facilities/ over draft facility of not less than the amount of Rs. 12.00 crores .
4.5	Sub-contractors' experience and resources:	Please replace the existing paragraph 4.5 as below: Sub-contractors' experience and resources shall not be considered in determining the bidder's compliance with the qualifying criteria.
4.6	Bid Invitation Year	2026-27
4.6	Period of Project	24 Months [N = 2 Years]
B. BIDDING DOCUMENTS		
9.2	Pre-Bid Meeting	Pre-bid meeting shall be held on 18.07.2026 at 12.30 P.M through video conference mode. Via link https://meet.google.com/tpo-enwp-fts . The bidder shall make the queries through email on or before 18.07.2026 by 11:30 A.M. 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/ corrigendum shall also 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 bidder shall also submit online and offline the soft copies (pdf format) of 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 <u>Design Basis Report (DBR) in Cover-III</u> , as per the details provided at Annexure III to ITB, at the end of this Section-I. <u>The Bidder shall furnish the following documents in Cover-IV:</u>

		i. Bid Security Fee remitted through Bank Guarantee. ii. Non-refundable Bid Processing Fee remitted through Demand Draft
13.2	Bid Price	Replace the contents of the Clause with the following. <i>The bidder shall fill the total bid price in figures online as Lump Sum Price.</i> The total bid price shall be excluding GST on Works Contract. GST on Works 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
16.1	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 Rs.1,05,00,000/- (Rupees One Crore Five Lakh) only for this particular work in shape of irrevocable Bank Guarantee from any Nationalized Bank/ Schedule Bank having Branch at Bhubaneswar.. <u>Bid Processing Fee:</u> The Bidder shall furnish a non-refundable Bid Processing Fee amounting to ₹ 1,05,000/- (amount inclusive of GST in shape of Demand Draft in favour of the Managing Director, OB & CC Ltd, as per e-procurement portal of Govt. of Odisha)
18	Format and Signing of Bid	Deleted as submission of bids is through online using DSC
D. SUBMISSION OF BIDS		
19	Sealing and Marking 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 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. Time and date of online submission is on or before 5:30 PM on 04.08.2026. For Cover-III &IV (hard copy), time and date of offline submission is on or before 5:00 PM of 07.08.2026 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. <i>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.</i>
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 05.08.2026 at 11.30 AM.
26.1 (b)	Bid Security and Bid Processing Fee	Read the Sub-Clause as: (b) Is accompanied by the required bid processing fee & Bid Security Fee / EMD;
26.1 (c)	Substantial Responsiveness (Technical Evaluation)	Read the Sub-Clause as: (c) 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 -I and II, the information provided in online mode shall prevail and the bidder's qualification shall be evaluated accordingly.
26.1 (e)	Financial Evaluation (Negotiation)	Read the Sub-Clause as: (e) 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.
F. AWARD OF CONTRACT		
31.3	Notification of Award & Signing of	The following is added below the paragraph:

	Agreement	The Bidder shall submit a detail resource-based work program using standard software (Primavera/MS Projects) 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 Mile Stones mentioned in Cl. 45.1 of Contract Data.																				
32.1	Performance Security	The Bidder shall furnish, Performance Security for this particular work in the form of e-Bank Guarantee from any Public Sector/ Private Sector Banks listed below, Payable by its Branch at Bhubaneswar in favour of the EIC cum Managing Director, OB & CC Ltd, Payable at Bhubaneswar. Being a Turn-Key Assignment, no additional Performance Security shall be required to be deposited by the selected bidder. List of Banks approved by finance Department, Government of Odisha vide Letter No.26061 dated.19.10.2022 List of Banks <table><tr><td><u>Public Sector Banks</u></td><td><u>Private Sector Banks</u></td></tr><tr><td>1. Canara Bank,</td><td>10.ICICI Bank</td></tr><tr><td>2.Punjab National Bank,</td><td>11. Axis Bank Ltd</td></tr><tr><td>3. State Bank India,</td><td>12. HDFC Bank</td></tr><tr><td>4. Union Bank of India,</td><td>13. Bandhan Bank</td></tr><tr><td>5.Bank of India,</td><td><u>RRBs and OSCB</u></td></tr><tr><td>6. Bank of Baroda,</td><td>14.Utkal Grameen Bank</td></tr><tr><td>7. UCO Bank</td><td>15.Odisha Gramya Bank</td></tr><tr><td>8.Indian Bank</td><td>16.Odisha State Co-operative Bank.</td></tr><tr><td>9.Indian Overseas Bank</td><td></td></tr></table>	<u>Public Sector Banks</u>	<u>Private Sector Banks</u>	1. Canara Bank,	10.ICICI Bank	2.Punjab National Bank,	11. Axis Bank Ltd	3. State Bank India,	12. HDFC Bank	4. Union Bank of India,	13. Bandhan Bank	5.Bank of India,	<u>RRBs and OSCB</u>	6. Bank of Baroda,	14.Utkal Grameen Bank	7. UCO Bank	15.Odisha Gramya Bank	8.Indian Bank	16.Odisha State Co-operative Bank.	9.Indian Overseas Bank	
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9.Indian Overseas Bank																						
33	Advance Payment and Security	The paragraph is replaced 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 (hundred ten) % the advance payment. The advance shall carry 10% (Ten) interest.																				

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**

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: “ Construction of Regional Sports Hub at Dhamnagar in the District of Bhadrak, Odisha on Turnkey Basis”

To:

The Chief Engineer- I

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 (From whom to be purchased)
	No.	Nos./Capacity	Owned/Leased		

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.

experience in Position proposed position.	Name	Years of Qualifications	Years of experience	the
		(From DD-MM-YY to DD-MM-YY)		
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 modified¹ in accordance with the Instructions to Bidders¹ 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]

To

_____ (date)

_____ (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 _____ 2026 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

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 policies 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 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 repaid 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 Employer 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 per 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 directed 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	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 a) 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, and

Clause Reference	Conditions	Data
		b) shall also be responsible for the design or specification of the Permanent Works. IV. 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. V. 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 other 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. VI. 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 under sub-paragraph (c). VII. 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. 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 Taking-Over Certificate is issued for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer. 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 Taking-Over

Clause Reference	Conditions	Data
		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 be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.
1.1.11	Defects Liability Period	1. Civil Works: The Defects Liability Period is 05 (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.

Clause Reference	Conditions	Data
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, Infrastructure Division, Cuttack 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	24 (Twenty-Four) Calendar months from the date of commencement
1.1.19	Site	The Site is located in District-Bhadrak, 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: Government of Odisha has decided to Construct Regional Sports Hub at Dhamnagar in the District of Bhadrak, Odisha. The work 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 provided in Section-8, Concept 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.

Clause Reference	Conditions	Data
2.2	Sectional Completion	N/A.
2.3	Order of priority	(a) Agreement (b) Letter of Acceptance, notice to proceed with the work. (c) Contractor's Bid (d) Contract Data (e) Conditions of Contract including Special Conditions of Contract (f) Terms of Reference, Design Brief & Scope of Work (Section 8 of Bid Document) (g) Specifications (h) Drawings (i) Bill of quantities (optional) and (j) Any other document listed in the Contract Data as forming part of the Contract
3	Language & Law	The language of the Contract documents is English. The law, which applies to the Contract, is the laws of Union of India.
7	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. <i>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.</i>
13.1 & 13.2	Insurance	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).
14	Site Investigation Reports	All reports are indicative and not exhaustive.
18.4	Stipulated Datelines for Approvals	As mentioned in Section 8

21	Possession of the Site	The Site Possession Date shall be as following: 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
Clause Reference	Conditions	Data
		settled amicably, both the parties will take the shelter of court of law at Bhubaneswar.
27.1	Programme	The Contractor shall submit a detail resource-based work program using standard software (Primavera/MS Projects) 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.
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	Change of scope proposal submitted by the Contractor shall be determined by the Engineer as below. a. Change of scope up to Five (5) percent of the Original Contract Price (both +ve / -ve COS), the Contractor/Agency have to execute the same without any excuse under all circumstances, failing which the Employer will proceed with the COS work at the risk and cost of the Contractor. b. Payment procedure of Change of Scope shall be as follows: i. In case of Positive change of scope (+ve COS) for tendered items, payment will be made as a deviation of the tendered quantity at the approved tender rate/ percentage (%) on pro-rata basis. ii. In case of Positive change of scope (+ve COS) for the items not mentioned in the schedule of payments and subsequent Payment schedule breakdowns requiring determination, change of scope will be evaluated as mentioned below: • For works where Schedule of Rates (SOR) of State's Public Works Department are available the same shall be

		applicable for determination of costs. • 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. • For item of works, rates of which could not be derived based on MORTH's Standard Data Book, CPWD Analysis shall be adopted. • For item of works, rates of which could not be derived based on CPWD Analysis, the prevailing market rates shall be worked out. The rates so arrived shall be approved by the Engineer which is binding on the Contractor. • Any change in scope shall be calculated on the basis of the following priority: i. Odisha State CSR ii. CPWD rate iii. MoRTH rate iv. Delhi Schedule Rate v. Lowest Market rate to be approved by a committee c. For all negative change of scope (-ve COS) deduction shall be made as per Contract approved rate/ percentage (%) on pro-rata basis mentioned in the schedule of payments, Section-9. For partial withdrawal of any work not expressly mentioned in schedule of payments, Section-9 and subsequent Payment schedule breakdowns, procedure defined in 37.5(b) (ii) will be followed in determination of negative change of scope (-ve COS). d. Change of Scope (both +ve / -ve COS) beyond Five (5) percent of the Original Contract Price, shall be done on mutual consent looking into the broader objective of comprehensive & holistic development of the Project. The final power of deviation lies with the Board of Directors of OB&CC.
37.6	Change of Scope	The total value of all change of scope of work shall not exceed 5 % of total contract price for the construction work.

39.2	Payment Certificates	Clause 39.2 of Section 3 is replaced as below: The Engineer shall check the Contractor's statement within 07 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).
40	Payments	Employer shall pay the Contractor within 07 days of certification of the Engineer as per Cl. 39.
42	Tax	The rates quoted by the Contractor shall be deemed to be inclusive the Royalty, Income Tax, Labour CESS. Additional Charges along with EMF & DMF on minor minerals as per letter no. RDM-MMS-MEET-0009- 2022, 38234 dtd. 10.11.2022 of Revenue & Disaster Management Department, Govt 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
Clause Reference	Conditions	Data
		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. <u>Design Milestone-I</u> All design activities as per the Scope of Project shall be completed within 120 days from the Notice to Proceed. <u>Construction Milestone</u> 1. Project Milestone-I Project Milestone-I shall occur on the date falling on the [35% 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 20% (twenty per cent) of the Contract Price. 2. Project Milestone-II Project Milestone-II shall occur on the date falling on the [70% 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 60% (Sixty per cent) of the Contract Price. 3. Project Milestone-III Project Milestone-II shall occur on the date falling on the [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.
Clause Reference	Conditions	Data
		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. Upon occurrence of a Contractor's Default / Poor Performance, the Employer shall, without prejudice to its other rights and remedies hereunder or in law, be entitled to encash and appropriate the relevant amounts from the Performance Security as Damages for such Contractor's Default / Poor Performance. Upon such encashment and appropriation from the Performance Security, the Contractor shall, within 30 (thirty) days thereof, replenish the Performance Security to its original level.
53 & 53.1	Operating and Maintenance Manual	As built drawings duly approved by the Engineer, Maintenance Manual (during maintenance period), 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. <i>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.</i>

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 work is 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

Clause 5.1 The Technical specifications contained herein shall be read in conjunction with other documents of bid.

Clause 5.2 The technical specification in accordance with which the entire work described therein after shall be carried out and completed by the Contractor, shall comprise the following:

PART I: GENERAL TECHNICAL SPECIFICATIONS.

PART II: SUPPLEMENTARY TECHNICAL SPECIFICATIONS.

Clause 5.2.1 **PART I: GENERAL TECHNICAL SPECIFICATIONS**

Exposure condition, wind speed and seismic zone are to be considered based on relevant IS Code. Flood and rainfall intensity are to be considered based on meteorological data and flood data and hydraulic data during design and execution of the work. The type of soil belongs mostly to sandy and loamy groups with varying ground water table that may require dewatering.

Other provisions, stipulations, guidelines and rules laid down in the National Building Code, 2016 and relevant IRC code shall be adopted for all structural, functional, legal, regulatory, obligatory, safety requirements for the buildings and the building services including plumbing and solid waste management with a view to deliver an integrated facility for the intended purpose. In NBC whenever “recommended” word is used, it is to be treated as a “mandatory” provision.

The following specifications shall be followed in this project.

- (i) OPWD/CPWD Specifications (Civil).
- (ii) CPWD Specifications for Electrical Works (Internal & External) & D.G. Sets.
- (iii) OPWD Specification for water supply, Sanitary Installation inclusive of drainage system as per relevant IS Codes, NBC & manuals.
- (iv) CPWD Specifications for Horticulture & Landscaping.
- (v) All relevant IS Codes for materials, testing and relevant BIS Codes of practices (IS 456: 2000, IS 800: 2007 and such other codes of practices) and other relevant IRC codes.
- (vi) IRC code.

Clause 5.2.2. **PART II SUPPLEMENTARY TECHNICAL SPECIFICATIONS.**

Any other provisions/ material / testing suggested by the bidder (or Contractor) for the building/ building services not covered under Clause 5.2.1 above, shall be governed by the relevant Technical Specification prevalent as good practice in the industry and shall be adopted after approval by the Engineer.

In case of any dispute arising out of the interpretations of the above, the decision of the Engineer shall be final and binding on the Contractor.

Clause 5.2.3 When an Amended/ Modified/ added Clause supersedes a Clause or part thereof in the said specifications, then any reference to the superseded Clause shall be deemed to refer to the Amended/Modified/ Added Clause shall always prevail.

DETAILED TECHNICAL SPECIFICATIONS

The works shall be performed conforming to the Indian Standard codes, specifications as per P.W.D, PHED, OERC, NBC, etc. as applicable. Wherever such specifications are not available, CPWD specifications, relevant references, manuals etc. shall be followed as directed by Employer.

5.1. OUTLINE SPECIFICATIONS - ARCHITECTURE

5.1.1. General Specifications

5.1.1.1. Architecture and Finishes

- (a) All works and finishing will be in accordance with the latest CPWD specifications and General Pool Residential Accommodation (GPRA) norms. All details and requirements contained in annexures and schedules are in variation to these specifications. All deviations from CPWD specifications are listed below and detailed technical specifications have been provided for the same in Sections below.
- (b) 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) 2016 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 such damage, 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 to remain 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.

5.1.1.2. 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.
- (b) 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 to the required scale and fully coordinated with all relevant disciplines. Whenever required the contractor shall arrange with meeting of his design team/engineers and designers on the drawings/ design documents submitted for design approval at engineer's designers place at his own cost.
- (c) Shop drawings shall be prepared by the contractor at least for the following works unless specified otherwise: -
 - (i) Structural steel works
 - (ii) UPVC Doors and Windows.
 - (iii) Curtain walls/façade Glazing system.
 - (iv) Tile works / Stonework.
 - (v) Lift Machine Room
 - (vi) Coordinating panels in case of Cast in situ Concrete Panels.

- (vii) Finishing drawings and details
- (viii) Shaft/Duct Covering.
- (ix) Woodwork.
- (x) Modular Cabinets.
- (xi) Fire Doors.
- (xii) Waterproofing.
- (xiii) Railings.
- (xiv) Mild steel works/fabrications.

5.2. DETAILED SPECIFICATIONS ARCHITECTURE

The latest CPWD Specifications and General Pool Residential Accommodation (GPRA) norms 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 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 blockwork superstructure
- (c) Wall plaster (amenity buildings)
- (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) Wooden interior doors
- (k) Aluminum exterior doors
- (l) Wooden Fire doors- All Fire doors shall be wooden fire doors.
- (m) Wooden flooring (engineered wood / laminated wooden)
- (n) Mild steel works
- (o) Structural steel works
- (p) Glass (windows, mirror and railings)
- (q) False ceilings
- (r) Bathroom fixtures
- (s) Kitchen fixtures
- (t) Woodwork - cabinetry and furniture
- (u) Hardware / ironmongery
- (v) Structural glazing

- (w) Lifts
- (x) Safety and architectural railings

The following specifications will be taken in appendix to the CPWD specifications and IS Codes for specific conditions, namely -

5.2.1. *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.

5.2.2. *Chemicals*

The chemicals used for the soil treatment shall be any one or combination of the following with the concentration shown against each aqueous emulsion:

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.

5.2.3. *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 litres/ sq. meter of surface area.

5.2.4. *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 litres/ Sq.m 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.

5.2.5. *Treatment for R.C.C Framed Structures*

The treatment described above applies essentially to masonry foundations where there are voids in 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-litres/ Sq.m. of the vertical surface. The other details of the treatment shall be as laid down above.

5.2.6. *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 litres per Sq.m. Light rodding may be carried out in the soil surface to facilitate absorption of the emulsion.

5.2.7. *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.

5.2.8. *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.

5.2.9. *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.

5.2.10. *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 rate of 5 litres per Sq.m. of the surface. The application should be carried out slowly to enable the masonry surface to absorb the emulsion.

5.2.11. *Anti-Termite Treatment at Points of Contact of Wood Work*

Refer to CPWD Specifications

5.2.12. *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 who is 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.

Concreting/ Tremix Flooring

5.3.1. 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.

5.3.2. 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.

5.3.3. Materials

Cement-ordinary portland

Sand-natural / manufactured

sand Aggregate - max. size 10 to

20mm Water - potable

Floor hardener - @3kg/Sq.m

5.3.4. 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 surface of 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.
- (i) Hardener screed
 - (i) Hard top to be prepared as per the specifications with Nitohardner and one part of 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.

5.3.5. *Curing*

- (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 a period of at least one week.

5.3.6. *Waterproofing and Insulation*

These specifications cover the general requirements of waterproofing systems to the various parts of the structure. The contractor shall 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 along with adverse chemicals like sulphate & chloride etc.. The contractor is fully and totally responsible to provide buildings and infrastructure that are water tight and leak proof. The contractor will submit a waterproofing and sealant plan to be approved by the Engineer along within 45 Days of commencement of contract.

5.3.6.1 *Codes References*

- (a) IS 73: Paving Bitumen Specifications
- (b) IS 702: Specifications for Industrial Bitumen
- (c) IS 1322: Specifications for Bitumen felts for Water Proofing and Damp Proofing.
- (d) IS 2645: Specifications for Integral Cement Water Proofing Compounds
- (e) IS 3370: (Part -1) Code of Practice for Concrete Structures for the Storage of Liquid: Part -1 General Requirements.
- (f) IS 3384: Specifications for Bitumen Primer for Water Proofing and Damp Proofing
- (g) IS 7193: Specification for Glass Fibre Bitumen Felts
- (h) IS 12200: Provision of Water Stops at Transfers Construction Joints in Masonry and Concrete Dams - Code of Practice.
- (i) IS 12432: (Part-3) Application for Spray Applied Insulation-Code of Practice Part-3 Polyurethane/ Polyisocyanurate

5.3.6.2 *General Waterproofing Requirements*

- (a) The work shall be carried out by an approved specialised waterproofing agency that has minimum of 10 years of experience in the proposed waterproofing system.
- (b) The specifications given below against each item are indicative in nature. The contractor in consultation with the proposed specialised waterproofing agency shall propose their detailed specification in line with the requirements given below including consumption to achieve required thickness (including wastage) and shall submit such specifications for approval by the Engineer.
- (c) For certain items two optional specifications are mentioned. The Contractor shall quote for both and shall furnish the detailed specification including makes for both options. The Employer may select an appropriate option based on its merits.
- (d) 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.

- (e) On completion of the works, Contractor has to submit a comprehensive guarantee valid for minimum 10 years.
- (f) The extent of waterproofing required for different structural elements shall be as approved by the Engineer and Contractor's specifications shall match such requirements.
- (g) Integral waterproofing to be done in all wet areas mandatorily.
- (h) Additional waterproofing measures for basement protection to be done by the contractor through HDPE and vertical HDPE membrane.
- (i) The contractor shall have to submit a Bank Guarantee of percentage fixed by the client as security against warranty to be released after the warranty period of waterproofing given by contractor expires.
- (j) 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.
- (k) 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 moulds etc.
- (l) The Contractor is liable for all preparatory works to effect a defect free treatment, staging, scaffolding, curing, 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.
- (m) Ponding test is mandatory over all water proofing works for the durations as specified by the Engineer.
- (n) Measurement for all terrace, toilet, kitchen and balcony works shall be made only for the plan areas measured clear. Works done on vertical surfaces including 'vattas' shall not be paid separately.
- (o) Waterproofing details to be submitted by contractor for the joint between the beam bottom and filler wall for review and approval.
- (p) Water Proof Coating- Cold applied water based modified polyurethane hybrid elastomeric waterproof membrane at minimum 0.8mm dft in one coat having solids by volume:620/o, Tensile Strength ASTM D412:1.75MPa, elongation ASTM D412>350%, Tear Strength ASTM D624:13N/mm, Adhesion to
- (q) Substrate; 1.9MPa concrete, Crack Bridging static/dynamic: 2mm ASTM C836, Resistance to water: 10m pressure & SRI Value I OG for white to be used on the roof including parapet wall surface as per manufacturer direction.
- (r) Coving at right angle- All right angle junctions between floor and wall shall be provided with coving of size 75mmx75mm minimum 15mm thickness in cement mortar 1:4 admixed with FOSROC/SIKA/equivalent chemicals @ 2 litres per 50kg of cement after saturating the surface with water and applying a slurry primer coat.
- (s) Protective Coating- Providing and applying PU Coating FOSROC/SIKA/equivalent on the applied waterproofing surface as per manufacturer direction.(Make:MYK / Fosroc /Tremco Pvt.Ltd./Pidilite /Sika/Sunanda)

5.3.6.3 Material Requirements

- (a) Acceptable Manufacturers:

The following is a list of acceptable manufacturers but is not limited to and may

be amended upon showing relevant and merit supporting evidence. Contractor can provide materials which are equivalent or superior then the ones specified after approval of the engineer in charge.: Pidilite, BASF, Fosroc, Sika, Cico & MC Bauchemie.

(b) Acceptable Proprietary Products:

The following is an indicative, non-exhaustive list of proprietary products.

- (i) Acrylic Polymer Modified Two component Cementitious system
- (ii) SBS polymer reinforced membrane system
- (iii) Liquid Spray applied elastomeric polyurethane membrane system
- (iv) Spray applied polyurethane foam system

The waterproofing system chosen for various structures is subject to approval from the Engineer.

(c) Source Quality:

The contractor must obtain proprietary waterproofing products directly from the manufacturer.

(d) Other civil material related with waterproofing:

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). The Employer/Engineer may demand the conformance of these materials from the Specialised 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.

(e) Mixes:

The contractor must mix waterproofing material as specified by the manufacturer. Follow exact instructions as mentioned in the respective technical literature. Mix waterproofing in quantities that can be applied within 20 to 30 minutes from time of mixing. The liquid applied coatings/membranes may be applied by brush, roller, squeegee, trowel or spray. Prefabricated membranes may be applied by priming manufacturer's literature. and torching or as specified in the

5.3.6.4 Execution

(a) Examination

(i) Site Visit:

Prior to waterproofing installation, arrange visit to project site with waterproofing manufacturer's representative. Representative shall inspect and certify that concrete surfaces are in acceptable condition to receive the waterproofing treatment.

(ii) Verification of Substrates:

Verify that concrete surfaces are sound and clean, and that form release agents and materials used to cure the concrete are compatible with waterproofing treatment.

(iii) Examination of Defects:

Examine surfaces to be waterproofed for form tie holes and structural defects such as honeycombing, rock pockets, faulty construction joints and defects are to be repaired in accordance to manufacturer's product data and point

cracks. Such
(b) below.

(b) Preparation

(i) Concrete Finish:

Prior Concrete surfaces to receive waterproofing treatment shall be free from scale, excess oil, laitance, curing compounds and foreign matter. Horizontal surfaces shall have a rough wood float, smooth or broom finish, as required by the waterproofing manufacturer.

(ii) Surface Preparation:

Smooth surfaces (e.g. where steel forms are used) or surfaces covered with excess form oil or other contaminants shall be washed, lightly sandblasted, water blasted, or acid etched with muriatic acid (as necessary) to provide a clean absorbent surface. Surfaces to be acid-etched shall be saturated with water prior to application of acid.

(iii) Repair of Defects:

Form Tie Holes. Construction Joints. cracks: Chip out defective areas in a 'U' shaped slot 25 mm wide and a minimum of 25 mm deep. Clean slot of debris and dust. Soak area with water and remove excess surface water. Apply a polymer modified cementitious bonding coat of approved material to the slot. Then fill cavity with a non-shrink, waterproof, cementitious grout / epoxy mortar, while the bonding coat is tacky. Compress tightly into cavity using pneumatic packer or block and hammer. Where the concrete is defective, do injection grouting with high pressure (140 psi) grouting machine using cement admixed with non-shrink grouting admixture. Rock Pockets, Honeycombing or Other Defective Concrete: Rout out defective areas to sound concrete. Remove loose materials and saturate with water. Remove excess surface water and apply a polymer modified cementitious bonding coat of approved material to the area. While the bonding coat is still tacky, fill cavity to surface level with non-shrink grout. Where the concrete is defective, do injection grouting with high pressure (140 psi) grouting machine using cement admixed with non-shrink grouting admixture.

(c) Application

(i) Construction Joints:

Apply cementitious/other suitable bonding material/epoxy Nito bond in slurry form to joint surfaces between concrete pours, just prior to pouring fresh concrete. Moisten surfaces prior to the bonding coat application. Where joint surfaces are not accessible prior to pouring new concrete contractor must consult manufacturer for application procedure.

(ii) Coves:

Make a minimum 4 inch (diagonal) cove / vata at all 900 interfaces in concrete surfaces where waterproofing is carried out, without fail.

(iii) Surface Application:

After repairs, surface preparation, treatment of construction joints, cracks, honeycombs, tie-holes, etc., have been completed in accordance with manufacturer's product data and as specified herein, apply / provide the waterproofing material as specified in the manufacturer's technical and application data sheet to concrete surfaces. Application rates, thicknesses and locations shall be as indicated in the drawing. When brushing, work slurry with the surface of the concrete, filling surface pores and hairline

cracks. When spraying, hold nozzle close enough to ensure that slurry is forced into pores and hairline cracks. When torching, uniformly burn the surface when overlapping, to ensure that the membrane adheres uniformly.

(iv) Sandwich (Topping) Application:

When treated structural slabs are to receive a concrete or other topping, place the topping only after the initial curing period of the material is being used, is completed. Lightly pre-water when rapid drying conditions exist.

(d) Application

(i) General:

For cementitious materials, begin curing as soon as the applied waterproofing material has hardened sufficiently so as not to be damaged the treatment with water as per the manufacturer's instructions. In warm climates, by a fine spray. Cure more-than-normal curing duration may be necessary to prevent excessive drying of coating. For liquid applied membranes / Pre-fabricated membranes, natural air curing for duration as described in the manufacturer's technical data sheet.

(ii) Air circulation:

Do not lay plastic sheeting directly on the waterproofing coating as air contact is required for proper curing. If poor circulation exists in treated areas, it may be necessary to provide fans or blown air to aid curing of waterproofing treatment.

(iii) Water-holding structures:

For concrete water-holding structures such as reservoirs, water treatment tanks and wet wells, cure the waterproofing system for a minimum of 3 days and then allow the waterproofing system to set for 7 days before structure with liquid. For structures holding hot or corrosive liquids, cure waterproofing system for 3 days and allow setting for 15 days.

(iv) Protection:

During the curing period, protect the treated surfaces from damage by wind, sun rain and temperatures below 20 C. If plastic sheeting is used for protection, it must be raised off the waterproofing coating to allow sufficient air circulation.

(e) Interface with other materials

(i) Backfilling:

Do not backfill for 36 hours after application. If backfill takes place within seven days after application, then backfill material shall be moist so as not to draw moisture from waterproof coating.

(ii) Paint, epoxy or similar coatings:

Do not apply paint or other coatings until waterproofing treatment has cured and set for a minimum of 21 days. Before applying or coating, neutralize treated surface by dampening with water and then washing waterproofed surface with 15% (HCL) muriatic acid, diluted i a ratio of one part acid to four parts water by volume. Flush acid off treated concrete surfaces.

(iii) Grout, Cement Parge Coat, Plaster or Stucco:

Because the waterproof coating forms a relatively smooth surface and the

resulting waterproof coating reduces the suction characteristics of the concrete, it may be necessary to use a suitable bonding agent for proper bonding of cementitious systems (IPS, screed, plaster, etc.) if they are applied.

(iv) Responsibility to Ensure Compatibility:

The respective manufacturers' must confirm in writing regarding compatibility of their waterproofing treatments with other coatings, plaster, stuccos, tiles or other surface-applied materials. It shall be the responsibility of the manufacturer / installer of the waterproofing material to take whatever measures are necessary, including testing, to ensure acceptance by or adhesion to their waterproofing system.

(f) Field Quality Control

(i) Observation:

Do not conceal installed waterproofing system before it has been observed by Engineer, waterproofing manufacturer's representative and other designated entities.

(ii) Flood Testing:

Perform flood test on completed waterproofing installation for a minimum of 72 hours before of other construction. Plug or dam drains and fill area with water to a depth of at least 100mm. If leaks are discovered, make repairs and repeat tests until no leaks or dampness is observed.

(g) Cleaning & Protection

(i) Cleaning:

Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures. Ensure that cleaning agents do not harm or damage the waterproofing coating in any way what so ever.

(ii) Protection:

Take measures to protect completed waterproofing system from damage immediately after application. Do not permit traffic on unprotected coating or membrane.

5.3.6.5 Submittals

- (a) General: Submit listed submittals in accordance with conditions of the contract and ensure every submittal is complete and correct in every way before submitting.
- (b) Product Data: Submit product data, including manufacturers specifications, installation instructions, and general recommendations for waterproofing manufacturer's certifications or other data substantiating that products comply with applications. Also include requirements of the contract documents.
- (c) Test Reports: Submit for acceptance, complete test reports from government/NABL approved independent testing laboratories certifying that waterproofing system conforms to performance characteristics and testing requirements specified herein.
- (d) Manufacturers Certification: Provide certificates signed by manufacturer or manufacturer's representative certifying that the materials to be installed comply in all respects with the requirements of this specification, and that the specialise executing waterproofing agency is qualified and approved to install the materials with manufacturer's product data.

in accordance

- (e) **Manufacturers** **Field** **Report:** **provide**
copy of report from manufacturer's representative conforming that the surfaces to which waterproofing is to be applied are in a condition suitable to receive the same.

5.3.6.6 Quality Assurance

- (a) **Manufacturer:** Provide products of manufacturer with no less than 20 years' experience in manufacturing the waterproofing and insulation materials offered by them for the required work along with details of where the product is manufactured. Manufacturers that cannot provide the performance test data specified herein will not be considered for the project.
- (b) **Specialised Waterproofing agency:** Specialised executing waterproofing agency shall be experienced in the installation of the offered waterproofing materials as demonstrated by previous successful installations, and shall be approved by the manufacturer in writing. The agency shall have experience in executing waterproofing works amounting to at least 15,000 Sqm. in the past seven (07) years for the waterproofing systems proposed for this project. This requirement can be achieved through one or more projects.
- (c) **Pre-installation conference:** Prior to installation of waterproofing, conduct meeting with waterproofing agency, Engineer in Charge, employers representative and waterproofing manufacturer's representative to verify and review the following:
- (d) Project requirements for waterproofing as set out in the contract documents.
- (e) Manufacturers product data including application instruction
- (f) Substrate conditions and procedures for substrate preparation and waterproofing installation.
- (g) **Technical Consultation:** the waterproofing manufacturer's representative shall provide technical consultation on waterproofing application. The manufacturer through the Contractor shall submit drawings for typical details and terminations, shall conduct regular site visits and carry out inspections during execution of waterproofing works.

5.3.6.7 Delivery and Storage

- (a) **Delivery:** Deliver packaged waterproofing materials to the project site in original undamaged / unopened containers / pallets, with manufacturer's labels and seals intact. Each delivery should be approved by the contractor. Material delivered shall be accompanied by manufacturer's certificate for quality parameters and date of manufacture / expiry.
- (b) **Storage:** Material shall be stored in a dry, well ventilated and covered storage. Ensure that material is not in contact with earth and is stored as per guidance of manufacturer's literature.
the
- (c) **Compliance:** comply with manufacturer's product data regarding condition of substrate to receive waterproofing, weather conditions before and during installation, and protection of the installed waterproofing system.

5.3.6.8 Guarantee

The Contractor shall guarantee the waterproofing installation against defects caused by faulty workmanship or materials for a period of 10 years from date of substantial

completion. The guarantee will cover the surfaces treated and will bind the Contractor to repair, at his expense, any and all leaks through the treated surfaces which are not due to structural weakness or other causes beyond his control such as fire, earthquake, tornado and hurricane.

5.3.6.9 Areas of Application & Indicative Method

(a) Roof Waterproofing

(i) Styrene Butadiene Styrene Based (SBS) Membrane

Supplying, providing and applying water proofing treatment with Membrane type water proofing methods using 4mm thick polymer modified Bituminous membrane of approved makes of either Styrene Butadiene Styrene (SBS) based or Atactic Poly-Propylene (APP) based with UV resistant, ground chemical resistant, high melting points, flexible and elastic with high adhesive strength. The membrane shall be reinforced with non-woven polyester reinforcement of minimum of 160 g/sqm including coating with compatible primer of bituminous base and torch application with overlap of 100 mm wherever required. The reinforcement provided shall be able to withstand the traffic flow density and after construction, shall carry a minimum guarantee period of 10 years. Cost to include laying loosely over the surface / after priming and torching the prefabricated overlap at ends. The slope making part consists laying of 110 mm average thick light weight concrete of specified grade mixed with Water proofing admixture as per manufacturers specifications approved by Engineer/Employer with a minimum guarantee period of 10 years. Cost to include cement slurry with water proofing compound applied over the surface after cleaning the surface, laying of light weight concrete to necessary gradient and joint free water proof plastering in CM 1:2 and impression marking. Treatment must continue along the parapet wall for 300 mm height in the shape of round vata along with curing and all other associated tasks. Cost will include the treatment along wall up to min 300 mm and no extra measurements shall be accounted for the wall treatment. The laying of light weight concrete is by using light weight aggregates of perlite having higher compressive strength and highest fire resistance with thermal / acoustic insulation properties, anti-corrosion, anti-condensation, etc. of perlite in the required proportion to get the desired density, mixing, transportation, placing, compacting and finishing to the required level with necessary side supports, equipment's. etc. complete

(ii) Using Spray Applied Polyurethane (PU) Membrane (Foam)

The waterproofing must be carried out by well trained professionals and shall be carried under the strict supervision of the manufacturer, as per the technical recommendations. The overall waterproofing system shall have a warranty of 10 years. First the substrate must be prepared for application, this will include cleaning of the surface, treating of construction joints, filling of honeycombs and sealing of voids by using appropriate grouting method. The instant setting PU spray insulation must be then applied in layers of considerable thickness to make up the final layer of average 40mm. The foam thus formed post spraying and initial setting must have smooth to orange peel texture. The puff insulation shall be minimum 40-45 kg/cum density, Chlorofluorocarbons free and shall be supplied by the original manufacturer of both the components of the insulation system. Post initial setting time as per the manufacturers recommendations, a waterproofing application shall be done above PUF insulation by applying an epoxy or polyurethane primer to block the open cells. It shall be followed by spray application of second coat of polyurethane. The Contractor shall

select the waterproofing membrane based on technical parameters such as high elongation combined with high tensile strength materials, high solids, puncture resistance, water vapour permeability, crack bridging capability, waterproofing sensitivity to high relative humidity, waterproofing chemistry, adhesion to multiple substrates and chemistry compatibility certificate with PUF insulations. Waterproofing shall be applied at minimum average 1.5mm dry film thickness above insulation. The membrane thus formed should be polyurethane based with low VOC and should have good crack bridging properties as per ASTM C1305.

A water ponding test must be carried out for testing water tightness after proper curing as per manufacturer specifications.

Over this coat, loosely lay 300 gsm geotextile with a min of 50mm wide overlap sealed with tape. A protective screed of M20 with slope 1:100 of minimum 65mm thickness, containing polypropylene fibres (12mm length) at 0.9kg/m³ applied with broom finish. The screed is to be laid with 10mm wide construction joints and the joints must be filled with a polysulphide or polyurethane sealant. The above coat must be well cured for a minimum of 7 days. All around on the roof, at the parapet wall junction, an angular fillet 50mm x 50mm shall be trowel applied in cement-sand mortar 1:3 proportion modified with SBR polymer mixed in 10% by weight of cement.

For parapet, clean surface free of laitance, grease, old paints, contaminants, curing compound with wire brush/grit blasting. Clean the surface with compressed air. Damaged or loose concrete should be replaced and repaired with a polymer modified mortar. Small cracks must be filled with appropriate crack seal of approved agencies. Post preparation, apply a primer of acrylic emulsion polymer, properly selected fine fillers, white pigments and additives in water as a medium. Post preparation, the waterproofing as provided on the flat surface shall be taken vertically covering entire parapet walls followed by UV Stable top coat.

(b) Waterproofing to Toilet, Kitchen and Balcony

The first part consists of grouting the porous slab area (if required) with low viscosity epoxy injection.

The second part consists of treating the cracks and construction joints by routing-out to a minimum ¾" x ¾" groove and treating it with a specialised non-shrink cementitious compound - modified with SBR polymer mixed at 20% by weight of cement.

The third part consists of making vata (gola) at the interface joint of the toilet slab and masonry wall with a specialised non-shrink cementitious compound with SBR polymer 20% by weight of cement mixed with cement and sand in 1:3 ratio.

The fourth part consists of sealing / packing all joints of inlet/outlet pipes, etc. with a hydro-swelling gasket in paste form with a specialised non-shrink cementitious compound grout and topping it with liquid-applied, Flexible Cementitious Waterproofing Membrane.

The fifth part consisting of providing and applying 2-component, liquid-applied, Acrylic Polymer Modified Cementitious system applied in two coats to achieve a 2mm dry

thickness as per manufacturer's specifications approved by Engineer over the entire toilet / balcony / utility sunk slab and walls up to 1000mm height from FFL in case of dry area and up to 2000mm height from FFL in case of shower area. Coarse sand sprinkling shall be done to ensure mechanical anchoring with the next layer.

The sixth part consisting of providing and laying avg. 15 mm thick, CM 1:4 plaster

admixed with Integral Waterproofing Compound @ 100 ml / bag of cement and virgin polypropylene fibres (12mm length) of fibrillated grade @ 1 packet / bag of cement, over the fifth part.

(c) Lift Pit Waterproofing

- (i) Applying Waterproofing Treatment with Membrane Type Waterproofing method in box-type fashion, to Lift Pit Base Slab and Wall using SBS polymer modified self-adhesive bituminous membrane of approved makes of minimum 1.6mm thick based with UV resistant, ground chemical resistant, high temperature resistance, flexible and elastic with high adhesive strength. The membrane shall include HDPE Laminate with 250% elasticity and must be self-adhesive application with overlap of 100 mm wherever required. The Laminate provided

shall be able to withstand the traffic flow density; scope includes grouting the construction joints, cracks, honeycombs, etc. The works shall be complete as per manufacturer specification and directed by the Engineer.

- (ii) Protective Coat to Water Proofing System: Applying cement sand (1:4) screed 20mm thick with integral waterproofing compound as Protective Layer over the waterproofed surface as per specification and as directed by the Engineer. Fixing of specified and approved Polystyrene Board over the as Protective Layer over the waterproofed wall surface as per manufacturer specification and as directed by the Engineer

(d) Over Head Tank (R.C.C) Waterproofing (wherever applicable)

Providing and applying Acrylic Polymer Modified Cementitious Waterproof Coating in 2 or 3 coats as per manufacturers' specification to achieve a 2mm DFT as approved by the Engineer to the RCC slab and walls, complete. The treatment to include cleaning and wire-brushing the concrete surface, treating all the cracks with low viscous epoxy grouts, construction joints with hydro-swelling gasket and honeycombs by grouting with specialized non-shrink cementitious compound, grouting the annular space between the pipe and concrete with hydro-swelling gasket in paste form encapsulating with prepacked non-shrink grout, providing and applying smooth CM 1:3, 25 mm thick plaster in double coat admixed with SBR modified plaster 10% by weight of cement to be mixed with cement/sand in 1:3 ratio, using river sand screened and washed, at all leads, lifts, heights, scaffolding, curing, complete, the works shall be complete as per manufacturer specification and directed by the Engineer. Final coat shall be 400 microns food grade epoxy coating. Ensure the waterproofing coating is CFTRI approved and food safe, to ensure the water contained therein is potable in nature.

(e) Brick Aggregate Cement Concrete Layer

Providing and laying plain Brick Aggregate Cement concrete layer of ratio 1:4:8 (1 cement : 4 sand : 8 brick Jelly) the brick jelly size shall be 3/4" as filling course, the mortar for the concrete filling shall be CM 1:4 and admixed with integral waterproofing compound and mortar plasticizer, curing, complete. the scope includes mechanical mixing, transporting, placing, leveling, compacting and curing all material and labour, the works shall be complete as per specification and as directed by the Engineer.

(f) Roof Finishes

- (i) Pressed Clay Tiles-Roof finish on all buildings

Providing and laying 20 mm thick Pressed Clay Tiles of approved make laid over 20 mm thick cement mortar 1:3 mixed with crude oil 10% by weight of cement and pointing of joints in same mortar including waterproofing compound, including flashing of corners, the tiles shall be laid with clear slope such as to avoid water stagnation, the works shall be complete as per specification and as directed by the

Engineer

(ii) Solar Reflective Paint

Roofs provided with high reflective coatings remains cooler than those with low reflectance surfaces and are known as cool roofs. Cool roofs can reduce the building heat gain and can save the summer time air conditioning expenditures, with excellent crack bridging capabilities that can accommodate movements due to thermal variations, these paints should have Solar reflective Index of min. 99 as per ASTM E1980, elongation of minimum 100%, solid content minimum 55% & Adhesion strength/tensile strength of minimum 1 N/mm².

(g) Expansion Joints (wherever applicable)

Providing and laying waterproofing of expansion joint, as per specifications herein with a minimum guarantee period of 10 years: The first part consisting of providing and fixing the polyethylene backer, then wire-brushing the internal sides of the concrete where the sealant is to be applied. Also, wire-brushing is to be done on the top surface of the concrete up to 200mm on either side of the expansion joint. The second part consists of providing and fixing the polyethylene backer sheet into the expansion joint leaving specified depth from the top of the slab. The third part consists of providing and applying Polyurethane primer coating onto the sides of the expansion joint up to the specified depth from top of the slab. The fourth part consists of providing and filling Polyurethane sealant (for width up to 25mm) or Polysulphide sealants (for width up to 50mm) having elongation of minimum 400% into the slot up to the surface of the slab. Joints greater than 25mm shall be sealed of expansion joints with 1mm thick flexible polyolefin tape to be sandwiched between layers of epoxy. PU sealants shall not be used above joints more than 25mm.

(h) Waterproofing of following areas shall be covered in this specification

- a. Basement Waterproofing Treatment
- b. Basement top / Podiums / Fire Tender Movement Area / Driveway / Landscape / Ramp Waterproofing Treatment
- c. Water tank- Internal Area Waterproofing Treatment
- d. STP / ETP -Internal Area Waterproofing Treatment
- e. Pipe Inlet / Outlet Waterproofing Treatment

Area Wise Recommended Waterproofing System Sr.	Areas of Waterproofing	System Recommended	Properties	Specification Standards

1	Basement Raft	Fully bonded, pure HDPE Pre-bond pre-formed recommended adhesive layer and granular layer. In case of pile raft, both membrane and crystalline admix are preferred.	Thickness : 1.2mm (Min. 0.85mm HDPE layer) Puncture Resistance : > 1000 N Elongation : 500% Tensile Strength : 25 Mpa Low Temp Flexibility : -15degC Adhesion to Concrete : 880N/m Hydrostatic Head : > 60M Cold Temp Flexibility : - 25degC Roll Size : 2.4 Mtr x 20 Mtr Selvedge : 75 mm	ASTM D 3767 ASTME 154 ASTM D 412 ASTM D 412 modified ASTM D 903 ASTM D 5385 modified ASTM D 1970 or Equivalent Indian Standard. ---
2	Basement - Retaining Wall (Unconfined)	Fully bonded, cross laminated, valeron HDPE lining SBS modified Self adhesive pre-formed SAM XL	Thickness : 1.6mm Elongation : 230/180% Puncture Resistance : 220N Tensile Strength : 42/48 Mpa	DIN EN 1849-1 ASTM D 882 ASTME 154 ASTM D 882 ASTM D 1970

Area Wise Recommended Waterproofing System Sr.	Areas of Waterproofing	Properties		Specification Standards
		membrane Hydrophilic water bar in all horizontal and vertical CJs	Roll Size : 1Mtr x 10Mtr Selvedge : 100mm	--- ---
3	Basement - Construction & Starter Joint / Driveway /	A synthetic butyl rubber, hydroswellable hydroswell HDPs (Hydro re-swellable water bar)	Specific Gravity: 1.35 - 1.5 Hydrocarbon Content: 47% min Shore A Hardness: 40-50 Expansion Volume rate: >100% C/s Section: 20mm x 10mm Tensile Strength: 20Kgf/cm ²	ASTM D 71 ASTM D 4 ASTM D 2240 N.A. N.A. ASTM D 412
4	Basement - Rock Anchors / PRPs	Pure Polyurethane flashing made of PU coating with polyester mesh reinforced.	Tensile Strength: > 4 Mpa Solid Content: 90% Hardness(Shore A): 75 Water Vapour Perm: >14g/m ² /day	ASTM D 412 ASTM C 836 ASTM D 2240 (15") ISO 9932:91

5		Epoxy grout comprised of liquid epoxy resin, hardener, properly selected and graded aggregates filler and additives used for sealing and capping. Meets the requirement of ASTM standards	Compressive Str. (7D): 90 Mpa Tensile Strength (7D): 12 Mpa Flexural strength(7D): 20 Hardness Shore D (7D): >80 Pull of Strength (7D): 2.5 Mpa	BS: 6319- 1983, part – 2 BS: 6319- 1983, part – 7 BS: 6319- 1983, part – 3 ASTM D 2240 BS: 1881, part 207
6	Basement top / Podiums / Fire Tender Movement Area	Pure Polyurethane based, seamless, brush applied liquid applied waterproofing cum root resistant membrane.	DFT: 1.5mm Elongation: 400% Tensile Strength: > 4 Mpa Solid Content: 90% Hardness(Shore A): 75 Resistant to Roots: Resistant Fire Resistant: Pass	N.A. ASTM D 412 ASTM D 412 ASTM C 836 ASTM D 2240 (15") EN 13948 Euroclass F ISO 9932:91

Area Wise Recommended Waterproofing System Sr.	Areas of Waterproofing	System Recommended	Properties	Specification Standards
			Water Vapour Perm: >14g/m ² /day	
7	Water tank Internal Area	Food Grade, Portable epoxy polysulphide combination, EPW grade, liquid applied membrane system, requires No Protection	Solid content: 100% Tensile strength: 6 Mpa Elongation > 50% Adhesion to concrete>1.5 Mpa Shore D Hardness : 50 Food grade Testing: Non Toxic	N.A. ASTM D 412 ASTM D 412 ASTM D 4541 ASTM D 2240 BS 6920
8	STP / ETP Internal Area	Chemical Resistant epoxy polysulphide combination, EP grade, liquid applied membrane system, requires No Protection.	Solid content: 100% Tensile strength: 6 Mpa Elongation > 50% Adhesion to concrete>1.5 Mpa Shore D Hardness : 50	N.A. ASTM D 412 ASTM D 412 ASTM D 4541 ASTM D 2240

9	Pipe Inlet / Outlet – Pipe sealing tape	Non reinforced, cold applied, twin side adhesive bitumen Bathseal tape which comprises of polymerised bitumen sandwiched between a plastic released films on either side.	Thickness: 1.5mm Softening point (R&B): >60°C Elongation (compound): >500% Water absorption at 24 hrs: <0.3 Water permeability @5bar: NIL Adhesion strength: 1.0 N /mm Crack bridging ability: >1.5 mm Cold temperature flexibility: < -6°C	UEAtc ASTMD 36 ASTMD 412 ASTMD 570 BS EN 12390 ASTMD 1000 ASTM C 836 UEAtc
10	Pipe Inlet / Outlet – Bore packing	High strength, non-shrink, free flow, cementitious grout comprises of hydraulic setting binders, selected aggregates and	Compressive str. (7D): 55 Mpa Tensile Strength (28D): 5 Mpa Flexural Strength(28D): 10Mpa Adhesion Strength: 1.5 Mpa	ASTM C 109: 1999 ASTM C 307 ASTM C 580 BS 1881, Part 207

Area Wise Recommend d Waterproofin g System Sr.	Areas of Waterproofing	System Recommended	Properties	Specification Standards
		expansion control additives that need only addition of the requisite quantity of water at site. Meets the requirements of ASTM-C-1107 & CRD-C-621-83. (W/P ratio: 0.13 – 0.15)		
11	Pipe Inlet / Outlet	Pure Polyurethane flashing made of PU coating with polyester mesh reinforced.	Tensile Strength: > 4 Mpa Solid Content: 90% Hardness(Shore A): 75 Water Vapour Perm: >14g/m ² /day	ASTMD 412 ASTM C 836 ASTMD 2240 (15") ISO 9932:91

Providing and laying single component acrylic waterproofing cum ant carbonation protection coating in external wall over concrete. Protection coating shall be high build, crack bridging with thickness of 200 microns, UV stable, shall offer elongation of 150%.

First part consist of substrate preparation which includes cleaning the surface, removing all stages of formwork, release agent, grease, efflorescence, laitance, algae or other contaminant that may prevent proper adhesion. Remove organic materials by scraping, brushing or high- pressure water cleaning and on some rough rendered or dashed surface, it is advantageous to use fairing mortar to close the surface, thus preventing the possibility of pinholes occurring. Cracks wider then hairline should be patched using butyl tape. Second part shall consist of priming the surface with acrylic primer or curing membrane to be applied in plastered and concrete substrate. Third part shall consist of application of 200 microns coating using nap roller or airless spray.

5.4. *Paint Works*

The provision of the latest revisions of the following IS: Codes shall form a part of this specification.

IS: 63 Whiting for Paints Ready mixed paint, brushing, grey filler, for Enamels, for use over primers.

IS: 426 Specification for paste filler for colour coats.

IS: 428 Specification for Distemper, Oil Emulsion, and colour as required. IS: 710 Marine Plywood

IS: 1200 (Part XIII) Method of Measurement of Building and Civil Engg Works - White Washing, colour washing, distempering and other finishes.

IS: 1477 (Part 1) Code of practice for painting of ferrous metals in buildings Pre-treatment IS: 1477 (Part 11) Code of practice for finishing of ferrous metals in buildings. Painting

IS: 2338 (Part 1) Code of practice for finishing of wood and wood-based materials Operations and workmanship for finishing

IS: 2338 (Part 11): Code of practice for finishing of wood and wood-based materials

IS: 2395 (Part 1): Code of practice for painting concrete masonry and plaster surfaces. Operation and workmanship

IS: 2395 (Part 11) Code of practice for painting concrete, masonry and plaster surfaces IS: 159 Specification for ready mixed paint, brushing, acid resistant

IS: 2524 (Part 1) Code of practice for painting of non-ferrous metal in buildings Pre-treatment IS: 2524 (Part II) Code of practice for painting of non-ferrous metal in buildings Painting

IS: 5410 Specification for cement paints, colour as required

Other IS Codes not specifically mentioned here but pertaining to painting form part of these specifications.

All paint work including materials, preparation, workmanship and application procedures to follow CPWD specifications.

5.5. *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

5.5.1. 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 2" (38mm) outside diameter by 5/64" (2 mm) 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 patch fittings 4 no for each glass panel, SS base plates, etc.

5.5.2. All posts and other components shall be constructed using the following:

Stainless steel grade AISI type 316, surface to be 320 grain/grit finish; posts to be 2" (50 mm) by 1/2" flat bar, finish and final 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.

5.5.3. 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.

5.5.4. 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.

5.5.5. 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.

5.5.6. 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.

5.5.7. Protection after installation

General contractor must provide protective covering on handrails and guardrails if construction is not yet finished in the area where the railings are installed.

5.5.8. 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.

5.6. UPVC Doors and Windows

UPVC/Vinyl known as Unplasticised Polyvinyl Chloride is a superior material made from rigid, impact-resistant polyvinyl chloride (PVC) with hollow spaces inside to make them resistant to heat loss and condensation. All uPVC Doors and Windows to be as per Section 9.28 of CPWD Specification 2019 Vol 1.

Frameless toughened **glass door** should be 12 mm thick with derma premium fittings.

5.6.1. Properties of UPVC Windows

- (a) Thermal conductivity - The thermal conductivity of PVC is 0.14 kcal/m.hr°C
- (b) Weather resistance / anti-ultraviolet - highly weather resistant quality and should have high impact resistant formulation. It should withstand long exposure in extreme weather change under scorching sun, storms, dryness, high humidity. No brittleness and quality deterioration should occur in the windows.
- (c) Sound proofing - UPVC Windows should be designed using multi-chambered profile with tight seals. An average sound separation of 22-25 dB in single glazing and 30 dB in double-glazing is to be achieved.
- (d) Electricity insulation - UPVC windows should have high electrical insulation which exceeds 1015 ohms-cm. It should be absolutely safe from electrical conductivity.
- (e) Fire retardant - The windows should be flame retardant and shall not cause, support or enhance the natural development of fire.
- (f) Water proof - UPVC Windows shall absorb water below 0.1%
- (g) Corrosion resistance - UPVC windows should be highly resistive to the attacks of acids, alkalis, waste gases, and salts.
- (h) Environment friendly - UPVC window systems should be environmentally friendly and they should be fully recycled and reused for the production of PVC profiles.
- (i) Other features
 - (i) All corners of the window system are to be welded, to form a single monotonous and rigid structure.
 - (ii) Windows systems should be provided with multi-locking mechanism that locks at four places so there won't be any space for leakages.
 - (iii) Friction stays, locking systems, all hardware should be of the highest grade. All hardware to be checked for their 20000 cycles of operation, ensure suitable warrantee on hardware.
 - (iv) All gaskets used in the system should be soft EPDM gaskets having longer life than any regular rubber gaskets.
 - (v) Drainage mechanism is to be provided with all parts of the window system so that no water can accumulate in the system. In addition to that drainage caps are also fitted over the drainage hole to drain out water against wind direction.

- (vi) Periphery sealing is to be done with the help of silicone sealant.

5.6.2. Type of Windows

(a) Sliding Windows

The sliding window is made up of two (or more) sashes that slide horizontally, to the left or right, on tracks. The sliding window can be made wider and taller with the addition of sashes. The sliders work on a 'ride over' mechanism.

Result: The track on which the sash slides is raised slightly above the ground, preventing dust from settling in the track. The dust-free track ensures a far smoother sliding motion when compared to conventional sliders.

(b) Casement Windows

The casement window opens inwards or outwards with the help of a sash that is fixed on outer frame. The design can vary from fixed, side hung or top hung.

(c) Combination Windows

Combination window is an integration of two windows of the same type (like casement- casement) or different types (casement-slider or fixed-slider).

5.6.3. Composition

Only CPE modified uPVC meeting the requirement of RAL RG 716/1 and DIN 7748/0803528 or equivalent shall be used. No reworked material is to be used in any profile; whether used internally or externally.

5.6.4. Profile Marking

The main frame profile shall be permanently marked at approximately 1 meter intervals with an identifying mark which enables the name of the profile systems supplier, date of manufacture and extruder to be identified without extraction of the window.

5.6.5. Quality Control

The extrusion process must be quality controlled and the appropriate standards relating to impact strength, technical performance and consistency.

5.6.6. Profile Construction

The profile depth should be minimum of 58mm with a nominal wall thickness, internally and externally of 2.8mm. The profile shall have a minimum of two sealed chambers for transoms and mullions and 3 sealed chambers for frames and sashes.

5.6.7. Internal Profile Drainage

The internal drainage shall be isolated from chambers into which reinforcements can be placed or through which frame fixing pass drainage shall be either through the base or alternatively to the face, concealed by face drainage caps.

5.6.8. Pressure Equalization

Pressure equalization for glazing rebates and for frame rebates shall be carried out in accordance with the recommendation of the profile Systems supplier to ensure efficient drainage in adverse conditions.

5.6.9. Window Performance:

Windows must meet the requirements with respect to air permeability, water tightness,

wind resistance, local extreme weather conditions and should be designed as per IS 875.

5.6.10. *Strength and Safety of Moving Parts*

The moving parts of the windows must have sufficient strength and robustness to withstand accidental static and dynamic loads in use, without any permanent deflection or breakage. The overall evaluation will be based on the experience from use and subject to approval by the Engineer.

5.6.11. *Glazing beads*

Glazing beads shall be of the one-foot snap in design and shall be extruded uPVC mitred at the corners. All glazing beads shall be with a co-extruded gasket of a multi-fin design to maintain security and weather performance. Gasket material shall be thermos-plastic elastomer.

5.6.12. *Glazing gaskets*

All glazing gaskets and weather seals are to be extruded from non-migratory EPDM. Glazing gaskets shall be of continuous length. Gasket may be subjected to random testing and shall be obtained from the profile systems supplier.

5.6.13. *Weather seals*

Weather seals shall consist of a double sealing system. Seals on the sash and the frame shall be of continuous length and for outward opening windows the seal on the sash shall be joined to a 50mm length of pressure relief seal at the bottom of the opening whereas the seal on the frame shall be joined on the top of opening.

Weather seals and pressure relief seals, which shall be obtained from the profile systems supplier, shall be capable of removal without disturbing the glazing systems or removal of the frame or sash.

5.6.14. *Glazing*

All glazing shall be internally beaded. Minimum glass thickness is to be 5mm thick and has to be selected considering the wind loads in the area and the location where the glass is being used. This has to be as per the Engineer. Glass type has to be considered as per IGBC Gold rating. The windows shall be constructed in such a manner that the glazing or deglazing can take place without the removal of the sash or frame.

5.6.15. *Welded joints*

All corner joints shall be homogeneously fusion heat welded in accordance with the instructions of the profile systems supplier. The resulting joints shall be finished by the grooving/knifing method. Solvent welded joints shall not be allowed.

5.6.16. *Reinforcement*

All transoms and mullions shall be fully reinforced, irrespective of size with corrosion resistant galvanized steel. All other profiles to be reinforced as per the specification of the profile systems supplier which shall suit the proposed style application relative to exposure, elevation and height above the ground level.

Reinforcing shall be secured by suitable screws in accordance with the instructions of the profile systems supplier.

All galvanized steel reinforcing profiles shall comply with BS 2989 1982 Grade G 275N or equivalent.

5.6.17. *Mechanical Joints*

The mechanical jointing of mullions and transoms shall be carried out in strict accordance with the instructions/recommendations of the profile systems supplier using only approved mechanical coupling components.

5.6.18. *Hardware*

All hardware shall be manufactured from corrosion resistant material and be approved by the profile systems supplier.

All ferrous screws, nuts, bolts and other fastening or fixing, shall be of stainless grade. Coating shall be either sherardized according to BS 4921 dichromate zinc plated and recommended for use in the fabrication of uPVC windows.

Metal that are in contact with each other shall be compatible so as to prevent galvanic corrosion of dissimilar metals by electrolytic action. All hardware should ideally be fixed by attachments through the uPVC to the reinforcement; alternatively, it should be fixed in purpose designed screw ports or at least two thickness of uPVC.

Hardware with provision for adjustment shall be accessible for adjusting after the window has been installed. Hardware used to open and close the window shall be replaceable without removing the outer frame from the structure.

(a) **Friction hinges**

Top hung and side hung opening out lights shall have two friction stays per light and be of stainless-steel construction.

The size of the friction stay will depend on size, weight, hanging and exposure of the relevant sashes. This will be determined from table provided by the hinge manufacturer.

All side hung friction stays are to incorporate a riser block to allow the sash to be supported in its closed position.

(b) **Butt hinges**

Where external butt hinges are used they must be of the security pin type which does not allow removal of the hinge pin from outside.

(c) **Espagnolette handles**

(d) **All espagnolette striking plates are to be purpose designed and secured to the outer frame by approved screw fixing. The espagnolette mechanism shall be of multi locking points depending on size.**

All ironmongery where possible shall be screwed into frame reinforcing, or fixing screws must penetrate a minimum of two wall thickness or an equivalent screw port, to obtain sufficient purchase.

5.6.19. *Fixing the Frame to the Building*

The gap between the structural opening and the UPVC frame shall be between 5 to 10mm all round, which should be filled by injectable Polyurethane (PU) foam after completion of fixing for best frame and wall bonding and for sound and thermal insulation and finally applying neutral cure low modulus Silicon sealant to make joint water proof.

Fixing points shall be to all four sides of a frame, spaced 150mm to 250mm from corners and not more than 600mm apart elsewhere. Fixing shall be by direct drilling 10mm hole through UPVC frame to building wall. Each fixing shall penetrate into building structure by no less than 40mm and ultimate fixing with anti-corrosive plated anchor bolts through these holes.

All heads of all fixing screws shall be covered with appropriate plastic cover caps.

5.6.20. *Warranty*

The contractor shall arrange a certificate of warranty against any manufacturing or installation defect, valid for 5 years for rectification of the defect.

5.7. *Woodwork and Joinery*

The provision of the latest revisions of the following I.S. codes shall form a part of the specifications

- IS 205 Specifications for non-ferrous metal butt hinges
- IS 287 Recommendation for maximum permissible moisture content of timber used for different purposes.
- IS 303 Specification for plywood for general
- purpose. IS 362 Specification for parliamentary
- hinges
- IS 419 Specification for putty for the use on window frames
- IS 883 Code of practice for design of structural timber in building.
- IS 1003 Specification for timber panelled and glazed shutters Part II - Window and ventilator shutters.
- IS1200 Method of measurement of building and civil part XXI Engineering works - wood work and joinery.
- IS:1341 Specification for steel butt hinges
- IS:1658 Specification for fibre hard boards
- IS: 1761 Specification for transparent sheet glass for glazing and framing purposes.
- IS: 3087 Specification for wood particle boards (medium density for structural timber in building)
- Other I.S. codes not specifically mentioned here but pertaining to woodwork and joinery form part of these specifications, along with CPWD specifications for all seasoning, workmanship, fitting and finishing.

5.8. *TIMBER FIRE DOORS*

5.8.1. This specification establishes the materials, constructional and performance requirements for all Fire Doors works used at any location.

GENERAL REQUIREMENTS

Joinery

All the specifications for building works shall conform to the latest Indian Standard Codes of practice unless otherwise specified for local material.

Any reference to Indian Standard Code of practice shall mean the latest version of the relevant standards issued, upto the date of receipt of tender documents.

All the work shall be carried out in a workman like manner to the entire satisfaction of the Employers Representative. The work shall be guaranteed in quality of material and workmanship.

Variations in the specifications shall not be permitted unless they are agreed by the Employers Representative in writing.

In the absence of any specifications / relevant code of practice for any material or workmanship, the National Code of Practice shall be followed in consultation with the

Employers Representative

Submissions Required Prior to Fabrication

Submit to the Employers Representative/Engineer before fabrication, complete system description including the following information:

Name of the manufacturers of products.

Names address and telephone numbers of local representatives for products.

Types, model numbers and names of products, and indication whether products are "off the shelf" or custom fabricated. Include specific information on finishes - thickness, patented process name, process description and test data.

Detailed information on products to be manufactured specially for this project if required.

Detailed system description including standard details and manufacturer's literature; and large- scale details of specially fabricated products.

Statement that the proposed system meet the regulatory requirements, and all construction and warranty requirements specified; noting in detail any exceptions.

Shop drawings: Provide Shop drawings showing the following information where appropriate to the items. Layout (sectional plan and elevation of complete assembly)

Full size section of members.

Methods of assembly, type and location of exposed non-corrosive screws. Methods of installation, including fixings, anchorage, caulking, flashings. Junctions and trim to adjoining surfaces.

Fittings and accessories

Sealants: Submit manufacturer's product specifications, handling, installation/curing instructions and performance test data sheets for each elastomeric product proposed. Submit test report certificates for elastomeric sealants on aged performance, including hardness, stain resistance, adhesion, cohesion or tensile strength, elongation, low-temperature flexibility, compression test, modulus of elasticity, water absorption, and resistance to ageing, weight loss, deterioration through exposure to heat, ozone and ultraviolet light.

Samples: The Contractor shall fabricate and install full size specimens of the Doors as called for by the Engineer in Charge at the expense of Contractor.

Warranty: The installation shall be guaranteed against faulty workmanship/ materials, etc. for a minimum period of TEN YEARS from date of completion. All faulty materials/workmanship shall be replaced and restored to full operation at no cost to Owner within the guarantee period.

FIRE DOOR

Fixing of fire resistant 120min rated proprietary make timber door with Timber frame profile of size & finish as specified in the drawings.

The frames shall have Provision for 4 nos. anchor bolt fasteners on each vertical jamb; 3 mm thick base plate pre-punched cut outs to receive ironmongery. 3 mm thick hinge back plate pre- drilled to receive hinge screw. The frame shall be in three pieces bolted at top jamb to vertical jamb for direct installation at site. All cut outs including hinge plates, strike plates have mortar guard cover. The frame shall be primed with zinc phosphate staving primer and finished with fire retardant paint of approved colour.

The timber door shutter shall be constructed out of sandwiched non combustible boards and finished with 15mm hardwood edge band on all four edges. Shutters shall not have any visible screws or fasteners on either face. The door construction shall be proprietary fire retardant & heat insulating suitable for Stability, Integrity and

Insulation, type tested at CBRI Roorkee as per IS 3614 part II and BS 476 part 20. Shutters have 18mm x 3mm shielded intumescent strip on the three edges except the bottom. The thickness of the shutter shall be 50mm. The shutter shall be primed with wood primer and finished with synthetic enamel paint of approved shade.

The door shall be complete with ironmongery such as Stainless Steel Ball Bearing Hinges, SS D-Pull Handle, SS Push Plate, Mortice lock with Escutcheon and pin cylinder, Heavy Duty Door Closer, etc.

The double shutter door shall be additionally provided with Flush Bolts and Easy Clean Floor Socket

Shutters

Fire rated shutters should be proprietary fire resistant double walled timber panels finished on all four sides & confirming to code.

The overall thickness of fire rated shutters should not exceed 45mm for ½ hour rated doors 50 mm for 1 hour rated doors and 60mm for 2 hour rated doors and should confirm to the code.

Flushed double skin shutters with fire resistant infill material confirming to code requirements shutters to have no visible screws or fasteners on either face.

The infill material is to be resin bonded honeycomb kraft paper with thermal insulation and is bonded to the inner face of the shutter.

Shutters are to be fabricated in factory with pre-punched cutouts and reinforcements to receive ironmongery.

Shutters to have pre-drilled hinge plated with hinge guard covers, concealed lock box with fixing brackets and pre-tapped holes.

Shutter to have door closer reinforcement pads provided at appropriate location.

Shutters are to be suitable cleaned and etch primed with zinc phosphate primer, minimum 35 microns dry film thickness.

Shutters are finished with premium quality thermo setting paint in RAL 9001 gray shade semi glossy finish, minimum 35 microns dry film thickness

Shutters are finished with premium quality fire resistant hard wood veneer and semi-glossy finish melamine polish (min 35 microns dry film thickness)

All fire rated shutters to be provided with intumescent strips on three sides (top & both sides) as per the fire code requirements.

VISION PANEL FOR FIRE DOORS

Vision panel to be of size as mentioned in detailed drawings, - thickness to withstand 2 hours fire rated clear wired borosilicate glass make: Pyran

IRONMONGERY

The sets shall be as indicated and to be used for the respective doors, and indicated in the joinery drawings.

IRONMONGERY SETS

All locks shall be master keyed floor wise and grand mastered for the whole building. All cylinder locks shall include strike plates. The Ironmongery shall consist of sets as defined in the detailed drawings with the following typical items.

Butt hinges—brush steel finish

Mortice cylinder dead lock—brush steel

finish D type pull handles brush steel finish

Push Plates-~~brush steel finish~~
 Flush bolts-~~brush steel finish~~
 Over head door closer-~~brush steel finish~~
 Easy clean floor socket-~~brush steel~~
 finish)
 Provision for Access controlled locking system- brush steel
 finish Mortice Cylinder dead lock with lever handle
 Panic bars- Dorma or approved equivalent
 Mortice Cylinder dead lock with snib
 Mandatory Signage as per the Code/NBC

2016. ACOUSTIC PERFORMANCE

Wooden doors have to guarantee acoustic performance, special attention should be paid in the all-around door's perimeter. In order to avoid weakening the sound insulation of walls, all the acoustic doors, shall have an all-round rubber seal (acoustic kit) and when higher acoustic performance is required, a helical door hinge to ensure the right seal in the bottom side.

5.9. Plywood

All cabinets would be of Boiling Water Proof Plywood confirming to IS:710.

5.10. STEEL FIRE DOORS AND FRAMES

ACOUSTIC PERFORMANCE

Doors have to guarantee acoustic performance, special attention should be paid in the all-around door's perimeter. In order to avoid weakening the sound insulation of walls, all the acoustic doors, shall have an all-round rubber seal (acoustic kit) and when higher acoustic performance is required, a helical door hinge to ensure the right seal in the bottom side.

Steel fire doors & frames & assemblies.

Vision Panels, frame trim in

doors. 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.

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 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 shall 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.

Products

Manufacturers

As per approved

list Materials

Steel Sheet, General: Thickness dimensions, including those referenced in IS 277, are minimums for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

Honeycombed Kraft paper core. Borosilicate clear toughened Glass.

Primer: Manufacturer's standard rust-inhibitive primer, suitable as a base for specified finish paints such as Zinc Phosphate Stoving Primer (35 microns DFT)

Thermosetting Paint (35 microns DFT)

Anchors and Accessories: Manufacturer's standard units suitable for type of wall construction, and as follows.

Provide square profile stops with mitered corners for glazing. Use galvanized items for units built into exterior walls.

Provide countersunk flat or small oval head fasteners where exposed to view.

Doors and Frames

HOLLOW METAL FIRE DOOR (2 Hours Fire Rating) WITH HONEY COMB CORE

Fire door shall be 2 hour fire rated and door quality shall be approved by CBRI and tested conformed to IS : 3614 Code or its Equivalent British Standard.

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.

Frame

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.

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 frame preparations Frames to be provided with 3 mm thick back plates on all jambs with provision for anchor bolt fixing to wall openings. All frames to have reinforcement pads for fixing of door closer, at appropriate location as per manufacturer's details.

Frames to have factory finish-pre-punched cut outs to receive specific hardware and iron mongery.

Frames to be provided with hinge plates 3 mm thick pre-drilled to receive hinges for screw mounted fixing. All cut outs including hinge plates, strike plates to have mortar guard covers from inside to prevent cement, dust ingress into cut outs at the time of grouting.

Frames to have rubber shutter silencer on strike jambs for single shutter frames and on the head jambs for double shutter frames.

Finish

Door frames to be suitably cleaned with solvents and etch primered for receiving primer and top coats. Door frames to be primered in zinc phosphate stoving primer (35 microns DFT).

Door frames to be finished in thermo setting Polyurethane Paint (35 microns DFT) of approved colour and make as specified.

Fire door shutter

Material - Fire door shutter to be manufactured from 1.25 mm (18 gauge) galvanized sheets conforming to latest IS : 277 Code of GPL Grade with Z 120 coating or its Equivalent British Standard.

Manufacture - Shutters to be press formed to 46 mm thick double skin hollow door with lock seam joints at stile edges. Shutters to have no visible screws or fasteners on either face. Internal reinforcement to be provided at top bottom and stile edges for desired fire rating.

Door Shutter Cores Shutters to be provided with honeycomb kraft paper core to be bonded to the inner faces of the shutter.

Door shutter preparations Shutters to be factory prepared with pre-punched cutouts and reinforcements to receive iron mongery as per final finish hardware schedule. The shutter should have an interlocking arrangement at this stile edges for flat surface on either side.

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 for Fire rated door

Vision panel to be provided with Borosilicate Clear Toughened Glass of the thickness 6 mm for upto 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 primed for receiving primer and top coats. Shutters to be primed 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 type specified that produces a door complying with CBRI tests.

Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom. Clearances for Fire-Rated Doors: As required by IS 3614.

Single Acting, Door-Edge Profile: Square edge, unless beveled edge is indicated. Tolerances: Comply with by IS 3614.

Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hotrolled steel sheet.

Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to IS 3614 on fully operable door assemblies.

Unless otherwise indicated, provide thermal-rated assemblies with U-value of 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) or better.

Sound-Rated (Acoustic) Assemblies: Where shown or scheduled, provide door and

frame assemblies fabricated as sound-reducing type, tested according to IS 3614.

Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with requirements as per good practice for door and frame preparation for hardware.

Door frame preparation:

Frames to be provided with 3 mm thick back plates on all jambs with provision for anchor bolt fixing to wall openings. All frames to have reinforcement pads for fixing of appropriate location as per manufacturer's details.
door closer, at

Frames to have factory finish-pre-punched cut outs to receive specific hardware and iron mongery.

Frames to be provided with hinge plates 3 mm thick pre-drilled to receive hinges for screw mounted fixing. All cut outs including hinge plates, strike plates to have mortar guard covers from inside to prevent cement, dust ingress into cut outs at the time of grouting.

Frames to have rubber shutter silencer on strike jambs for single shutter frames and on the head jambs for double shutter frames.

Door shutter preparation:

Shutters to be factory prepared with pre-punched cutouts and reinforcements to receive iron mongery as per final finish hardware schedule. The shutter should have an interlocking arrangement at this stile edges for flat surface on either side.

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 flush fixing at site.

For shutter with door closer reinforcement pads to be provided at appropriate location as per manufacturer's design.

Frame Construction: Fabricate frames to shape shown.

Fabricate interior knockdown, drywall slip-on frames for in-place gypsum board partitions.

For exterior applications and frames installed in masonry, fabricate frames with mitered or coped and continuously welded corners, rabbets, stops, and seamless face joints. Provide welded frames with temporary spreader bars.

Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

Locate hardware as indicated on Shop Drawings or, if not indicated, according to the following: Hinges:

Bottom Hinge: 255mm from door bottom to bottom of

hinge. Top Hinge: 125mm from door top to top of hinge.

Centre Hinge: Centre between top and bottom hinge.

Extra Hinge: 150mm from bottom of top hinge to top of extra

hinge. Lock: 965mm from finished floor to centre of lever or

knob.

Push Bar: 1120mm from bottom of door to centre of bar.

Push Plate: 1120mm from bottom of door to centre of plate. Pull Plate: 1065mm from bottom of door to centre of pull. Exit Device: 1010mm from finished floor to centre of pad. Deadlock Strike: 1120mm from floor, centered.

Glazing Stops: Manufacturer's standard, formed from 0.8-mm steel sheet.

Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.

Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors. Astragals: As required by applicable standards to provide fire ratings indicated.

FINISHES

Shutters to be suitably cleaned with solvents and etch primed for receiving primer and top coats. Shutters to be primed 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.

Execution

Door frame fixing

The door frames should be assembled adjacent to the place of installation as the frames are not designed for transporting in an assembled condition. After assembly it is to be ensured that all threaded preparations are covered from the back of the frame using self adhesive strip to prevent penetration of mortar back-fill into screw threads. The head member of assembled frame shall be positioned against jambs ensuring correct alignment and secured using M8 x 20 long plated bolts together with nuts spring and flat washers. The assembled frame shall be kept in position within the opening by means of bracing. In order to correctly position the frame against finished floor level or equalise on adjustable floor anchors where specified, shim shall be used under jambs. The frame shall be checked for squareness, alignment, twist etc. with carpenters bevel and plumb.

A tie rod shall be fixed to the frame during installation to ensure the correct dimensions between the frame rebated and the same may be removed after installation.

Where a 2nd fix application is required a shim detail is suggested to take up gap between frame and existing opening.

Existing masonry wall openings Metal expansion shields Brace, position, level etc. Mark all positions of fixings on wall.

Remove frame and drill wall to appropriate specified size. Fit rod anchor shells metal expansion bolts into the wall. Fit jamb spacer bracket into back of frame profile. Reposition frame back into opening and realign.

Lightly screw machine screws into shells, shim behind frame.

Slowly tighten screws continually checking plumb, square etc. Finally ensure frames are not deformed as tightened.

After fixing the frame shall be grouted with cement mortar 1:3 or Plaster of Paris or Gypsum powder as approved. Gap between frame and wall to be closed by cement pointing using cement mortar 1:3. Back full the frame through holes provided and insert nylon plugs.

Door shutter fixing

Fix all the hardware to the door shutter like hinges, flush bolts, bolts, mortice locks, door closer, door stoppers, handles etc. with the appropriate screws and bolts supplied.

The shutter is to be then fixed to the frame which is already installed. Align the shutter to match the hardware to the cutouts in the frame. Tighten the hinge screws. iii Application of Fire / Smoke UL 10 C / UL 1784 (2001) classified seal (for smoke check if specifically required)iv. Astragals: As required to provide fire ratings indicated.

ADJUSTING, CLEANING & CALIBRATION

Cleanup: Remove excess weld splatter by grinding flush with adjacent surfaces, without grinding skips or gouging parent metal. Refer to Section 09900 - Paints and Coatings for surface preparation, primer and field applied finish coats.

Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer & apply final finish wherever required.

Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

Manufacturer/Distributor's Field Services: After installation is complete, provide the services of hardware supplier's AHC for an inspection. AHC shall inspect completed door openings to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final approved submittals. Further adjust hardware as necessary during inspection Perform inspection in the presence of the Engineer and Owner's maintenance personnel.

Check closers to ensure proper operation.

Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

a. Verify levers are free from binding.

Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning. Report findings, in writing, outlining corrective actions and recommendations.

Final Adjustment: Whenever hardware installation is made more than one month prior to occupancy of a space or area, as applicable, return to work during the week prior to occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for operation of heating, ventilating and cooling equipment.

For door closers, provide final adjustment of door closers to ensure that all doors close and latch properly to prevent false door held alarms or intrusions and compliance with maximum opening pressure.

Adjust closer to complete full closing cycle in less than 4 to 6 seconds without abrupt change of speed between "sweep" and "latch" speeds.

Adjust "back-check" according to manufacturer's instructions.

Power Up and Test: Provide powered up testing of doors in the presence of the installer of electrified hardware, as applicable, to ensure final adjustments to electrified components.

maintenance of hardware and hardware finishes. This training shall be coordinated with training conducted in accordance with Demonstration and Training.

5.11. *Aluminium Louver System - for pipe covering in stilt areas and shafts on typical floors.*

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 such as 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.

OUTLINE SPECIFICATIONS LANDSCAPE

5.12. *OUTLINE SPECIFICATIONS LANDSCAPE*

5.13.1. GENERAL SPECIFICATIONS FOR HARDSCAPE WORKS

- (a) All works and finishing will be in accordance with latest (Central Public Works Department) CPWD specifications 2019 and all annexure and schedules are in variation to these specifications. All deviations from CPWD Specifications are listed, and detailed technical specifications have been provided for the same.
- (b) These specifications are for work to be performed, items to be supplied and materials to be used in the design and construction works as shown and defined in the drawings/finishes in the attached annexures and herein to the satisfaction of the Employer/ Engineer in Charge
- (c) If specifications for any item of work or material is not available either in the CPWD Specifications, or in the Specifications herein, the relevant IS specifications or NBC 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 of a high standard and quality. The contractor shall take all steps necessary to address deficiencies, if any, identified by the Engineer, or his representative. 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 as stated in general specification 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 Employer / Engineer and conform to the specification and approved list of items from manufactures and suppliers. The contractor shall produce all invoices, vouchers or receipts for any materials if called upon to do so by the Employer/ Engineer.
- (f) After contract award, a sample of all landscaping materials under this specification is to be submitted to the Employer/ 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 or specified, 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. The manufacturers having ISI marked material shall be preferred.
- (h) Perform all work in conformance with all applicable local codes and ordinances, and comply with best practice structural requirements, and relevant design codes and guidelines.
- (i) The contractor is required to be familiar with the specifications and the requirements and shall maintain uniform quality and consistency in workmanship throughout the execution of the work.
- (j) The Employer has provided a list of designs and specifications. The Contractor is

required to develop the concept design further, by employing qualified and competent architects, horticulturists & engineers etc. for the full and thorough schematic design, detailed design and good for construction drawings for implementation of the project.

- (k) Prior to the start of any construction works on site, the contractor should make sure that the below listed items have been executed.
- (i) Site investigation for obtaining all the information on the nature of the site, weather, environmental and soil conditions;
- (ii) Site investigation shall include, but not be limited to:
- All existing features identified to be retained should be managed and handled in accordance with the below listed procedures.
 - Existing features include hard landscape structures as well as trees and other soft landscape features and elements.
 - No structural elements should be removed/ relocated without written permission of the Engineer.
 - All protected elements should be clearly identified and labelled; the Contractor's site team should be aware of all the items to be protected.
 - Identify areas of limited access, incomplete work by others or any other issues which may hamper the execution of the softscape works;
 - Locate and identify all known land and water contaminants;
 - Recommendations for further investigations
- (l) Unless otherwise noted, protect all trees and any other vegetation within, or near the sites where landscaping works are underway. Replace any vegetation damaged by the works with specimens of equal or better quality, size and species;
- (m) Notify the Engineer at least 3 days prior to all required field observations, inspections and approvals;
- (n) Prior to the any works on site the contractor shall prepare and submit a Site Clearance Plan which will include, amongst other items, a demolition plan & tree protection and removal plan.
- (o) Submit samples of paving, fixtures, fittings and other specified landscape materials to Engineer. Obtain Engineer approval and ensure compliance to the schedule of finishes prior to bulk procurement and supply to site. For bidding purposes, the Contractor shall base his/her bid on the suppliers and materials (with options) as listed in this specification. After award of contract award the contractor may propose alterations or substitutions where these will result in a betterment or added benefit to the Employer. Alteration or substitution of materials, fixtures or fittings without agreement and written approval from the Engineer is not permitted.
- (p) Prepare mock-ups for all specified or detailed paving types and layouts, kerbs, manhole covers, paving, lighting, furniture, signage (to scale) for review by the Employer.
- (q) All materials (hardscape, signage, furniture etc.) to be delivered on site in packaging that should not allow for cracks, chippings or discolorations of the material.
- (r) Ensure all surfaces including mounded landforms are smooth and evenly transitioned between contours or spot levels as noted. Fall landform and hard surfaces as shown on drawings, ensure no ponding occurs. Earthworks are

to be inspected and approved by the Engineer before planting or surface finishes are applied.

- (s) The contractor shall design the landscape area with proper drainage for both hard and soft areas. The contractor will verify the surface drainage of all planting areas and notify the Engineer of any discrepancies, obstructions, or other conditions considered detrimental to proper execution of the work and plant growth.
- (t) Ensure that landscape drainage systems are free from silt, debris and obstructions, and are freely running during, and upon completion, of the contractor's work.
- (u) Install surface drainage components to ensure positive drainage falls to all inlets. Ensure all drainage grates and support structures are suitable for vehicles and traffic loads. All grates and frames to be either galvanized finish or stainless steel, unless noted otherwise.
- (v) Prior to completion of landscape works, ensure satisfactory operation of all materials and fixtures, including pavements, furniture, structures, lights, irrigation and drainage. Ensure all plants and turfs are healthy and growing.
- (w) Submit to the Employer, Operations Manuals, based on manufacturer's recommendations describing operating and maintenance procedures for materials and fixtures including irrigation, electrical works, water features, paint systems, and gardens and lawns maintenance procedures.

Kerbs & Edges

This section of the specification covers the general requirements for kerbs and edges (along roads, planting beds, sand beds and any other material change interface) and allied works including all materials, labour, curing, tools etc. Road kerbs shall comply with the specifications outlined under the Section Kerbs in the Road Specifications document.

General:

All the kerbs & edges are to follow the following specifications:

- (a) Cast in situ kerbs shall be closely monitored for quality of mix, labour and curing, all Precast Kerb units to be delivered on site in packaging that should not allow for cracks, chippings or discolorations of the material.
- (b) Kerb sizes (in the case of precast), colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow the Tender design Document recommendations unless otherwise specified.
- (c) Fixing of the kerb and any structural related details shall be as per the contractor's detailed design and specifications.
- (d) Contractor shall reject any kerb units that do not comply with the above requirements. The Engineer shall reserve the right to reject the inaccurate products.

Execution:

- (a) All works shall be executed in accordance with relevant CPWD specifications unless specified.
- (b) Cutting to be neat and accurate, without spalling. Form neat junctions with minimum cut. If minimum cut is not possible then the contractors shall use oversized unit;
- (c) Units to be positioned true and levelled along the top and front faces, in a mortar bed placed on accurately prepared subgrade.

- (d) The ends of units shall be buttered with bedding mortar as laying proceeds. Joints shall be completely filled, tightly butted and surplus mortar removed immediately
- (e) After bedding has set, secure units with a continuous haunching of concrete;
- (f) Deviation in finish kerb levels should be no more than 5mm, horizontal and vertical alignment should not exceed 3mm in 3m.

Preservation of Trees General Notes

- (a) No existing trees should be cut/ pruned without written permission of Engineer or his representative.
- (b) All works shall be carried out in coordination with experienced horticulturalist;
- (c) All works related to existing trees shall be in accordance with relevant local norms and regulations;

Trees to be removed

- (a) Any existing trees identified as "to be removed" or any dead trees shall be removed;
- (b) Contractor shall cut and fell, as close to the ground as possible;
- (c) Trunks to be cut to convenient lengths;
- (d) Root stumps shall be removed to a minimum depth of 800mm below ground level;
- (e) Any debris or material that comes from the above works shall be utilized in accordance with waste management plan.
- (f) All works shall follow health and safety procedures.

Trees to be retained

- (a) Trees to be retained shall be identified as "to be retained";
- (b) All retained trees should be clearly identified and information signs should be displayed on site in prominent positions at each entrance;
- (c) All retained trees shall be marked by visible, durable tags, lettered to tree number or symbol (if any) on the drawings.
- (d) Trees should be fenced off the works area if possible, in all cases tree trunk and roots should be protected from site works;
- (e) Protected area should be in a shape of a circle around each tree with radius of half the tree's height, measured from tree trunk.
- (f) Do not allow for soil compaction under the tree;
- (g) Do not store any materials or site equipment under or near the trees.
- (h) Do not allow for any vehicles to be parked near retained trees or to pass under the trees;
- (i) Prevent damage to tree bark; do not attach any items to trees.
- (j) Do not expose tree roots;
- (k) Do not fill against tree trunks, even temporarily;
- (l) Open excavation under tree canopy should be carried for as short period as possible. If exposing roots is necessary, temporarily line with polyethylene sheet to reduce evaporation;

- (m) Use only hand methods to locate, expose, and cleanly remove the soil around roots on the line of excavation. Root systems should be preserved intact.
- (n) When it is necessary to cut the roots bigger than 25mm diameter, make sure the cutting does not disturb remaining root system. Cut should be smooth with no ragged edges. Cut surface should be immediately treated with bituminous fungicidal sealant.

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:
 - (i) Watering every alternate days @ 20 litres /watering cycle
 - (ii) Applying FYM @ 10kg/ tree/ annum
 - (iii) Trimming, pruning as & when required under guidance of the site-in-charge etc.
 - (iv) 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.
- (b) The Lawn should be regularly mowed and maintained as good green carpet.

GENERAL SPECIFICATIONS FOR EXTERNAL LIGHTING

General Specifications

This section of the specification covers the general requirements for all works including all materials, labour, and the form work, to be used in the

All site furniture, signage & lighting are to follow the following specifications:

- (a) Design details and materials as outlined in the Tender Design Document.
- (b) Material quality and details to Engineer's specification and to comply with SP 72 (2010): National Lighting Code 2010 [ETD 24: Illumination Engineering and Luminaries];
- (c) Prior to execution the contractor shall submit shop drawings for the Engineer's approval. Approval period for the Engineer shall be limited to 21 days. Shop drawings to include material detail specifications, fixing details and any other relevant information;
- (d) After contract award, the Contractor shall submit samples of all material types in specified colours, finishes and with any special features (if applicable) for approval of the Engineer prior to commencement of works.
- (e) All items should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance;
- (f) Sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow the submitted Tender Design Document and the approved shop drawings;
- (g) Installation on site and any structural related details should be included/ Contractor's addressed in the final specifications. This shall also be included in the shop drawings for the Engineer's approval;
- (h) The Contractor shall reject any units/material that does not comply with the above requirements. The Engineer reserves the right to reject the inaccurate products or any products that do not meet approved specifications.

External Lighting

Exterior lighting performs a number of functions related to night-time safety, security, pathfinding, and illumination of Base landmarks or special features.

- (a) In lighting, as in signage there is a hierarchical order of priority: at the highest priority level, activity areas and primary walkways should be lit to become the focus of pedestrian activity after dark; at the lowest level of priority one may find.
- (b) Site illumination enhances the safety of traffic and pedestrians crossing; it is used to provide warnings about hazards and helps increase security and reduce vandalism.
- (c) All materials and installation shall conform to the latest National Electrical Code and all applicable local codes.

Materials & Durability

Outdoor lights should be sturdy and made from materials that resist corrosion and wear. Powder-coated finishes have long-term resistance to the outdoor elements while soda lime glass stays tough throughout the seasons. LED path lights are highly suggested, as they keep costs low with reduced power consumption and burn cool with options in color temperature.

- (a) For street lighting, IP65/IP66 luminaires should be used to ensure sufficient resistance to dust, particulates and inclement weather. [IEA]
- (b) As outdoor luminaires may be hit by falling tree branches or other debris in strong

winds or even may be subject to outright vandalism, a minimum of IK08 is recommended.

Quality criteria

Quality criteria describe essential aspects such as luminance, light colour, colour rendering, light distribution, flicker, glare and others. Refer Electrical specifications given by MEP team.

Safety criteria

Luminaires for street lighting must be protected against foreign matter (both solid and liquid), mechanical impacts as well as voltage fluctuations in order to guarantee their continuous proper operation. For this purpose, requirements on ingress protection, impact protection and voltage protection are typically specified.

Procurement

The procurer shall specify the streets and paths for which the street lighting system will be designed, or lighting system components shall be procured. The system shall be specified based on the standard IS 1944 and EN13201. Among others the procurer shall specify:

- (a) Illuminance levels
- (b) uniformity levels
- (c) lighting system maintenance factors

Installation

For installation on a foundation please observe the following:

- (a) The foundation and parts of the product in contact with soil, must not be covered by soil or in contact with aggressive chemical elements.
- (b) The size of the foundation depends on the topography, condition of the soil and must be determined as per site conditions.
- (c) We recommend to drain the mounting area to ensure no water logging at all times, also considering durations of heavy downpour.
- (d) Height of foundation above ground level may be revised to suit the site conditions especially considering the expected water level stagnation.
- (e) Template supplied is suggested to be used for locating the center to center (CC) distance of foundation bolts
- (f) Cable has to be routed through the bottom base plate (cable entry hole)
- (g) It is absolutely essential to use the enclosure gasket if provided in correct position, else the IP rating of the luminaire will be compromised.
- (h) Insert luminaire into the mounting plate and fix with non-corrosive 304-grade stainless steel screws.

External Lighting Typologies

Streetscapes Lighting

Designing and implementing a roadway lighting system requires evaluating many factors: visibility, economics, aesthetics, safety, environmental conditions, materials, space geometry (width of roadway, kerb location, etc.), pavement reflective properties, extreme grades and curves of roadway, intersections, landscaping, etc.

A general guideline to follow when implementing a roadway lighting design:

- (a) Determine the classification of roadway, area, and pavement to establish the set of lighting standards /local codes that needs to be followed.
- (b) Per luminaire choice, design geometry of space including mounting height and pole spacing, etc.
- (c) Street lighting needs to be consistent and conform to the street hierarchy on Base.
- (d) For all 4 lane roads, use regularly spaced, single luminaries 12m high in an opposite arrangement on either side of the carriageway no street lights shall be located within the central median.
- (e) For details of pole spacing and illumination refer to National Lighting Code SP:30: 2011 (Part 5)
- (f) For details of pole spacing and illumination refer to National Lighting Code SP:30: 2011 (Part 5); and
- (g) The luminaires will operate with an IP66 rated with LED lamps.
- (h) Light poles should be coordinated with other streetscape elements, and utility equipment both above and below ground, should be coordinated when placing lighting fixtures.

Parking Lots Lighting

Parking lots share similar characteristics that should be considered when implementing a lighting design. These include traffic locations, security /emergency lighting locations, vertical/horizontal illuminance levels, color rendition, uniformity, glare, and obtrusive light.

General guidelines to follow when designing a parking lot lighting system:

- (a) Maintain illuminance levels at entrances to at least match surrounding public lighting.
- (b) Choose an appropriate luminaire that has proper color rendering capabilities according to local ordinances and appropriate shielding/reflectors to reduce glare and obtrusive light.
- (c) Per distribution of chosen luminaire, design geometry of parking lot system including mounting height and spacing to achieve required uniformity.
- (d) Incorporate safety lighting into design to abide by local and building ordinances.

5A206.6.4

Pedestrian Spaces Lighting

A common use of lighting is to illuminate spaces designated for pedestrian use. Adequate lighting can prevent accidents, assist police protection, and facilitate pedestrian traffic flow. Ideally, these things can be achieved while allowing for energy savings through the effective application of light. Below are site-specific recommendations for several spaces designated for pedestrian use.

Illumination levels for streetscape projects that provide full pedestrian lighting on sidewalks should have a minimum average illumination level as per National Electrical Codes. The uniformity ratio should be designed for 3:1.

The IP rating of the connector between fixture and main cable must be equal to or greater than the IP rating of the Luminaire.

5A206.8 Execution

- (a) Installation and Fixing of all lighting shall be as per the manufacturer's requirements/specifications, and the contractor's specification.
- (b) All works shall be executed in accordance with CPWD specifications and Tender design Document.
- (c) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and strong winds, sun, heavy rainfall, especially during monsoon season.
- (d) During installation avoid damage to already executed works (paving, edging, wall cladding etc.). Any faults should be corrected to same quality and appearance.
- (e) After installation leave the area clean and tidy, do not leave any elements, tools or materials on site. Any waste should be handled in accordance with waste management plan.

OUTLINE

SPECIFICATIONS CIVIL STRUCTURES

5.13. OUTLINE SPECIFICATIONS CIVIL STRUCTURES

5.14.1. Earthwork in excavation and filling - General

5.14.1.1. Scope

This specification covers the general requirements for Excavation and Filling Works to be carried out at the site.

5.14.1.2. General Requirements

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 neighbouring properties, etc.

5.14.1.3. Related Work

The Contractor shall provide all labour, equipment, materials and any incidentals necessary to complete all aspects of work included in the drawings and specifications.

- (a) Clearing, grubbing and removing all vegetation from the site.
- (b) Earthwork in excavation including disposal of the excavated material and necessary dressing to make surface ready to receive binding.
- (c) Stacking of excavated earth within the site to make use of it for backfilling. (d) Filling and back filling and compaction of fills.
- (e) Removal and disposal of surplus material.
- (f) Stone soling to roads and paving and necessary shoring to protect sliding of earth.
- (g) Dewatering works till the number of slabs as instructed by the Structural Engineer are constructed.
- (h) Any temporary Cast-In-Situ Concrete works

5.14.1.4. Codes and Standards:

The following standards shall be followed:

S. No	Code	Description
1	IS: 3764-1996	Excavation Work-Code of Safety
2	IS: 1498-1970	Classification and identification of soils for general engineering purposes
3	IS: 1200-2002-Part 1	Methods of Measurement of Building and Civil Engineering Works - Earthwork

S. No	Code	Description
4	SP27	Handbook of method of measurement of building works
5	British Standard 1377	Methods of test for Soils for Civil Engineering Purposes
6	British Standard 5930	Code of Practice for Site Investigations
7	Local Building Regulations and Statutory Regulations	

5.14.1.5. Definitions

- (a) Clear: The removal of trees, scrub and artificial obstructions including fences, concrete slabs, kerb and channel, remains of old buildings and the like.
- (b) Grub: The removal of tree stumps and roots.
- (c) Topsoil: Topsoil is all surface soils which have sufficient humus to support plant growth without resort to artificial fertilization.
- (d) Cut: A general term for 'in place' material removed by digging from the ground. The term 'excavation' or derivatives thereof may be used interchangeably.
- (e) Fill: A general term for material spread and compacted over the ground to make up finished levels or levels to sub-grade. The term 'Embankment' or derivatives thereof may be used interchangeably.
- (f) Sub-Grade: The finished, trimmed and prepared surface of the earth works completion of all cut and fills operations. The term 'formation level' or derivatives after thereof may be used interchangeably.
- (g) 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.
- (h) Base course: A selected filling layer spread and compacted to levels immediately below road wearing course.
- (i) Spoil: Excess cut material remaining at the end of filling operations.
- (j) 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.

5.14.1.6. Site Preparation

A) Site Inspection Preamble

Any Site details or site information included in the Contract documents or Drawings are provided for the Contractor's guidance only. The information provided may not be a complete 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.

B) 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.

C) 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.

D) Setting Out And Clearing Of The Site - Rates To Include.

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.

E) 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.

F) 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/Alluvial Soil

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.

G) *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 Chiselling, 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.

H) *Classification of Soils - Rates to Include:*

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.

1) 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 Engineer in Charge. 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 Manufacturer's specification, and it shall be restricted to the quantity required to enable the 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.

2) Excavation in Soft / Ordinary Rock

In ordinary rock, excavation shall be carried out by crowbars, pick axes 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.

3) Method Of Excavation - Rates To Include:

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.

L) 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 Engineer in Charge. If excavated to greater length, width or depth or required, the extra work occasioned thereby, shall be done at contractor's expenses. Extra than shown

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 Engineer in Charge 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.

M) *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.

N) *Disposal / Carting Of Surplus Earth - Rates To Include:*

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.

O) *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 make shift arrangement.

p) Shoring And Strutting - Rates To Include:

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.

q) Protection - Rates To Include

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 remove the surface and 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.

R) Earthwork Fills

a) Methodology for Depositing Fills

1) General filling

- Selected filling material as per BOQ from a 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.

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.

3) 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.

4) 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 limits
- (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

c) Classification

- 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:

5) Frequency of Tests

i Structural Fill:

- a) One test for each 500 Cum. placed.
- b) One test whenever there is a change of gradation or placement conditions.

ii 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.

iii 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 out side
- 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.

iv Material Specifications for Fill and Water

a) 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.

b) 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.

c) 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.

d) 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.

e) 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 with approved material all at the Contractor's expense.

f) Treatment of Formations

Treatment of formations generally includes:

- Trim excavations to required profiles and levels.
- Remove all loose material.

g) Excess excavation:

- Backfill any excavations taken deeper than required with shall be filled with mass concrete.
- Where such excess excavation is carried out without approval, necessary extra backfilling shall be at the contractor's expense.

h) 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.

i) 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 tonnes 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 seven tonnes, spread over at least three 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)
“Determination of the density of soil on the site – Sand replacement test”	
Standard Maximum	BS 1377: 1975 Clause 4.1 Test 12 (or as
updated) Dry Density	: Determination of dry density/ moisture
content	
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 at least 24 hours' notice of when formations will be 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-time presence of the Contractor's 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.

Table for compaction requirements

Fill Materials	Min. Passes	Min. Energy*	Min. Compaction
General Fill	3	4550 Kg	95%
Structural Fill:			
Confined spaces	4	1150 Kg	95%

Open spaces	3	4450 Kg	95%
Crushed stone:			
Confined spaces	4	1150 Kg	-
Open spaces	3	4450 Kg	-
Catch	3	4450 Kg	95%

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.

j) Rates To Include For Excavation Items

Apart from other factors mentioned elsewhere in this Contract, rates for the item of excavation shall also include for the following:

- Clearing site.
- Setting out works as required.
- Providing shoring and shuttering to avoid sliding of soil and to protect adjacent structures and subsequently by removing the same.
- 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.
- Bailing and pumping out water as required and directed.
- 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.
- Necessary protection including labour, materials, and equipment to ensure safety and protection against risk or accident.
- Drilling of small holes as directed to explore the nature of substratum if necessary.

k) Measurement For Excavation

Excavation for foundation of columns, beams, walls and the like shall be measured as per drawing, dimensions of concrete (bed concrete where so specified) at the lowest level in regard to length and breadth and depth shall be computed from the concerned excavation levels and ground levels taken before excavation. Any additional excavation required for working space, planking dewatering and strutting etc. shall not be measured and paid for separately but rates quoted for excavation shall include for all these factors. No increase in bulk after excavation shall be made.

Prior to start of Project the Contractor shall verify and approve the block levels and benchmarks established and approved by the Engineer. The Contractor shall verify the drawing/ drawings for the entire Site

and sign in acceptance of the same. In case of any discrepancy the same shall be checked and will be recorded and agreed after cross verification at the Site jointly by the Contractor and the Engineer in Charge. The above established benchmarks and ground levels will be the basis for computing the quantum of excavation.

After site clearance a joint survey by the Contractor and the Engineer in Charge will be carried out based on the approved survey drawing / drawings to establish ground levels before excavation.

On completion of excavation, a joint survey will be carried out based on the approved survey drawing / drawings at the Contractor's establishment to establish the excavated levels and ascertain if the work is as per Drawings and Specifications with respect to depth and area. The portions excavated for working space, slopes as shown on drawings will be measured for payment. Extra portions excavated, due to the Contractor's working method, if any, will not be measured or paid. No extra claims whatsoever will be entertained in this respect.

The method adopted for computing volumes shall be as per Simpson's Rule.

During excavation, if hard rock / soft rock is found or noticed anywhere within the excavation area, the same should be intimated to the Engineer in Charge so as to make the joint record of note with location. If the computation of hard rock / soft rock quantity is found to be difficult, due to irregular levels both at top and founding level, then stack measurement will be considered for payment with the consideration of deduction of voids to the extent of 50%. The stacks as measured and taken into account at once will be earmarked and kept protected until the completion of whole excavation and computation of quantity.

I) Rates To Include For Backfilling Item

Apart from other factors mentioned elsewhere in this Contract, rates for the item of backfilling item of work shall also include for the following:

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.

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 to 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.

Concrete General

Scope

This section gives the technical requirements for all structural concrete in building and civil Construction Management works except where otherwise modified or amended within the Contract. All general requirements are given in this specification covering, but not limited to;

definitions; Contractor's responsibilities; site conditions; site safety; construction program; quality control; materials; testing; site transportation and accommodation; temporary works; maintenance and as-built drawings.

- A. Where the structural concrete is to be used in any building works, the concrete shall comply with the requirements of the latest version of Indian Standards (IS), except where more stringent requirements are specified herein. A complete set of all these documents shall generally be available at site with the Contractor.
- B. List of certain important Indian Standards and Codes applicable to this work is given below. However, the applicable standards and codes shall be as per, but not limited to the list given below:

Sr No	Code	Description
1	IS: 383	Coarse and fine aggregates from natural sources for concrete
2	IS: 432	Specification for mild steel, medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
3	IS: 455	Portland slag cement
4	IS: 456	Code of practice for plain and reinforced Concrete
5	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures
6	IS: 460	Specification for test sieves (Part I, II & III) 1. Wire cloth test sieve 2. Perforated plate test sieve 3. Method of examination of test sieves
7	IS: 515	Specification for natural and manufactured aggregates from natural sources for concrete
8	IS: 516	Method of test for strength of concrete

Sr No	Code	Description
9	IS: 650	Standard sand for testing of cement
10	IS: 875 (Part I, II, III)	Design loads for building structure
11	IS: 1199	Methods of sampling and analysis of concrete
12	IS: 1200	Methods of measurement of building and Civil / Architect / Engineering Works
13	IS: 1322	Specification for bitumen felt for water proofing and damp proofing
14	IS: 1489	Portland-Pozzolana cement Fly Ash based and Calcined Clay Based
15	IS: 1566	Hard drawn steel wire fabric for Concrete Reinforcement
16	IS: 1786	Specification for cold-worked steel high Strength deformed bars for concrete reinforcement
17	IS: 1792	Specification for concrete mixers

18	IS: 1834	Hot applied sealing compound for joint in concrete
19	IS: 1838	Preformed fillers for expansion joint in concrete pavements and structures
20	IS: 1893	Earthquake resistant design
21	IS: 2062	Steel for general structural purposes
22	IS: 2074	Ready mixed paint, air drying, red oxide Zinc, Chrome Painting
23	IS: 2204	Code of Practice for Construction of Reinforced Concrete Shell Roof
24	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates
25	IS: 2386	Methods of test of aggregates for concrete
26	IS: 2430	Methods of sampling of aggregates for concrete
27	IS: 2438	Roller pan mixer
28	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement
29	IS: 2505	Concrete Vibrators Immersion Types

Sr No	Code	Description
30	IS: 2506	General requirements for screed board concrete vibrators
31	IS: 2514	Concrete vibrating tables
32	IS: 2571	Code of practice for laying in-situ cement concrete flooring
33	IS: 2645	Specification for Integral cement water proofing compound
34	IS: 2722	Portable swing weigh batchers for concrete (Single and double bucket type)
35	IS: 3025	Methods of sampling and test (physical and chemical) for water and waste water
36	IS: 3067	Code of practice for general design details and preparatory works for damp proofing and water proofing of buildings
37	IS: 3370	Code of practice for concrete structures for the storage of liquids
38	IS: 3414	Code of practice for design and installation of joints in buildings
39	IS: 3558	Code of practice for use of immersion vibrators for consolidating concrete
40	IS: 3812	Specification for fly ash use as Pozzolona and admixtures
41	IS: 3025	Methods of Sampling and test (Physical and Chemical for water)
42	IS: 4031	Methods for physical tests for hydraulic concrete

43	IS: 4082	Recommendation on stacking and storage of construction materials at site
44	IS: 4326	Code of practice for earthquake resistant design and construction of building
45	IS: 4656	Form vibrators for concrete
46	IS: 4671	Expanded polystyrene for thermal insulation purposes
47	IS: 4925	Batching and mixing plant
48	IS: 4926	Specification for ready mixed concrete
49	IS: 4995	Criteria for design of reinforced concrete bins for storage of granular and powdery materials
50	IS: 4998	Criteria for design of reinforced concrete chimneys
51	IS: 5256	Code of practice for sealing expansion joints in concrete lining on canal
52	IS: 5816	Method of test for splitting tensile strength of concrete cylinders
53	IS: 6452	Specification for high alumina cement for structural use

Sr No	Code	Description
54	IS: 64 61	Glossary of terms relating to cement concrete
55	IS: 6494	Code of practice for water proofing and underground water reservoirs
56	IS: 6509	Code of practice for installation of joints in concrete pavements
57	IS: 6909	Specification for super sulphated Cement.
58	IS: 7293	Safety code for working with Construction machinery
59	IS: 7861	Code of practice for extreme weather concreting 1. Recommended practice for hot weather concreting 2. Recommended practice for cold weather concreting
60	IS: 8041	Specification for rapid hardening Portland cement (first revision)
61	IS: 8042	Specification for white Portland cement (first revision)
62	IS: 8043	Specification for hydrophobic Portland cement (first revision)
63	IS: 8112	43 Grade ordinary Portland cement
64	IS: 9012	Recommended practice for shotcreting
65	IS: 9013	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens
66	IS: 9103	Admixtures for concrete
67	IS: 10268	Recommended guidelines for concrete mix design

68	IS: 11384	Code of practice for composite construction in structural steel and concrete
69	IS: 12118	Two-part polysulphide-based sealant
70	IS: 1220	Code of practice for provision of water Stops at transverse contraction joints in masonry and concrete dams
71	IS: 12269	53 Grade ordinary Portland cement.
72	IS: 12600	Low heats Portland cement
73	SP: 23	Handbook of concrete mixes
74	SP: 24	Explanatory Hand book on Indian Standard code for plain and reinforced concrete (IS:456-1978)
75	SP: 27	Handbook of method of measurement of building works

- C. The Contractor must understand thoroughly any such requirements stated by the foregoing Codes and Regulations before tendering. He shall also construct the work in strict accordance with this Specification, working drawings and written instructions issued by the Engineer in charge.
- D. If the Contractor wishes to substitute any of the codes mentioned above with other authoritative standards or codes, he shall submit details of these authoritative standards / codes along with two complete copies to the Engineer in Charge for approval. Approval for such substitution shall be at the discretion of the Engineer in Charge and will not be given unless the Engineer in Charge considers the proposed standard or code of practice will give a quality of finished work equal to or better than the specified standard.
- E. The Engineer in Charge reserves the right to check the work constructed by the Contractor, and his setting out at such times as he may deem fit. There is however no obligation on his part to make such checks and any omission by him to observe errors shall not relieve the Contractor of his responsibilities in these respects.

Preliminary Information from Contractor

The Contractor shall submit the following information on his proposals for the approval of the Engineer in Charge before work is commenced:

- (a) Source of supply of all aggregates / concrete / bricks / solid & hollow blocks
- (b) Source of supply of cement
- (c) Source of supply of water
- (d) Grading curves for coarse and fine aggregate
- (e) Certificate of soundness of cement
- (f) Results of tests for organic and inorganic impurities of aggregates and water
- (g) Results of tests drying shrinkage of aggregates
- (h) Source of supply of reinforcement

steel (i) Test Certificates for

reinforcing steel (j) Types of water
bars

(k) Types of joint fillers and sealant

(l) Positions of all construction
joints

(m) Types of formwork

Bar bending Schedules

Reinforcement bar bending schedules shall be prepared by the Contractor and submitted to the Engineer in Charge on this project as and when directed.

Use of Concrete

No concrete of any particular mix proportions shall be incorporated into the Works until all the requirements of this specification have been met in respect of those mix proportions and have been approved by the Engineer in Charge.

Approvals

A minimum of 14 working days before construction commences the Contractor shall supply to the Engineer in Charge for his approval details of his proposed layouts of concrete plant and on-site workshop, details of form work systems and construction devices, eg. Cranes, chutes, scaffolding, which he proposes to use for structural concrete. The information is to be sufficiently detailed to enable the Engineer in Charge to approve or otherwise.

Where the Contractor proposed to use climbing tower cranes or any type of plant which places any load on the reinforced concrete structure, he must furnish full details of such plant to the Engineer in Charge for approval a minimum 14 days before the work is commenced. If approved by the Engineer in Charge, the structure will be strengthened to carry such loads and the Contractor shall be responsible for any resulting additional design and construction costs or time incurred. Loads from such plant or equipment shall only be imposed on such completed storey of the structure where the loaded concrete has already attained the minimum specified 28 days compressive strength.

The Contractor should note that further approvals for works, as indicated in the Technical Specifications, are required before construction starts. The Contractor is wholly responsible for obtaining these approvals and no claim for delays or additional payments will be entertained due to the Contractor's failure to obtain such approvals in adequate time.

Any approval, instructions, permission, checking, review etc. whatsoever by the Engineer in Charge, shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship etc.

Contractors Responsibility and Defects

The Contractor shall furnish all skilled and unskilled labour, plant, equipment, scaffolding, all materials etc. required for complete execution of the work in accordance with the drawings and as described herein and / or as directed by the Engineer in Charge.

The fact that the Contractor has used materials, etc. to the approval of the Engineer in Charge shall in no way relieve the Contractor of his responsibilities of producing a concrete of the required minimum strength, workability, shrinkage characteristics etc. for the purpose to which it is put.

Any defects due to materials and workmanship not being in accordance with this specification shall be made good to the satisfaction of the Engineer in Charge by the Contractor's own expense.

Contractor at the Contractor

The Contractor shall be responsible for making good to the satisfaction of the Engineer in Charge any damage to the permanent structure which may be caused by his plant.

If the Contractor desires to leave any permanently embedded supports for his shuttering, etc. in the concrete, he must furnish in writing exact details of his proposals and approval must be obtained from the Engineer in Charge.

Source of Supply

The Contractor shall not alter the source of supply of any material from that initially approved by the Engineer in Charge without the prior written permission of the Engineer in Charge.

Supervision

The Contractor shall employ competent personnel whose first duty will be the supervision of all stages of mixing, placing and site testing of all concrete and for the supervising of the preparation of cubes for testing.

Safety and Site Conditions

The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials.

Quality Control

Reference shall be made to the accompanying **General Specification** for Quality Control Requirements

The Contractor shall submit to the Engineer in Charge, within 14 days of award, a Quality Manual in accordance with ISO 9001. The Quality Manual shall outline the Quality Control measures that the Contractor shall put in place to carry out the Works and shall include the Quality Control of the Sub-contractors. The Quality Manual shall include a Project Quality Plan. The Quality Manual shall be reviewed by the Engineer in Charge and, upon acceptance, shall be implemented by the Contractor.

The Contractor shall submit to the Engineer in Charge, within 14 days of award, a list of the Quality Control Personnel proposed for the Works and shall outline roles and responsibilities. Staff listed shall include the Project Manager, Quality Control Superintendent and Project Foreman. If for some reason, a person so listed is unable to fulfil their role in this Works, then the Contractor shall find an equivalently qualified person to fill that vacancy. Details of the proposed replacement shall be submitted to the Engineer in Charge before.

The Contractor shall establish, document and maintain an inspection and testing system capable of producing objective evidence that the Works conform to the Specification, whether carried out by the Contractor or his sub-contractors, or procured from vendors. A summary of this system shall be included in the Quality Manual.

Materials

Cement

Type of Cement

The cement used shall be any of the following with prior approval of the Engineer in Charge.

- High strength ordinary Portland cement (Grade 43) conforming to IS: 8112.
- Portland Pozzolana cements conforming IS: 1489.
- Portland slag cements conforming to IS: 455.

Unless otherwise specified ordinary Portland cement of 43 grade conforming to IS 8112-2005 shall be used for all non-standard concrete works.

Ordinary Portland cement (53 Grade) conforming to IS: 12269 shall be used for important concrete works and grades M30 and above.

White or coloured Portland cement shall comply with physical requirements of IS 8112 and pigments shall be inorganic oxide pigments, either natural or synthetic in origin complying with the requirements of BS: 1014 Pigments whether added just before mixing or by the cement manufacturer shall only be incorporated in the proportions approved.

Super sulphate and high alumina cement shall not be used in any part of the works unless specified.

For non-structural concrete work OPC 43 shall be used and for concrete work and design mix of grade M15 and above OPC 53 shall be used. All non-structural working contactor can go for PPC

Certification and Testing of Cement

The Contractor shall obtain a manufacturer's certificate of test in accordance with the appropriate standard for each consignment of cement delivered to the site and shall immediately forward these certificates to the Engineer in Charge for his retention.

Notwithstanding the manufacturer's certificate the Engineer in Charge may require that any cement delivered to the site, or elsewhere for use in the works, shall be sampled and tested as per IS specifications. Any batch of cement so tested which fails to comply with this specification will be rejected. The cost of any such testing shall be borne by the Contractor. Cement older than 3 months is not to be used for any works on site.

Delivery and Storage of Cement

Cement of different types and manufacture shall not be mixed one with another. Cement shall be transported to site in covered vehicles adequately protected against water. All cement shall be delivered to the Site or elsewhere for use in the Works in the original sealed bags of the manufacturer or in approved bulk containers.

The Contractor shall make his own arrangements for the storage of adequate quantity of cement and all cement shall be kept in a dry place and protected from deterioration. Cement,

unless delivered in bulk, shall be stored and neatly stacked in piles not exceeding 10 bags high in weather proof closed sheds well away from walls, the floor of which shall be with raised wooden plank flooring to prevent deterioration by dampness or intrusion of foreign matter, Storage under tarpaulins shall not be permitted. Cement delivered in bulk shall be stored in a weather proof silo.

Each consignment of cement shall be clearly identified, stored separately with clear identifiable stack number and used in chronological order of receipt i.e. the first received being first used.

Daily record of cement received and consumed shall be maintained by the Contractor in an approved form and a copy submitted to the Engineer in Charge once a week.

Inspection of Cement

Any cement which, upon inspection, is considered by the Engineer in Charge to have deteriorated in any way will be rejected.

Any type and grade of cement more than 3 months old shall invariably be tested to ascertain that it satisfies the acceptability requirements.

All cement rejected for any cause shall be removed from the project site immediately.

Bulk cement shall be used only if the Engineer in Charge approval in writing has been obtained. Bulk cement shall conform in all respects to the relevant clauses above. Automatic weighing equipment shall be used for weighing the cement to be added to each batch.

Cement for use in all concrete floor slabs and beams shall be obtained from a single source to maintain uniformity of colour.

Fly ash

If any grade of concrete requires fly ash to be added for the items covered in BOQ the following procedure shall be followed and shall be complied in conjunction with the Structural consultant's approval and to comply with latest codal requirements.

The weight of fly ash shall be restricted to maximum 35% to total weight of cementitious material as per IS 3812-Part 1. However, if PPC cement is to be used then use of Fly ash shall be avoided.

(a) Fly ash used for cement concrete shall be conforming to IS 3812 Part 1. Physical and Chemical requirements of fly ash shall confirm to IS. Moisture content of fly ash shall be as specified by the Engineer in charge. Testing of fly ash shall be carried out according to IS 1727.

(b) Fly ash shall be stored in such a way to permit easy access for inspection and identification of each consignment. Manufacturer or supplier of fly ash has to furnish certificate for standard of fly ash. The consignment shall also be marked with the Standard Mark.

(c) Fly Ash shall be obtained only from authorized dealers.

Aggregates for Concrete

Type of Aggregates

Aggregates mean both coarse and fine inert materials used in the preparation of concrete. Aggregates shall consist of natural sands, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete complying with IS: 383 and shall be chemically inert, clean, hard, strong, durable against weathering of limited porosity and free from such quantities of deleterious materials as may cause corrosion of reinforcement or may impair the strength and / or durability of the concrete. Additionally, the flakiness index when determined by the sieve method described in IS 2386 shall not exceed 35 for any size of concrete aggregate. Total percentage of all deleterious materials, including coal, lignite, clay lumps, and materials finer than 75 microns, soft fragments and shale but excluding mica shall not exceed 5%. However, for crushed fine aggregate, total percentage of coal and lignite and clay lumps shall be limited to 2%.

Aggregates shall not contain water soluble sulphur trioxide in excess of 0.1%

The chloride ion content of the fine and coarse aggregate shall not exceed 0.06% and 0.02% respectively by mass of dry aggregate. If either aggregate exceeds these limits the material may still be considered acceptable by the Engineer in Charge provided that the total chloride ion concentration derived from the aggregates is not greater than 0.35% by mass of the cement in the mix.

All aggregates shall comply with IS: 2386 and IS: 383 in respect of impurities and additionally with the following

- a) Absorption
6% maximum by weight for ordinary
construction 2% maximum for waterproof
- b) Construction
alt 1% maximum (equivalent anhydrous calcium percentage
by weight of cement).
- c) S
hell 8% maximum by
- d) C
arbonates weight 10% maximum by
weight

The drying shrinkage of the aggregates measured in accordance with IS: 2386 shall not exceed

- a) 0.06% for general purpose concrete
- b) 0.04% for pre-cast concrete, concrete for special purposes and water proof concrete.

For reinforced concrete work, aggregates conforming to IS: 383 & IS: 2386 having a maximum size of 20 mm shall be used. For certain reinforced concrete works, aggregates having a maximum size other than 20 mm size shall also be used as called for in the drawings. However, for lean concrete provided as mud mat below structural concrete, maximum size upto 40 mm shall be used.

Aggregates (coarse or fine) with a specific gravity below 2.6 shall not be used without special permission of the Engineer in Charge. Sand and crushed rock shall be prepared for use by such

screening or washing, or both, as necessary to remove all objectionable foreign matter at contractor's cost.

Fine Aggregate: Fine aggregate shall mean aggregate which pass through IS Sieve 4.75 mm (3/16 B.S.) test sieve to IS: 2430, leaving a residue not more than 5% and shall conform to IS:

383. It shall be sand from a natural source approved by the Engineer in Charge. Machine-made sand will be acceptable provided the constituent (rock/gravel) is sound, hard, and dense and is acceptable to the Engineer in Charge. Sand containing any trace of salt shall be rejected. The fine aggregate for concrete shall be graded within limits as specified in Table 1 of IS: 383 - 1970 and the fineness modules shall range between 2.60 to 3.20. The machine-made sand may be used for concrete works as per acceptable standards. All other civil works river sand will be used. Manufactured sand only conforming to ZONE 2 will be permitted.

Artificial / Crushed Sand

Considering the recent deficiency in availability of river sand, another alternative is manufactured sand or crushed sand. The long-term substitute for river sand is manufactured sand or crushed sand from V.S.I. Crushers. The manufactured sand must have cubical particles or spherical particles which can be generated only from V.S.I. Crushers by Cleavage crushing. Due to cleavage breaking of the particle the surface is smoother. Sand manufactured from any other process/ machine cannot have cubical shape. Fine aggregates manufactured by Compression crushing (Jaw crusher, Cone crusher, Roll crusher, Hammer mill) are flaky and more angular in shape. The surface texture is very rough. Therefore, such fine aggregate is not suitable for concreting and other construction work. The Plasticity of concrete reduces and results in honey combing. So, the process of manufacturing should be such that it should give Cubical particles. Flaky particles increase voids over cubical or spherical particles about 5 to 6 percent more and reduce the strength of concrete. Vertical shaft Impactor principle is used for crushing bigger particles, for shaping the crushed metal (giving better shape of the particle) and for crushing fines aggregates below 4.75 mm. It is best machine for making sand from stone. Sand manufactured by Vertical Shaft Impactor is of cubical shape. Such sand can be used for all types of construction work, Concreting, plastering etc. and is better substitute to river sand.

From the above following are the requisites of sand:

- All the sand particles should have higher crushing strength.

- The surface texture of the particles should be smooth.
- The edges of the particles should be grounded.
- The ratio of fines below 600 microns in sand should not be less than 30%.
- There should not be any organic impurities
- Silt in sand should not be more than two percent.
- Total limit of 5 % in crushed stone sand the permissible limit of fines below 150 microns may be up to 20 %. This does not affect the 5 % permissible limit.

Coarse Aggregate:

Coarse aggregate shall mean aggregate of which not less than 95% by weight is retained on a 4.75 mm mesh IS test sieve to IS: 2430 and shall conform to Table 2 of IS : 383 1970. It shall be obtained from crushed granite, trap, basalt or similar approved stones from approved quarry. Coarse aggregate shall be chemically inert when mixed with cement and shall be angular in shape and free from soft friable thin porous laminated or flaky pieces. It shall be free from dust and other foreign matter. Unless otherwise specifically stated, for all RCC works the size of coarse aggregate shall be 20 mm and downsize.

Between the limits specified for coarse and fine aggregates the grading shall be such as to produce dense concrete of a consistency, which will work into position without segregation, and without the use of excess water content.

Aggregates for waterproof concrete shall be non-porous, not subject to internal movement, change in volume, shape or structure and suitable in every respect for use in water proof concrete.

Lightweight aggregate shall be 5mm exfoliated vermiculite or similar material approved by the Engineer in Charge

Approval of Aggregate

A minimum of 14 working days before the commencement of any concrete work, the Contractor shall forward to the Engineer in Charge for approval, details of his proposed source of supply of aggregates giving the aggregate group classification and typical physical properties as required by IS: 383.

The Engineer in Charge shall be given advance notice of any alteration in the source of supply of aggregate.

Certification of Aggregates

The Contractor shall provide the Engineer in Charge with a certificate for his retention at such regular intervals as the Engineer in Charge may prescribe from time to time showing that all aggregates have been re-tested since the date of the last such certificate and showing that they continue to comply with the requirements of this specification.

Samples of aggregate of different sizes and types shall be sent to an approved

laboratory for testing prior to the commencement of any concrete works. The cost of such testing shall be borne by the Contractor. Notwithstanding any certificate of compliance, the Engineer in Charge may at any time require that any aggregate delivered to the site, or elsewhere for use in the works be sampled and tested. Any aggregate so tested which fails to comply with this specification will be rejected. Delivery and Storage of Aggregates. No deliveries in bulk shall be commenced until the Contractor has demonstrated to the satisfaction of the Engineer in Charge that the samples comply with this specification.

The samples approved by the Engineer in Charge shall be representative of the grading and general quality of the aggregate delivered during the course of the work.

Graded aggregate as recommended / shown in Table 2 in the document, only shall be used for all R.C.C. Works.

Any aggregate, which in the opinion of the Engineer in Charge, has become contaminated or does not conform to the foregoing requirements may be rejected by the Engineer in Charge.

Each size of aggregate shall be stored on separate platform or stockpile and such platform or stockpile shall be sufficiently removed from each other. In order to prevent materials at edge of the piles from getting intermixed with each other, bund walls shall be constructed.

Testing of Aggregates

Tests shall be carried out on samples obtained from the delivered aggregates taken at intervals required by the Engineer in Charge in accordance with IS: 2386. Tests shall be carried out in the presence of the Engineer in Charge and to the expense of the Contractor.

Should a sample fail to comply with any of the tests the Engineer in Charge may, at his discretion, either reject the batch from which the sample was taken, order it to be washed and / or screened, or permit it to be used with variations in the proportions or the concrete mixes specified. Any batch of aggregate rejected by the Engineer in Charge shall be removed from site forthwith.

Grading Aggregate

Aggregates will be subjected to sieve analysis to IS: 2386, and the limits of acceptance are as shown in Table 1 and 2. The Engineer in Charge may require further analysis to be made if there is any alteration in the type of aggregate. The cost of any such analysis is to be borne by the Contractor.

The Contractor is to provide a set of IS sieves and weighing equipment with accuracy to 0.5% of the mass of test sample and carry out sieve analysis to IS: 2386 on site as required by the Engineer in Charge at the expense of the Contractor.

The Contractor shall carry out sieve analysis for coarse and fine aggregates at the minimum of one per week at each stockpile. At the start of the contract, sieve analysis should be taken twice per week at each stockpile until the consistency of grading is evident and agreed by the Engineer in Charge.

Table 1

IS Sieve	Percentage Passing

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Designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90 - 100	90 - 100	90 - 100	95 - 100
2.36 mm	60 - 95	75 - 100	85 - 100	95 - 100
1.18 mm	30 - 70	55 - 90	75 - 100	90 - 100

IS Sieve	Percentage Passing			
600 Micron	15 - 34	35 - 59	60 - 79	80 - 100
300 Micron	5 - 20	8 - 30	12 - 40	15 - 50
150 Micron	0 - 10	0 - 10	0 - 10	

Table 2

IS Sieve Designation	A						B			
	% Passing by Weight for single sized ungraded aggregate of nominal size						% Passing by Weight of graded aggregate of nominal size			
	63 mm	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
80 mm	100	-	-	-	-	-	100	-	-	-
63 mm	85 - 100	100	-	-	-	-	-	-	-	-
40 mm	0 - 30	85 - 100	100	-	-	-	95 - 100	100	-	-
20 mm	0 - 5	0 - 20	85 - 100	100	-	-	30 - 70	95 - 100	100	100
16 mm	-	-	-	85 - 100	100	-	-	-	90 - 100	-
12.5 mm	-	-	-	-	85 - 100	100	-	-	-	90 - 100
10 mm	0 - 5	0 - 5	0 - 20	0 - 30	0 - 45	0 - 50	10 - 35	25 - 50	30 - 70	40 - 85
4.75 mm	-	-	0 - 5	0 - 5	0 - 10	0 - 20	0 - 5	0 - 10	0 - 10	0 - 10

2.36 mm	-	-	-	-	-	0	-	-	-	-
						-5				

Water and Ice for Concrete

Water for use in mixing and curing concrete shall be clean, fresh and free from injurious amounts of oils, acids, alkalis, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete. The maximum permissible values of impurities shall be as given in clause no. 5.4 of IS: 456 - 2000. Water storage tanks shall be covered to the satisfaction of the Engineer in Charge to prevent contamination.

In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time tests specified in IS:456.

The Engineer in Charge may require that any water be sampled and tested at the expense of the Contractor by the method given in IS: 3025. Water failing the criteria given in the appendix to IS: 3025 will be rejected.

The Contractor shall produce test results of water proposed to be used on the job for approval by the Engineer in Charge before using for concrete works.

Water for use in mixing with cement shall neither be hotter than 25°C nor colder than 5°C at the time of mixing

Wherever temperature-controlled concrete is specified, the Contractor may establish an ice making plant of required capacity at site.

Measures for Controlling Alkali Aggregate Reaction

Measures to control the occurrence of alkali-aggregate reaction (AAR) in concrete shall be submitted to the Engineer in Charge for approval. In the absence of alternative proposals, such control shall be achieved by limiting the reactive alkali content of the concrete as described in clauses 2.5.2 to 2.5.4 below unless in the opinion of the Engineer in Charge the concrete element will not be subjected to moisture ingress throughout its design life.

The reactive alkali of concrete expressed as the equivalent sodium oxide per cubic metre of concrete shall not exceed 3.0 kg.

The equivalent sodium oxide (Na₂O) content of the concrete shall be determined in accordance with the following steps:

The equivalent Na₂O shall be calculated by the expression:

$$\text{Equivalent Na}_2\text{O} = A + B + C$$

Where;

A is the sum of the acid-soluble alkalis (expressed as equivalent Na₂O) of cement, admixture and water

B is equal to 1/6 the total alkalis of pulverised fuel ash (PFA) (expressed as equivalent Na₂O) and

C is equal to 0.76 times the chloride ion (Cl) of the aggregate

The acid-soluble alkali content of the cement shall be determined in accordance with IS: 4032 and shall be taken as the average of the latest 25 daily determination of equivalent sodium oxide plus twice the standard deviation of the results.

The acid soluble alkali content of admixtures shall be determined in accordance with IS: 4032.

The acid-soluble alkali content of water shall be determined in accordance with American Public health Association (APHA) 17 ed. 1989) Sections 3500-K and 3500-Na.

The total alkali content of the PFA shall be determined in accordance with IS: 4032 and shall be taken as the average of 25 weekly determination plus twice the standard deviation of the results.

The equivalent sodium oxide content of the coarse and fine aggregates shall be calculated from the quantity of chloride ion present measured in accordance with IS: 2386.

The calculation indicating the amount of the reactive alkali in the concrete mix should be submitted by the concrete supplier to the Engineer in Charge.

Admixtures

No admixtures of cements containing additive shall be used in concrete unless specified or approved by the Engineer in Charge. Such approval will not be given unless in the Engineer in Charge

's opinion specific benefit to the density or quality of the concrete will result. Additives so approved shall be used strictly in accordance with the manufacturer's recommendations and written instructions. Admixtures should not have detrimental effect on reinforcement.

The Contractor shall obtain the written approval of the Engineer in Charge for use of additives if they differ from those specified by the Engineer in Charge, and their use is proposed by the Contractor but not specified by the Engineer in Charge.

The Contractor shall submit the following details of any admixtures or cement containing additives for approval before using:

Brand name and manufacturer's literature.

Proposed dosage as per manufacturers specification and detrimental effects, if any, of under dosage and/or over dosage.

Method of adding to the concrete mix and Details of the Chloride content

The chloride ion content of admixtures for concrete containing embedded metal or for concrete containing sulphate resisting Portland cement shall not exceed 2% by mass of admixture or 0.03% by mass of the cementitious content, whichever is the less.

Calcium chloride as accelerating admixture is not permitted to be used.

Where the use of admixtures is specified or approved, they shall comply with the requirements of IS: 9103 and shall be of proven make and from a reputed manufacturer.

The Contractor shall produce latest test results carried out at approved Government Test Houses for the approval of the Engineer in Charge, before use.

Approved admixtures shall be stored in watertight weatherproof containers clearly marked to show the contents.

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.

Steel bar Reinforcement

Refer separate specification given elsewhere.

Joint Fillers and Sealants

Joint fillers shall be pre-formed and of a proprietary brand in accordance with the drawings or similar approved by the Engineer in Charge and shall be placed in manufacturer's recommendations and written instructions. accordance with the

Joint sealants shall be as described in the drawings, or similar approved by the Engineer in Charge and shall be used strictly in accordance with the recommendations and written instructions.

Poured joint sealing compound shall be a hot poured rubber bitumen compound complying with the requirements of IS: 1580 or BS: 2499 unless otherwise specified.

Water Stops

Water Swelling Bars made up of flexible polymer composites shall be used at construction joints of retaining walls and water retaining structures and wherever specified with proper overlaps at joints of approved makes as per Engineer in Charge's approval.

Water stops shall be either metallic like copper or non-metallic like PVC.

Water stops shall be pre-formed and of a proprietary brand in accordance with the drawings, or similar approved by the Engineer in Charge.

Water stops shall be used at all construction joints in Water Tanks or other structures designated as Watertight Structures.

Curing Compounds

Concrete curing compound for structures shall be a liquid resin or wax-resin base membrane curing compound of an approved proprietary brand. It shall have a minimum curing efficiency of 75% and shall contain a fugitive dye.

Aluminised curing compound shall, when applied at the rate of approximately 0.25 litres / m² by a mechanical sprayer with low pressure fine spray, become stable and impervious to evaporation of water from the concrete surface within 60 minutes after application.

The curing compound shall contain sufficient flake aluminium in finely divided

dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The curing compound shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application.

Concrete curing compound for carriage ways shall be a non-pigmented liquid resin or wax-resin base membrane curing compound of a proprietary brand. It shall achieve a 96% efficiency index and shall be available both with and without a fugitive dye.

The Contractor shall supply test certificates, prepared by an approved testing laboratory, to show that the compound will provide the required curing efficiency.

Curing compounds shall not be detrimental to the applied finish and surface treatments specified on the drawings.

Damp-proof Membranes

Damp-proof Membranes (DPM) generally for use below non-suspended ground floor slabs shall be 1200 gauge (0.3mm) polythene sheet complying with Packaging and Industrial Film Association Standard 6/83 and shall be laid and jointed in strict accordance with the manufacturers printed instructions.

Concrete - Workmanship

Steel Reinforcement

Refer separate specification given elsewhere.

Form work and False work (Should also be read with Special Form work in the relevant section)-

Type of 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 designed 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 or edges 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 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 is 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, struttred 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 approval has been given to the Contractor's scheme submitted along 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.

Atheletic track specification:

Providing and laying Synthetic Athletics Track FULL PUR SYSTEM with FULL EPDM only (without re-cycled rubber) which should comply with Environmental compatibility of VOC (Volatile Organic Compound) content as per DIN-V-18035-6. Including "WA" Standard markings on the surface all complete as per requirements/specifications laid down by "WA" class -II certification and as per direction of the Engineer-in-charge. The synthetic Track should conform to the following specifications

Property	Requirement	Test norm
Tensile strength	0.5N/mm ² 0.3N/mm ²	IAAFDINV18035-6
Elongation at break	>40% IAAF	DINV18035-6
Force reduction	35-50%	IAAF(23°C) +
Vertical deformation	0.6-2.5mm	IAAF(23°C)
Standard deformation	0.6-1.8mm	
	(at 0-40°C)	DINV18035-6
Thickness	>15mm	DINV18035-6
Relative abrasion	>1.0	DINV18035-6
Friction(sliding coefficient)	>0.5 <1.1	DINV18035-6
Spike resistance	Class1	DINV18035-6
Remaining indentation	<1.0mm	DINV18035-6
Ageing	Pass	DINV18035-6
Environmental requirements	Limit values for	
	DOC, EOX, Heavy metals,	
	smell	DINV18035-6

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.

Internal Metal Ties for Form work

Where internal metal ties are permitted, their removable parts shall be extracted without damage to the concrete and the remaining holes shall be carefully pressure grouted using epoxy grout. No permanently embedded metal part shall have less cover than that indicated for adjacent steel reinforcement.

Internal metal ties in fair faced concrete work shall be arranged in an approved neat, regular, consistent pattern throughout the work.

Details of internal metal ties shall be submitted to the Engineer in Charge for approval well in advance prior to their use in the works.

The CLIENT/ may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and size of such tie-bolts in consultation with the Engineer in Charge. Holes left in the concrete by these tie-bolts shall be filled as specified by the Engineer in Charge at no extra cost. No through tie will be permitted in all liquid / earth retaining walls / slabs, basement walls etc.

Holes in Form Work

When holes are to be provided in formwork for pipes, weep holes and the like, shall be neatly trimmed to accommodate the pipe and caulked with an approved material to form a grout-tight joint.

Sloping Form Work

When concrete is to be deposited to a steeper slope than 15° from the horizontal top forms shall be used to enable the concrete to be properly compacted.

Cast in Pipes / Sleeves / GI Puddle Flanges

Where required in external walls, retaining walls and like structural elements, cast in pipes and sleeves shall be fixed securely in place and shall be provided with GI puddle flanges and hydrophilic caulking compounds as specified on the drawings

The Contractor shall fix pipe sleeves and inserts or box out to form holes and chases to specified size and incorrect positions before placing concrete. Hardened concrete shall not be cut to provide holes or chases without prior approval. Where reinforcement passes through form work, the form work shall be designed and constructed to maintain the reinforcement in its correct position and to minimise leakage of concrete or grout.

Approval of Form Work

For each concrete pour requiring form work propping, the Contractor shall submit to the Engineer in Charge, well in advance prior to commencement of form work and propping, details and / or calculations of all proposed form work and props, along with a detailed programme of the work. Such approval, if given, shall in no way relieve the Contractor of his responsibility for the safety or adequacy of such form work for its purposes.

Classification of Form work with respect to its intended usage

Contractor shall note that the system of form work for its intended usage proposed in the BOQ shall be adhered to. For all the form work systems covered in BOQ such as DOKA etc. Contractor shall submit the detailed methodology based on the manufacturers' TABLA, MIVAN,

recommendations for structural and all other type of loading conditions, including submission of shop drawings and its approval for which the formwork system shall be designed, to the Engineer in Charge. Formwork system demo and site visits for such system display, mock-ups and the corrective measures suggestions on such systems by the Engineer in Charge shall be implemented and adhered to.

Surface Treatment for Form Work

The inside surface of forms, except for permanent form work, or unless otherwise agreed by the Engineer in Charge, shall be coated with an approved material to prevent adhesion of the concrete.

Surface retarders or release agents shall not be used without prior approval. Release agents shall not be used where surface treatments require bonding adhesives to be applied.

Mould oils or release agents shall be of a type, which shall have no adverse effect to concrete and, on any finishes, to be applied to the concrete or on the appearance of fair faced concrete. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not come into contact with reinforcement or pre-stressing tendons. Different release agents shall not be used in formwork to concrete, which shall be visible in the finished works.

Care should be taken that mould oils or release agents do not accumulate at the bottom

of form work. If the form work is not used within 24 hours, a further coat of mould oil or release agent shall be applied before casting the concrete.

Cleaning of Form Work

- All rubbish, particularly chippings, shavings and sawdust shall be removed from the interior of all form work immediately before concrete is placed. In the case of deep sections an opening shall be left at the base to enable such cleaning to be adequately completed.
- The Contractor shall provide compressed air jet and / or a water jet free from any oil or other contamination for the cleaning of form work.

Inspection of Form work

Concreting shall not commence until the Engineer in Charge has had an opportunity to inspect the form work and any enclosed reinforcement and given his approval to commence concreting.

The erection, casing and striking of the form work shall be done under the personal supervision of a competent foreman.

Stripping of Form Work

Form work shall be stripped with the approval of the Engineer in Charge at such a time and in such a manner without disturbing, damaging or overloading the finished concrete work or the structure.

The Contractor shall inform the Engineer in Charge before removal of any form work. at which the form work is removed shall be the Contractor's responsibility subject to the The time minimum periods between completion of any concreting and removal of forms as given below:

In normal circumstances forms shall not be released until the concrete has achieved a strength of at least twice the stress to which the concrete may be subjected as the time of removal of form work in accordance to clause no. 11.3 of IS:456-2000.

Table 3

Type of Formwork	Minimum Period Before striking formwork	
	For Concrete made using OPC	For Concrete made using Cement other than OPC or using mineral admixtures like Fly Ash and slag
a) Vertical formwork to columns, walls, beams	16-24 h	16-24 h

b) Soffit formwork to slabs (props to be refixed immediately after removal of formwork)	3 days	7 days
c) Soffit formwork to beams (props to be refixed immediately after removal of formwork)	7 days	10 days
d) Props to slabs:		
1) Spanning upto 4.5 m	7 days	7 days
2) Spanning over 4.5 m	14 days	14 days
e) Props to beams and arches:		
1) Spanning up to 6.0 m	14 days	14 days
2) Spanning over 6.0 m	21 days	21 days

For other cements and lower temperature, the stripping time recommended above may be suitably modified in consultation with the Structural Engineer.

Adverse weather conditions or different cement may cause the above periods to be increased. In case, the Contractor wish to reduce these striking times, he must satisfy the Engineer in Charge that the strength of the concrete at such time and the structural system is adequate to withstand the dead and imposed loads applied to it. Before reducing the striking times, the Engineer in Charge agreement shall be obtained in writing.

In case of special structures, such as shells, folded plates, etc., the sequence of removal of forms shall be as per drawings or as directed by the Engineer in Charge.

In case of cantilever slabs, the removal of forms shall begin from the outer edge and proceed towards the support, whereas in the case of slabs supported on two/four sides, the removal of forms shall begin from centre to supports. Form work to cantilevers shall be removed only with the approval of the Engineer in Charge.

Formwork props shall be positioned between permanent supports such that the members are supported at maximum 3m centre-centre in both directions.

When, in the opinion of the Engineer in Charge, the striking of formwork should be detrimental to or may prejudice the safety of the structure, the formwork shall be left in.

The Contractor shall be responsible for the demolition and re-concreting of any damaged or defective work howsoever caused at his own expense. The use of epoxy for bonding fresh concrete shall be carried out as directed by the Engineer in Charge at no extra cost.

If the props are to be left in place whilst the soffit forms to slabs and beams are to be removed, the props shall be so designed as to remain in position throughout the striking process without having to be temporarily removed. The use of props designed so that a few can be taken away at a time and replaced immediately shall be subject to the Engineer in Charge approval.

No construction loads shall be supported from any un-shored portion of the structure under construction. The number of floors requiring propping shall be as instructed by the Engineer in Charge according to the design loads of such floors.

Aluminium Formwork (ALF) Requirements

a) The design, engineering, and construction of the formwork are the responsibility of the Contractor. Formwork shall be designed in accordance with IS 14687 and IS 456. The broad scope of work shall comprise the following:

- Formwork designing by the Turney Contractor design team/firm;
- Ordering and procurement of the same;
- Fabrication of shuttering panels, if necessary;
- Erection of Aluminium formwork etc. shall be the responsibility of the Contractor.

It shall be designed for the anticipated loads, lateral pressures, and stresses. It should also be capable of withstanding the pressures resulting from placement and vibration of concrete.

The Aluminium Formwork (ALF) system, if adopted, shall be of proven technology and of a renowned proprietary firm. The system should be able to form all of the critical concrete elements to produce a monolithic shear wall structure including, but not limited to; walls, floor slabs, columns, beams, stairs, window hoods, balconies and accordance with the Contractor's design team/firm's design. various decorative features in exact

The contractor shall allow sufficient time in his approved programme/schedule for procurement of the Aluminium formwork system (placing order, manufacture and shipment). The Contractor shall submit the details of the formwork system selected for procurement, including shop drawings (sizes, dimensions, numbers, floor plan configuration assigned, etc.) including manufacturer, location of manufacturer, delivery schedules, and other pertinent data to the Engineer for review a minimum of 4 weeks prior to placing the order.

The basic element of Aluminium formwork is the panel which is a framework of extruded Aluminium sections, welded to an Aluminium sheet. This shall produce lightweight panel with an proper stiffness to weight ratio, yielding minimal deflections under concrete loading. Panels shall be manufactured in standard sizes with non-standard elements produced to the required size and shape to suit the project requirements. The panels shall be made from a high strength Aluminium alloy with the face or contact surface of the panel, from 4 mm thick plate, which is welded to a framework of specially designed extruded sections to form a robust component.

The Use of Aluminium Formwork (ALF) shall comply with the following requirements

- a) Source of supply of all aggregates / concrete / bricks / solid & hollow blocks
- b) All ALF formwork shall be new and designed and manufactured specifically for Tunkey project requirements.
- c) Given that ALF formwork has an expected design life, the contractor shall monitor the iterations (number of repetitions) of the formwork used, and the Contractor shall maintain a log and history of the same.
- d) All formwork shall be manufactured to manufacturer's recommended

replacement cycle, the contractor shall notify the Engineer of the same. At that time a joint inspection will be performed of the formworks to determine if, and when, replacement is warranted, based on the condition of the formwork (or individual elements of the same) and the quality of the wall finishes that is produced.

e) If or when a piece or element of formwork is found to be damaged, producing unacceptable quality finishes or otherwise unacceptable, it shall be replaced and taken out of service immediately.

f) The formwork design shall be carried out by professional design team/firm to provide a complete service embracing all aspects of architectural, structural and building services design.

g) The formwork shall be designed and constructed to the shapes, lines and dimensions shown or shall take account of safety and surface finish. The formwork shall be manufactured out of Aluminium (as per the manufacturers specifications), sufficiently rigid and tight to prevent loss of grout or mortar from the fresh concrete.

h) The formwork shall be designed to make full use of the structural efficiencies and operational advantages gained from this method of concrete structure construction.

i) Formwork shall be designed to withstand the worst combination of self-weight, reinforcement weight, wet concrete weight, concrete pressure, construction and wind loads together with dynamic effect caused by placing, vibrating and compaction of the concrete.

j) Forms shall be designed and constructed to maintain rigidity throughout the placing, ramming, vibration and setting of the concrete to the required shape, position and level and specified class of finish within the allowable tolerances.

k) All joints shall be sufficiently tight to prevent leakage of grout. Due regard shall be taken to the type of mix when considering the design pressure on the formwork. The formwork shall be pre-cambered by an amount equal to the expected maximum deflection.

l) ALF elements shall be kept neat and clean and free from build-up of concrete.

Erection of ALF Formwork

The formwork consists of High strength special Aluminium alloy components. All components are fitted together and erected using simple pin and wedge system.

The panels shall be held in position by a simple pin & wedge that pass-through holes in the outside rib of each panel. The panels shall fit precisely, securely and require no bracing. Walls shall be held together with high strength wall ties, while decks are supported by beams and props.

Trial erection of the formwork shall be carried out in factory conditions by the manufacturer to ensure that all components are correctly manufactured, and no components are missed, and they are numbered and packed in such a way to make site

erection very easy. The Contractor will notify the Engineer a minimum of 3 weeks prior to the trial erection so that the Engineer and/or Employer may view and inspect the formwork. The costs associated with the Engineer's and/or Employer's travel and inspection of the formwork shall be borne by the Contractor.

With Aluminium formwork, a high quality of finished formed surface can be achieved using Aluminium panels eliminating the plastering. Direct application of skim coating of putty shall offer a perfect finish to The External and Internal Walls.

Stripping of Formwork

Forms shall not be struck off until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of formwork. The time schedule or period after which the formwork can be removed shall be as indicated by the Contractor's structural consultant.

Immediately after stripping the formwork, all concrete elements shall be inspected carefully. Any defective areas in the concrete surface shall be rectified or made good expeditiously before the concrete has properly cured.

Precautions to be Taken While De-Shuttering

- (d) The formwork shall be capable of being dismantled and removed from the cast concrete without shock, disturbance or damage.
- (e) CPF Liner

A Controlled Permeability Formwork (CPF) liner shall be used on the inside faces of the formwork for all water retaining structures (tanks) to produce a denser concrete with a surface that is free of blowholes and other surface blemishes.

The CPF liner shall have a British Board of Agreement (BBA) certificate or other similar independent third-party certification from an approved authority.

The CPF liner shall have the following characteristics:

- (f) Material: non-woven polypropylene, needle punched and thermally bonded
- (g) Weight: 250 g/m²
- (h) Thickness at 2kPa: 1.2mm
- (i) Pore size: < 30 microns
- (j) Air permeability at 800 kPa:
- (k) 100-500l/m²/sec Tear strength (ASTM D1117): Min: 125 N

Release agents shall not be used with the liner and any residual release agent remaining on forms from previous use shall be removed.

The CPF liner shall be installed either by mechanical tensioning or gluing and shall be used in accordance with the manufacturer's technical guidelines.

One CPF Liner on the formwork shall be used only 3 times. In other words, repeatability of the liner shall be only 3 times. Care should be taken, when re-using formwork that its surface shall be smooth and clean and that it shall be free from warping or other deformations. The Liner, after being used 3 times, shall be disposed-off as per manufacturer's guidelines and prevailing Environmental laws.

Reuse of Forms

The Contractor shall obtain permission for reusing of forms. Before reuse, all forms shall be thoroughly scraped, cleaned, all nails and adhering substances removed, holes and leaks satisfactorily plugged, joints examined and wherever necessary repaired and inside surfaces treated as specified herein before.

Form work materials shall be cleaned after use and maintained in good condition. Any timber which has shrunk, warped or split and any forms which are damaged to such an extent as to weaken the form or to affect the quality or appearance of the concrete shall be replaced or repaired. If the strength and composition of the form work has so far deteriorated due to repeated uses that in the opinion of the Engineer in Charge it will no longer adequately perform its function, then it shall not be used again and is to be removed from site.

Nominal Cover to Reinforcement

Nominal Cover

Nominal cover is the design depth of concrete cover to all steel reinforcement, including links. It is the dimension used in design and indicated in the drawings. It shall be not less than the diameter of the largest bar at that particular face.

Nominal cover to meet durability requirement.

Minimum values for the nominal cover of normal-weight aggregate concrete which should be provided to all reinforcement, including links depending on the condition of exposure described given in Table 16 of IS 456 2000

Table 4

Table 16 of IS 456-2000 Nominal Cover to Meet Durability Requirements.

Exposure	Nominal Concrete Cover in mm not less than
Mild	20
Mode rate	30
Severe	45
Very Severe	50
Extreme	75

Cover to Reinforcement for specific structural elements shall be as mentioned in the Structural GFC Drawings

General

Where a sawn form work finish is specified or in all cases where no alternative finish is specified, the surface of the concrete shall be not worse than that obtained by the use of properly designed moulds of close jointed swan boards. Small surface blemishes caused by entrapped air will be permitted but the surface should be free of voids, honey combing or other defects.

Should any concrete in the works, in the opinion of the Engineer in Charge, fail to match the standard sample in surface finish then the Engineer in Charge may for this sole reason order the removal of all such substandard concrete which shall be replaced with acceptable concrete all

Samples of Finishes

For all specified finishes apart from sawn form work the Contractor shall provide a sample panel at least 2.4m x 1.2m in vertical surface area including a typical horizontal and vertical joint in the form work and the construction techniques that the Contractor proposes for the actual works. The sample when approved shall form the standard for the entire works. All unsuccessful samples shall be removed from the site.

Fair Faced Finish (F1)

Where fair faced finish (F1) is specified the irregularities of the finish shall be no greater than those obtained from the use of wrought thickness square edged boards. The boards shall be arranged in a uniform patten as specified or approved.

The concrete surface shall be smooth, free from fins, lippings, board marks or other irregularities and shall be even with sharp true arises. Only very minor blemishes or voids shall occur and there shall be no staining and no dis-coloration. The finish is intended to be left as struck and the only treatment generally permitted is light manual abrasion with a carborandum stone to remove minor marks. Patching of any description will not normally be permitted.

Isolated blow holes not exceeding 10mm diameter will be permitted, but otherwise surface is to be free from voids, honey combing or other large defects. Small defects shall be made good and blow holes filled with mortar specially mixed to match the colour and texture of the concrete.

Abrupt irregularities shall not exceed 2mm.

Rough Board Finish (F0)

Where rough board finish (F0) is specified it shall be produced using form work or form work linings of approved rough textured seasoned wood boards with moisture content of between 10% and 20%. These boards to be of varying textures and to be arranged to give uniform overall effect. Boards shall be assembled to prevent penetration or loss of grout between them. Gaps greater than 5mm shall be filled. Form work shall be soaked with water before erecting and shall be kept damp until concrete is placed. Cover spacers and bolts shall be positioned to the satisfaction of the Engineer in Charge.

The number of uses of form work linings will be limited to their ability to provide the required finish.

The finish shall be left as struck. Any blemishes shall not be made good until inspected by the Engineer in Charge. After inspection minor voids and irregularities on surfaces shall be filled with a matching mortar to the Engineer in Charge's approval, using a sponge rubber faced float. Discoloration will not be permitted.

Worked Surface Finish

The surface of concrete after casting shall be generally be finished level or to falls as specified with one of the following surface finishes as indicated on the drawings.

Type U1: The concrete shall be uniformly levelled and screeded to produce a plain surface. No further work shall be carried out to the surface unless it is to be used as a first stage for a type U2 or U3 finish.

Type U2 : After the concrete has stiffened sufficiently, the type U1 finish shall be floated by hand or machine sufficiently just to produce a uniform surface free from screed marks.

Type U3 : When the surface moisture has disappeared and the concrete stiffened sufficiently to prevent laitance from being worked to the surface, a Type U1 finish shall be steel trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

The following methods may also be specified in conjunction with the above to provide specific qualities of finish.

- Wood float to give an even textured surface
- Steel trowel or power float to give a smooth un-textured surface
- Scratch with a stiff brush to give a slightly roughened even texture
- Tamp with the edge of a board to give an even texture of parallel ribs
- Other finishes as specified and executed in an approved manner.

The Contractor shall not wet the concrete surface to assist working and shall not add cement to produce the specified finish without the prior approval of the Engineer in Charge.

Construction, Contraction and Expansion Joints

In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the Engineer in Charge (all joints shall be applied with Nitobond EP or approved equivalent make). Such joints shall be kept to a minimum. The joints shall be at places where shear force is nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also, a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber.

Prepared joint shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

- Clear gap shall be maintained between all structural elements as mentioned in drawing at all floors.

Filler material or sheet overlaps above EJ shall be filled with flexible material as per specifications with min. compressible & elongation values mentioned in drawing. These fillers or overlaps shall be designed to allow movements as mentioned in drawings.

All services like pipes, ducts, hangings etc. shall be designed to allow movements as specified above.

Waterproofing on EJ shall be coordinated by contractor with vendors & share details to design for review before execution.

The Contractor shall be responsible for the position and detail of construction joints not specified in the Contract subject to the Indicative acceptable spacing given in Table 3 (below). Such joints shall be arranged so as to minimise the possibility of the occurrence of shrinkage cracks.

All soffits of slabs, retaining wall inner surfaces need not be plastered for which all exposed joints shall be rendered with grey & white cement and quarry dust mixed in the proportion of 1:1:1 with the use of gunny bags.

Table 5 - Indicative Acceptable Spacing of Construction Joints

Element	Maximum Area (m ²)	Minimum Dimension (m)
Waterproof concrete walls	25	5
Waterproof concrete slabs	100	1 0
Slabs with major restraint at both ends	100	1 3
Slabs with major restraint at one end only	250	2 0
Slabs with little restraint in any direction	500	3 0
Walls (other than above)	40	1 0

Vertical construction joints shall be properly made to form a vertical grout tight joint. Where reinforcement passes through the face of the joint the stopping off board shall be drilled so that the bars pass through the board shall be made in sections with

half round indentations in the joint faces for each bar.

Where the Contractor's proposed construction joints result in alterations to the reinforcement, he shall provide full revised details for the Engineer in Charge approval a minimum 14 working days prior to commencement of the works.

The Contractor shall furnish the upper surface of lifts of concrete walls and columns horizontal and clean the form work of adhering concrete before the next lift is placed

- At all construction joints, both horizontal and vertical, the surface of the previously placed concrete shall be suitably treated to remove laitance and to expose the coarse aggregate thus forming an irregular surface key for adjacent concrete. This work shall be carried out to the satisfaction of the Engineer in Charge by the following or other approved methods (in either case the surface shall thoroughly washed and cleaned after roughening).

After the initial set has taken place but before final set (a minimum period of 4 hours after casting) the coarse aggregate shall be exposed by the use of water jet and stiff brushing or an air-and-water jet.

After final set has taken place (a minimum period of 4 hours after casting) the laitance shall be removed and coarse aggregate shall be exposed by bush hammering taking care not to loosen the aggregate in the face of the concrete matrix.

The Contractor shall ensure the surface of the construction joint is coated with approved polymer bonding agent prior to concreting afresh immediately.

At least 72 hours shall be left between completion of concreting one bay and the start of concreting any adjacent bay.

Panels of walls and slabs shall be cast in such a sequence as to minimise and control the effect of shrinkage at construction joints.

Form work to construction joints shall be rigid and shall accommodate projecting reinforcement without bending or displacement.

Where kickers are cast at base of walls and columns, these shall be cast monolithically with the base slab.

if placing of concrete has to be unexpectedly stopped, the Contractor shall form construction joints as directed by the Engineer in Charge.

Contraction joints and Expansion joints shall be formed as detailed where shown on the Drawings.

Concrete shall not be placed on both sides of Contraction or Expansion joint at the same time.

Water stops shall be provided at all construction joints in water retaining structures. The details of all such joints shall be approved by the Engineer in Charge.

Concrete Mixes

General

Reference shall be made to concrete mixes as Nominal mix concrete or Designed Mix

concrete. Nominal mix concrete is denoted by proportions of cement, fine aggregate and coarse aggregate such as 1:5:10, 1:4:8, 1:3:6 or 1:2:4. The proportion referred to is by weight (mass). 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 Contract or 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 given in Table 6 (below).

The cement content not including fly ash and blast furnace slag in excess of 450 kg/m^3 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.

Table 6

Table 5 of IS 456 2000 Minimum Cement Content, Maximum Water- Cement Ratio and minimum Grade of Concrete for Different Exposures with Normal Weight Aggregate of 20mm and Nominal Maximum size

S.No	Exposure	Plain Concrete				Reinforced Concrete	
		Minimum Cement Content Kg/m^3	Maximum Free water Cement Ratio	Minimum Grade of concrete	Minimum Cement Content Kg/m^3	Maximum Free water Cement Ratio	Minimum Grade of concrete
i)	Mild	220	0.60	-	300	0.55	M20
ii)	Moderate	240	0.60	M 15	300	0.50	M25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very Severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

Notes: Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2.(IS 456 latest version).The additions such as fly ash or ground granulated blast furnace slab may be taken into account in the concrete composition with respect to cement content and water cement

ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of Pozzolona and slag specified in IS 1489 (part-1) and IS 455 respectively.

Higher Minimum Cement Content as mentioned in the above chart and the BOQ, higher of the two for each case will prevail.

Nominal Mix Concrete

Nominal mix concrete shall normally be used only for plain cement concrete works and less important reinforced concrete works where shown on drawings or specifically allowed by the Engineer in Charge. Such concrete shall not require preparation of trial mixes and all such concrete shall be mixed in a mechanical mixer. Proportions for nominal mix concrete shall be according to Table-9 of IS: 456-2000. In addition, standard proportion by volume shall be used wherever specified.

In proportioning concrete, the cement shall be measured by weight (mass). The quantities of fine and coarse aggregates may be determined by volume (for corresponding weight) but preferably by weight. If fine aggregates are moist, the amount of surface water shall be determined. Also, an allowance shall be made for bulking in case of volume batching, in accordance with IS:2386 (Part-III). The weight of aggregate shall be measured when the aggregates are dry. Due allowance shall be made for the water content of moist aggregates. All the above data shall be maintained properly, to the satisfaction of the Engineer in Charge.

Table 7

Table 9 of IS 456 2000 Proportions for Nominal Mix Concrete

Grade of Concrete	Total Quantity of Dry aggregate by Mass per 50 kg of cement, to be taken as the cum of the Individual masses of fine and coarse aggregate kg.	Proportion of fine aggregate to coarse aggregate (by mass)	Quantity of water per 50 kg of cement, max ¹
M 5	800	Generally 1:2 but subject to an upper limit of 1:1 $\frac{1}{2}$ and a lower limit of 1:2 $\frac{1}{2}$	60
M 7.5	625		45
M 10	480		34
M 15	330		32
M 20	250		30

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.

Table - 8

Grade of Concrete Deviation (N/mm²)	Assumed Standard
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 the cement. Any water required to be absorbed by aggregate is excluded. To keep the water-cement ratio 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/m³. 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 do so 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 intervals at the Contractor's expense and shall be accurate to within 2%. Certificates of accuracy 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 is 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, care should 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 approval by 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 types of 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

Table 9

Nature of Concrete	Workability	Slump in mm		Type of Construction
		M in.	M ax.	
Conventional	Medium	50	100	All RCC works
Pumpable	High	100	150	All RCC works.

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 rated capacity of the mixer.

Prior to the first mix each day being agitated in the mixer a rich cement / sand mix shall be used to 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 discretion of 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.

Placing Conditions	Degree of Workability	Slump(mm)
Blinding concrete, Shallow sections, pavements using pavers	Very low	a) Refer IS 1199
Mass Concrete Lightly reinforced sections in labs, beams, walls, columns, floors, Hand placed pavements, Canal lining, Strip footings.	Low	25-75
Heavily reinforced sections in slabs, beams, walls, columns,	Medium	50-100
Slip form work, pumped concrete	Medium	75-100
Trench fill-In-situ piling	High	100-150
Termite concrete	Very High	b) Refer IS: 9103

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. 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 deck on 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 all times. Any build-up in the lines of material from previous operations shall be cleaned out preparatory 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 be carried 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 hopper or discharge lines.
- All lines shall be cleaned free of concrete prior to resumption of pumping after each breakdown
- 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, wet Hessian 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 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 hours notice.

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 shall be 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 underwater.

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 may be 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 separation of 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 be on 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.

Any concrete, which in the opinion of the Engineer in Charge shows signs of initial setting before or during placing, shall not be used and it shall be removed at the Contractor's expense.

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 treatment.

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 8004 or 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 required level

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 one day.

A technically competent person shall supervise the sampling of fresh concrete and the making of concrete test cubes.

Additional test cubes of concretes shall be taken and placed near the area of concreting of 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 at site.

Table 10

**Table 11 of IS 456 2000 Characteristic
Compressive Strength Compliance Requirement**

Specified Grade	Mean of the Group of 4 Non-overlapping consecutive Test results in N/mm²	Individual Test results in N/mm²
M 15	$\geq f_{ck} + 0.825 \times \text{established standard deviation (rounded off to nearest 0.5 N/mm}^2)$ or $f_{ck} + 3 \text{ N/mm}^2$ whichever is greater	$\geq f_{ck} - 3 \text{ N/mm}^2$
M 20 or above	$\geq f_{ck} + 0.825 \times \text{established standard deviation (rounded off to nearest 0.5 N/mm}^2)$ or $f_{ck} + 3 \text{ N/mm}^2$ whichever is greater	$\geq f_{ck} - 3 \text{ N/mm}^2$

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 inspections,

structural members' references, names or personnel present and details 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 the cube 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 to clause 16.1 of IS: 456 2000.
- The variation between the lowest and highest shall not be more than 15% of the mean of the three.

- In addition to the water tank curing method specified in IS-516, cubes may be cured on Site 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 $27^{\circ}\text{C} \pm 3^{\circ}\text{C}$.
- 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 at the Contractor's expense. The locations of these cores to be taken shall be decided by concreting day for test
the Engineer in Charge These cores shall be treated as in 3.8.3 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 locations directed by the Engineer in Charge.
- The diameter of the concrete cores should be 150 mm for 40 mm aggregate concrete, 100 mm 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 given by 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 with cement 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 when adjusted 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 grade strength *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 should not be more than "few".
- Cores shall not be tested for strength at ages less than 28 days and no adjustment shall be made 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 age 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 unlikely that 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 ± 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) ± 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 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) Carry out, 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 cantilever. 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

Table 11

Item	Tolerance

1	Variations from the plumb		
1a)	In the lines and surfaces of columns, piers, walls and arises		
	In 3m	5 mm	
	In any storey or 6 m maximum	10 mm	
	In 12 m or more	20 mm	
1b)	For exposed corner columns, control-joint grooves and other conspicuous lines		
	In any storey or 6 m maximum	5 mm	
	In 12 m or more	10 mm	
2.	Variation from the level, or from the grades indicated on the drawings **		
	At any point (from true elevation)	± 10 mm	but not more than 5 mm variation between two points within 6 m in a horizontal plane.
3.	Variation of the linear building lines from established position in plan and related position of columns, walls and partitions.		
	In any bay or 6 m maximum	10 mm	
	IN 12 m or more	25 mm	
No tolerance that would result in encroachment on adjoining properties is permissible			
4.	Variation in the sizes and locations of sleeves, floor openings and wall openings	5 mm	
5.	Cross sections of columns and beams, thickness of walls, slabs and other parts of the building		
	Upto 0.5 m	$\pm 5/-3$ mm	
	Over 0.5 m	$\pm /-5$ mm	
6.	Footings		
6a.	Variation in dimensions in plan	± 25 m m#/- 10m m	

Ite m		Toler ance	

6b.	Misplacement or eccentricity	2%	of the footing width in the direction of misplacement but nor more than +25 mm#
6c.	Reduction in thickness	50 mm	of specified thickness
7.	Variation in steps		
7a.	IN a flight of stairs		
	Rise	3 mm	
	Tread	5 mm	
7b.	In consecutive steps		
	Rise	2 mm	
	Tread	3 mm	
** Variation in floor level are to be measured before removal of supporting shores # Applies to concrete only, not to reinforcing bars or dowels Except otherwise shown on drawings, these are maximum allowable tolerances.			

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.

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 polystyrene particles.

iii. 1:1:4 mix (640 kg.m3): 45 kg. Cement and 0.028m3 sand to 2.155 kg. Expanded polystyrene particles.

c) 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**.

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
 - iii. Location of drainage outlets / down pipes
 - iv. The thickness of screeding and finishes
 - v. 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.

MODE OF MEASUREMENT

Unless noted otherwise in the Bill of Quantities, the method of measurement for various items shall be generally in accordance with IS: 1200

STEEL REINFORCEMENT

General

Related Works

- Concrete Formwork
- Cast in-situ Concrete

Applicable Standards

Sr No	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 steel	IS: 1786

Grade	Description	Conforming to
Fe 500	High strength deformed / ribbed steel	IS: 1786
Fe 550	High strength deformed / ribbed steel	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 500D is preferred option for this project. Use of 550MPa reinforcement shall be subject to approval from CLIENT/ Engineer in Charge 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 Engineer in Charge.

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/ Engineer in Charge can get work done Contractor's risk and cost shall impose a penalty of Rs 500 (Rupees Five Hundred only) per by 3rd Party at the

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 / rebend 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 Ø	0.22 kg/ m
7 mm Ø	0.39 kg/ m
10 mm Ø	0.62 kg/ m
12 mm Ø	0.89 kg/ m
14 mm Ø	1.21 kg/ m
16 mm Ø	1.58 kg/ m
18 mm Ø	2.00 kg/ m
20 mm Ø	2.47 kg/ m

22 mm Ø	2.98 kg/ rm
• 25 mm Ø	3.85 kg/ rm
28 mm Ø	4.83 kg/ rm
32 mm Ø	6.31 kg/ rm
36 mm Ø	7.99 kg/ rm
40 mm Ø	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 rebend 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/ Engineer in Charge 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/ Engineer in Charge 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 Engineer in Charge.
- 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 Engineer in Charge /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 Contractor's expense in the manner and the locations approved by the Structural at the Consultant.
- No additional cost shall be paid for the lapping & the rate should be inclusive of the cost of lapping.
- 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 L_d (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 $2L_d$ 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

- Adequately secure with tying wire or approved steel clips.
- Bend the tying wires well back clear of forms.

Concrete Cover

- 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

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.

MEASUREMENTS

Reinforcement shall be measured as follows:

- Length of different diameters of bars actually placed in position including laps shall be measured nearest to a centimeter and their weights calculated as shown on the drawings or as instructed by the Structural Consultant
- Weights per meter shall be as mentioned in Clause 3 / 2.3.7
Rolling margin to be considered in quoted rates.
- The Contractor shall account for all these in its quoted rate.
- Rate build-up shall include, in addition to cost of material (ie will not be measured and paid for separately)

Block Work

General

Description of Work

This section shall cover all masonry work required. Unless otherwise shown, mentioned or directed all masonry work shall be of solid concrete block and all walls shall extend to full height upto the bottom of the structural member above.

Quality Assurance

- Physical properties of solid concrete blocks shall generally conform to relevant IS: 2185 Part 1 & IS: 2185 Part 2

Submittals

Product Data:

Contractor shall submit manufacturer's product data to show compliance with the technical specification.

Certificates:

Contractor shall submit test certificates of crushing strength, water absorption, drying shrinkage etc. of concrete masonry blocks as specified in IS: 2185 Part 1

Samples:

Submit for verification purposes, samples of block units and obtain approval before placing order with suppliers.

Products

Blocks shall comply with the requirements of IS: 2185 and as indicated below.

Block

Blocks shall comply with the requirements of IS: 2185 and as indicated below.

- Blocks shall be generally hard, sound, square, clean and sharp with well-defined edges.
- Blocks shall be of grade 'C' as per Table 2 of IS 2185 (Part I)
- Minimum average compressive strength of units: 5N/mm².
- Minimum compressive strength of individual units: 4N/mm².

Minimum density of blocks: 1800kg/m³.

Dimensions:

Thickness - 100, 150, 200, 250 & 300 mm as shown in the drawing

Length - 400, 500 or 600 mm

Height - 200 mm

- Tolerance: The variation in the length of the units shall not be more than ± 5 mm and variation in height and width of units, not more than ± 3 mm.

Cement

Ordinary Portland cement of grade 43 complying to IS: 8112 shall be used unless otherwise specified. or PPC complying to IS1484 Part 1

Sand

- Sand for masonry mortars shall have the quality and particle size grading conforming to IS: 2116 latest edition. The grading of sand for use in mortar for unreinforced and reinforced blockwork shall be within the specified limits for respective works. The fineness modulus of sand for mortar in unreinforced block work shall be between 2.9 and 2.3 and the same for reinforced block work shall be between 2.9 and 2.1 and whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles may be processed to comply with the standard by screening and or blending. Any deviation may be allowed at the discretion of Engineer. Sand shall be hard, durable, clean and free from dirt clay, organic matter or other impurities. Percentage of clay and all other deleterious substances shall not exceed 5% by weight of sand. when tested per IS: 2386 Part 1 and 2.

Water

Water conforming to IS: 456 and as approved by the Engineer shall be used.

Admixtures

Additives or admixtures conforming to IS: 9103, IS: 3812 and IS: 2645 may be added to the cement or concrete mix conforming to the IS specifications, meeting approval of the Engineer. Admixtures shall be chloride free and melamine polymer based, if approved. Other additives or admixtures not being governed by Indian Standards shall be tested and checked that the same are not detrimental to durability. However, any addition shall only be after the approval of the Engineer.

Ancillary Materials

- Construction sealant.
- Lintels: Provide RCC lintels over all doors and wall openings in block work. Size of the lintel shall be as per structural drawing.

Sleeper beams & mullions: Any block wall of height more than 2.5m shall be provided with R.C.C. sleeper beams (Beams to be constructed over block work) at lintel level. If the wall height is more, sleeper beams should be placed at every 2.5m. It shall be also provided with R.C.C. mullion at every 3.0m length. Size of the sleeper beams and mullions shall be as per structural drawing.

Execution

Joints

The joints, both horizontal and vertical, shall be 10 mm thick. The exposed joint shall be raked to form an effective 'key' with the plaster and unexposed joint shall be stuck smooth

Mortar Mix

The mortar mix for laying shall be one-part cement to four parts of sand (1:4), unless otherwise specified.

Horizontal (Bedding) Joints

Mortar shall be spread over the entire top surface of the block including front and rear faces as well as the webs to a uniform layer of 10mm thickness. Joints shall not be bigger than 10mm and shall be raked 10 mm. deep while mortar is green. Raking back shall be carried out at an angle not steeper than 45 degrees in case all the block work is not raised together.

Vertical (Cross) Joints

For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or to the next unit to be laid alongside of it. However, it will be more convenient to apply mortar on the edges of the succeeding unit when it is standing vertically and then placing it horizontally well pressed against the previously laid unit. In any case, whatever the method used for applying mortar, care shall be taken to produce well compacted vertical joints.

In the case of two cell blocks, there may be a slight depression on their vertical sides, which shall also be filled up with mortar to secure greater lateral rigidity.

Mortar shall not be spread so much ahead of the actual laying of the units, so that it tends to stiffen and lose its plasticity, thereby resulting in poor bond.

When the mortar has stiffened slightly, it shall be firmly compacted with a jointing tool. The mortar shall be pressed against the unit with a jointing tool after the mortar has stiffened to affect intimate contact between the mortar and the masonry unit and obtain a weather tight joint.

If necessary, mortar may be added, particularly to the vertical joints, to ensure that they are well filled.

Mortar joints shall be moistened with a fine water spray for about 7 days or alternatively masonry shall be covered with polyethylene sheets to retain the moisture as approved by the Engineer.

Laying of Blocks

For horizontal joints, all concrete blocks shall be laid with the thicker part of shell face up for easy handling and laying.

Pieces of hollow blocks shall in no case be used anywhere. Machine cut pieces of solid blocks, free of any cracking and chipping, may be used where they are absolutely necessary subject to prior approval of the Engineer.

All block walls abutting concrete columns or walls shall be bonded to the same with approved 6 mm dia 250 mm long galvanized M.S. dowels or approved G.I. butterfly ties left from the concrete columns while casting, at every alternate course of block.

The first course of concrete masonry shall be laid with great care, making sure that it is properly aligned, levelled and plumbed. This will assist the mason in laying succeeding courses to obtain a straight and truly vertical wall.

Before laying the first course the alignment of the wall shall be marked on the foundation footings. For this purpose, the blocks for this course shall first be laid dry that is without mortar over the footing, along a string tightly stretched between properly located corners of the wall in order to determine the correct position of the blocks including those of the cross walls joining it and also adjust their spacing. When the blocks shall be removed, a full mortar bed shall be spread on the footing and these blocks shall be laid back in place truly level and plumb. Concrete block work shall be laid in English bond. Concrete Block shall not be wetted like brick masonry prior to use. In drier climatic seasons, top and sides of blocks may be slightly moistened to avoid absorption of water from mortar. Bounding column surface(s) and beam bottom shall be prepared properly by hacking to avoid debonding. The string shall then be stretched tightly along the faces of the two corner blocks and the faces of the intermediate ones adjusted to coincide with the line. Thereafter each block shall be removed and re-laid over a bed of mortar. After every three or four blocks have been laid, their correct alignment, level and verticality shall be carefully checked. The units shall not be realigned tapped or in any way moved after initial placement as movement shall break the bond between units and mortar, after which the mortar will not re adhere well to the masonry units.

The construction of walls may be started either at the corners or started from one end proceeding in the other direction. If the corners of the wall are built first, they shall be built four or five courses higher than the center of the wall. As each course is laid at the corner, it shall be checked with a level or straight edge to make certain that the faces of the blocks are all in the same plane. Each course, in building the corners, shall be stepped back by a half block and the horizontal spacing of the block shall be checked by placing a mason's level diagonally across the corners of the block.

When filling in the wall between the corners, a mason's line shall be stretched from corner to corner for each course and the top outside edge of each block shall be laid to this line. The manner of handling or gripping the block shall be such as to position the block properly with minimum.

As each block is laid, excess mortar extruding from the joints shall be cut off with the trowel and thrown back on the mortarboard and to be reworked into the fresh mortar. If the work is progressing rapidly, the extruded mortar cut from the joints may be applied to the vertical face shells of the block just laid. Should there be any delay long enough for the mortar to stiffen the block, the mortar shall be removed to the mortarboard and

reworked. Dead mortar that has been picked up from the scaffold or from the floor shall not be used.

Block work shall be constructed only up to a few centimeters below the structural members above leaving a gap between the block and the structural member. The last layer of block masonry shall be laid by provisioning a groove of 15mm x 12 mm on the external side, which should be filled up with epoxy-based mortar and Metal before plastering or other finishing work is taken up.

In the case of cavity walls, both thicknesses shall be carried up together and in no case shall one thickness be carried up more than two courses in advance of the other.

Block work to be done up to lintel level first and further work will proceed only after fixing / laying of cable / duct / pipes etc. No claim in this regard is acceptable.

Closure Block

When installing the closure block, all edges of the opening and vertical edges of the closure block shall be buttered with mortar. The closure block shall be carefully lowered into place. If any of the mortar falls out leaving an open joint, the closure block shall be removed, fresh mortar applied, and the operation repeated. Closure unit locations shall be staggered throughout the length of wall.

Precautionary Measures

The following measures shall be taken to prevent formation of cracks.

- While curing, the block masonry shall be lightly sprinkled with water and not made excessively wet.
- Expansion joints shall be provided in walls exceeding 30 m in length.
- Unless otherwise specified 8 mm dia bar shall be provided in the bed joints in block work, one course above and one course below windows and above doors in order to distribute the shrinkage / temperature stresses occurring at the corners of openings, more uniformly throughout the walls and cost of such steel shall be covered in the rates of relevant items.
- In framed structures, erection of partition and panel walls shall be delayed taking care of deformations due to structural loads.
- Partition wall should be suitably reinforced in lower courses to strengthen against excessive deflections of floor slabs and should be separated from the ceiling by a layer of resilient material. Joint shall be carried out in plaster or any other finish.
- 100 mm wall shall be reinforced in alternate courses with two 8 mm dia longitudinal steel bars to strengthen against excessive deflections of floor slabs and such cost shall be covered in the rates of the item. Joint shall be filled with cement sand mortar (1:3).

Height of masonry construction

Block wall is to be constructed upto a maximum height of 1400mm in one lift.

Bearing Walls

When two bearing walls meet or intersect and the courses are to be laid up at the same time, a true masonry bond between at least 50 percent of the units at the intersection shall be ensured. Single reinforcement bar of 8 mm dia shall be provided at every such location within the hollow & as such cost shall be covered in the rates of relevant items.

Hollows at the intersection of two walls are to be filled and compacted with M-20 grade concrete. However, concrete pour shall be stopped 25 mm below the top surface of the top course to provide the key for the next pour.

Rendering and Other Finishes

Rendering shall not be applied to the walls when they are wet or during monsoon. The walls must be finished only after they are fully dried.

Where plastering is required, all joints of block work shall be fully raked to a depth of at least 10 mm while carrying out the block work.

Plaster Work

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 m² area to demonstrate the specified plastering.

PRODUCTS

Cement

Ordinary Portland cement of grade 43 complying to IS: 8112 shall be used unless otherwise specified. Or PPC conforming to IS: 1489.

Sand

Sand for plaster work shall have the quality and particle size grading conforming to IS: 1542 latest edition. Sand shall be hard, durable, clean and free from dirt clay, organic matter or other impurities. Percentage of clay and all other deleterious substances shall not exceed 5% by weight of sand when tested per IS: 2386 Part 1 and 2.

Water

Water conforming to IS: 456 and as approved by the Engineer shall be used.

Admixtures

Additives or admixtures conforming to IS: 9103, IS 3812 and IS2645, may be added to the cement or concrete mix conforming to the IS specifications, meeting approval of the Engineer. Admixtures shall be chloride free and melamine polymer based, if approved. Other additives or admixtures not being governed by Indian Standards shall be tested and checked that the same are not detrimental to durability. However, any addition shall only be after the approval of the Engineer.

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.

Cement Based Wall Putty

Overall internal plaster and ceiling plaster white cement-based wall putty shall be applied unless otherwise specified.

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 centers. 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.

Mix Proportions

The mortar for plastering shall be of proportion as specified in the item schedule. The mixes specified in the schedule are volumetric. Volumetric mixing shall be based on each ingredient.⁷ dry volumes of

Mixing

Cement and fine aggregates shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster. Mixing shall be done mechanically. However, manual mixing will be allowed at the discretion of the Engineer. Manual mixing, where adopted shall be carried out on a clean watertight platform. After water is added during mixing, the mix shall be held back and forth for 10 to 15 minutes. In machine mixing, the mixer shall run at least five minutes after placing all the ingredients in the drum. Only so much quantity of mortar which can be used within half an hour after the addition of water shall be prepared at a time. Any mortar for plaster which is set or partially set shall be rejected and shall be removed forthwith from the site.

Internal Plaster

The proportions of sand and cement shall be as specified in CPWD Specifications for wall and ceiling and shall cover all irregularities, undulations, depressions due to chasing etc. in the surface to be plastered. The mortar shall be applied slightly more than specified, thick and pressed and levelled with wooden ruler or straight edge to finished thickness. Straight edges shall be freely used to ensure a perfectly even surface. The finished surface shall be true and even and present uniform texture throughout and all joining marks shall be eliminated. All corners, edges and angles shall be made perfectly to line, plane and plumb. All exposed angles and junctions of walls, doors, windows, beams, slabs etc. shall be carefully finished so as to furnish a neat and even surface.

Plastering items amongst all other things as described in various items also include:

- Preparation of surfaces to receive the plaster, providing cement plaster of the specified average thickness and proportions with specified number of coats.
- All labour, materials, scaffolding, use of tools and equipment to complete the plastering work as per specifications.
- Curing for 10 days.
- Cleaning the surface of doors, windows, floors or any other surfaces where plastering might have splashed.
- Finishing the portion of plaster left above any type of skirting work to be finished rounded or as directed by the Engineer, in a separate operation after laying of floor and skirting.

The item shall also include rounding up of corner and angles making sharp corners and angles finishing around ceiling rose and electrical fittings etc. fixed by other agencies, junctions of roof and wall or beam with the finish as specified in the item. Plastering of brick and concrete cornice and copings and plastering in restricted areas if any shall not be measured separately.

Architectural bands and narrow widths of plaster over structural as well as non-structural and the line when prepared in the same thickness of plaster shall not be measured separately and shall be covered by respective plaster items.

All interior plaster shall be extended upto 12 mm below the skirting or dado level at no extra cost wherever required.

Wall Putty Punning

Unless otherwise specified, all internal wall & ceilings 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.

Sand Faced Cement Plaster

The surface to be plastered shall first be thoroughly cleaned down. All joints shall have been raked out in case of brickwork/block work/stone masonry as the work proceeds. Concrete surface shall also be clearly hacked, and wire brushed if not already done before plastering is taken up. The surface to be plastered shall be well wetted for a minimum period of 6 hours before commencing the work. The mortar for all plaster work shall be cement sand mortar of mix as specified in the BOQ/schedule of items.

Double scaffoldings required for facility of construction shall be provided by the contractor at his own expenses wherever directed by the Engineer. The contractor shall take all measures to ensure the safety of the work and workmen. Any instruction of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to property or injury to persons, resulting from faulty scaffolding, defective ladders and materials or otherwise arising out of his default in, this respect. Proper scaffolding shall be provided to allow easy approach for workmen and supervisory staff to every part of the work.

Base Coat - The surface to be plastered shall first be dabbed out with cement mortar to cover all irregularities and faces upto proud part. The dabbings which shall be of proportion as specified in BOQ/schedule of items and a 12 mm. thick layer shall then be applied/scored and keys shall be formed on the surface by thoroughly combing it with heavy horizontal lines about 12 mm apart and about 3 mm deep when mortar has just set.

Second Coat - The cement mortar for sand faced plaster shall have washed and approved sand with slightly larger proportions of coarse materials, but not exceeding 3 mm. The proportion of cement to sand shall be as specified in BOQ/schedule of items. The water is gradually added to make the mixture homogenous. The thickness of finishing coat excluding key shall be 6 mm. A reasonable time (not more than 48 hours) shall be allowed after application of base coat for thorough drying before the application of second coat. After application the surface should be finished with a wooden float lined with cork closely pricked on with wet sponge tapped gently to bring sand particles into prominence.

Water Proofing Compound / Admixtures

Whenever specified, waterproofing compound or admixtures of approved make shall to the mortar and mixed strictly in accordance with manufacturer's specification and to the be added entire satisfaction of the Engineer.

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.

Piling Works

Indian Standards

Indian standards to be followed are:

All relevant standards as specified elsewhere in this volume are applicable.

- IS:456 Code of practice for plain and reinforced concrete
- IS:516 Method of test for strength of concrete.
- IS:2911 Code of practice for design and construction of pile Foundation.
- Part I Sec 1, 3 Concrete piles, driven cast-in-situ
- Part I Sec 2, 4 Concrete piles, and Bored cast-in-situ concrete piles.

Material

Cement, Coarse Aggregate, Fine Aggregate, Water, Admixture and Steel Reinforcement shall be as detailed in specification and in the BOQ.

Reinforcement shall conform to IS: 1786 (latest version) grade Fe-500 for mechanical properties and shall be Corrosion resistant steel and it should be OPWD approved.

- . The reinforcement in the pile shall consist of the following:

a) Longitudinal/Ties/Spacer bar Reinforcement provided shall be as per approved design with respect to diameter, numbers and should run through the entire length of the pile. d) Cover Clear cover to reinforcement shall be as per approved design (min 75mm).

Bentonite

Bentonite powder to be used by mixing with water in suspension shall be such as to maintain the stability of excavation in trench/bore. Each consignment of bentonite powder received by the contractor shall be accompanied by the Test Certificate from the manufacturer stating its properties as determined by the supplier / manufacturer. The Certificate shall be submitted to the PM/Consultant for his record.

Polypropylene fabric

Fabric Type	Non- woven
Material Composition	100% polypropylene
Weight	180-200 gm/Sqm
Thickness	1.6mm (Approximately)
Weft way	30 Kg
Warp way	30 Kg
Air permeability	110 lts/Sqm/Second at 100mm water
Min bursting strength	16 Kg/Sq.cm.

Equipment and Accessories

The equipment and accessories will have to be selected depending upon strata, location of work, capacity, size and weight of pile to be handled. These shall be approved by the PM/Consultant prior to being brought to site and use shall be as approved by the PM/Consultant.

Scope Of Work

This section covers for providing bored reinforced concrete load bearing pile foundations including boring work, steel reinforcement, cast-in-place concrete piles, finishing of pile heads and all other work as required.

The work included consists of all necessary services and furnishing of all labour, material, tools, equipment and related items for full performance of the contract items as shown on the drawings, or as specified or reasonably implied or incidental to construction developments between trades.

In brief, items of work shall be as follows:

Coordination of drawing and setting out at site.

Boring for piles including chiseling hard strata like boulder/weathered and hard rock, bentonite slurry disposal, off generated material, keeping the site clean,

etc.

Providing and fixing steel reinforced cage with or without anti-corrosive treatment and fixing liner to reinforced cage as specified in BOQ.

Placing all work furnished by other trades informs before casting the concrete, fixing liner to reinforced cage if any.

- Cast in-situ concrete piles to required depths and heights
- Chipping and building up of pile heads
- All other miscellaneous concrete and related work shown in the drawings and/or called for in the BOQ.

The contractor shall be responsible for the safe load capacity of each pile and/or group of piles and shall guarantee his workmanship and materials against any damage resulting therefore to the building superstructure erected on the pile foundation.

The contractor shall, taking into account the site investigation information available and his own local knowledge, submit, with his tender, the full details of his proposals for the piles.

The contractor shall include in his tender, provision for a qualified site engineer experienced in piling construction to supervise the work and who shall be approved by the PM/Consultant, and who will work full-time at the site.

During progress of works, all care shall be taken to safeguard nearby existing structure, excavated areas, adjacent piles etc.

The contractor shall take all care in spacing of piles

- Practical movability and aspect of installation
- Nature of the load transfer to the soil and possible reduction in bearing capacity of a group of piles thereby.

Founding Strata

The pile should penetrate minimum 3 times the pile diameter into the founding strata. The founding strata is defined as the strata in which penetration by chiseling with a 3/4-ton chisel dropped from a height of 1 m continuously for half an hour does not exceed 15 cm.

The contractor shall provide and maintain, during the progress of his work, a suitable firm working surface at the site and as the work proceeds shall remove from the site all excavated material and rubbish arising thus to the satisfaction of the PM/Consultant.

The contractor shall, during the progress of the works, maintain full records of each pile constructed including the soil profile as bored, the length and diameter of the pile and the quantity of concrete placed in the pile in the proforma as detailed hereunder or as directed by the PM/Consultant.

The contractor shall take every precaution to avoid damage to the existing structures in the vicinity and adjacent piles. All claims arising on account of any

damage caused to the existing structures in the vicinity as a result of construction of pile foundation shall be borne by the contractor.

The minimum grade of concrete to be used for piling shall be M30 and minimum cement content shall be 400kg/cum. Concrete in aggressive surroundings due to presence of sulphates etc shall be as per provision of IS 456.

Workmanship

Bored Cast In Situ Piles

Co-ordination of Drawings

The contractor shall co-relate all relevant Architectural, Structural and Services drawings and satisfy himself that the information available therein is complete and unambiguous. Any discrepancy in drawing shall be brought to the notice of the PM/Consultant prior to execution of the work. Any aspect overlooked by the contractor shall be corrected by the contractor at his cost.

Setting Out

A benchmark shall be established by constructing a masonry pillar or marking on a suitable structure at the site. Based on the drawing the contractor shall prepare a layout drawing indicating pegs setting in both direction for approval of the Engineer in charge. The approved setting out shall be carried out at site with the use of Theodolite, steel tapes, etc. For proper execution it is recommended that a well-built masonry pillar be provided with top surfaces that are smooth finished to predetermined levels and marked sharply with axis for cross reference. The contractor shall ensure that all benchmarks, pillars and other marks used in setting out are protected and preserved till the completion of operation. The contractor shall be fully responsible for the accuracy and sufficiency of layout, and to achieve the standard of work required.

Boring

Boring may be done by rotary or percussion equipment, grabbing equipment or by reversed or directed mud circulation method. Stabilization of the sides of the bore hole, if required, should be done by the use of drilling fluids or casing.

The drilling fluid, where required should be used at least from the level of subsoil water and the hole should then be always kept almost full of the fluid which should preferably be kept in motion. The density and composition of the fluid shall be such as to suit the requirements of the ground conditions and to maintain the line materials from the borings in suspension. A 5% bentonite suspension would be generally suitable.

Construction sequence from the centre onwards from a group of piles shall be prepared and submitted for approval of the Engineer in charge.

Jetting

Jetting by means of water may use in fine grained soil having very small percentage of clay. Jetting shall be carried out only after express permission of the Engineer in charge.

Jet tubes may be casted into piles. There may be two or four jet holes depending upon type of method approved by the Engineer in Charge. Alternatively tow of more jet pipes may be attached to the sides of pile. Balanced arrangement of jet is essential to avoid pile to lead off. Jet shall be tested before driving commences.

The quantity of water required to make the jetting effective will vary with the nature of the ground and the size of pile. Precaution shall be taken to avoid collecting of water when it comes to ground surface. It shall be ensured that stability of the piling and piling plant is not endangered by softening of the ground.

Jetting shall be stopped before completing the driving.

Jetting shall be stopped when it any tendency of pile tips being drawn towards the piles already driven in noticed.

Cleaning

The bottom of the bore holes shall be cleaned of all the spoils and sediments before placing the concrete and after placing of cage reinforcement so that the bases of piles shall be free from loose material.

Reinforcement

Reinforcement used shall be made up into cages sufficiently well-wired to withstand handling without damage. Bars shall be placed at sufficient distance to allow easy flow of concrete. The lateral ties and spiral binding shall not be closer than 15 cm centre to centre. Care shall be taken to preserve correct cover of 6.0 cm or as specified in drawings and alignment of reinforcement throughout the whole operation of placing the concrete.

Concreting

Concreting shall start as soon as possible after the completion of boring. If bore holes are not concreted within two hours, they shall be cleaned thoroughly prior to placing the concrete.

Concreting shall be done so as not have any voids formed due to faulty consolidation of entrapped air. The volume of concrete placed shall be observed and checked to monitor any deviation in the volume of the concrete placed.

Concreting shall be placed by means of a tremie pipe.

It shall be ensured that the concrete entering the termite pipe does not get mixed up with slurry. The tremie pipe shall extend up to the bottom of the bore hole at the start and shall be withdrawn in sections as the level of concrete rises in the bore holes, but its discharge end shall at all times be embedded in the concrete to a minimum depth of one metre or a sufficient head to prevent the inflow of soil and water.

All large bore piles shall be brought up to 60 cm or higher as directed than the theoretical cut- off point to permit all laitance and weak concrete to be removed and sound correct length keying in the pile cap.

Additional precautions shall be taken in tremie pipe concreting

- a. Concrete shall be coherent, minimum cement content 400 kg/cum and slump 150 mm.
- b. When concreting is carried out under water a temporary casing to full length of the bore or 2 M in non-collapsible strata shall be installed to avoid drop of sides into concrete.
- c. The hopper and tremie should be a closed system embedded in the placed concrete, through which water cannot pass.
- d. For tremie pipe concreting pipe shall be of minimum 200 mm dia. and size of aggregate maximum 20 mm.
- e. First charge should be placed with a sliding plug pushed down the tube with a steel plate of adequate charge to prevent mixing of concrete and water. Plug should not be left in concrete as lump.
- f. Tremie pipe should always penetrate into concrete.
- g. Pile should be wholly concreted with tremie method to avoid laitance from being entrapped within the pile.
- h. All tremie pipe shall be cleaned after use.

Withdrawal of Casing

Extraction of casing in the case of large dia. bore piles shall be done in such a way that no necking or shearing of the concrete in the shaft takes place.

Finishing Pile Heads

The top of the piles shall be brought up above the finished level to permit all laitance and weak concrete to be removed. It shall be ensured that pile heads are properly keyed into the pile cap. A minimum distance of 7.5 cm or as specified in the drawings shall be maintained.

All large bore piles shall be brought up to 60 cm or higher as directed than the theoretical cut- off point to permit all laitance and weak concrete to be removed and sound correct length keying in the pile cap.

Tolerances

The contractor shall exercise every care to ensure that all the piles are located at the correct assigned positions as indicated in the drawings. The piles shall be, as accurately as possible, true to the vertical.

Permissible positional deviation for bored piles shall not be greater than 7.5 cm for piles up to 180 cm in diameter at the level of the bottom of the pile cap. The deviation from the vertical shall not be more than 1 in 100.

Records

A competent supervisor shall be present to record the necessary information when the pile is being driven. The data record shall be kept in the form as prescribed in IS 2911 (Part I) Appendix H or as directed by the Engineer in Charge.

Testing Of Piles

Load Tests

Tests shall be carried out in accordance with the requirements of IS 2911 (Part I).

Testing Procedure

Load tests on a pile shall not be carried out earlier than four weeks from the time of casting of the pile. The contractor shall submit the description of his procedure for carrying out the load test for the approval of the PM/Consultant, at least one month prior to the first load test. The Engineer in Charge reserves full rights for demanding modifications of the test procedure proposed by the contractor.

Number of Tests

The number of load tests carried out by the contractor shall be carried out as per IS 2911 Part IV.

Equipment

The contractor shall provide all necessary equipment for supplying specified vertical loads on top of the test piles and measuring settlement of the piles. The equipment provided shall be capable of slowly applying and maintaining loads to within an accuracy of 1% and measure deflection to accuracy of 0.02 mm.

Before commencing load testing of piles, all load testing equipment, e.g. hydraulic jacks, pressure gauges, deflecto metres, etc. shall be tested for their accuracy from an approved laboratory. The testing deflecto metres along with their test certificates shall be kept in the custody of the Engineer in Charge until start of the test. The hydraulic jacks shall be placed on the pile only on the date of testing in the presence of the Engineer in Charge

Loading Device

The device for applying vertical load shall be suitably designed to avoid impact, lateral forces, tilting, etc. And shall have an arrangement for gradual applications of load by means of a hydraulic jack and for reading at close intervals. The load shall be in the form of suitable kentledges/reactions.

In the absence of a loading platform, the loading device may be as under.

The hydraulic jack reacts against heavy RS joists or a suitable load frame held down by anchor piles or other anchorages. The anchor piles may be working piles, but they shall be sufficient in number and adequately reinforced to take the full tension with proper factor of safety.

Apparatus for Measuring Settlement

The apparatus for measuring settlement shall consist of 4 dial gauges permitting a reading of 0.02 mm accuracy. The dial gauges shall be fixed to a datum bar whose ends rest upon non- movable supports. The supports for the datum bar with reference to which the settlement of the pile would be measured shall be at least $5 \times d$ away clear from the piles, 'd' being the diameter of the pile.

Preparation of Pile Head for Testing

The pile head shall be at the cut-off level of the pile. However, if the cut-off level is considerably below the ground level, the test pile may be made as directed by the Engineer in Charge. It shall be constructed up to ground level and due deductions shall be made in the pile capacity to account for the resistance offered by the soil from the theoretical cut-off level to the test level of the pile. In this regard the decision of the Engineer in Charge shall be final and binding. The head of the pile shall be capped in such a manner as to produce a horizontal plane bearing surface.

Loading Procedure

The maximum test load shall be 1.5 times the anticipated working load on the pile for routine and cyclic load tests and 3.0 times the anticipated working load or load to destruction, as decided by the PM/Consultant for initial load tests.

Procedure for Initial Tests

- Initial tests are specifically recommended for adequate investigation in case of major projects. Tests shall be carried out as soon as possible.
- The tests shall be carried out by applying a series of loads on the RCC cap over a pile or a group of piles unaided by any other support. The load shall be applied by means of the hydraulic jack reacting against a loaded platform (device as detailed earlier), which shall be preloaded to not less than two and a half times the estimated safe load carrying capacity of the pile. The hydraulic jack shall be of adequate capacity and shall have a pressure gauge and remote-control pump.
- The test load shall be applied in equal increments of about one-fifth of the estimated safe load or as directed by the Engineer in Charge. Alternate loading and unloading at each increment shall be performed and the elastic and plastic settlements recorded.
- Readings of settlement and rebound shall be recorded with the help of at least two dial gauges (preferably four) of 0.02 mm sensitivity and resting on diametrically opposite ends of the pile cap. The dial gauge shall be fixed to a datum bar whose ends rest on non- movable supports. The supports for datum bar with reference to which the settlement of the pile would be measured, shall be at least $5d$ away, clear from the piles where d is diameter of the pile.
- Each stage loading shall be maintained till the rate of movement of the pile cap is not more than 0.02 mm per hour.

Loading shall be continued till the settlement of the pile top equals one-tenth of the diameter of the pile stem (one-tenth of the side in case of square piles), or the load is three times the estimated safe load on the pile, whichever is earlier.

The full test load shall be maintained for 24 hours. If the settlement has not reached a steady value within a period of 24 hours, the full test load shall be retained until the settlement recorded for the next 24 hours remains constant.

The safe load on the pile shall be the least of the following:

- Two-thirds of the final load at which the total settlement attains a value of not more than 12 mm. Unless it is established that a total settlement different from 12 mm is permissible in a given case on the basis of nature and type of the structure. In the latter case the actual total settlement permissible shall be used for assessing the safe load instead of 12 mm.
- Two-thirds of the final load at which the net settlement attains a value of 6 mm.
- 50% of the final load at which the total settlement equals one-tenth of the pile diameter or one tenth of the side in square pile as the case may be.

Procedure for Routine Test

It shall be the same as in the case of the initial test detailed above. If desired by the PM/Consultant, working load application shall be in increments of 25, 50, 75, 100, 125 and 150 percent of the anticipated working load. Full test load shall remain on the pile for 24 hours. The test may be carried out on one or more working piles.

The safe load shall be assessed as the least of the following:

- Two-thirds of the initial load at which the total settlement attains a value of not more than 12 mm. Unless it is established that a total settlement different from 12 mm is permissible in a given case on the basis of the nature and type of the structure. In the latter case, the actual total settlement permissible shall be used for assessing the safe load instead of 12 mm.
- Two-thirds of the final load at which the net settlement increases to 6 mm, unless more settlement is permissible.

Procedure for Cycle Loading

The loading shall be applied on the test pile or group of piles by the hydraulic jack assembly with pressure gauge in increments of about one-fifth of the assumed safe load. The reaction shall be obtained against a loaded platform or heavy R.S. joist bolted down to anchor piles.

Alternate loading and unloading shall be carried out at each stage and subsequent elastic rebound in the pile shall be measured accurately by a minimum of two (preferably four) settlement gauges fixed at diametrically opposite ends to a datum bar resting on immovable supports. In order to simulate the secondary fluctuations of load,

a cycle of loading and unloading may sometimes be repeated at 5-to 10-minute intervals before applying the next higher load. Loading shall be continued till there is a marked progressive settlement of the pile. In the end full test load shall remain on the pile.

Tension Tests

If required, tension tests shall be done for a maximum test load of 2 times the safe tension capacity of the pile.

Two adjacent working piles shall be treated as reaction piles and tensile loading applied by means of hydraulic jack against a steel joist (built-in if necessary) resting on the reaction piles.

The contractor shall submit his proposal for testing along with detailed sketches and computations pertaining to the test for the approval of the PM/Consultant at least one month before the date of the test.

Alternate loading, unloading and recording of readings shall be done in the same manner as for cyclic loading.

Low Strain Pile Integrity Testing

Conduct Low Strain Pile Integrity Testing on R.C. Bored Pile Foundations using Pile Integrity Tester equipment manufactured by Pile Dynamics Inc. of USA or TNO of Netherlands that conforms to ASTM D5882.

The test shall be conducted by generating impact of handheld hammer and the averaged curve shall be velocity record as a function of time. In general, atleast 2 locations shall be tested for pile more than 600mm diameter.

Test Preparation:

The test shall be conducted minimum 10 days after pile installation and after the pile top concrete has been chipped off to sound concrete level and made uniform. The pile top shall be free from water, dirt or other debris.

The pile head shall be made smooth using carborundum stone or grinder or chisel on atleast 2 locations one at the center of the pile and other 300mm away from the center for data collection.

Result Preparation

The data must be displayed on the field such that atleast preliminary evaluation can be made. An interim report shall be submitted within 3 days of field testing. A complete report to be submitted within 7 days after the test showing graphical wave form indicating velocity versus time plot, interpretation of results showing discontinuities, cross-sectional or material changes if any, concrete quality etc. The test shall be conducted in accordance with ASTM D5882.

High Strain Dynamic Pile Testing

Conduct High Strain Dynamic Pile Testing on R.C. bored piles using Pile Driving Analyzer. The equipment shall have ability to record both force and velocity. Both strain and acceleration sensors shall be used to collect data & atleast 2 piles shall be connected at diametrically

opposite sides of the pile. The test and equipment shall conform to ASTM D4945-1989. The test shall be conducted by an experienced independent test agency.

Equipment and Site Arrangement:

High Strain Dynamic Testing shall be performed using Pile Driving Analyzer, with its allied strain and acceleration sensors, cables etc. The pile shall be tested minimum 14 days after installation.

The hammer weight and setup arrangements shall be as per specifications of test agency; however, the following guidelines can be used. The test shall be conducted by impacting the pile top with a hammer whose weight is 1% to 1.5% of the test load. The drop height shall normally vary from 1m to 3m. A single line crane or winch and tripod shall be used for the impact.

The pile head for the test shall be rebuilt to 1.5 times pile diameter using formwork or casing. If casing is used, windows 200mm x 200mm shall be cut into the pile at 1.5diameters for fixing sensors. Plywood cushion and steel plate shall be placed onto the pile head before impact and this shall be based on test agency recommendations although minimum 20mm thickness shall be used.

Test Results:

The report shall be submitted within 1 week of testing and shall include force velocity curves, pile capacity, simulated static load test curve, net & total pile displacement, pile integrity. A (Case Pile Wave Analysis) CAPWAP analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile.

Pile Integrity Test:

Pile integrity test is done to assess the continuity of piles. With this test necking or bulging and uniformity of quality of concrete is checked. It is a Non-Destructive integrity test method for foundation piles. (Low strain method)

Test Equipment: The equipment shall have the following minimum requirements: The analog to digital resolution shall be at least 24 bits,

The sampling frequency shall be at least 25,000 Hz.

Data shall be stored such that additional processing or further wave analysis is possible.

Data shall be displayed in the field for evaluations of preliminary data quality and interpretation.

The equipment shall allow attachment of a motion sensing device capable of measuring acceleration, velocity or displacement due to the impact of the pile top with a handheld hammer.

Test Preparation

For cast in place piles, integrity testing shall not be performed until the concrete has cured for a minimum of seven (7) days unless

otherwise approved by the engineer. The pile head shall be free from water, dirt or other debris. The concrete at the pile top surface must be relatively smooth and provide sufficient space for attaching the motion sensing device and for the hammer impact area.

100% of all piles shall be integrity tested. If less than 100% of piles are initially tested, additional piles may be selected for testing at the discretion of the engineer if circumstances either during or after pile installation should make a piles' integrity suspect, or if the initial tests reveal major defects.

Acceptance and Rejection

Shafts with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted. Where no clear toe reflection is apparent, the experienced test engineer shall state to which shaft depth the test appears to be conclusive. Where reflections from locations with significant reductions in pile area or pile material strength or stiffness above the pile toe are observed, the pile has a serious defect. If the record is complex, the results may be deemed inconclusive. Construction records (concrete usage, grout pressure records, soil borings) may be valuable in result interpretations or additional numerical analysis modeling may be used to quantify the record. The decision to reject and replace, or repair, any defective shaft is at the sole responsibility of the engineer-of-record for the foundation.

Remedial Action

Rejected or questionable piles may be replaced. Questionable piles may also be subjected to further testing, e.g., static load testing, dynamic load testing, core drilling, ultra-sonic logging, etc. Remedial action may include pressure grouting through core holes. If the pile top appears questionable, further pile top cut-off and retesting may be advisable. If a majority of piles diagnose as "inconclusive", partial or even complete pile excavation or another test method may be necessary for pile acceptance.

Failure of Test

If the tested pile does not satisfy the specified requirements of a successful test and if the failure is attributed to defective workmanship or negligence on the part of the contractor, all costs of the load test, the cost of providing and installing additional

piles, cost of additional or enlarged pile caps and other work necessitated because of the defective pile, shall be at the cost of the Contractor.

Defective Piles

The PM/Consultant reserves the right to reject any pile which, he considers, has not been constructed according to specifications. The contractor shall leave the rejected piles in place or pull them out as judged appropriate and directed by the . Engineer in Charge . No extra payment will be made on this account.

The cost of extra piles at new locations, their reinforcement, concrete, etc. and any other additional work required as a result of rejection of defective piles shall be borne by the contractor.

Measurements

Empty boring should be taken separately & payment should be made on excavation on foundation.

Concrete shall be measured separately in running meters from the founding level to the theoretical cut-off level of the pile.

Boring through boulders and rocky strata except in respect of isolated boulders not exceeding the diameter of pile shaft shall be measured and paid extra over.

- Reinforcement in piling shall be paid separately.
- Permanent liners, if specified and provided, shall be measured separately and paid as per unit specified in BOQ.
- Load testing shall be enumerated for one or the group of piles.

Sheet Piling

Scope

The work shall consist of furnishing and placing the specified kinds and types of piles at the location.

Site Preparation

All site preparation as may be required or as shown on the drawings and any excavation within the area to be occupied by piles shall be completed before the piles are driven.

Protection Of Pile Heads

The heads of all piles shall be protected during driving by suitable caps, rings, heads, blocks, mandrels, and other devices

The heads of steel piles shall be cut square and fitted with a steel-driving cap.

Driving heads, mandrels, and other devices shall be provided by the Contractor as needed for special types of piles and shall conform to the recommendations of the pile manufacturer.

Driving Sheet Piling

The piling shall be driven in such a manner as to insure perfect interlocking throughout the entire length of each pile to the depth specified. The piles shall be held in proper alignment during driving by means of assembling frames or other suitable temporary guide structures. Temporary guide structures shall be removed when they have served their purpose.

At any time that the forward edge of the sheet pile wall is found to be out of correct alignment:

(a) the piling already assembled and partly driven shall be driven to the required depth, and (b) taper piles shall then be driven to bring the forward edge into correct alignment before additional regular piling is assembled and driven. The maximum permissible taper in a single pile shall be one-fourth inch per foot of length.

The Contractor shall cut the piles off at the specified elevations. The length of pile cut off shall be sufficient to permit the removal of all damage material.

Steel sheet piles shall be cut off in clean, straight lines as shown on the drawings. Any irregularities shall be leveled off with deposits of weld metal or by grinding before placement of bearing caps.

Defective Piles

Any pile damaged in driving, driven out of its proper location, driven below the specified cut off elevation, or inaccurately cut off shall be corrected by one of the following methods, whichever is approved by the Engineer:

- The defective pile shall be pulled and replaced or re-driven;
- A new pile shall be driven adjacent to the defective pile; or
- The defective pile shall be spliced or built up or a sufficient portion of the footing shall be extended to properly embed the pile.

All piles pushed up or dislocated by the driving of adjacent piles or by any other cause shall be re-driven to the proper position.

Any sheet pile ruptured in the interlock or otherwise damaged during driving shall be pulled and replaced.

SOIL ANCHORS

Tieback holes to be drilled to depths at an angle of 10 degrees to the horizontal. Auger must be positioned such that a projection of the hole centerline coincides with the tieback. Angle of tieback can be increased or decreased by approximately 5 degrees as necessary due to field conditions encountered after obtaining prior approval from the Engineer.

High strength rods shall be installed in the holes using spiders to center the rod in the hole. Rod is to project from hole so a coupler can be readily fitted. High strength grout is to be immediately injected into the primary penetration area. The high strength grout shall have a minimum compressive strength of 3000 psi. at 28 days. The slump at time of placement shall be more than 1 inch and less than 3 inches.

Contractor will be responsible for re-drills or tieback replacement for those, which fail to meet test loads.

The tieback rods shall extend through holes cut in the sheeting. The installation of the stiffeners, and anchor plate with grout when specified, shall follow with tightening the anchor nuts.

When grout has attained the minimum strength specified, stress shall be applied to the rod to 200 percent of the design load for 10 minutes. After the test has been performed, the stress and certified by a testing the laboratory.

The Contractor shall install wedge washers as required to correct any misalignment of anchor rod with wale seat. Anchors shall be stressed straight and true. Kinking or sharp curvature in anchors under tension shall be cause for rejection. Rod shall show no excessive

movement at the test load during testing time and the testing jack shall be capable of holding test load for 10 minutes without bleeding off of pressure.

ROAD WORKS

1. SCOPE OF WORKS

The work to be carried out under this contract shall comprise but not limited to the supply, installation, setting to work and construction of all items that are necessary for a complete working of Road Works, Parking and Storm Water Drain as per specifications drafted in these sections, and tender drawings referred in the schedule of drawings and other related contract documents.

It is understood and agreed that the Contractor, has by careful examination of the plans and Specifications, and the site where appropriate, satisfied himself as to the nature and location of the works, and all conditions that must be met in order to carry out the works under this section of the Contract.

This specification is intended to cover the Design, Installation and Construction of Road Works, Parking, Pathways and Storm Water Drain.

It is not the intent of this specification to explain completely all details of design and installation. However it is required that the complete works shall confirm in all respect to the highest standard of engineering and workmanship and the installation shall be capable of performing in continuous operation under the extreme external ambient condition.

The General layout and Construction details are shown on the drawing. Contractor shall follow the design drawings for general layout as a minimum. Any changes required to the layout to facilitate future changes or to comply with the regulation shall be brought to the attention of the Engineer prior to commencement of works.

Contractor shall submit working drawings for review and approval prior to commencement of the works. The drawings shall be in AutoCAD format and submitted in 2 set of Hard copy and soft copy.

2. CODES & STANDARDS

3.1 Codes and Standards.

1. The specification for various items of work shall be same as specified for such items in the MORTH SPECIFICATIONS FOR ROAD AND BRIDGE WORKS, FIFTH REVISION, IRC SP:63-2018 and all other relevant BIS codes.
2. In case there is no specific mention of a particular detail, the mode of specification as prescribed in MORTH SPECIFICATIONS for such an item shall be followed.
3. In the event of contradiction between the MORTH specifications referred to above and this Contract document, the provisions of this Contract document shall prevail.

3. Specifications

Following relevant MORTH SPECIFICATIONS required for this project has been given with same

clause numbers.

201. CLEARING AND GRUBBING

301. EXCAVATION FOR ROADWAY AND DRAINS

304. EXCAVATION FOR STRUCTURES

305. EMBANKMENT CONSTRUCTION

401. GRANULAR SUB-BASE

406. WET MIX MACADAM SUB-BASE/BASE

408. CEMENT CONCRETE KERB AND KERB WITH CHANNEL

502. PRIME COAT OVER GRANULAR BASE

503. TACK COAT

504. BITUMINOUS MACADAM

507. DENSE BITUMINOUS MACADAM / SEMIDENSE BITUMINOUS MACADAM

512. BITUMINOUS CONCRETE

1601. REINFORCEMENT

1701. CONCRETE

803. ROAD MARKINGS

201. CLEARING AND GRUBBING

201.1. Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 100 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications

201.2. Preservation of Property/Amenities

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines,

sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials etc., and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3.

201.3. Methods, Tools and Equipment's

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the subgrade. Also, all vegetation such as roots, undergrowth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several meters, shall be suitably treated.

201.4 Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lifts and up to a lead of 1000 m.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

201.5. Measurements for Payment

Clearing grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees up to 300 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm
- iii) Above 900 mm to 1800 mm
- iv) Above 1800 mm

Cutting, including removal of stumps and roots of trees of girth above 300 mm and backfilling to required compaction shall be measured in terms of number according to the sizes given below:-

For this purpose, the girth shall be measured at a height of 1 meter above ground or at the top of the stump if the height of the stump is less than one meter from the ground.

201.6. Rates

201.6.1. The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lifts and up to a lead of 1000 m.

201.6.2. The Contract unit rate for cutting (including removal of stumps and roots) of trees of girth above 300 mm shall include excavation and backfilling to required compaction, handling, salvaging, piling and disposing of the cleared materials with all lifts and up to a lead of 1000 m.

201.6.3. Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earthwork items and the Contract unit prices for the same shall be considered as including clearing and grubbing operations.

301. EXCAVATION FOR ROADWAY AND DRAINS

301.1. Scope

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the grubbing and stacking of or hauling to sites of

embankment and subgrade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

301.2 Classification of Excavated Material

301.2.1. Classification: All materials involved in excavation shall be classified by the Engineer in the following manner:

(a) Soil

This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having dimension in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

301.2.2. Authority for classification: The classification of excavation shall be decided by the Engineer and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer.

301.3. Construction Operations

301.3.1. Setting out: After the site has been cleared as per Clause 201, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and the establishment of bench marks. The Contractor shall be responsible for the maintenance of bench marks and other marks and stakes as long as in the opinion of the Engineer, they are required for the work.

301.3.2. Stripping and storing topsoil: When so directed by the Engineer, the topsoil existing over the sites of excavation shall be stripped to specified depths constituting Horizon "A" and stockpiled at designated locations for re-use in covering embankment slopes, cut slopes, berms and other disturbed areas where re-vegetation is desired. Prior to stripping the topsoil, all trees, shrubs etc. shall be removed along with their roots, with approval of the Engineer.

301.3.3 Excavation - General: All excavations shall be carried out in conformity with the directions laid here-in-under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilized as decided upon beforehand.

While planning or executing excavations, the Contractor shall take all adequate precautions against soil erosion, water pollution etc. as per Clause 306, and take appropriate drainage measures to keep the site free of water in accordance with Clause 311.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or as directed by the Engineer. The Contractor shall not excavate outside the limits of excavation. Subject to the permitted tolerances, any excess depth/width excavated beyond the specified

levels/dimensions on the drawings shall be made good at the cost of the Contractor with suitable material of characteristics similar to that removed and compacted to the requirements of Clause 305.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes, these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an approved manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimize erosion and ponding, allowing for natural drainage to take place. If trees were removed, new trees shall be planted, as directed by the Engineer. The cost of planting new trees shall be deemed to be incidental to the work.

301.3.4. Methods, tools and equipment: Only such methods, tools and equipment as approved by the Engineer shall be adopted/ used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

301.3.5. Excavation of road shoulders/verge/median for widening of pavement or providing treated shoulders: In works involving widening of existing pavements or providing treated shoulders, unless otherwise specified, the shoulder/verge/median shall be removed to their full width and to levels shown on drawings or as indicated by the Engineer. While doing so, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the disturbed/loosened portion removed completely and re-laid as directed by the Engineer, at the cost of the Contractor.

301.3.6. Excavation for surface/sub-surface drains: Where the Contract provides for construction of surface/sub-surface drains to Clause 309, excavation for these shall be carried out in proper sequence with other works as approved by the Engineer.

301.3.7 Slides: If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc. shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

301.3.8. Dewatering: If water is met within the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

301.3.9. Disposal of excavated materials: All the excavated materials shall be the property of the Employer. The material obtained from the excavation of roadway, shoulders, verges, drains cross-drainage works etc., shall be used for filling up of (i) roadway embankment, (ii) the existing pits in

the right-of way and (iii) for landscaping of the road as directed by the Engineer, including levelling and spreading with all lifts and lead up to 1000 m and no extra payment shall be made for the same.

All hard materials, such as hard murrum, rubble, etc., not intended for use as above shall be stacked neatly on specified land as directed by the Engineer with all lifts and lead up to 1000 m.

Unsuitable and surplus material not intended for use within the lead specified above shall also, if necessary, be transported with all lifts and lead beyond initial 1000 m, disposed of or used as directed by the Engineer.

301.3.10 Backfilling:

Backfilling of masonry/concrete/Hume pipe drain excavation shall be done with approved material after concrete/masonry/Hume pipe is fully set and carried out in such a way as not to cause undue thrust on any part of the structure and /or not to cause differential settlement. All space between the drain walls and the side of the excavation shall be refilled to the original surface making due allowance for settlement, in layers generally not exceeding 150 mm compacted thickness to the required density, using suitable compaction equipment such as mechanical tamper, rammer or plate compactor as directed by the Engineer.

301.4 Plying of Construction Traffic

Construction traffic shall not use the cut formation and finished subgrade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the Contractor at his own expense.

301.5 Preservation of Property

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which, in the opinion of the Engineer, shall be continued in use without any change. Safety measures taken by the Contractor in this respect, shall be got approved from the Engineer. However, if any of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his expense. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of the Engineer, the actions initiated by the Contractor to replace/restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/restoration directly through any other agency at the risk and cost of the Contractor after issuing a prior notice to the effect.

301.6. Preparation of Cut Formation

The cut formation, which serves as a subgrade, shall be prepared to receive the sub- base/base course as directed by the Engineer.

Where the material in the subgrade (that is within 500 mm from the lowest level of the pavement) has a density less than specified in Table 300-2, the same shall be loosened to a depth of 500mm and compacted in layers in accordance with the requirements of Clause 305.

Any unsuitable material encountered in subgrade level shall be removed as directed by the Engineer and replaced with suitable material compacted in accordance with Clause 305.

301.7. Finishing Operations

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces. When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock (hard or soft) where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Clause 902. Where directed, the topsoil removed earlier and conserved (Clauses 301.3.2. and 305.3.3) shall be spread over cut slopes, where feasible, berms and other disturbed areas. Slopes may be roughened and moistened slightly, prior to the application of topsoil, in order to provide satisfactory bond. The depth of topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 100 mm.

301.8. Measurements for Payment

Excavation for roadway shall be measured by taking cross-sections at suitable intervals in the original position before the work starts and after its completion and computing the volume in cu. m. by the method of average end areas for each class of material encountered. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods.

At the option of the Engineer, the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The Contractor shall see that these remain intact till the final measurements are taken.

For rock excavation, the overburden shall be removed first so that necessary cross-sections could be taken for measurement. Where cross sectional measurements could not be taken due to irregular configuration or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of stacks of excavated rubble after making 35 per cent deduction therefrom. When volumes are calculated in this manner for excavated material other than rock, deduction made will be to the extent of 16 per cent of stacked volumes.

01. Works involved in the preparation of cut formation shall be measured in units indicated below: Loosening and re-compacting the loosened material at subgrade	cu. m.
02. Loosening and removal of unsuitable material and replacing with a suitable material and compacting to required density	cu. m.
03. Stripping including storing and reapplication of topsoil	cu. m.
04. Disposal of surplus material beyond initial 1000 m lead	cu. m.

301.9. Rates

301.9.1. The Contract unit rate for the items of roadway and drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation

for:

- (i) setting out;
- (ii)Transporting the excavated materials and depositing the same on sites of embankments, spoil banks or stacking as directed within all lifts and lead up to 1000m or as otherwise specified;
- (ii)Trimming bottoms and slopes of excavation;
- (iv) Dewatering;
- (v) Keeping the work free of water as per Clause 311; and
- (vi) All labour, materials, tools, equipment, safety measures, testing and incidentals necessary to complete the work to Specifications.

301.9.2. The Contract unit rate for loosening and re-compacting the loosened materials at subgrade shall include full compensation for loosening to the specified depth, including breaking clods, spreading in layers, watering where necessary and compacting to the requirements.

301.9.3. Clause 301.9.1 and 305.8 shall apply as regards Contract unit rate for item of removal of unsuitable material and replacement with suitable material respectively.

301.9.4. The Contract unit rate for the items of stripping and storing topsoil and of reapplication of topsoil shall include full compensation for all the necessary operations including all lifts, but leads up to 1000 m.

301.9.5. The Contract unit for disposal of surplus earth from roadway and drain excavation shall be full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the initial lead of 1000 m.

304. EXCAVATION FOR STRUCTURES

304.1. Scope

Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, head walls, cutoff walls, pipe culverts and other similar structures, in accordance with the requirements of these Specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstructions, necessary for placing the foundations; trimming bottoms of excavations; backfilling and clearing up the site and the disposal of all surplus material.

304.2. Classification of Excavation

All materials involved in excavation shall be classified in accordance with Clause 301.2.

304.3 Construction Operations

304.3.1 Setting out: After the site has been cleared according to Clause 201, the limits of excavation shall be set out true to lines, curves and slopes to Clause 301.3.1.

304.3.2. Excavation: Excavation shall be taken to the width of the lowest step of the footing and the sides shall be perpendicular to the face of the footing where the nature of soil allows it. Where the nature

of soil or the depth of the trench and season of the year do not permit vertical sides, the Contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer.

The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone from an adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of the excavation.

304.3.3 Dewatering and protection:

Normally, open foundations shall be laid dry. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, depression of water level by well-point system, cofferdams and other necessary works to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the Contractor but subject to approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipment's etc., inside the enclosed area.

If it is determined beforehand that the foundations cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid under water by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other similar means.

At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area.

The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

304.3.4. Preparation of foundation:

The bottom of the foundation shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete or masonry of the

foundation at the cost of the Contractor as per Clause 2104.1. Ordinary filling shall not be used for the purpose to bring the foundation to level.

When rock or other hard strata is encountered, it shall be freed of all soft loose material, cleaned and cut to a firm surface either level and stepped as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer. In the case of excavation in rock, annular space around footing shall be filled with lean concrete (1:3:6 nominal mix) up to the top level of rock.

If the depth of fill required is more than 1.5 m above the top of the footing, filling up to 1.5 m above top of footing shall be done with lean concrete (1:3:6 nominal mix) followed by boulders grouted with cement.

304.3.5. Slips and slip-outs: If there are any slips or slip-outs in the excavation, these shall be removed by the Contractor at his own cost.

304.3.6. Public safety: Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS: 3764.

304.3.7. Backfilling: Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thickness. The compaction shall be done with the help of suitable equipment such as mechanical tamper, rammer, plate vibrator etc., after necessary watering, so as to achieve a density not less than the field density before excavation.

304.3.8. Disposal of surplus excavated materials: Clause 301.3.11 shall apply.

304.4. Measurements for Payment

Excavation for structures shall be measured in cu. m. for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer, Excavation over increased width, cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the Contractor in executing the work and shall not be measured and paid for separately.

Preparation of rock foundation shall be measured in square meters. Foundation sealing, dewatering, including pumping shall be deemed to be incidental to the work unless separate provision is made for in the Contract. In the latter case, payment shall be on lump sum basis as provided in the Bill of Quantities.

304.5 Rates

304.5 .1. The Contract unit rate for the items of excavation for structures shall be payment in full for carrying out the required operations including full compensation for :

- (i). Setting out;
- (ii). Construction of necessary cofferdams, cribs, sheeting, shoring and bracing and their subsequent removal;
- (iii). Removal of all logs, stumps, grubs and other deleterious matter and obstructions, for placing the foundations including trimming of bottoms of excavations;
- (iv). Foundation sealing, dewatering including pumping when no separate provision for it is made in the Contract;
- (v) Backfilling, clearing up the site and disposal of all surplus material within all lifts and leads up to 1000 m or as otherwise specified; and
- (vi). All labour, materials, tools, equipment, safety measures, diversion of traffic and incidentals necessary to complete the work to Specification.

304.5.2. The Contract unit rate for preparation of rock foundation shall be full compensation for cutting, trimming and cleaning the foundation surface and filling/sealing of all seams with cement grout or mortar including all materials, labour and incidentals required for completing the work.

304.5.3. The Contract unit rate for transporting material from the excavation for structures shall be full compensation for all labour, equipment, tools, and incidentals necessary on account of the additional haul or transportation involved beyond the initial lead of 1000 m.

305. EMBANKMENT CONSTRUCTION

305.1. General

305.1.1. Description: These Specifications shall apply to the construction of embankments including subgrades, earthen shoulders and miscellaneous backfill with approved material obtained from roadway and drain excavation, borrow pits or other sources. All embankments, subgrades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

305.2 Materials and General Requirements

305.2.1. Physical requirements:

305.2.1.1. The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, murrum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/subgrade.

The following types of material shall be considered unsuitable for embankment:

- a) Materials from swamps, marshes and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS: 1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;
- a) Clay having liquid limit exceeding 70 and plasticity index exceeding 45;
- and f) Materials with salts resulting in leaching in the embankment.

305.2.1.2. Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent when tested as per IS: 2720 – Part 40) shall not be used as a fill material. Where an expansive clay with acceptable "free swelling index" value is used as a fill material, subgrade and top 500 mm portion of the embankment just below subgrade shall be non-expansive in nature.

305.2.1.3 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO₃) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementitious materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as SO₃) exceeding 0.5 percent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

305.2.1.4. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when being placed in the embankment and 50 mm when placed in subgrade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle size shall not be more than two-thirds of the compacted layer thickness.

305.2.1.5. Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the subgrade.

TABLE 300-1. DENSITY REQUIREMENTS OF EMBANKMENT AND SUBGRADE MATERIALS

	S.No	Type of Work	IS2720 (Part 8)	Maximum laboratory dry unit weight when tested as per
1		Embankments up to 3 metres height, not subjected to extensive flooding.		Not less than 15.2 kN/cu. m.
2		Embankments exceeding 3 metres height or embankments of any subject to long periods of inundation		Not less than 16.0 kN/cu. m

3	Subgrade and earthen shoulders/ verges/backfill	Not less than 17.5 kN/cu. m

Notes:

(1) This Table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

(3) The material to be used in subgrade should also satisfy design CBR at the dry unit weight applicable as per Table 300-2

305.2.2. General requirements:

305.2.2.1. The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the subgrade and the embankment portion just below the subgrade.

305.2.2.2. Borrow materials: Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer/the Engineer, arrangement for locating the source of supply of material for embankment and subgrade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the Contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising therefrom.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable material is removed and used separately for use in the permanent works

without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density requirements as in Table 300-2 shall yield the design CBR value of the subgrade.

TABLE 300-2 COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUBGRADE

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part8)
1. Subgrade and earthen shoulders	Not less than 97
2. Embankment	Not less than 95
3. Expansive Clays	
a) Subgrade and 500 mm portion	Not allowed
b) Remaining portion of embankment	Not less than 90

just below the subgrade

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

(i) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.

(ii) A graph of density plotted against moisture content from which each of the values in (i) Above of maximum dry density and optimum moisture content were determined.

(iii) The Dry density-moisture content - CBR relationships for light, intermediate and heavy

comp active efforts (light corresponding to IS : 2720 (Part 7), heavy corresponding to IS : 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the subgrade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

305.3. Construction Operations

305.3.1. Setting out: After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1. The limits of embankment/subgrade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/subgrade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

305.3.2. Dewatering:

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

305.3.3. Stripping and storing topsoil: In localities where most of the available embankment materials are not conducive to plant growth, or when so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

305.3.4. Compacting ground supporting embankment/subgrade:

Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 300-2.

In case where the difference between the subgrade level (top of the subgrade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 per cent relative compaction with respect to the dry density as given in Table 300-2, the ground shall be loosened up to a level 0.5 m below the subgrade level, watered and compacted in layers in accordance with Clause 305.3.5 and 305.3.6 to not less than 97 per cent of dry density as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required

degree of compaction.

Embankment or subgrade work shall not proceed until the foundations for embankment/subgrade have been inspected by the Engineer for satisfactory condition and approved.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 305.2.1, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

305.3.5 Spreading material in layers and bringing to appropriate moisture content

305.3.5.1. The embankment and subgrade material shall be spread in layers of uniform thickness not exceeding 200 mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per Clause 305.3.6. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross- section of the embankment.

305.3.5.2 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS : 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 per cent above to 2 per cent below the optimum moisture content determined in accordance with IS : 2720 (Part 7) or IS : 2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the subgrade.

305.3.5.3. Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good

by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

305.3.6 Compaction:

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred, sheep foot or pad foot rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS : 2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment /subgrade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If inspite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

305.3.7. Drainage: The surface of the embankment/subgrade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

305.3.8. Repairing of damages caused by rain/spillage of water: The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

305.3.9. Finishing operations: Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross-sections and dimension shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved earlier (Clause 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of Clause 308.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

305.4 Construction of Embankment and Subgrade under Special Conditions

305.4.1. Earthwork for widening existing road embankment: When an existing embankment and/or subgrade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment/subgrade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment/subgrade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers/plate compactors/power rammers or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

305.4.2. Earthwork for embankment and subgrade to be placed against sloping ground: Where an embankment/subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/subgrade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping ground.

Where the Contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and subgrade work as approved by the Engineer.

305.4.3. Earthwork over existing road surface: Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

(i) If the existing road surface is of granular or bituminous type and lies within 1m of the new subgrade level, the same shall be scarified to a depth of 50mm or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

(ii) If the existing road surface is of cement concrete type and lies within 1 m of the new subgrade level the same shall be removed completely.

(iii) If the level difference between the existing road surface and the new formation level is more than 1 m, the existing surface shall be permitted to stay in place without any modification.

305.4.4. Embankment and subgrade around structures: To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures up to a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS :

2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in Appendix 6 of IRC : 78 (Standard Specifications and Code of Practice for Road Bridges-Section VII) in respect of the type of material, the extent of backfill, its laying and compaction etc. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2502/309.3.2 (B) unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any

structural member so as to cause any damage to them or excessive pressure against the structure.

305.4.5. Construction of embankment over ground incapable of supporting construction equipment: Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geo synthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

305.4.6. Embankment construction under water: Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

305.4.7. Earthwork for high embankment: In the case of high embankments, the Contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at his own cost. The Contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserves the right to accept or reject it.

If necessary, stage construction of fills and any controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the Contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of surcharged fill results in any surcharging material, which is unacceptable for use in the fill being surcharged, lying below formation level, the Contractor shall remove the unacceptable material and dispose it as per direction of the Engineer. He shall then bring the resultant level up to formation level with acceptable material.

305.4.8. Settlement period: Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc., or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contract or as directed by the Engineer.

305.5. Plying of traffic:

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or subgrade without the prior permission of the Engineer. Any damage arising out of such use

shall, however, be made good by the Contractor at his own expense as directed by the Engineer.

305.6. Surface Finish and Quality Control of Work

The surface finish of construction of subgrade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

305.7. Subgrade Strength

305.7.1. It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfies the requirements of design CBR.

305.7.2. Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of construction subgrade shall be determined on undisturbed samples cut out from the compacted subgrade in CBR mold fitted with cutting shoe or on re-molded samples, compacted to the field density at the field moisture content.

305.8. Measurement for Payments

Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic meters by the method of average end areas.

The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu. m of suitable material brought to site from road and drainage excavation forms one cu. m. of compacted fill and all bulking or shrinkage shall be ignored.

Construction of embankment under water shall be measured in cu. m. Construction of high embankment with specified material and in specified manner shall be measured in cu. m. Stripping including storing and reapplication of topsoil shall be measured in cu. m. Work involving loosening and re-compacting of ground supporting embankment/subgrade shall be measured in cu. m. Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measured in cu. m. Scarifying existing granular/bituminous road surface shall be measured in square meters. Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6. Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu. m.

305.9. Rates

305.9.1. The Contract unit rates for the items of embankment and subgrade construction shall be payment in full for carrying out the required operations including full compensation for:

(i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the Contract ;

(ii) Setting out;

(iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved;

(iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and subgrade as applicable;

(ii) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;

(iii) Spreading in layers, bringing to appropriate moisture content and compacting to Specification requirements;

(iv) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;

(v) Restricted working at sites of structures;

(vi) Working on narrow width of embankment and subgrade;

(vii) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the Contract;

(xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the Specifications;

(xii) Dewatering; and

(xiii) Keeping the embankment/completed formation free of water as per Clause 311.

305.9.2. In case the Contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the Contract for construction of embankment and subgrade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

305.9.3. Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil and of reapplication of topsoil.

305.9.4 Clause 301.9.2 shall apply as regards Contract unit rate for the item of loosening and re compacting the embankment/subgrade foundation.

305.9.5. Clause 301.9.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material respectively.

305.9.6. The Contract unit rate for scarifying existing granular/bituminous road surface shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. This will also comprise of handling, salvaging, stacking and disposing of the dismantled materials within all lifts and up to a lead of 1000 m or as otherwise specified.

305.9.7 Clause 202.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

305.9.8. The Contract unit rate for providing and laying filter material behind abutments shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

305.9.9. Clause 305.4.6 shall apply as regards Contract unit rate for construction of embankment under water.

305.9.10 Clause 305.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

401. GRANULAR SUB-BASE

401. 1. Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

401.2. Materials

401.2.1. The material to be used for the work shall be natural sand, murrum, gravel, crushed stone, or combination thereof depending upon the grading required.. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 400-1.

While the grading's in Table 400-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse-graded materials for each of the three maximum particle sizes are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

401.2.2. Physical requirements: The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part III). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which be taken as being the density relating to a uniform air voids content of 5 percent.

TABLE 400-1. GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve		Per cent by weight passing the IS sieve		
Designation		Grading I	Grading II	Grading III
75.0	mm	100	-	-
53.0	mm	80-100	100	-
26.5	mm	55-90	70-100	100
9.50	mm	35-65	50-80	65-95
4.75	mm	25-55	40-65	50-80
2.36	mm	20-40	30-50	40-65
0.425	mm	10-25	15-25	20-35
0.075	mm	3-10	3-10	3-10
CBR Value (Minimum)		30	25	20

TABLE 400-2. GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve		Per cent by weight passing the IS Sieve		
Designation		Grading I	Grading II	Grading III
75.0	mm	100	-	-
53.0	mm		100	
26.5	mm	55-75	50-80	100
9.50	mm			
4.75	mm	10-30	15-35	25-45
2.36	mm			
0.425	mm			
0.075 mm		<10	<10	<10
CBR Value (Minimum)		30	25	20

Note : The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS : 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 percent respectively.

401.3. Strength of sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remolded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

401.4. Construction Operations

401.4.1. Preparation of subgrade:

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

401.4.2. Spreading and compacting: The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer. When the sub-base material consists of combination of materials mentioned in Clause 401.2.1. Mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work. Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having Unidirectional cross fall and super elevation and shall commence at the edges and progress towards the center for portions having cross fall on both sides.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

401.6. Arrangements for Traffic

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112..

401.7. Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic meters. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

401.8. Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- (i) Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (iii) All labour, tools, equipment and incidentals to complete the work to the Specifications;;
- (iv) carrying out the work in part widths of road where directed; and
- (v) Carrying out the required tests for quality control.

406. WET MIX MACADAM SUB-BASE/BASE

406.1. Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as direction by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 200 mm upon approval of the Engineer.

406.2. Materials

406.2.1. Aggregates

406.2.1.1. Physical requirements: These aggregates shall be crushed stone. The aggregates shall

conform to the physical requirements set forth in Table 400-10 below. Sevaliya special aggregate is only acceptable.

TABLE 400-10. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB-BASE/BASE COURSES

	Test	Test Method	Requirements
01.	Los Angeles abrasion value	IS : 2386 (Part-4)	40 percent (Max.)
	Or Aggregate Impact value	IS : 2386 (Part-4) or IS : 5640	30 percent (Max)
02.	Combined Flakiness and Elongation indices (Total)	IS : 2386 (Part-1)	30 percent (Max)

Aggregate may satisfy requirements of either of the two tests.

** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

If the water adsorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part- 5).

406.2.1.2. Grading requirements: The aggregates shall conform to the grading given in Table 400-11.

TABLE 400-11. GRADING REQUIREMENTS OF AGGREGATES FOR WET MIX MACADAM

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall

not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

406.3. Construction Operations

406.3.1. Preparation of base: Clause 404.3.1. Shall apply.

406.3.2. Provision of lateral confinement of aggregates: While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 407.4.1.

406.3.3. Preparation of mix: Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pug mill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

406.3.4. Spreading of mix: Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self-propelled, having the following features: (i) Loading hoppers and suitable distribution mechanism

(ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.

(iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of layer and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

406.3.5 Compaction: After the mix has been laid to the required thickness, grade and cross fall / camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, smooth wheel roller of 80 to 100 kN

weight may be used. For a compacted single layer up to 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall / super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 meter straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and re compacted.

406.3.6. Setting and drying: After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4. Opening to Traffic

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

406.5. Surface Finish and Quality Control of Work

406.5.1. Surface evenness: The surface finish of construction shall conform to the requirements of

Clause 902.

406.5.2. Quality control: Control on the quality of materials and works shall exercised by the Engineer in accordance with Section 900.

406.6. Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and re compacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.7. Arrangement for Traffic

During the period of construction, arrangement of traffic shall be done as per Clause 112.

406.8. Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic metres.

406.9. Rates

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8.

408. CEMENT CONCRETE KERB AND KERB WITH CHANNEL

408.1. Scope

This work shall consist of constructing cement concrete kerbs and kerbs with channel in the central median and/or along the footpaths or separators in conformity with the lines, levels and dimensions as specified in the drawings.

408.2. Materials

Kerbs and kerb with channel shall be provided in cement concrete of Grade M20.

408.3. Type of Construction

These shall be cast-in-situ construction with suitable kerb casting machine in all situations except at locations where continuous casting with equipment is not practicable. In those situations, precast concrete blocks shall be used.

408.4. Equipment

A continuous kerb casting equipment of adequate capacity and controls, capable of laying the kerbs in required cross-sections and producing a well-compacted mass of concrete free of voids and honeycombs, shall be used.

408.5. Construction Operations

408.5.1. Kerb shall be laid on firm foundation of minimum 150 mm thickness of cement concrete of M10 grade cast-in-situ or on extended width of pavement. The foundation shall have a projection 50 mm beyond the kerb stone. Before laying the foundation of lean concrete, the base shall be levelled and slightly watered to make it damp.

408.5.2. In the median portions in the straight reaches, the kerb shall be cast in continuous lengths. In the portions where footpath is provided and/or the slope of the carriage is towards median (as in case of super elevated portions), there shall be sufficient gap/recess left in the kerb to facilitate drainage openings.

408.5.3. After laying the kerbs and just prior to hardening of the concrete, saw cut grooves shall be provided at 5 m intervals or as specified by the Engineer.

408.5.4. Kerbs on the drainage ends such as along the footpath or the median in super elevated portions, shall be cast with monolithic concrete channels as indicated in drawings. The slope of the channel towards drainage pipes shall be ensured for efficient drainage of the road surface.

408.5.5. Vertical and horizontal tolerances with respect to true line and level shall be ± 6 mm.

408.6. Measurements for Payment

Cement concrete kerb / kerb with channel shall be measured in linear meter for the complete item of work.

Foundation of kerb, where separately provided shall be measured in linear meter for complete item of work.

408.7. Rates

The Contract unit rates for cement concrete kerb / kerb with channel and foundation for kerb shall be payment in full compensation for furnishing all materials, labour, tools, equipment for construction and other incidental cost necessary to complete the work.

502. PRIME COAT OVER GRANULAR BASE

502.1. Scope

This work shall consist of application of single coat of low viscosity liquid bituminous material to an absorbent granular surface preparatory to any superimposed bituminous treatment or construction.

502.2.1. Materials

502.2.1. The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. These are:

- (i) Surfaces of low porosity; such as wet mix macadam and water bound macadam,,
- (ii) Surfaces of medium porosity; such as cement stabilized soil base,
- (iii) Surfaces of high porosity; such as a gravel base.

502.2.2. The different ranges of viscosity requirements for the primers to be used for the different types of surfaces to be primed as classified in 502.2.1, are given in Table 500-1.

TABLE 500-1. VISCOSITY REQUIREMENT AND QUANTITY OF BITUMINOUS PRIMER

Type of surface	Kinematic Viscosity of Primer at 60o C (Centistokes)	Quantity per 10 sq. m (kg)
Low porosity	30-60	6 to 12
Medium porosity	70-140	9 to 12
High porosity	250-500	12 to 15

502.2.3. The bituminous primer shall be Medium Curing Cutback (MC) produced by fluxing, in an approved manner, bitumen of 80/100 penetration grade with kerosene. The cutback shall be free from water and shall not show any signs of separation prior to use. Slow setting Cationic emulsion as per IS: 8887 may also be used, but the particular grade to be used for the work shall be got approved by the Engineer.

Sampling and testing of bituminous primer shall be as per IS: 217; IS: 454 and IS: 8887.

502.3. Weather and Seasonal Limitations

The bituminous primer shall not be applied on a wet surface or during dust storm or when the weather is foggy, rainy or windy. The prime coat for surface treatment should not be applied when the temperature in the shade is less than 10oC.

502.4. Construction

502.4.1. Equipment: The primer distributor shall be pneumatic tyred self-propelled pressure distributor equipped for spraying the material uniformly at the specified rates and temperatures. Spraying by manual methods may be allowed for small areas at the discretion of the Engineer. Power broom and/or blowers may be supplemented by hand brooms as directed by the Engineer.

502.4.2. Preparation of road surface: The surface to be primed shall be swept clean, free from dust and shall be dry. It shall be shaped to the specified grades and section. It shall also be free from

ruts, any other irregularities and segregated materials. Minor depressions and potholes may be ignored until the surface is primed, after which they shall be patched with a suitable premix material prior to the surface treatment.

502.4.3. Application of bituminous primer: The bituminous primer shall be sprayed/distributed uniformly over the dry surface, prepared as per Clause 502.4.2 using self-propelled sprayer equipped with self-heating arrangement, suitable pump, adequate capacity compressor and spraying bar with nozzles having constant volume or pressure system capable of supplying primer at specified rates and temperatures so as to provide a uniformly unbroken spread of primer. If the surface to be primed is as dry or dusty as to cause freckling of bituminous material, it shall be lightly and uniformly sprinkled with water immediately prior to priming; however, the bituminous material shall not be applied till such time as no surface water is visible. The primer shall be applied at the rate as specified in Table 500-1.

Temperature of application of a primer need only be high enough to permit the primer to be effectively sprayed through the jets of the spray bar and to cover the granular base surface uniformly in the desired quantity.

The desirable range of temperatures at the time application of MC-30, MC-70 and MC-250 grades shall be 30 to 550 °C; 50 to 80 °C and 75 to 100 °C respectively. For a bituminous emulsion primer, the range of spraying temperature may be 20 to 60 °C.

Following the application of bituminous material, the surface shall be allowed to cure for at least 24 hours or for any other period so as to allow penetration into the base course and aeration of volatiles from the primer material. If it is not absorbed within 24 hours after application, sand shall be spread over the surface to blot the excess primer. Care shall be taken to prevent over-priming; any pools of excess primer left on any part of the surface shall be swept out over the adjacent surface before spreading sand.

The primer coat shall be applied only on the topmost water bound macadam or any granular layer, over which the bituminous base course/wearing course is to be laid.

502.4.4. Curing of primer and opening to traffic: It shall always be ensured that while opening to any kind of traffic, the primed surface is fully cured and is not sticky to avoid being picked up by traffic. Normally, the primed surface shall be allowed to cure for not less than 24 hours and during this period no traffic of any kind shall be permitted.

502.4.5. Laying of bituminous course over primed surface: Bituminous base course or wearing course shall be laid over the primed water bound macadam, wet mix macadam or any other granular base course, in the usual manner as per relevant Specification for the same including the requirement of tack coat as per Clause 503.

502.5. Quality Control of Work

Control on the quality of materials and work shall be exercised by the Engineer in accordance with Section 900.

Prime coat shall be measured in terms of surface area of application in square meters.

502.8. Rate

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications.

503. TACK COAT

503.1. Scope

This work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction over it.

503.2. Materials

Binder: The binder used for tack coat shall be a bituminous emulsion or cutback as specified in the Contract

503.3. Construction Operation

503.3.1. Preparation of base: The surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the application of the binder, by using a mechanical broom or any other approved equipment/method as specified by the Engineer.

503.3.2. Application of binder: Binder may be heated to the temperature appropriate to the grade of cutback used and approved by the Engineer and sprayed on the base at the rate specified in Table 500-2. The normal range of spraying temperature for a bituminous emulsion shall be 20 0 C - 60 0 C and for a cutback 50 0 C – 80 0C if RC-70/MC-70 grade is used. It shall be the responsibility of the Contractor to carefully handle the inflammable bituminous cutback material so as to safeguard against any fire mishap. The binder shall be applied uniformly with the aid of either self-Propelled or towed bitumen pressure sprayer with self-heating arrangement and spraying bar with nozzles having constant volume or pressure system, capable of spraying bitumen at specified rates and temperature so as to provide a uniformly unbroken spread of bitumen. Work should be planned so that no more than the necessary tack coat for the day's operation is placed on the surface. After application and prior to succeeding construction allow the tack coat to cure, without being disturbed, until the water/cutter has completely evaporated, as determined by the Engineer.

TABLE 500-2. RATE OF APPLICATION OF TACK COAT

	Type Surface	Quantity of liquid Bituminous material in kg per 10 sq. m. area
i)	Normal bituminous surfaces	2.0 to 2.5
ii)	Dry and hungry bituminous surfaces	2.5 to 3.0
iii)	Granular surfaces treated with prime	2.5 to 3.0

iv)	Non bituminous surfaces	
	a) Granular base (not primed)	3.5 to 4.0
	b) Cement concrete pavement	3.0 to 3.5

Note: There is no need to apply a tack coat on a freshly laid bituminous course if the subsequent bituminous course is overlaid the same day without opening it to traffic.

503.4. Quality Control of Work

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

503.5. Arrangements for Traffic

During the period of construction, the arrangement of traffic shall be done to Clause 112.

503.6. Measurement for Payment

Tack coat shall be measured in terms of surface area of application in square meters.

503.7. Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) as applicable to the work specified in these Specifications.

504. BITUMINOUS MACADAM

504.1. Scope

The work shall consist of construction, in a single course, of compacted crushed aggregates premixed with a bituminous binder, to serve as base/binder course, laid immediately after mixing, on a base prepared previously in accordance with the requirement of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawing or as directed by the Engineer.

504.2. Materials

504.2.1. Bitumen: The bitumen shall be paving bitumen of suitable penetration grade (30/40 to 80/100) as per IS: 73. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions. Guidelines on selection of the grade of bitumen are given in Appendix-4.

504.2.2. Aggregates

504.2.2.1. The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at

least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

S.No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value*	IS : 2386 (Part-4)	40 per cent Maximum
2.	Aggregate Impact Value *	IS : 2386 (Part-4)	30 per cent Maximum
3.	Flakiness and Elongation Indices (Total) **	IS : 2386 (Part-1)	30 per cent Maximum
4.	Coating and Stripping of Bitumen Aggregate Mixtures	AASHTO T 182	Minimum retained coating 95 per cent
5.	Soundness (i) Loss with Sodium (ii) Loss with Magnesium Sulphate 5 cycles	IS : 2386 (Part-5)	12 per cent Maximum 18 per cent Maximum
6.	Water absorption	IS : 2386 (Part-3)	per cent Maximum

* Aggregates may satisfy requirements for either of the two tests.

** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

Note: If crushed slag is used, Clause 404.2.3. Shall apply. **504.2.2.2.** The aggregate for bituminous macadam shall conform to one of the two gradings in Table 500-4, depending on the compacted thickness; the actual grading shall be as specified in the Contract.

504.2.3. Proportioning of materials: The bitumen content for premixing shall be 3 to 3.5 per cent by weight of the total mix except when otherwise directed by the Engineer.

TABLE 500-4. AGGREGATE GRADING FOR BITUMINOUS MACADAM

IS Sieve Designation Per cent by weight passing the sieve

Grading 1

Grading 2

45.0 mm

100

26.5 mm	75-100	100
22.4 mm	60-95	75-100
11.2 mm	30-55	50-85
5.6 mm	15-35	20-40
2.8 mm	5-20	5-20
90.0 micron	0-5	0-5

The maximum compacted thickness of a layer shall be 100 mm.

The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

504.2.4. Variation in proportioning of material: The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content ± 0.3 per cent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests vide Section 900.

504.3. Construction Operations

504.3.1. Weather and seasonal limitations: The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when the atmospheric temperature in shade is 10oC or less.

504.3.2. Preparation of the base: The base on which bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross-sections in accordance with Clause 501, and a priming coat where needed shall be applied in accordance with Clause 502 as directed by the Engineer.

504.3.3. Tack coat: A tack coat as per Clause 503 shall be applied over the base.

504.3.4. Preparation and transport of mix: Bituminous macadam mix shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Hot mix plant shall be of suitable capacity preferably of batch mix type. Total system for crushing of stone aggregates and feeding of aggregate fractions in required proportions to achieve the desired mix, deployed by the Contractor must be capable of meeting the overall Specification requirements under stringent quality control. The plant shall have the following essential features:

A – General

(a) The plant shall have coordinated set of essential units capable of producing uniform mix as per the job mix formula.

(b) Cold aggregate feed system with minimum 4 bins having belt conveyor arrangement for initial proportioning of aggregates from each bin in the required quantities. In order to have free flow of fines from the bin, it is advisable to have vibrator fitted on bin to intermittently shake it.

(c) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyor to measure the flow of aggregates.

- (d) Dryer unit with burner capable of heating the aggregate to the required temperature without any visible unburnt fuel or carbon residue on the aggregate and reducing the moisture content of the aggregate to the specified minimum.
- (e) The plant shall be fitted with suitable type of thermometric instruments at appropriate places so as to indicate or record/register the temperature of heated aggregate, bitumen and mix.
- (f) Bitumen supply unit capable of heating, measuring/metering and spraying of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed in the required proportion.
- (g) A filler system suitable to receive bagged or bulk supply of filler material and its incorporation to the mix in the correct quantity wherever required.
- (h) A suitable built-in dust control system for the dryer to contain/recycle permissible fines into the mix. It should be capable of preventing the exhaust of fine dust into atmosphere for environmental control wherever so specified by the Engineer.
- (i) The plant should have centralized control panel/cabin capable of presetting, controlling/synchronizing all operations starting from feeding of cold aggregates to the discharge of the hot mix to ensure proper quality of mix. It should have indicators for any malfunctioning in the operation.
- (j) Every hot mix plant should be equipped with siren or horn so that the operator may use the same before starting the plant every time in the interest of safety of staff.

B - For Batch Type Plant

- (i) Gradation control unit having minimum four deck vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.
- (ii) Proper arrangement for accurate weighing of each size of hot aggregate from the control panel before mixing.
- (iii) Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

The temperature of binder at the time of mixing shall be in the range of 150oC to 163oC and that of the aggregate in the range of 155oC-163oC. provided that the difference in temperature between the binder and aggregate at no time exceeds 14oC.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly, and the discharge temperature of mix shall be between 130oC to 160 0 C.

The mixture shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue delay shall be removed from the work unit such conditions are corrected.

504.3.5. Spreading: The mix transferred from the tipper at site to the paver shall be spread immediately by means of self-propelled mechanical paver with suitable screeds capable of spreading, tamping, and finishing the mix true to the specified lines, grades and cross-sections. The paver finisher shall have the following essential features:

- (a) Loading hoppers and suitable distributing mechanism. (b) All drives having hydrostatic drive/control.
- (c) The machine shall have a hydraulically extendable screed for appropriate width requirement.
- (d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting of otherwise marring the surface. It shall have adjustable amplitude and variable frequency.
- (e) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- (f) The paver shall be fitted with an electronic sensing device for automatic levelling and profile control within the specified tolerances.
- (g) The screed shall have the internal heating arrangement.
- (h) The paver shall be capable of laying either 2.5 to 4.0 m width or 4.0 to 7.0 m width as stipulated in the Contract.
- (i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation.

However, in restricted locations and in narrow widths where the available plant cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 120 °C to 160 °C. In multi-layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the top-most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. Longitudinal and transverse joints shall be offset by at least 250 mm from those in the lower courses and the joint on the top-most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80°C before laying of adjacent material.

504.3.6. Compaction: After the spreading of mix, rolling shall be done by 80 to 100 kN rollers or other approved equipment. Rolling shall start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be completed in limited time frame.

The roller shall move at a speed not more than 5 km/h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, the rolling shall commence at the edges and progress towards the center longitudinally except that on super elevated and uni-directional cambered portions, it shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial or break-down rolling shall be done with 80-100 kN static weight smooth wheel roller (3 wheels or tandem), as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break-down rolling with vibratory roller of 80 to 100 kN static weight or pneumatic tyred roller of 150 to 250 kN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 MPa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks, with 60-80 kN tandem roller. During the final rolling, vibratory system shall be switched off. The joints and edges shall be rolled with a 80 to 100 kN static roller.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 per cent of the average laboratory density (obtained from Marshall Specimens compacted as defined in Table 500-10), there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose, nor excessive water poured on the wheels. Rolling operations shall be completed in every respect before the temperature of the mix falls below 100 °C. Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed thereby. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

504.4 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

504.5. The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6. Arrangements of Traffic

During the period of construction, arrangement of traffic shall be done to Clause 112.

504.7. Measurements for Payment

The work shall be measured as finished work in cubic meters or by weight in metric tonnes as provided in the Contract.

504.8. Rate

The contract unit rate for the work shall be payment in full for carrying out the required operations including full compensation for:

- (j) Making arrangements for traffic to Clause 112 except for initial treatment to verge, shoulders and construction of diversions;
- (ii) Preparation of base except for laying of profile corrective course but including filling of potholes;
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lifts;
- (iv) All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machineries, incidental to complete the work to the Specifications;
- (v) Carrying out the work in part widths of the road where directed; (vi) Carrying out all tests for control of quality; and
- (vii) The rate shall cover the provision of bitumen at 3.25 per cent of weight of total mix, with the provision that the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

507. DENSE BITUMINOUS MACADAM /SEMI DENSE BITUMINOUS MACADAM

507.1. Scope

This work shall consist of construction in a single course of 50 to 100 mm thick base/binder course to the following Specifications on a previously prepared base.

507.2. Materials

507.2.1. Bitumen: The bitumen shall be paving bitumen of Penetration Grade S 65 or A 65 (60/70) as per Indian Standard Specifications for "Paving Bitumen" IS: 73. In case of non-availability of bitumen of this grade, S 90 (80/100) grade bitumen may be used with the approval of the Engineer. Guidance to selection of the grade of bitumen may be taken from Appendix-4.

507.2.2. Coarse aggregates: The coarse aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall be treated with anti-stripping agents of approved quality in suitable doses. The aggregates shall satisfy the physical requirements set forth in Table 500-8.

If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The portion of the total aggregate passing 4.75mm sieve shall have a sand equivalent value of not less than 50 when tested in

accordance with the requirement of IS : 2720 (Part-37).

The plasticity index of the fraction passing the 425 micron sieve shall not exceed 4.

TABLE 500.8. PHYSICAL REQUIREMENTS OF AGGREGATES FOR DENSE BITUMINOUS MACADAM

Sl. No.	Test	Test Method	Requirement
1	Los Angles Abrasion * Value	IS: 2386 (Part-4)	40 per cent Maximum
2	Aggregate Impact value *	IS: 2386 (Part-4)	30 cent Maximum
3	Flakiness and Elongation** Indices (Total)	IS : 2386 (Part-1)	per cent Maximum
4	Coating and Stripping of Bitumen from Aggregate Mixtures	AASHTO 182 IS: (Part-5)	95 per cent
5	Soundness		
	(i) Loss with Sodium Sulphate	5 cycles	12 per cent Maximum
	(ii) Loss of Magnesium Sulphate	5 cycles	18 cent Maximum
6	Water absorption	IS : 2386 (Part-3)	2 per cent Maximum

* Aggregates may satisfy requirements of either of the two tests.

** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

Grading	1	2
Nominal Aggregate size	13 mm	10 mm
Layer Thickness	35 - 40 mm	25 - 30 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	

Table 500-15, Compaction of Semi-Dense Bituminous Concrete Pavement Layers.

37.5	-	-	
26.5	-	-	
19	100	-	
13.2	90 - 100	100	
9.5	70 - 90	90 - 100	
4.75	35 - 51	35 - 51	
2.36	24 - 39	24 - 39	
1.18	15 - 30	15 - 30	
0.6	-	-	
0.3	9 - 19	9 - 19	
0.15	-	-	
0.075		3 - 8	3 - 8
Bitumen content % by mass of total mix ²		Min 4.5	Min 5.0

Table 500-16, Requirements for Semi-Dense Bituminous Concrete Pavement Layers.

Minimum stability kN at 60° C	8.2
Minimum flow (mm) Maximum flow (mm)	2
Compaction level (Number of blows)	4
Percent air voids	75 blows on each of the two faces of the specimen
Percent voids in mineral aggregate (VMA)	3 - 5
Percent voids filled with bitumen (VFB)	See Table 500 - 12 below
	65 - 78

507.2.3. Fine aggregates: Fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve, consisting of crusher-run screening , gravel , sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

507.2.4. Filler: Filler shall consist of finely divided mineral matter such as rock dust, cement as approved by the Engineer.

The filler shall be graded within the following limits:

IS Sieve	Per cent passing by weight.

600	Micron	100
300	Micron	95 - 100
75	Micron	85 - 100

The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filter is cement or lime. When the coarse aggregate is gravel, 2 per cent by mass of total aggregate of Portland cement or hydrated lime shall be added and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the gravel is limestone.

507.2.5. Aggregate gradation: The combined coarse and fine aggregates and filler (when used) shall produce a mixture to conform to the grading set forth in Table 500-9.

Table 500-9. AGGREGATE GRADATION FOR DENSE BITUMINOUS MACADAM

Sieve Designation	Percentage passing the sieve by weight
37.5 mm	100
26.5 mm	90-100
13.2 mm	56-80
4.75 mm	29-59
2.36 mm	19-45
300 micron	

The aggregate mix, as used in work, shall not vary from the low limit on one sieve to the high limit on the adjacent sieve but shall be well graded.

507.3. Mix Design

507.3.1. Requirement of mix: Apart from conformity with grading and quality requirements of individual ingredients, the mix shall meet the requirements set out in Table 500-10.

Table 500-10. REQUIREMENTS OF DENSE BITUMINOUS MACADAM MIX

S. No.	Description	Requirements
1.	Marshall stability (ASTM Designation-D-1559) Determined on Marshall Specimens compacted	820 kg (1800 lb) minimum by 75 compaction blows on each end
2.	Marshall flow (mm)	2-4
3.	Per cent Air voids	3-5
4.	Minimum voids in mineral aggregates (VMA)	10 per cent-12 per cent
5	Per cent voids in mineral aggregates filled .	
	by bitumen (VFB)	65-75
6	Binder content per cent by weight of total .	Not less than 4.0 per cent
	mix	

507.3.2. Binder content: The binder content shall be so fixed as to achieve the requirements of the mix set out in Table 500-10. Marshall Method for arriving at the binder content shall be adopted, replacing the aggregates retained on 26.5 mm sieve by the aggregates passing 26.5 mm sieve and retained on 22.4 mm sieve.

507.3.3. Job mix formula: The Contractor shall intimate to the Engineer in writing, atleast 20 days before the start of the work, the job mix formula proposed to be used by him for the work and shall give the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows where each is applicable; (a) Binder, as percentage by weight of total mix;
(b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The results of tests enumerated in Table 500-10 as obtained by the Contractor;

v) Test results of physical characteristics of aggregates to be used;

vi) Mixing temperature and compacting temperature.

While working out the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the former.

The approved job mix formula shall remain effective unless and until modified by the Engineer. Should a change in the source of materials be proposed, a new job mix formula shall be established and got approved from the Engineer before actually using the materials.

507.3.4. Permissible variation from job mix formula: It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in Table 500-11. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

TABLE 500-11. PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA

S. No.	Description of Ingredients	Permissible variation by weight of total mix-in per cent
1	Aggregate passing 13.2 mm sieve and larger sieves	± 8
2	Aggregate passing 11.2 mm sieve and 5.6 mm sieve	± 7
3	Aggregate passing 2.80 mm sieve and 1.40 mm sieve	± 6
4	Aggregate passing 710 micron sieve and 355 micron sieve	± 5
5	Aggregate passing 180 micron sieve	± 4
6	Aggregate passing 90 micron sieve	± 2
7	Binder	± 0.3
8	Mixing temperature	$\pm 10^{\circ}\text{C}$

507.4. Construction Operations

507.4.1. Weather and seasonal limitations: Clause 504.3.1. Shall apply.

507.4.2. Preparation of base: The base on which Dense Bituminous Macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections in accordance with Clause 501 or as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical means cannot reach, other approved method shall be used. A priming coat where needed, shall be applied in accordance with Clause 502 or as directed by the Engineer.

507.4.3. Tack coat: A tack coat over the base shall be applied as per Clause 503.

507.4.4. Preparation of mix: Clause 504.3.4. Shall apply.

507.4.5. Spreading: The mix transported from the hot mix plant to the site shall be spread by means of a self-propelled paver with suitable screeds capable of spreading, tamping and finishing the mix to specified grade, lines and cross-section. Paver Finisher shall have the essential features as spelt out in Clause 504.3.5. However, in restricted locations and in narrow widths where the available equipment cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix. Similarly for smaller jobs, mechanical paver may be used with the approval of the Engineer.

The temperature of mix at the time of laying shall be in the range of 120-160 °C.

Mixes with a temperature of less than 120 °C shall not be put into paver spreader. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the center line of the road. Longitudinal and transverse joints shall be offset by at least 250 mm from those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter and the surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80 °C before laying of adjacent material.

507.4.6. Rolling: After spreading the mix by paver, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not more than 5 km/h, immediately following close to the paver. Generally the initial or breakdown rolling shall be done with 80-100 kN static weight smooth- wheeled roller. The intermediate rolling shall be done with 80-100 kN static weight vibratory roller or with a pneumatic tyred roller of 150-250 kN weight having a tyre pressure of at least 0.7 MPa. The finish rolling shall be done with 60-80 kN weight smooth wheeled tandem roller. All the Compaction operations, i.e., breakdown rolling and intermediate rolling can be accomplished by using vibratory tandem roller of 80-100 kN static weight. During initial breakdown rolling and finish rolling, no vibratory compaction shall be resorted to. The exact pattern of rolling shall be established after trial compaction as approved by the Engineer. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good. The rollers shall not be permitted to stand on pavement which has not been fully compacted and where temperature is still more than 70°C. Necessary precautions shall be taken to prevent dripping of oil, grease, petrol or other foreign

matter on the pavement either when the rollers are operating or standing.

The wheels of roller shall be kept moist to prevent the mix from adhering to them. But in no case shall fuel/lubricating oil be used for this purpose nor excessive water poured on the wheels. Rolling shall commence longitudinally from edges and proceed towards the center, except that on super elevated and unidirectional cambered portions, it shall progress from the lower to upper edge parallel to the center line of the pavement. The roller shall proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix and each pass of the roller shall overlap the preceding one by half the width of the rear wheel.

Rolling shall be continued till the density achieved is at least 98 per cent of that of laboratory Marshall Specimen (compacted as defined in Table 500-10) and all roller marks are eliminated. Skin patching of an area that has been rolled will not be permitted. Rolling operations shall be completed in all respects before the temperature of the mix falls below 100°C.

507.5. Opening to Traffic

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. The Dense Bituminous Macadam shall be provided with an appropriate wearing course as early as possible prior to regular opening to normal traffic and/or impending rain.

507.6. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and work shall be exercised by the Engineer in accordance with Section 900.

507.7. Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be done to Clause 112.

507.8. Measurements for Payment

Dense Bituminous Macadam shall be measured as finished work in cubic meters or tonnes as directed by the Engineer.

507.9. Rate

The contract unit rate for Dense Bituminous Macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 504.8 (i) to (vi). The rate shall cover the provision of bitumen in the mix at 4.5 per cent of the weight of the total mix, with the provision that the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

512.1. Scope

This work shall consist of construction in a single layer, bituminous concrete (asphaltic concrete) of thickness 25-100 mm on previously prepared bituminous course to the requirements of these Specifications.

512.2. Materials

512.2.1. Bitumen: Clause 507.2.1. Shall apply.

512.2.2. Coarse aggregates: Clause 507.2.2. Shall apply. The Stone Polishing Value as measured by BS: 812 (Part 114) shall not be less than 55. The aggregates shall satisfy the physical requirements as given in Table 500-8 except that the maximum value for the water absorption should be 1 per cent.

512.2.3. Fine aggregates: Clause 507.2.3. Shall apply.

512.2.4. Filler: Clause 507.2.4 shall apply.

512.2.5. Aggregates gradation: The mineral aggregates, including mineral filler shall be so graded or combined as to conform to the grading set forth in Table 500-23.

TABLE 500-23. AGGREGATES GRADATION FOR BITUMINOUS CONCRETE

IS Sieve Designation		Per cent passing the sieve by weight
26.5	mm	100
19	mm	90-100
9.5	mm	56-80
4.75	mm	35-65
2.36	mm	23-49
300	micron	5-19
75	micron	2-8

512.2. Mix Design

512.3.1. Requirement of mix: Apart from conformity with the grading and quality requirements of individual ingredients, the mix shall meet the requirements set forth in Table 500-24.

TABLE 500-24. REQUIREMENTS OF BITUMINOUS CONCRETE MIX

Sl. No	Description	
1	Marshall stability (ASTM Designation: D-1559) determined on Marshall specimens compacted	820 Kg (1800lb.) Minimum

	by 75 compaction blows on each end	
2	Marshall flow (mm)	2-4
3	Per cent voids in mix	3-5
4	Per cent voids in mineral aggregates (VMA)	Minimum 11-13 per cent
5	Per cent voids in mineral aggregates filled by bitumen (VFB)	65-75
6	Binder content, per cent by weight of total mix	Minimum 4.5
7	Water Sensitivity (ASTM D1075) Loss of stability on immersion in water at 60o C	Min 75 per cent retained strength
8	Swell Test (Asphalt Instt. MS-2, No. 2)	1.5 per cent Max

512.3.2. Binder content: The binder content shall be so fixed as to achieve the requirements of the mix set forth in Table 500-24. Marshall Method for arriving at the binder content shall be adopted.

512.3.3. Job mix formula: Clause 507.3.3. Shall apply except that the requirement of Bituminous Concrete mix shall be as per Table 500-24.

512.3.4. Permissible variations from the job mix formula: The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. The permissible variations of individual percentages of various ingredients in the actual mix from the job mix formula may be within the limits as specified in Table 500-11. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

512.4. Construction Operations

512.4.1. Weather and seasonal limitations: Clause 504.3.1. Shall apply.

512.4.2. Preparation of base: The base on which bituminous concrete is to be laid shall be prepared, shaped and conditioned to the specified levels, grade and cross fall (camber) in accordance with Clause 501 or as directed by the Engineer.

The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed by mechanical means or blown off by compressed air. In portions where mechanical means cannot reach, other approved method shall be used.

512.4.3. Tack coat: A tack coat complying with Clause 503 shall be applied over the base.

512.4.4. Preparation of mix: Clause 507.4.4. Shall apply.

512.4.5 Spreading: Clause 507.4.5. Shall apply.

512.4.6. Rolling: Clause 507.4.6. Shall apply.

512.5. Opening to Traffic

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

512.6. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

512.7. Arrangements for Traffic

During the period of construction, arrangement of traffic shall be done to Clause 112.

512.8. Measurements for Payment

Bituminous concrete shall be measured as finished work in cubic meters or tonnes as provided in the Contract.

512.9. Rate

The contract unit rate for bituminous concrete shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 504.8. (i) to (vi). The rate shall cover the provision of bitumen in the mix at 5.0 per cent of the weight of the total mix with the provision that variation of the quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

1601. REINFORCEMENT

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars (un-tensioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

1602. GENERAL

either mild steel/medium tensile steel or high strength deformed bars. They may be uncoated or coated with epoxy or with approved protective coatings.

1603. PROTECTION OF REINFORCEMENT

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements

shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc., as directed by the Engineer. Reinforcements shall be stored on block, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

Portions of uncoated reinforcing steel and dowels projecting from concrete, shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

1604. BENDING OF REINFORCEMENT

Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules.

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand or power to obtain the correct radii of bends and shape.

Bars shall not be bent or straightened in a manner that will damage the parent material or the coating.

Bars bent during transport or handling shall be straightened before being used on work and shall not be heated to facilitate straightening.

1605. PLACING OF REINFORCEMENT

a) The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

b) Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS: 280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1mm.

c) Bars shall be kept in position usually by the following methods:

(i) In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

(ii) In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed up to a level just below their location.

(iii) Layers of reinforcements shall be separated by spacer bars at approximately one meter intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

(iv) Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc., or other subsidiary reinforcement shall be provided to fix the reinforcements firmly in its correct position.

(v) Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted.

d) Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Reference shall be made to Section 1000 for other requirements.

e) Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

1606. BAR SPLICES

1606.1. Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or $1\frac{1}{4}$ times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

1606.2. Welding

1606.2.1. Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or great than that of the bars connected.

1606.2.2. While welding may be permitted for mild steel reinforcing bars conforming to IS : 432, welding of deformed bars conforming to IS : 1786 shall in general be prohibited. Welding may be permitted in case of bars other than S 240 grade including special welding grade of S 415 grade bars conforming to IS : 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE = \frac{C}{6} + \frac{Mn}{5} + \frac{Cr+Mg+V}{15} + \frac{Ni}{6} + \frac{Cu}{5}$$

is 0.4 or less.

1606.2.3. The method of welding shall conform to IS: 2751 and IS: 9417 and to any supplemental specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxyacetylene welding shall not be permissible. Any other process may be used subject to the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators, welding procedure are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall have to be qualified by tests prescribed in IS : 2751. Inspection of welds shall conform to IS : 822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

M.S. electrodes used for welding shall conform to IS: 814.

1606.2.4. Welded joints shall preferably be located at points where steel will not be subject to more than 75 per cent of the maximum permissible stresses and welds so staggered that at any on section, not more than 20 per cent of the bars are welded.

1606.2.5. Welded pieces of reinforcement shall be tested. Specimens shall be taken from the site and the number and frequency of tests shall be as directed by the Engineer.

1606.3. Mechanical Coupling of Bars

Bars may be jointed with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swagged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 per cent of the characteristic strength of the reinforcement bar.

1607. TESTING AND ACCEPTANCE

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by the Contractor at his own cost. The fabrication, furnishing and placing of reinforcement shall be in accordance with these specifications and shall be checked and accepted by the Engineer.

1608. MEASUREMENTS FOR PAYMENT

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in tonnes on the basis of IS: 1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

1609. RATE

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision. The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

1701. CONCRETE

The work shall consist of furnishing and placing structural concrete and incidental construction in accordance with these specifications and in conformity with the lines, grades and dimensions, as shown on the drawings or as directed by the Engineer.

1702. MATERIALS

All materials shall conform to Section 1000 of these Specifications.

1703. GRADES OF CONCRETE

1703.1. The grades of concrete shall be designated by the characteristic strength as given in Table 1700-1, where the characteristic strength is defined as the strength of concrete below which not more than 5 per cent of the test results are expected to fall.

TABLE 1700-1.

Grade Designation at 28 days, in MPa	Specified characteristic Compressive strength of 150 mm cubes
M 15	15
M 20	20
M 25	25
M 30	30
M 35	35
M 40	40
M 45	45
M 50	50
M 55	55

1703.2. The lowest grades of concrete in bridges and corresponding minimum cement contents and water-cement ratios shall be maintained as indicated in Tables 1700-2 and 1700-3.

1700-2. FOR BRIDGES WITH PRESTRESSED CONCRETE OR THOSE WITH INDIVIDUAL SPAN LENGTHS MORE THAN 30 M OR THOSE THAT ARE BUILT WITH INNOVATIVE DESIGN/CONSTRUCTION

(A) MINIMUM CEMENT CONTENT AND MAXIMUM WATER CEMENT RATIO

Structural Member	Min. cement content for all exposure conditions (kg/cu.m.)	Max. water cement ratio	
		Normal	Severe
a) PCC members	360	0.45	0.45
b) RCC members	400	0.45	0.40
c) PSC members	400	0.40	0.40

(B) MINIMUM STRENGTH OF CONCRETE

Member	Conditions of Exposure

	Moderate	Severe
a) PCC members	M 25	M 30
b) RCC members	M 35	M 40
c) PSC members	M 35	M 40

TABLE 1700-3. FOR BRIDGES OTHER THAN THOSE MENTIONED IN TABLE 1700-2 AND FOR CULVERTS AND OTHER INCIDENTAL CONSTRUCTION

Structural Member	Min. cement content (kg/cu.m.)		Max. Water cement ratio	
	Exposure Conditions		Exposure Conditions	
	Normal	Severe	Normal	Severe
PCC members	250	310	0.5	0.45
RCC members	310	400	0.45	0.4

(B) MINIMUM STRENGTH OF CONCRETE

Member	Conditions of Exposure	
	Moderate	Severe
a) PCC members	M 15	M 20
b) RCC members	M 20	M 25

Notes Applicable to Tables 1700-2 and 1700-3

- (i) The minimum cement content is based on 20 mm aggregate (nominal max. size). For 40 mm and larger size aggregates, it may be reduced suitably but the reduction shall not be more than 10 per cent.
- (ii) For underwater concreting, the cement content shall be increased by 10 per cent. (iii) Severe conditions of exposure shall mean alternate wetting and drying due to sea spray, alternate wetting and drying combined with freezing and buried in soil having corrosive effect.
- (iv) Moderate conditions of exposure shall mean other than those mentioned in (iii) above.

The cement content shall be low as possible but not less than the quantities specified above. In no case shall it exceed 540 kg/cu.m. of concrete.

1703.3. Concrete used in any component or structure shall be specified by designation along with prescribed method of design of mix i.e. “Design Mix” or “Nominal Mix”. For all items of concrete, only “Design Mix” shall be used, except where “Nominal Mix” concrete is permitted as per drawing or by the Engineer. “Nominal Mix” may be permitted only for minor bridges and culverts or other incidental construction where strength requirements are upto M 20 only. “Nominal Mix” may also be permitted for non-structural concrete or for screed below open foundations.

1703.4. If the Contractor so elects, the Engineer may permit the use of higher grade concrete than that specified on the drawing, in which event the higher grade concrete shall meet the specifications applicable thereto without additional compensation.

1704. PROPORTIONING OF CONCRETE

Prior to the start of construction, the Contractor shall design the mix in case of “Design Mix Concrete” or propose nominal mix in case of “Nominal Mix Concrete”, and submit to the Engineer for approval, the proportions of materials, including admixtures to be used. Water-reducing admixtures (including plasticisers or super-plasticisers) may be used at the Contractor’s option, subject to the approval of the Engineer. Other types of admixtures shall be prohibited, unless specifically permitted by the Engineer.

1704.1. Requirements of Consistency

The mix shall have the consistency which will allow proper placement and consolidation in the required position. Every attempt shall be made to obtain uniform consistency.

The optimum consistency for various types of structure shall be as indicated in Table 1700-4, or as directed by the Engineer. The slump of concrete shall be checked as per IS : 516.

TABLE 1700-4.

	TYPE	SLUMP(mm)
1	(a) Structures with exposed inclined surface (b) plain cement concrete	25 requiring low slump concrete to allow proper compaction 25
2	RCC structures with widely spaced reinforcements; e.g. solid columns, piers, abutments, footings, well steining	40 – 50 50 – 75
3	RCC structures with fair degree of congestion of reinforcement; e.g. pier and abutment caps, box culverts well curb, walls with thickness greater than 300 mm	
4	RCC and PSC structures with highly congested reinforcements e.g deck slab girders, box girders, walls with thickness less than 300 mm	75 – 125
5	Underwater concreting through tremie e.g. bottom plug, cast-in-situ piling	100 – 200

1704.2. Requirements for Designed Mixes

1704.2.1. Target mean strength

The target mean strength of the specimen shall exceed the specified characteristic compressive strength by at least the 'current margin'.

(i) The current margin for a concrete mix shall be determined by the Contractor and shall be taken as 1.64 times the standard deviation of samples test results taken from at least 40 separate batches of concrete of nominally similar proportions produced at site by the same plant under similar supervision, over a period exceeding 5 days, but not exceeding 6 months.

(ii) Where there is insufficient data to establish a current margin for the initial design mix

shall be taken as given in Table 1700-5:

TABLE 1700-5.

Concrete Grade	Current Margin (MPa)	Target Mean Strength (MPa)
M 15	10	25
M 20	10	30
M 25	11	36
M 30	12	42
M 35	12	47
M 40	12	52
M 45	13	58
M 50	13	63
M 55	14	69

The initial current margin given in the Table 1700-5 shall be used till sufficient data is available to determine the current margin as per sub-clause (i) above.

1704.2.2. Trial mixes

The Contractor shall give notice to enable the Engineer to be present at the making of trial mixes and preliminary testing of the cubes. The Contractor shall prepare trial mixes, using samples of approved materials typical of those he proposes to use in the works, for all grades to the Engineer's satisfaction prior to commencement of concreting. The initial trial mixes shall generally be carried out in an established laboratory approved by the Engineer. In exceptional cases, the Engineer may permit the initial trial mixes to be prepared at the site laboratory of the Contractor, if a full-fledged concrete laboratory has been established well before the start of construction, to his entire satisfaction. In all cases complete testing of materials forming the constituents of proposed Design Mix shall have been carried out prior to making trial mixes.

Sampling and testing procedures shall be in accordance with these specifications.

When the site laboratory is utilized for preparing initial mix design, the concrete plant and means of transport employed to make the trial mixes shall be similar to that proposed to be used in the works.

Test cubes shall be taken from trial mixes as follows. For each mix, set of six cubes shall be made from each of three consecutive batches. Three cubes from each set of six shall be tested at an age of 28 days and three at an earlier age approved by the Engineer. The cubes shall be made, cured, stored, transported and tested in accordance with these specifications. The average strength of the nine cubes at 28 days shall exceed the specified characteristic strength by the current margin minus 3.5 MPa.

1704.2.3. Control of strength of design mixes

a) Adjustment to Mix Proportions

Adjustments to mix proportions arrived at in the trial mixes shall be made subject to the Engineer's approval, in order to minimize the variability of strength and to maintain the target mean strength. Such adjustments shall not be taken to implement change in the current margin.

b) Change of Current Margin

When required by the Engineer, the Contractor shall recalculate the current margin in accordance with Clause 1704.2.1. The recalculated value shall be adopted as directed by the Engineer, and it shall become the current margin for concrete produced subsequently.

c) Additional Trial Mixes

During production, the Contractor shall carry out trial mixes and tests, if required by the Engineer, before substantial changes are made in the material or in the proportions of the materials to be used, except when adjustments to the mix proportions are carried out in accordance with sub-clause (a) above.

1704.3. Requirements of Nominal Mix Concrete

Requirements for nominal mix concrete unless otherwise specified, shall be as detailed in Table 1700-6.

TABLE 1700-6. PROPORTIONS FOR NOMINAL MIX CONCRETE

Concrete Grade	Total Quantity of dry aggregate by mass per 50 kg of cement to be taken as the sum of individual masses of fine and coarse aggregates (kg)	Proportion of fine to Coarse aggregate (by mass)
M 15	350	Generally 1:2, subject to upper limit 1:1.5 and lower limit of 1:1.25
M 20	250	Generally 1:2, subject to upper limit 1:1.5 and lower limit of 1:1.25

1704.4. Additional Requirements

Concrete shall meet with any other requirements as specified on the drawing or as directed by the Engineer. Additional requirements shall also consist of the following overall limits of deleterious substances in concrete:

a) The total chloride content of all constituents of concrete as a percentage of mass of cement in mix shall be limited to values given below:

- Prestressed Concrete : 0.1 per cent

- Reinforced concrete exposed to chlorides in service (e.g. structures located near sea coast) : 0.2 per cent

- Other reinforced concrete construction : 0.3 percent

b) The total sulphuric anhydride (SO₃) content of all constituents of concrete as a percentage of mass of cement in the mix shall be limited to 4 per cent.

1704.5. Suitability of Proposed Mix Proportions

The Contractor shall submit the following information for the Engineer's approval:

- a) Nature and source of each material
- b) Quantities of each material per cubic meter of fully compacted concrete c) Either of the following:
 - (i) Appropriate existing data as evidence of satisfactory previous performance for the target mean strength, current margin, consistency and water/cement ratio and any other additional requirement(s) as specified.
 - (ii) full details of tests on trial mixes.
- d) Statement giving the proposed mix proportions for nominal mix concrete.

Any change in the source of material or in the mix proportions shall be subject to the Engineer's prior approval.

1705. ADMIXTURES

Use of admixtures such as super plasticizers for concrete may be made with the approval of the Engineer.

As the selection of an appropriate concrete admixture is an integral part of the mix design, the manufacturers shall recommend the use of any one of his products only after obtaining complete knowledge of all the actual constituents of concrete as well as methodologies of manufacture, transportation and compaction of concrete proposed to be used in the project.

1706. SIZE OF COARSE AGGREGATE

The size (maximum nominal) of coarse aggregates for concrete to be used in various components shall be given as Table 1700-7.

TABLE 1700-7.

Components (mm)	Maximum Nominal Size of Coarse Aggregate

i) RCC well curb	20
ii) RCC/PCC well steining	40
iii) Well cap or Pile Cap Solid type piers and	40 abutments

iv) RCC work in girders, slabs, wearing coat, kerb, approach slab, hollow piers and piles	20
v) PSC work	20
vi) Any other item	As specified by Engineer

- a) 10 mm less than the minimum lateral clear distance between main reinforcements
- b) 10 mm less than the minimum clear cover to the reinforcements

The proportions of the various individual size of aggregates shall be so adjusted that the grading produces densest mix and the grading curve corresponds to the maximum nominal size adopted for the concrete mix.

1707. EQUIPMENT

Unless specified otherwise, equipment for production, transportation and compaction of concrete shall be as under:

- a) For Production of Concrete:
 - i) For overall bridge length of less than 200 metres - batch type concrete mixer diesel or electric operated, with a minimum size of 200 litres, automatic water measuring system and internal weigher (hydraulic/pneumatic type)
 - ii) For overall bridge length of 200 metres or more - concrete batching and mixing plant fully automatic with minimum capacity of 15 cu. m. per hour.

All measuring devices of the equipment shall be maintained in a clean and serviceable condition. Its accuracy shall be checked over the range in use, when set up at each site and thereafter periodically as directed by the Engineer.

The accuracy of the measuring devices shall fall within the following limits:

Measurement of Cement 3 per cent of the quantity of cement in each batch

Measurement of Water	3 per cent of the quantity of water in each batch

Measurement of Aggregate batch	3 per cent of the quantity of aggregate in each

Measurement of Admixture	5 per cent of the quantity of admixture in each batch

- F or Concrete : depending upon actual
 i) Transportation requirement minimum 2 tonnes
 Concrete dumpers capacity
 ii Powered hoists minimum 0.5 tonne capacity
) Chutes
 iii Buckets handled by cranes
) Transit truck mixer
 iv Concrete pump
) Concrete distributor
 v) booms
 vi Belt conveyor
) Cranes with skips
 vi Tremies
 i)

 vi
 ii
)

 ix
)
 x)
 b) For Compaction of Concrete:

i	Internal vibrators	size 25 mm to 70 mm
)		
i	Form vibrators	minimum 500 watts
i	Screed vibrators	full width of carriageway
)		(upto two lanes)
i		
i		
i		
)		

1708. MIXING CONCRETE

Concrete shall be mixed either in a concrete mixer or in a batching and mixing plant, as per these specifications. Hand mixing shall not be permitted. The mixer or the plant shall be at an approved location considering the properties of the mixes and the transportation arrangements available with the Contractor. The mixer or the plant shall be approved by the Engineer.

Mixing shall be continued till materials are uniformly distributed and a uniform colour of the entire mass is obtained, and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall mixing be done for less than 2 minutes.

Mixes which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer, the first batch of concrete from the mixer shall contain only two thirds of the normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

1709. TRANSPORTION, PLACING AND COMPACTION OF CONCRETE

The method of transporting and placing concrete shall be approved by the Engineer. Concrete shall be transported and placed as near as practicable to its final position, so that no contamination, segregation or loss of its constituent materials takes place. Concrete shall not be freely dropped into placed from a height exceeding 1.5 metres.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without the use of excessive quantity of water and without any segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork.

All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete.

No concrete shall be placed in any part of the structure until the approval of the Engineer has been obtained.

If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer. Concreting then shall proceed continuously over the area between the construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed.

Except where otherwise agreed to by the Engineer, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm when internal vibrators are used and not exceeding 300 mm in all other cases.

Concrete when deposited shall have a temperature of not less than 5 degrees Celsius, and not more than 40 degrees Celsius. It shall be compacted in its final position within 30 minutes of its discharge from the mixer, unless carried in properly designed agitators, operating continuously, when this time shall be within 1 hour of the addition of cement to the mix and within

30 minutes of its discharge from the agitator. It may be necessary to add retarding admixtures to concrete if trials show that the periods indicated above are unacceptable. In all such matters, the Engineer's decision shall be final.

Concrete shall be thoroughly compacted by vibration or other means during placing and worked around the reinforcement, tendons or duct formers, embedded fixtures and into corners of the formwork to produce a dense homogeneous void-free mass having the required surface finish. When vibrators are used, vibration shall be done continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that will not promote segregation. Over vibration shall be

avoided to minimize the risk of forming a weak surface layer. When external vibrators are used, the design of formwork and disposition of vibrator shall be such as to ensure efficient compaction and to avoid surface blemishes. Vibrations shall not be applied through reinforcement and where vibrators of immersion type are used, contact with reinforcement and all inserts like ducts etc., shall be avoided. The internal vibrators shall be inserted in an orderly manner and the distance between insertions should be about one and a half times the radius of the area visibly affected by vibration. Additional vibrators in serviceable condition shall be kept at site so that they can be used in the event of breakdowns.

Mechanical vibrators used comply with IS : 2502, IS : 2506, IS : 2514 and IS : 4656.

1710. CONSTRUCTION JOINTS

Construction joints shall be avoided as far as possible and in no case the locations of such joints shall be changed or increased from those shown on the drawings, except with express approval of the Engineer. The joint shall be provided in a direction perpendicular to the member axis.

Location, preparation of surface and concreting of construction joints shall conform to the additional specifications given in Appendix 1700/1.

1711. CONCRETING UNDER WATER

When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of mix to be used shall be got approved from the Engineer before any work is started. Concrete shall contain 10 per cent more cement than that required for the same mix placed in the dry.

Concrete shall not be placed in water having a temperature below 5 degrees Celsius. The temperature of the concrete, when deposited, shall not be less than 16 degrees Celsius, nor more than 40 degrees Celsius.

Coffer dams or forms shall be sufficiently tight to ensure still water conditions, if practicable, and in any case to reduce the flow of water to less than 3 metres per minute through the space into which concrete is to be deposited. Coffer dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the walls. Pumping shall not be done while concrete is being placed, or until 24 hours thereafter. To minimise the formation of laitance, great care shall be exercised not to disturb the concrete as far as possible while it is being deposited.

All under water concreting shall be carried out by tremie method only, using tremie of appropriate diameter. The number and spacing of the tremies should be worked out to ensure proper concreting. The tremie concreting when started should continue without interruption for the full height of the member being concreted. The concrete production and placement equipment should be sufficient to enable the underwater concrete to be completed uninterrupted within the stipulated time. Necessary stand-by equipment should be available for emergency situation.

The top section of the tremie shall have a hopper large enough to hold one full batch of the mix or the entire contents of the transporting bucket as the case may be. The tremie pipe shall not be less than 200 mm in diameter and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended even if a partial vacuum develops inside the

pipe. Preferably, flanged steel pipe of adequate strength for the job shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete to the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe, it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom end, thus establishing a continuous stream of concrete. It will be necessary to raise slowly the tremie in order to allow a uniform flow of concrete, but it shall not be emptied so that water is not allowed to enter above the concrete in the pipe. At all times after placing of concrete is started and until all the required quantity has been placed, the lower end of the tremie pipe shall be kept below the surface of the plastic concrete. This will cause the concrete to build up from instead of flowing out over the surface and thus avoid formation of layers of laitance. If the charge in the tremie is lost while depositing, the tremie shall be raised above the concrete surface and unless sealed by a check valve, it shall be re plugged at the top end, as at the beginning, before refilling for depositing further concrete.

1712. ADVERSE WEATHER CONDITIONS

1712.1. Cold Weather Concreting

Where concrete is to be deposited at or near freezing temperature, precautions shall be taken to ensure that at the time of placing, it has a temperature of not less than 5 degrees Celsius and that the temperature of the concrete shall be maintained above 4 degrees Celsius until it has thoroughly hardened. When necessary, concrete ingredients shall be heated before mixing but cement shall not be heated artificially other than by the heat transmitted to it from other ingredients of the concrete. Stock-piled aggregate may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or on sheet metal over fire. In general, the temperature of aggregates or water shall not exceed 65 degrees Celsius. Salt or other chemicals shall not be used for the prevention of freezing. No frozen material or materials containing ice shall be used. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to freezing weather shall have entrained air and the water content of the mix shall not exceed 30 litres per 50 kg of cement.

1712.2. Hot Weather Conditions

When depositing concrete in very hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 40 degrees Celsius while placing. This shall be achieved by stacking aggregate under the shade and keeping them moist, using cold water, reducing the time between mixing and placing to the minimum, cooling formwork by sprinkling water, starting curing before concrete dries out and restricting concreting as far as possible to early

mornings and late evenings. When ice is used to cool mixing water, it will be considered a part of the water in design mix. Under no circumstances shall the mixing operation be considered complete until all ice in the mixing drum has melted.

The Contractor will be required to state his methodology for the Engineer's approval when temperatures of concrete are likely to exceed 40 degrees Celsius during the work.

1713. PROTECTION AND CURING

Concreting operations shall not commence until adequate arrangements for concrete curing have been made by the Contractor.

Curing and protection of concrete shall start immediately after compaction of the concrete to protect it from:

- a) Premature drying out particularly by solar radiation and wind
- b) High internal thermal gradients
- c) Leaching out by rain and flowing water
- d) Rapid cooling during the first few days after placing
- e) Low temperature or frost
- f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement

Where members are of considerable size and length, with high cement content, accelerated curing methods may be applied, as approved by the Engineer.

1713.1. Water Curing

Water for curing shall be as specified in Section 1000.

Sea water shall not be used for curing. Sea water shall not come into contact with concrete members unless it has attained adequate strength.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacks, canvas, Hessian or similar materials and shall be kept constantly wet for a period of not less than 14 days from the date of placing of concrete.

1713.2. Steam Curing

Where steam curing is adopted, it shall be ensured that it is done in a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be after about four hours of placement of concrete to allow the initial set of the Concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased to about six hours.

The steam shall be at 100 per cent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete and the ambient air temperature shall increase at a rate not exceeding 5 degrees Celsius per hour until a maximum temperature of 67 degrees Celsius is reached. The maximum

temperature shall be maintained until the concrete has reached the desired strength.

When steam curing is discontinued, the ambient air temperature shall not drop at a rate exceeding 5 degrees Celsius per hour until a temperature of about 10 degrees Celsius above the temperature of the air to which the concrete will be exposed, has been reached.

The concrete shall not be exposed to temperatures below freezing for at least six days after curing.

1713.3. Curing Compounds

Curing compounds shall only be permitted in special circumstances and will require specific approval of the Engineer. Curing compounds shall not be used on any surface which requires further finishing to be applied. All construction joints shall be moist, cured and no curing compound will be permitted in locations where concrete surface are required to be bonded together.

Curing compounds shall be continuously agitated during use. All concrete cured by this method shall receive two applications of the curing compound. The first coat shall be applied immediately after acceptance of concrete finish. If the surface is dry, the concrete shall be saturated with water and curing compound applied as soon as the surface film of water disappears. The second application shall be made after the first application has set. Placement in more than two coats may be required to prevent streaking.

1714. FINISHING

Immediately after the removal of forms, exposed bars or bolts, if any, shall be cut inside the concrete member to a depth of at least 50 mm below the surface of the concrete and the resulting holes filled with cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties other holes and depressions, honeycomb spots, broken edges or corners, and other defects, shall be thoroughly cleaned, saturated with water, and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. Special pre- packaged proprietary mortars shall be used where appropriate or where specified in the drawing.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left exposed for its full length with clean and true edges.

Immediately on removal of forms, the concrete work shall be examined by the Engineer before any defects are made good.

a) The work that has sagged or contains honeycombing to an extent detrimental to structural safety or architectural appearance shall be rejected.

b) Surface defect of a minor nature may be accepted. On acceptance of such work by the Engineer, the same shall be rectified as directed by the Engineer.

1715. TOLERANCES

Tolerances for dimensions/shape of various components shall be as indicated in these specifications or shown on the drawings or as directed by the Engineer.

1716. TESTS AND STANDARDS OF ACCEPTANCE

1716.1. Concrete shall conform to the surface finish and tolerance as prescribed in these specifications for respective components.

1716.2. Random sampling and lot by lot of acceptance inspection shall be made for the 28 days cube strength of concrete.

1716.2.1. Concrete under acceptance shall be notionally divided into lots for the purpose of sampling, before commencement of work. The delimitation of lots shall be determined by the following:

(i) No individual lot shall more than 30 cu.m. in volume

(ii) At least one cube forming an item of the sampling representing the lot shall be taken from concrete of the same grade and mix proportions cast on any day.

(iii) Different grades of mixes of concrete shall be divided into separate lots

(iv) Concrete of a lot shall be used in the same identifiable component of the bridge

1716.2.2. Sampling and testing

1. Concrete for making 3 test cubes shall be taken from a batch of concrete at point of delivery into construction, according to procedure laid down in IS : 1199.

2. A random sampling procedure to ensure that each of the concrete batches forming the lot under acceptance inspection has equal chance of being chosen for taking cubes shall be adopted.

1. 150 mm cubes shall be made, cured and tested at the age of 28 days for compressive strength in accordance with IS : 516. The 28-day test strength result for each cube shall form an item of the sample.

1716.2.3. Test specimen and sample strength: Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or for any other purpose.

The test strength of the sample shall be the average of the strength of 3 cubes. The individual variation should not be more than + 15 per cent of the average.

1716.2.4. Frequency: The minimum frequency of sampling of concrete of each grade shall be in accordance with Table 1700-8.

TABLE 1700-8.

Quality of concrete in work, m3	No. of samples
1 – 5	1
6 – 15	2
16 – 30	3
31 – 50	4
51 – and above	4 plus one additional sample

for each additional 50 m3 or part thereof At least one sample shall be taken from each shift of work.

1716.2.5. Acceptance criteria

Compressive Strength

When both the following conditions are met, the concrete complies with the specified compressive strength:

- The mean strength determined from any group of four consecutive samples should exceed the specified characteristic compressive strength.
- Strength of any sample is not less than the specified characteristic compressive strength minus 3 MPa.

The quantity of concrete represented by the test results include the batches from which the first and last samples were taken, together with all intervening batches.

Chloride and Sulphate Content

The total chloride and sulphuric anhydride (SO₃) content of all the constituents of concrete as a percentage of mass of cement in the mix shall not exceed the values given in this section of the specifications.

1716.3. Density of Fresh Concrete

Where minimum density of fresh concrete is specified, the mean of any four consecutive samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 per cent of the specified value.

1716.4. Density of Hardened Concrete

Where minimum density of hardened concrete is specified, the mean of any four consecutive samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 per cent of the specified value.

1716.5. Permeability Test

The concrete should pass the following test if it is properly compacted and is not considered permeable.

- (i) Prepare a cylindrical test specimen 150 mm dia and 160 mm high
- (ii) After 28 days of curing, the test specimen is fitted in a machine such that the specimen can be placed in water under pressure up to 7 bars. A typical machine is shown in Appendix 1700/11.
- (iii) At first a pressure of one bar is applied for 48 hours, followed by 3 bars for 24 hours and 7 bars for next 24 hours.
- (iv) After the passage of the above period, the specimen is taken out and split in the middle by compression applied on two round bars on opposite sides above and below.
- (v) The water penetration in the broken core is to be measured with a scale and the depth of penetration assessed in mm (max. permissible limit 25 mm).

1716.6. If the concrete is not able to meet any of the standards of acceptance as prescribed, the effect of such deficiency on the structure shall be investigated by the Contractor as directed by the Engineer. The Engineer may accept the concrete as sub-standard work. Any additional work required by the Engineer for such acceptance shall be carried out by the Contractor at his cost. In case the concrete is not found to be acceptable after investigation, the Contractor shall remove the rejected concrete forthwith.

1717. MEASUREMENTS FOR PAYMENT

Structural concrete shall be measured in cubic meters. In reinforced or pre stressed concrete, the volume occupied by reinforcement or pre stressing cables and sheathing shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

1718. RATE

The contract unit rate for structural concrete shall cover costs of all materials, labour, tools, plant and equipment required for mixing, transporting and placing in position, vibrating and compaction, finishing and curing as per this section or as directed by the Engineer, including all incidental expenses, sampling and testing, quality assurance and supervision. Unless mentioned separately as an item in the Contract, the contract unit rate for concrete shall also include the cost of providing, fixing and removing formwork required for concrete work as per Section 1500.

Where concrete is found to be acceptable as sub-standard work, the Contractor shall pay a discount over contract unit rate, as decided by the Engineer. For deficiency in compressive strength of concrete when accepted by the Engineer, the reduction in rate may be applied as under:

Design Strength – Observed Strength
 Per cent reduction = ----- X 100
 Design Strength

Clause A-1.0 Paver Blocks on Parking Pavement

Item : The works concern the laying of interlocking colored (pigmented) concrete block pavement on a prepared base.

Clause A-1.1 Materials

The paving blocks shall be made with cement concrete having a minimum compressive strength of 40 MPa. The quantity of cement in the mix shall not be less than 350 kg/cum. The coarse aggregate shall have a size of 5-12 mm. The blocks shall be manufactured in a plant capable of producing the blocks of required quality, strength, finish and dimensional tolerance. The thickness of the blocks shall be 85 mm for the parking pavement. The following dimensional tolerances shall be observed:

	Plan dimension :	2 mm
	Thickness :	3 mm

The block shall be laid over 50 mm thick sand bedding. The gradation of the bedding sand shall be as under:

Sieves Size (mm)	Percent
9.50 mm	100
4.75 mm	95-100
2.36 mm	80-100
1.18 mm	50-95
600 micron	25-60
300 micron	10-30
150 micron	0-15
75 micron	0-15

Clause A-2.0 Materials

The block pavement shall be laid over a prepared base. Suitable edge restraints in plain cement concrete M-40 grade shall be provided to confine the bedding sand and to provide support against the horizontal thrust that can develop between blocks while under traffic.

The bedding sand shall be spread manually to a uniform thickness of 200 mm. The sand shall have moisture content of 6-8 percent. The sand shall then be screed by a mechanical screed and compacted.

The pre-cast blocks shall be laid manually or by suitable machines. Block laying shall start at or near an edge restraint and proceed continuously to terminate at another edge restraint. The blocks shall be laid to any standard pattern such as herring bond, structure bond or basket weave. The joint shall be 2-4 mm.

The blocks shall be compacted with vibratory plate compactors. The joints shall be filled with sand by spreading a thin layer of sand working it into the joints. Following this, one or two further passes by a plate compactor shall be made. If necessary, sand can be washed by sprinkling water. The pavement shall be opened to traffic after the joints are fully filled in. the finished pavement shall confirm to the following

Plan deviation

From any 3 m line	10 mm (max)
From any 10 m line	20 mm (max)

Vertical deviation

From designated level	10 mm

Clause A-2.1 Measurement for Payment

The works shall be measured in square meters.

Clause A-2.2 Rate

The contact unit rate for interlocking pre-cast block shall include the cost of all materials, labour, tools and plants and all over incidental works and expenses all complete as per specifications.

the locations shown on the drawings or as ordered by the Engineer and in accordance with the requirements of these Specifications.

water. The storage space must also permit easy inspection, removal and storage of the materials. Aggregates of different sizes shall be stored in partitioned stack-yards. All such materials even though stored in approved godowns must be subjected to acceptance test as per Clause 903 of these Specifications immediately prior to their use.

803. ROAD MARKINGS

803.1. General

The colour, width and layout of road marking shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer.

803.2. Materials

Road markings shall be of ordinary road marking paint, hot applied thermoplastic compound, or reflectorized paint as specified in the item and the material shall meet the requirements as specified below.

803.3. Ordinary Road Marking Paint

803.3.1. Ordinary paint used for road marking shall conform to Grade I as per IS: 164.

803.3.2. The road marking shall preferably be laid with appropriate road marking machinery.

803.3.3. Laying thickness of road marking paint shall be as specified by the Engineer.

803.4. Hot Applied Thermoplastic Road Marking

803.4.1. General:

(i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.

(ii) The thermoplastic compound shall be screeded/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

(iii) The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.

(iv) Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

803.4.2. Thermoplastic Material

803.4.2.1. General: The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads.

803.4.2.2 Requirements:

(i) **Composition:** The pigment, beads, and aggregates shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-3.

TABLE 800-3. PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL (Percentage by weight)

Binder	18.0 min.	18.0 min.

Glass Beads	30-40	30-40
Titanium Dioxide	10.0 min.	-
Calcium Carbonate and		
Inert Fillers	42.0 max.	See
Yellow Pigments	-	Note

Component	White	Yellow

Note: Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this Specification are met.

(ii) **Properties:** The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part I), shall be as below:

(a) **Luminance:**

White: Daylight luminance at 45 degrees – 65 per cent min. as per AASHTO M 249

Yellow: Daylight luminance at 45 degrees - 45 per cent min. as per AASHTO M 249

(b) **Drying time:** When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

(c) **Skid resistance:** not less than 45 as per BS 6044.

(d) **Cracking resistance at low temperature:** The material shall show no cracks on application to concrete blocks.

(e) **Softening point:** 102.5 ± 9.5o C as per ASTM D 36.

(f) **Flow resistance:** Not more than 25 per cent as per AASHTO M 249.

(g) **Yellowness index (for white thermoplastic paint):** not more than 0.12 as per AASHTO M 249

iii) **Storage life:** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.

iv) **Reflectorisation:** Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.3.

v) **Marking:** Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1. The name, trade mark or other means of identification of manufacturer
2. Batch number
3. Date of manufacture
4. Colour (white or yellow)
5. Maximum application temperature and maximum safe heating temperature.

iv) Sampling and testing: The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM /BS method. The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.3. Reflectorising glass beads

803.4.3.1 General: This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-3 and Type 2 beads are those which are to be sprayed on the surface vide clause 803.6.3.

803.4.3.2 The glass beads shall be transparent, colourless and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in clause 803.4.3.3.

803.4.3.3 Specific requirements

A. Gradation: The glass beads shall meet the gradation requirements for the two types as given in Table 800-4.

Sieve Size	Per cent retained	
	Type 1	Type 2
1.18 mm	0 to 3	-
850 micron	5 to 20	0 to 5
600 -do-	-	5 to 20
425 -do-	65 to 95	-
300 -do-	-	30 to 75
180 -do-	0 to 10	10 to 30
Below 180 micron	-	0 to 15

Table 800-4. GRADATION REQUIREMENTS FOR GLASS BEADS

B. Roundness: The glass beads shall have a minimum of 70 per cent true spheres.

C. Refractive index: The glass beads shall have a minimum refractive index of 1.50.

D. Free flowing properties: The glass beads shall be free of hard lumps and clusters and shall dispense

readily under any conditions suitable for paint striping. They shall pass the free flow-test.

803.4.3.4 Test methods: The specific requirements shall be tested with the following methods:

i) Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution (specific gravity 1.10). Cover the desiccator and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.

ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part I).

iii) The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all specified herein and shall certify that the material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer.

803.4.4. Application properties of thermoplastic material

803.4.4.1. The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.4.2. The material upon heating to application temperatures, shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.5. Preparation:

(i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

(ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

803.4.6. Properties of finished road marking:

- a) The stripe shall not be slippery when wet.
- b) The marking shall not lift from the pavement in freezing weather.
- c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperature of 100 deg C.

- d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
- e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- f) The color of yellow marking shall conform to IS Colour No. 356 as given in IS: 164.

803.5. Reflectorised Paint

Reflectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirement of Clause 803.4.3.

803.6. Application

803.6.1. Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

803.6.2. The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

803.6.3. The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.

803.6.4. The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS -3262 (Part 3).

803.6.5. The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

803.7. Measurements for Payment

803.7.1. The painted markings shall be measured in sq. meters of actual area marked (excluding the gaps, if any). In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

803.8. Rate: The Contract unit rate for road markings shall be payment in full compensation for furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these Specifications complete as per the approved drawing(s) or as directed by the Engineer and all other incidental costs necessary to complete the work.

**OUTLINE SPECIFICATIONS BUILDING
MEP SERVICES**

BUILDING MEP SERVICES OUTLINE SPECIFICATIONS

Mechanical Ventilation and Air-Conditioning System

General

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 under scope of work including residential, Hostel and amenity buildings. The mechanical ventilation and air-conditioning systems shall be designed for these facilities as per following codes NBC/ ECBC/ ASHRAE/ BIS/ SMACNA.

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, developed full and comprehensive final designs and specifications ready for construction to meet all Employers requirement as stated in the General Specification Section.

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.

Planning, designing and execution of mechanical ventilation, air-conditioning, pressurization system etc. shall be as per NBC norms, National Fire codes and local CFO requirement. The Contractor shall assist EIC in obtaining NOC from fire department certifying that all provisions have been made as per their approval. All the fees shall be paid by the Contractor.

The Contractor shall furnish the electrical cable schedule and calculations in support of suitability of the selected electrical cable sizes.

The Contractor shall require to maintain the adequate spares for 2 years of DLP.

In Keeping with the intent of Turnkey 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.

The following documents shall be submitted by the Contractor to the Engineer for approval for the various building types.

- (a) General Arrangement drawing of fans, AHU fan section and scrubber Unit.
- (b) Design Calculation, Data sheet and Performance curves of the Fans.
- (c) Air Flow diagram of Ventilation and Air-conditioning system
- (d) Foundation Details of Fans, AHU fan section and Scrubber, Pipe Trestle Line.
- (e) Design, detail engineering, development including preparation of power control, interlocking and sequence, annunciation schemes, layout drawings etc. for MCCs, Control desks of entire system.
- (f) Detail engineering for Air-conditioning load and ventilation system.

- (g) Submission of all the drawings required for detail engineering, erection including foundation drawing for all equipment, drives, testing and commissioning.
- (h) 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.
- (i) Write-up manual on Operation / Control monitoring of the Ventilation and Air-conditioning system etc.
- (j) Manual for Maintenance, overhaul, replacement parts of the equipment.
- (k) Replaceable parts with ordering information.
- (l) Leaflets, catalogues of equipment, accessories etc.
- (m) Material test certificates, Equipment test certificates etc.
- (n) Shop drawings of the Ventilation and Air-conditioning system.
- (o) Any other certificate/ drawing/ manuals deemed necessary.
- (p) Wherever applicable soft copies, CDs, CAD drawings are to be

given. 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.

System Description

Air conditioning for Residential flats, Hostel and other Amenity Buildings

- (a) For Amenities, the proposed air conditioning system shall consist of air cooled Ductable indoor units with individual outdoor unit comprised of reciprocating / rotary compressors for each space. These indoor units shall be connected to outdoor units through a copper refrigerant pipe system. The indoor split units shall be an independent on-off control, temperature setting etc. Contactor to condensate 'uPVC' drain pipe insulated with 6mm thick nitrile rubber insulation for the design and provide the electrical power points and ductable air conditioning system. Ductable units shall be installed by individual occupants.
- (b) In Residential and Hostel Buildings only electrical power points and provision of condensate drain for split / window type air conditioning units are provided. Air conditioning units shall be installed by individual occupants.

Materials and Construction Specifications

Axial flow Fans

Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

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.

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..

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.

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 volts. 50 cycles. 3 phase AC power supply, provided with class 'F' insulation. Motor shall be 415±10%

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.

Drive : to fan shall be direct.

Vibration Isolation : The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

Accessories : The following accessories shall be provided with all fans :

- i. Outlet cone for static pressure regain.
- ii. Inlet cone.

Fan silencers may be provided where specifically called for in Schedule of Quantities. Fans shall be factory assembled and shipped with all accessories.

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.

Axial flow Fans (for Fire, Smoke and Heat Exhaust)

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.

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.

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.

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.

Motor: shall be energy efficient IE2 (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. Motor shall have minimum efficiency of IE 2 or as specified in the schedule of quantities.

Drive : Fan shall be provided through direct .

Vibration Isolation : The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

Accessories : The following accessories shall be provided with all fans :

- i. Outlet cone for static pressure regain.
- ii. Inlet cone.

Fan silencers may be provided where specifically called for in Schedule of Quantities. Fans shall be factory assembled and shipped with all accessories confirming to UL standards.

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 specification for power and smoke ventilation.

3-2002 smoke and heat control system 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.

Centrifugal Fan

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.

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.

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.

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.

Shaft shall be constructed of steel, turned, ground and polished.

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.

Motor : Fan motor shall be energy efficient and suitable for $415 \pm 10\%$ 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.

Drive to fan shall be provided through belt with adjustable motor sheave and a standard belt guard. Belts shall be of the oil-resistant type.

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.

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.

Supply & Installation of Artificial Turf from FIH/FIFA Preferred Manufacturer having pile height of 13mm recommended for multipurpose ground, should have following specifications;

Composition PE, Structure Monofilament curl, Dtex PE8000, Tape thickness 130µm±15µm, Tape width 0.8-1.0mm, Pile height 13mm±1mm, Gauge 3/16 inch, Stitches per 10cm 34±1, Stitches per m2 71400 ±100, Total yarn weight 1860g/sqm ±10%, Primary backing "PP + polyester fiber short-staple +, Mesh scrim inlay", Secondary backing Latex, Total carpet weight 3100g/sqm ±10% Installation of Turf should be done using a seam tape & suitable PU adhesive.

Propeller Fan

Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

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.

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 dynamically balanced at the manufacturer's works. statically and

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.

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. Motors shall be suitable for either horizontal or vertical service as indicated on Drawings.

Accessories : The following accessories shall be provided with propeller fans :

- i. Wire guard on inlet side and bird-screen at the outlet.
- ii. Fixed or gravity louvers built into a steel frame at the outlet.
- iii. Regulator for controlling fan speed for single phase fan motor.
- iv. Single phase preventers for 3 phase

fans

Car Park Ventilation & Smoke Extraction Fans

System description and functional responsibilities: 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 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.

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.

Not Used

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.

The system principles are as follows:

- a. Smoke control designed to provide such a much safer engineered system.
- b. Fully automatic smoke control.
- c. Lower the air temperatures during fires.
- d. No ductwork distribution.
- e. Improved firefighting access.
- f. High air movement preventing fire spread.
- g. Efficient cross ventilation.

The main extract fan shall be axial fans mounted in parallel. All fans shall be located close to risers as shown in the drawings. 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 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 / impulse 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 250 degree C 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 250 degree C 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

CO Detection: The car park ventilation systems shall be controlled by an individual CO- Monitoring system for entire car park located on each level 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.

CO Sensor: The sensor shall be suitable for wall mount & capable of following features:

- a. Digital display of the CO level : 0 to 200 ppm
- b. Analog output : 4 to 20 mA / 0-10VDC
- c. Low Voltage operation : 24 VAC / VDC
- d. Wall Mount Configurations
- e. Test Switch : Provides mode for system self test.
- f. Automatic Calibration (Field Calibration Kit)
- g. Over-range indication.
- h. Start-up mode : steps display and output through test ranges.
- i. Solid Stat sensor : Life expectancy of 7 to 10 years.
- j. 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, sturdy 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 :

- a. Power 24 VAC / VDC @ 150 mA
- b. Measurement range 0 to 200 ppm of CO (4-20 mA)
- c. Electrical class General purpose, non-hazardous.

- d. Operating temperature range 0 deg. To 125 deg.F (-18 deg. To 52 deg.C)

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.

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 separate for each zone of entire car parking and shall control all exhaust & jet fans. The broad logic shall be as follows:

- a. 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:-
- b. 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.
- c. 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.
- d. 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.
- e. 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.

Fire stop mortars to be provided for vertical penetration of Electrical, ELV & Fire shafts. Further all the Penetrations through the walls would be sealed to maintain the fire integrity as per NBC 2016.

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 sealed 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.

AIR HANDLING UNITS

The air handling fan section units shall be double skin construction, draw-thru/ blow thru type comprising of various sections, filter section, fan section, mixing box (wherever the return air and fresh air are ducted).

Casing: Double skinned panels shall be 25mm $\pm$ 2mm thick made of galvanized steel, pressure injected with PU foam insulation (density 40 kg/m³) with K factor not exceeding 0.02 Watt/Mc shall be fixed to minimum 1.5 mm thick aluminium alloy twin box section structural framework with stainless steel screws. Outer sheet of panels shall be made of galvanised prepainted with PVDF and fire resistant of 0.63 mm thick, and inner sheet of 24

Gauge plain G.I. Sheet.

The entire framework shall be mounted on an aluminium alloy or galvanized steel (depending on size) channel base as per manufacturer's recommendation. The panels shall be sealed to the framework by heavy duty neoprene gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminum / hard nylon with stainless steel pivots, handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on-site assembly with continuous neoprene gasket. All fixing and gaskets shall be concealed.

Units shall have hinged, quick opening access door in the fan section and also in filter section where filters are not accessible from outside. Access doors shall be of double skin construction similar to unit.

Internal panels shall be fabricated so that there are no gaps between the panel and frame work. Fabrication clearances shall be closed with blank-off pieces or with sealant. Partitions shall be of sufficient thickness to prevent deflection and vibration during AHU operation. Manufacturer shall provide suitable stiffening by means of box type members across the same. AHU shall be with clean inside surfaces with beveled corners to the best possible extent without crevices as may allow growth of algae / fungus. In case on internal fittings such as dampers, the same shall be with beveled edges and without sharp corners to prevent operator injury. There shall be no screws projecting into AHU or air stream. If the same is unavoidable, the tips shall be fitted with rubber caps to prevent operator injury.

AHU panels shall be factory fitted with pressure ports for DPT installation. The number and size of these shall be confirmed in the AHU technical approval stage. In case opening is to be made in AHU panel, the same shall be with C-channel all around to prevent entry of PUF into air stream. The channels shall be cut at 45 degrees at the corners to avoid overlap. Material for the channel shall be same as that of internal skin of AHU.

Rubber grommets shall be provided at all entry points into AHU such as coil connection, cable entry etc. The same shall be double lip tight fitting to prevent air leakage.

All access doors shall be outward opening. For doors provided downstream of the fan, especially in high static AHUs, additional clamps shall be provided along periphery of door to maintain constant pressure and ensure proper sealing.

Water resistance marine light with power cabling and limit switch shall be included

Micro switch with wiring for Door shall be provided such that fan motor shall stop upon opening the door.

Dampers shall be opposed blade type. Blades shall be made of double skinned airfoil aluminium sections with integral gasket and assembled within a rigid extruded aluminium alloy frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in teflon bushes. Manual dampers shall be provided with a bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorised operation. Damper frames shall be sectionalised to minimise blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.

Fan motors shall be energy efficient (IE-3) and shall be $415 \pm 10\%$ volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 rpm for forward curved fan and 2900 rpm for backward curved fan. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type. For three stage filtration AHUs, belt drive shall not be used and direct driven plug fans shall be used.

Fans shall be "AMCA certified" centrifugal, backward curved / backward curved airfoil so as to give maximum efficiency for given duty condition. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency 75% for backward curved/ airfoil. Fan casing shall be made of galvanised steel sheet. Fan wheels shall be made of galvanised steel. Fan shaft shall be grounded C40- 45 carbon steel and supported in self-aligning plummer block operating less than 75% of first critical speed, grease lubricated bearings. Fan wheels and pulleys shall be individually tested and precision balanced dynamically. Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard.

Motors shall be mounted inside the AHU casing on slide rails for easy belt tensioning. Motors shall drive heavy duty V-belt, constant pitch, drive selected at minimum 110% of motor horsepower.

Both fan and motors assemblies shall be mounted on a deep section aluminium alloy or galvanised steel (depending on size) base frame.

Combination spring and rubber anti vibration mounts shall be provided for isolating the unit casing. Flame retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan discharge.

Filters: Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having anodised aluminium frame. The filter shall have minimum 90% efficiency down to 10 microns. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. Filter framework shall be fully sealed and constructed from aluminium alloy.

Supplying, Installation, Testing and Commissioning of Totally anticorrosive Bobbin Wound filters with polyester resin and fibreglass filter 900 mm diameter, fitted with pressure gauge, manual air bleeder, water drain and emptying plug, fitted with 1" reinforced collector arms and diffuser injected in polypropylene and fiberglass, transparent lid to provide easy access to the inside of the filter for easy operation with v-clamp system, filtration velocity $50\text{m}^3/\text{hr}/\text{m}^2$ or better. Max.EN ISO 9001 :2000 Standard.working pressure : $2.5\text{ kg}/\text{cm}^2$. Flow rate = $32\text{ m}^3/\text{hr}$ or better & inlet / outlet connection 2" (63mm) i/c SITC of 2" (63mm) Multi-port valve with six channels to carry out different functions in an hydraulic circuit. Its design, basically functional, offers a wide range of possibilities of connection to any installation, assuring perfect water- tightness and comfortable handling. Body, cover and handle in injection-moulded ABS. Distributor in PPO. Gaskets in EPDM and metallic elements in Stainless Steel. It should also have site glass in polypropylene.

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 paint to match the finish over the adjoining shop painted surface.

Air handling unit shall be selected for the lowest operating noise level i.e not exceeding 65 dbA @ 3 metre distance from the equipment. Fan performance rating and power consumption data, with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation.

DRY SCRUBBERS

The scrubber unit shall be CE certified and of the Dry type.

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.

Scrubber unit shall be an Industrial Grade Electrostatic Air Cleaner. The supplier must have at least 10 years' experience with good track record in maintaining and servicing such equipment.

The unit shall be designed and constructed and supplied by a manufacturer specializing in the research, design and manufacture of products specified in this section with a minimum of ten years of documented experience, and capable of issuing complete catalog data on the total product.

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.

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.

Base Construction : The sections are to be mounted on a structural C-channel or floor mounting or ceiling suspension. Lifting lugs shall be incorporated in the base channel to allow for rigging.

The external finish shall be a durable industrial grade semi-gloss epoxy coating.

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.

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.

To achieve effective performance, the proposed IEAC shall fulfill the following design consideration :

a. Test Report

The rated efficiency shall be up to 95% based on the **NIOSH 5026 OIL MIST TEST**. Past on situ test reports of 90% to 95% of the said test method must be submitted.

The Industrial Electrostatic Air Cleaner must also be rated at 90% to 95% ASHRAE Std 52.2 and the test report shall not be more 5 years old must be submitted.

b. Contact Time

The air velocity entering the IEAC's Ionizing & Collection Cell Section shall be at 2.5 m/sec to a maximum of 3.2 m/sec, parallel pass. Ionizing and cell dimensions must be indicated and proper calculation shall be submitted prior to the installation of the equipment.

The contact time shall be at least 0.1 second.

c. Collection Area

Minimum Filtration Area shall be 2 m² per 1000 CMH

Power supplies shall be 100% solid state, operate on 240 VAC, 50 HZ, 1 Phase input and provide a dual high voltage output of 12 to 13 KVDC for the ionizer and 6.0 to 6.5 KVDC for the collector, in normal operation conditions. Current output at the high tension shall be 12mA. A maximum power output for the solid state power supply shall be from 50 watts to up to 150 watts to maintain the specified collection efficiency.

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.

Outstanding Features: The power pack shall incorporate a short circuit arc protection with automatic power restoration system to prevent overload. Should arcing takes place (due to collection cells being loaded with contaminants or should there be a fault in the unit), the power

pack shall be able to automatically cut off the supply to stop the arcing and reset after a few seconds. This is to prevent and drastically reduce the risk of fire from continuous arcing.

BMS (Building Management System) Interface: The power supply (pack) shall have a 2 wire dry contacts (NO/NC) for remote link to Building Management System. This is for performance indication of the air cleaning system. Should there be a fault or if service is required, the dry contacts close and a signal is sent to the building BMS System. Should there be multiple units, all the dry contacts can be looped into a set of signal. This ensures proper monitoring of the status of each unit. The systems like Ventilation, Pressurization, Lifts, Fire Pumps will be integrated with fire alarm system and status will be available at centralized location. This is to be integrated with the main BMS system provided in other (Clinical) package.

There shall be 2 LED lights (Green & Red) installed on the access door of the unit to indicate the status of the air cleaning system.

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. The manufacturer shall be informed of any local variances to the National Electrical Code.

Approval / Code Requirements

a. The EAC shall be tested in accordance to CE Certification. It shall comply with Directives : 2006/95/EC Low Voltage

: 2004/108/EC Electromagnetic Compatibility b It shall also meet the following standards

Standards : EN 60335-1:2012, EN 60335-2-65:2003+A11:2012
: EN 55014-1:2006+A2:2011, EN 550142:1997+A2:2008,
: EN 6100-3-2:2006+A2:2009, EN 61000-3-3:2013

Air cooled packaged and split air conditioning units

The Units shall consist of hermetically sealed Scroll compressor, motor, air cooled condenser, sump heaters (for packaged units only), integral refrigerant piping and wiring, all mounted on a steel frame.

Indoor unit to be installed for Split Unit within building, shall be housed in insulated cabinet consisting of cooling coil, blower with motor, filter & insulated drain pan.

The Air Cooled Packaged Unit shall consist of hermetically sealed Scroll compressor, motor, sump heaters, integral refrigerant piping and control panel duly wired to compressor and air cooled condenser all mounted on a steel frame. The Air cooled condenser with fan duly mounted on a common frame shall be installed on the wall openings with suitable angle iron / channel frame to be provided by contractor. The suitable starters, switches, power & control cabling between Air Cooled Packaged Unit and Air Cooled Condenser shall be included by the contractor.

Compressor shall be hermetic 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, A.C. supply.

Refrigerant piping and fittings interconnecting compressor and condenser shall be all copper and valves shall be brass / gunmetal construction.

The indoor & outdoor units shall be sectionalised / cabinet construction. Indoor units shall be consisting of fan section, coil section, filter section, and drain pan. Outdoor unit shall consist of condenser coil, fan & compressor. In case of package units, the compressor shall be mounted within the indoor units and in case of split unit, the compressor shall be mounted with the

outdoor units. Each section shall be constructed of thick sheet steel all welded / bolted construction, adequately reinforced with structural members and provided with sufficient access panels for proper lubrication and maintenance. Base panel shall be constructed of fabricated steel structure provided with an under frame suitably braced. Each unit shall include one piece drain pan constructed of 20 gauge galvanised sheet steel plate. Drain pan shall extend under coil and fan sections with drain connections. Removable panels in fan and coil sections shall provide access to all internal parts. Panels shall be internally section "Insulation" for the thermal insulation and acoustic lining. lined with 2.5 cm thick fibreglass as per

Fan motor shall be suitable for 415 ± 10% volts or 230±10% volts, 50 Hz, A.C. Supply, Single phase, motors shall be provided with permanent capacitor. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 rpm.

Fan wheels and housing shall be fabricated from heavy gauge steel. Fan wheels shall be of double-width, double inlet forward-curve, multi-blade type enclosed in a housing and mounted on a common shaft. Fan housing shall be made of die-formed steel sheets with streamlined inlets to ensure smooth air flow into the fans, fan shaft bearing shall be oil/grease lubricated. All rotating parts shall be dynamically balanced individually, and the complete assembly shall be statically and hydraulically balanced. Fan speed shall not exceed 1000 rpm and maximum fan outlet velocity shall be 550 meters per minute.

Coils shall be of fin and tube type having aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and air velocity across each coil shall not exceed 100 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory-tested at 21 Kg. per sq.cm air pressure under water. Tube shall be mechanically / hydraulically expanded for minimum thermal contract resistance with fins. The number of fins shall be 4 to 5 per cm.

The indoor and outdoor units shall be provided with ribbed rubber pad vibration isolators.

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.

High wall split AC Unit shall be BEE-4 Star labeled based on the latest energy efficiency rating system.

Packaged Ductable split AC Unit shall be BEE-4 Star labeled / ASHRAE-90.1 compliant, based on the latest energy efficiency rating system.

5A403

Air Distribution

Scope

The scope of this section comprises supply, 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.

Duct Materials

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
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

TABLE 5A403.2.1-1: DUCT SIZING

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.

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 expenses

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.

Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

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.

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.

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.

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.

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.

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.

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.

All ductwork shall be independently supported from building construction.

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.

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.

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.

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

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.

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.

Dampers

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.

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.

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.

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 & stiffness (k value) corresponding to set

point pressure.

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.

Supply and Return Air Registers

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.

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.

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.

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.

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.

Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.

Annexure-I

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

Annexure-II

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)	1991) BIS-660-1963 (Reaffirmed 1991)
Metal air ducts.	Air conditioning (Safety Code)
BIS-659-1964 (Reaffirmed	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 welds.
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 - 2018	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
BIS -5424-1989 (Reaffirmed 1994)	work 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

Circuit Breakers

BIS-13947-1993 (Part-II) IEC 947 -2

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
	American Society of Heating Refrigeration and Air Conditioning.
	Fundamentals 2017
	Systems and Equipment 2020
	Applications 2019
ASHRAE Hand Books	Refrigeration 2018
	ASHRAE Indoor air quality
	Sections Standard 62.1-2019.
	ASHRAE 90.1-2019
	ASHRAE 55
	ASHRAE 52.1 and 52.2
IEC	Relevant Sections.
(ECBC,2017)	Energy Conservation Building Code of India -2017
SMACNA	Duct construction standards as per relevant BIS Codes & SMACNA standards
(NBC)	National Building Code of India

Elevator Technical Specification

General

These specifications are intended to describe a quality elevator system using all new equipment, parts, materials, components installation, and service techniques.

The following standards and design criteria are for the guidance of the elevator system in understanding features and facilities and the quality of after sales services required to meet Employers requirement under the contract/package.

The Contractor shall regard these standards and specifications describing a complete, functioning system with necessary intelligence, flexibility and riding comfort provided herein. The Contractor shall submit his/her proposal based on one of the makes of elevators provided in this specification. The contractor may, after contract award, submit a request for a variance to the Engineer if an alternate elevator or feature is proposed which will result in benefit or betterment to the Employer while continuing to meet the requirements as stated herein.

The load calculation, location and design of the lifts shall be based on NBC, 2016 standards and specifications with a minimum speed of 1.5 m/s and a “good” quality service standard in residential building as per NBC, 2016.

The lift shall be comprise of all fail safe measure as specified in relevant IS code (IS 14665 of 2015 : Part I, IS -14665 of 2009 Part V, IS 4591 of 2012, IS -15785 of 2007 and National Building code 2016 as revised from time to time.

Governing Codes and Permits

Code (Indian Equipment)

Equipment shall comply with the following codes including latest modifications / additions / alterations, if any.

Code of Practice for installation, operation and maintenance of electric and good lifts.
BIS: 14665: 2000, IS 14665 of 2015 Part I, IS 1491 of 2012, IS 15785 of 2007.

Harmonised Guidelines and space standards for barrier free built environment with disability and elderly persons, MOUD

List of Indian Standards

List of Acts / Bye-Laws

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 (as well as methods 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

Maintenance and Scheduled Outages

Routine outages and maintenance schedule shall be permitted in consultation with Engineer. No equipment shall be taken out of service for routine scheduled maintenance without a minimum 7 day notice to Engineer. When equipment is out of service due to unforeseen circumstances including emergency and equipment break down. The Contractor shall respond immediately to mitigate and notify the Engineer and resolve the problem and work continuously to place the equipment back in service as soon as possible.

Inspection and Testing

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.

Tests at site of completed works shall demonstrate the following, among other things.

The equipment installed shall comply with specification in all respects and is of the correct rating for the duty and site conditions.

All items operate efficiently and quietly to meet the specified requirements.

All electrical circuits are correctly protected and that protective devices are properly coordinated.

The Contractor shall provide all necessary instruments and labor for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Engineer and shall provide test certificate signed by a properly authorized person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by's expense unless Engineer called for. the Contractor

If it is proved that the installation or part thereof is not satisfactorily carried out, then the Contractor shall be liable for the rectification and retesting of the same as called for by the Engineer whose decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere.

Passenger Elevators

Elevators shall include all elements conforming to specifications or as amended herein. Elevators covered by this specification shall be provided, installed, tested, commissioned, certified and approved as per statutory requirements by Elevator Inspectorate

All lifts shall be Machine room less (MRL) type. Machine shall be mounted on the guiderail with provision of proper rescue.

Notes- One Fireman's switch at ground floor for each bank of elevators shall be provided.

Emergency light of adequate illumination level shall be provided in all lift cars. It shall be operated by self-contained nickel cadmium batteries completed with self-maintained trickle charger. The battery shall be able to maintain the full illumination continuously for a period not less than two hours.

There shall be no loss of passenger capacity due to the interior finishes. Hence, provision of at least 200 Kg weight for interior finishes shall be kept for passenger elevator. Flooring shall be aluminum chequered plate with 5 mm thick in the passenger elevator.

5A407.5.3.3 Provisions shall be provided to install speakers and CCTV in all the elevators. The provision of central monitoring system of CCTV camera with UTP cables shall be provided.

Safelock rubber tiles flooring shall be a mix of natural rubber & recycled rubber with elephant skin pattern. It functions as UV resistant and thicker layer of rubber matting protect the floor and the user. It should dampens sound and absorbs shock. 50 x 50 cm tile size should be 4.6 kg.

Equipment

Hoisting machines shall be gearless type.

Gearless hoisting machine shall be AC induction or P.M.S.M. ACV3F gearless traction type motor with brake, drive sheave, and deflector sheave assembled and compactly mounted on a continuous bed-plate and set on steel beams. Sound isolating pads shall be installed beneath the machine bed-plate to reduce vibration or air borne noise

The motor shall be reversible type particularly designed for elevator service with high starting torque and low starting current. Sound reducing material shall be installed under machine. Motor shall be capable of minimum 180 starts per hour.

The machine shall be located on guide rail. Suitable beams shall be furnished for mounting deflector pulleys, if required by the Contractor.

Hoist machine mounted direct drive shall be provided with digital, closed-loop velocity encoder.

Requirements for permanent lifting hooks hoisting beams and access hatches shall be indicated on the drawings by the elevator system, supplier / installer.

The motor shall be reversible type particularly designed for elevator service with high starting torque and low starting current. Sound reducing material shall be installed under machine. Hoist machine mounted direct drive shall be provided with digital, closed-loop velocity encoder.

Ladders and platforms with handrails and toe boards for overhead sheave access within the bounds of the machine room. Headroom available is limited to 4500 mm only.

Emergency Cranking

The hoisting machines shall be fitted with arrangement of hand crank to allow release of hoist brake and provide for manual movement of the car in case of emergency. These tools shall be hung up on a tool board fitted to in the last landing, with instructions for their use clearly written on the board both in English and the local language.

Speed Governor

The car safety shall be operated by a mechanical centrifugal type car and counterweight driven speed governor located in the suitable location. of the hoist way. The governor shall actuate a switch when excessive descending speed occurs, disconnecting power to the hoist motor and applying the brake prior to deployment of the safeties.

Power Conversion and Regulation Units for direct-current power for the operation of hoist machine brake, door operator, dispatch processor, signal fixtures, etc., \ solid-state, alternating current, variable voltage \ variable frequency (ACV3F), I.G.B.T converter/inverter drives \ controllers

Units shall be designed to limit current, suppress noise, and prevent transient voltage feedback into building power supply, Suppress solid-state converter noises, radio frequency interference, and eliminate regenerative transients induced into the mainline feeders or the building standby power generator. Units shall be internal heat sink cooling fans as required,

Direct drive, solid-state, digital type encoder shall be provided to update car position at each floor and automatically restore the same after power loss.

Note: All Elevator equipment including their supports and fastenings to building shall be from the building structure minimize objectionable noise and vibration transmission to car, building structure , or adjacent occupied areas of building.

Elevator Materials

Elevator landing door will be 2 hours rated to be provided and traveling cable shall be flame resistant. All other electrical cables shall also be flame resistant and housed in metal conduit or other metal enclosures.

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.

Buffers

Oil or spring type buffers shall be provided in the pit in compliance with IS: 14665. Clearance from underside of car resting on a fully compressed buffer shall be as per IS. Buffer shall be designed for design speed + 15%. The oil buffers shall be self-resetting type and shall be provided with means for determining the oil level.

Car

Car shall be center opening. A car-frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform. Car enclosure shall be of non-scratchable SS vandal proof of standard thickness. . The car safety shall be integral with car- frame or shall be mounted on the bottom members of the car-frame and shall be of the flexible guide clamp type designed to stop and hold a fully loaded car which exceeds descending speed. Safeties shall conform to IS:14665.

The car platform shall be of chequered aluminum plate of 5 mm thick. The entire platform shall rest on rubber pads, so designed to form an isolating cushion between the car and car frame. Platform deflection shall be limited to maximum 3 mm under maximum normal operating conditions.

Interior Handrail (3 sides) shall be provided in each elevator. Elevator handrail shall be made 16 gauge stainless steel with 40 mm dia.

In case of freight or service elevators, the platform shall be provided with slip resistant 5 mm thick vandal proof Aluminum chequered plate flooring. The platform shall be arranged to accommodate one piece load of mechanical / electrical equipment etc.

Rubber encased coil spring tension adjusted roller guides shall be provided for passenger elevators with speed of 1.5 m/s or greater, mounted on top and bottom of the car frame, and on top and bottom of the counterweight frame to engage their respective guide rails. Service elevators and low speed elevators can have sliding guides on car and counterweights.

Car Top Station

A car top operating station shall be comprised of key operated switch and constant pressure up/down buttons which shall be provided on each elevator. The car shall respond to up/down command at inspection speed. The Contractor shall provide LED light fixture switched from car top station.

Counterweight

A structural steel frame with cast iron or steel plate filler weights shall be furnished to provide proper counterbalance for smooth operation.

Counterweight Guard

A metal counterweight guard shall be furnished and installed at the bottom of the hoist way, and shall wrap around counterweight rails for a height of no less than 1.80 m in order to protect accidental contact.

Hoist/Belts and Governor Ropes

Hoist ropes shall be traction steel of size, construction and number to insure proper operation of the elevator and give satisfactory and safety assurance. Governor ropes manufacturer's specifications shall be steel or to suit

All ropes shall consist of at least eight strands wound about a hemp core center. All ropes shall conform to IS:14665. The minimum factor of safety for ropes shall be 10.

Elevator Operating Devices

Redundant series wired terminal stopping devices shall be provided to slow down and stop the car automatically at the terminal landings. Resetting a tripped device shall be done manually only.

Terminal and Final Limit Switch

Terminal switches shall be provided to slow down / stop the car at the terminal landings. These terminal switches shall act independently of the operating device or final limits switches. Ultimate or final limit switches shall also be provided to automatically cut off the power and apply brake in case the car travel beyond terminal landings.

Traveling Cables

Travelling cable shall be secured to the cars underside. Cable shall be clear of all obstructions while car is in motion. Rubbing or chafing of cables against hoist way or equipment within hoist way to be avoided.

Lighting and power cable shall be with Fire retardant outer sheath.

Shielded wires and cables shall be provided for music, car access control, phone, CCTV, etc. Twisted type, 4 pair 14/0076 music cables and 4 pair 0.5 dia. Cat 3 cable for communication system shall be used. Travelling cables shall be flexible and suspended to relieve strain on individual conductors. A minimum of 10% spare conductors shall be provided in travelling cable.

Wiring

All wiring and electrical interconnections shall comply with governing codes. Wiring shall 1100 volt grade FRLS type and shall run in metal conduit, tubing or approved electrical raceways. Travelling cables shall be flexible and suspended to relieve strain on individual conductors. A minimum of 10% spare conductors shall be provided in travelling cable

Elevator Entrances and Car Door

All landing hoist way entrance door shall have center opening horizontal sliding type doors unless otherwise specified suitable for a clear opening for each type of elevator and shall include flush doors of hollow metal construction, extruded aluminum sill with anti-slip grooving and hanger supports and hanger cover shall be provided. Exposed surfaces of doors and frames shall be finished as directed by the Engineer and as per architectural specifications.

Sheave type two point suspension ball bearing door hangers and tracks shall be furnished for each hoist way opening. Sheaves shall not be less than 58 mm diameter and adjustable ball bearing rollers shall take the up thrust of the doors.

Elevator Entrances to have minimum two Hour Fire Protection. Complete entrances bearing fire labels from a nationally recognized testing laboratory approved within the governing jurisdiction.

Car doors shall, unless specifically stated, be center parting, automatic power operated, variable frequency door operator or PWM DC door operator and electronic door detector. Infrared light beams shall be provided to act as a safety curtain across the door entrance to monitor the door closing only the door at the landing where the car is stopping shall be opened.

Car doors shall be hung plumb and even, to within 1 mm. with minimum number of 4 gibbs per leaf. Floor gibbs shall be well fitted so as to prevent popping noise as a car passes structural members, or car in motion in a shared shaft, etc. Hoist way doors shall be hung plumb and show a maximum of 6 mm joint at sides, top and bottom and 2 mm at centre joint. Narrow door frame or jamb panel shall be supplied by elevator the Contractor. A soft chime shall ring prior to doors closing and opening.

Frames: 14 Gauge Hollow Metal at All Floors

Door Panels shall be made of 16 gauge steel, sandwich construction without binder angles. Leading edges of center-opening doors shall be provided with rubber astragals. Each car and hoist way door leaf shall be fitted with minimum of two (2) gibbs per panel, one at leading and one at trailing edge with gibbs in the sill groove entire length of door travel. Sight Guards: 14 gauge, same material and finish as hoist way entrance door panels. Construct without sharp edges.

Sills: Extruded Aluminium

Sill Supports: Structural or formed steel shall be designed to support door sill based upon car loading classification.

Struts and Headers: Vertical support shall be provided of entrances and related material with door open bumpers on entrances equipped with vertical struts.

Upon the car reaching landing in response to a hall or car call, a soft chime in the car shall sound. Door open period shall be adjustable to within a range of + 1 second. Door-open-period on all floors except lobby floor shall be shortened to the extent that door closure will commence 2 seconds (field adjustable) following the sensor beam interruption by the last boarding or disembarking passenger. This period shall be adjustable to 1.5 seconds $\pm$ 1.0 seconds. Normal door-open period shall be overridden by the car's CPU. Door closure shall override "door-open period" where car loading has reached by pass limit, or when another car approaches the lobby floor.

An approved positive interlock shall be provided for each hoist way entrance which shall prevent operation of the elevator unless all doors for that elevator are secured and shall maintain the doors in their closed position while the elevator is away from the landing. Emergency access to the hoist way as required by governing codes shall be provided.

Car and Hoistway Door Operator

For each elevator door, an electric VVVF door operator or PWM DC door operator shall be furnished to simultaneously open the car and hoist way doors when the car is at a landing. The doors shall be closed simultaneously by motor power. Emergency key provision shall be made to open doors at all landing from outside of the hoist way.

In the event of interruption of electric power or failure of the door operator, it shall not be possible to open the car door manually from within the car.

An electric contact for the car door shall be provided which shall prevent elevator movement away from the landing unless the door is in the closed position. Each hoist way door shall be equipped with a positive electromechanical interlock and auxiliary door closing device so that the elevator can be operated only after the interlock circuit is established.

The doors shall open automatically while the car is leveling at the respective landing. The doors shall automatically close after a predetermined time interval has elapsed, but the pressure of the "door open" button provided in the car shall reverse the motion and reopen the momentary

doors and reset the time interval unless overridden by the electronic door monitor. Door operation shall be consistent, smooth and quiet at all floors, regardless of door weight or varying air pressure.

Door Control Device

3D, Infra-red door detector with minimum 150 cross beams with LEDs on edges and with variable timing shall be installed on each elevator with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to full height of door above finished floor.

This device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation. In event of device failure, provide for automatic shutdown of car at floor level with doors open.

After beams of door control device are obstructed for a predetermined time interval (minimum 20.0 - 25.0 seconds), warning signal shall sound and doors shall attempt to close with a maximum of 1 kg.m kinetic energy. Activation of the door open button shall override

nudging operation and reopen doors.

When beams are interrupted during initial door opening door shall be hold open for minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0 - 1.5 seconds after beams are re-established.

Voltage Fluctuations

Vendor shall provide inbuilt auto voltage regulator with the Elevator power panel.

All electrical equipment supplied by the Elevator the Contractor shall withstand an incoming supply voltage fluctuations of +10% - 10% and Frequency fluctuations of + 3% to - 3%.

Over-Load Feature

Elevators shall be fitted with the load weighing feature to illuminate "Over Load" and defeat the car's operating circuits when car load reaches 120% or more of rated load. Car platform may require stiffening to minimize margin of error resulting from excessive deflection. Overload feature and / or circuit defeat for elevators shall conform to governing code.

Elevator system shall have provision to bypass all calls after 80 % loading

5A408.11 Automatic Rescue Devices (ARD)

The automatic rescue devices (ARD) meant for the purpose of bringing the lift car to the nearest landing doors are used due to frequent power failures being the common phenomenon. The ARD shall have the following specifications:

ARD should move the elevator to the nearest landing in case of power failure during normal operation of elevator.

ARD should monitor the normal power supply in the main controller and shall active rescue operation within 10 seconds of normal power supply failure.

It should bring the elevator to the nearest floor at a slower speed than the normal. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is complete by the ARD the elevator is automatically switched to over normal operation as soon as normal power supply resumes.

In case of normal power resumes during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing, it automatically be switched to normal power operation.

All the lift safeties shall remain during the ARD mode operation.

The battery capacity should be adequate so as to operate the ARD at least seven times a day provided the duration between usages is at least 30 minutes and same shall be dry and maintenance free rechargeable type.

Automatic Self-Levelling

The elevator shall be provided with automatic self-leveling feature that shall bring the elevator car level to within ± 3 mm of the landing floor regardless of load or direction of travel. The automatic self-leveling feature shall compensate for over travel and rope stretch.

Car Speed

Car speed shall be based on the travel distance and number of floors as per the design brief.

5A408.14 Acceleration / Deceleration

Acceleration / Deceleration shall be linear and smooth. Stops shall be without cable oscillations. Acceleration and Deceleration shall be site adjustable.

Noise Levels

Noise from moving equipment including door operation, car motion, fan, etc. shall not intrude into adjoining spaces by more than 20 dB and adjoining occupied areas by not more than 10 dB. (All octave bands)

Noise level inside the car shall not exceed 50 dB. Without car cabin fan running

Noise level inside the car shall not exceed 55 dB in case of door opening / closing. The noise level shall be measured at zero gravity.

Lateral Quaking and Vertical Vibrations

Lateral quaking and vertical vibrations should not exceed 20 gal and 85 dB respectively. The Contractor to demonstrate these parameters at site with performance analyzer.

Car Position Indicator (Passenger Cars)

Scrolling alpha numeric car position indicator shall be installed above each operating panel. The position of the car in the hoist way shall be shown by illuminating announcement of the corresponding landing at which the car is stopped or passing.

Lighting

Elevator shall be provided with lighting and alarm bell in each cab through car mounted dry cell rechargeable battery with minimum 5 years life expectancy and solid state battery charger, necessary changeover relays. Location of light fixture to be coordinated with Interior Designer. Light output shall be minimum 50 LUX at floor level. Mirror inside the elevators shall be of approximately width equal to door width and height shall be minimum 3 feet

Hall Buttons (All Cars)

For elevators hall buttons shall be provided at each terminal landing. A single micro movement push button shall be provided at top most and the lowest floor landing, two micro movement buttons on a single plate shall be provided at each intermediate floor. When a hall call is registered by momentary pressure on a landing button, that button shall become illuminated and remain illuminated until the call is answered.

Call Button

Selection for call button for passenger car shall be as per the Engineer. Service/Freight elevator call buttons shall be as per manufacturer's standard product. The catalogues of the buttons offered shall be submitted to Engineer for approval.

Fixture Finishes

The metal faceplates of the signal and operating fixtures in the cars and at the landings, along with the metal accessories in the cars, shall be hair line stainless steel. Push button fixtures at the landings, all fixtures form and finishes, etc. shall be subject to Engineers approval.

- 5A408.21 Automatic Elevator Retrieval System
- 5A408.21.1 All elevators shall be equipped with automatic elevator retrieval system which shall, upon signal from the central fire alarm system or manually operated key switch, cause all elevators to be dispatched automatically to the ground floor. Elevators shall, open their doors and remain at the ground floor. All floor and car buttons shall be rendered ineffective until the system is manually reset. A key operated switch shall be provided at the ground floor to activate and reset the retrieval system manually. System shall be in line with NBC 2016 recommendations.
- 5A408.22 Inspection Operation-All Elevators
- 5A408.22.1 A switch shall be provided in the car to permit operation of the elevator from top of the car for inspection purposes, with car and hall buttons inoperative. Car shall travel at inspection speed not exceeding 0.5 m/s. Motion of car shall require constant pressure to directional button.
- 5A408.23 Independent Service (All Cars)
- 5A408.23.1 A key operated switch shall be provided in the car operating station which, when actuated, shall disconnect the elevator from the hall buttons and permit operation from the car buttons only.
- 5A408.24 Car Operating Panel
- 5A408.24.1 The car operating panel shall contain a bank of micro movement illuminated buttons marked to correspond to the landings serviced. Faceplate shall be constructed of stainless steel, satin finish or TOUCH SCREEN wherever specified.
- 5A408.24.2 It shall include floor buttons, alarm button, door open button, door close button and emergency push-to-call button. Plates shall be configured as per local building code accessibility standards including Braille.
- 5A408.24.3 Operating controls shall be within 900 mm to 1200 mm above the car floor.
- 5A408.24.4 The emergency alarm button shall be connected to the 12 volt rechargeable battery circuit. A locked compartment integral with operating panel shall contain:
- (a) Auto/manual/inspection key operated switch.
 - (b) Up/down button
 - (c) Fan switches
 - (d) Synthesized voice announcements
- 5A408.24.5 On sounding of general fire alarm, the elevator shall if in motion, express to the ground floor. If stopped, the elevator shall open its doors and remain there until reset. Emergency talk-back system shall be provided, installed in integral cabinet and connected to the EPABX by the low tension the Contractor.
- 5A408.24.6 All Passenger Elevators of 13 passenger capacity and above shall be provided with 2 No. Car operating panels and 8 Passenger Elevator shall be provided with 1 No. Car operating panel.
- 5A408.24.7 Elevator vendor shall provide COP design to architect for review and coordination with Elevator cab finishes.
- 5A408.25 Elevator Control Panel (ECP)
- 5A408.25.1 ECP shall be vertical, totally enclosed cubicle constructed of sheet steel with hinged doors on the front and screwed panels or hinged doors on the back, giving easy access to all components inside the controller. The cubicle enclosure shall be minimum of IP 22. Panel ventilating fan shall be provided to maintain components temperature within

limits.

- 5A408.25.2 It will have a microprocessor with solid state switching devices sequenced and interlocked It will have monitoring points for Elevator position and Emergency Stop ECP should be located such that it can be easily accessed from the last landing and shall be key locked and vandal proof.
- 5A408.25.3 It will provide protection but not restricted to the
- 5A408.25.4 following: No-voltage or sustained under voltage
- 5A408.25.5 Over current in any component
- 5A408.25.6 Phase reversal of the power
- supply 5A408.25.7 Over load
- 5A408.25.8 Single phasing
- 5A408.25.9 ECP shall be arranged to cut-off the power supply, apply the brake and bring the car to rest at the nearest landing in the event any of the above failures occur. Same should happen, in the event of a signal from the Fire Alarm Control Panel.
- 5A408.26 Automatic Load Bypass
- 5A408.26.1 Transducers in the car platform shall monitor passenger load which shall override "pre-programmed door open period" and dispatch the loaded car from the low terminal. The load weighing device shall also function in the same manner on all intermediate and top floors and in addition shall express to the next car call and ignore all hall calls. Hall calls which are bypassed shall not be canceled. The automatic load bypass device shall be field adjusted for 50% - 75% of rated load.
- 5A408.27 One Car Simplex (Service)
- 5A408.27.1 Operation shall be automatic by means of the car and landing buttons. Stops registered by the momentary actuation of the car or landing buttons shall be made in order in which the landings are reached in each direction of travel after the buttons have been actuated. All stops shall be subject to the respective car or landing button being actuated sufficiently in advance of the arrival of the car at that landing to enable the stop to be made. The direction of travel for an idle car shall be established by the first car or hall button actuated.
- 5A408.27.2 UP" landing calls shall be answered while the car is travelling in the up direction and "DOWN" landing calls shall be answered while the car is travelling down. The car shall reverse after the uppermost or lowermost car or landing call has been answered, and proceeds to answer calls and landing calls registered in the opposite direction.
- 5A408.27.3 If a car without registered car calls arrives at a floor where both up and down hall calls have registered, it shall initially respond to the hall call in the direction that the car was travelling. If no car call or hall call is registered for further travel in that direction, the car shall close its doors and immediately reopen them in response to the hall call in the opposite direction. Direction lanterns shall indicate the changed direction and initiate gong when the doors reopen.
- 5A408.28 Collective Selective Group Control for Passenger Elevators
- 5A408.28.1 The elevator system shall have UP and DOWN buttons at each landing to select the desired direction of travel. The microprocessor-based controller to memorize all car and landing calls, and the system shall answer all registered calls sequentially and preferably in the current direction of movement.
- 5A408.28.2 Each of the landing call shall be automatically allocated to the best placed (nearest car travelling in the same direction). Control to be designed such that cars are effectively

spaced to give even service.

- 5A408.28.3 Optimized response to hall calls shall be achieved by computing a relative system response (RSR) time for each registered hall call. The computation of each car's RSR time to a call shall be based on, but not limited to, such relevant factors as distance, service to previously assigned car and hall calls, car load, direction, door and car motion status, and coincidence of car and hall calls. The car with the least RSR shall have such a call assigned to it.
- 5A408.28.4 RSR computations for each hall call shall be repeated several times a second and the hall call assignment might be changed if a more suitable car is found available.
- 5A408.28.5 All cars to be parked at ground floor when there are no unanswered calls.
- 5A408.28.6 A car arriving at a floor to park shall not open its doors. Cars shall open their doors only when stopping in response to a car or hall call.
- 5A408.28.7 If for any reason the doors are prevented from closing and the car is unable to respond to a call, it shall lose its assignment and the call shall be transferred to the other car.
- 5A408.28.8 When a car is filled to a predetermined load setting, it shall no longer stop for hall calls. Any registered hall call shall remain registered for the next elevator to respond.
- 5A408.28.9 When the independent service switch in the car operation station is actuated, that elevator shall be disconnected from the hall button riser/s and operate independently from car buttons only.
- 5A408.29 Car to Lobby Operation
- 5A408.29.1 Provide a key operated switch for each elevator at the main floor which, when actuated, shall cause the corresponding elevator to make a trip to the lobby as soon as the car is available for response to the special call.
- 5A408.30 Next Car Up
- 5A408.30.1 "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".
- 5A408.31 Despatch
- 5A408.31.1 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.
- 5A408.32 Earthing (Electrical Grounding)
- 5A408.32.1 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
- 5A408.32.2 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.
- 5A408.33 Additional Information
- 5A408.33.1 The Contractor shall submit details / samples / photographs / catalogues for following. These shall be relevant to the project and the Contractor shall indicate which of these are being for provision into the elevators. The Contractor shall take approval from Engineer before purchase of material.

- (b) Car Operating Panel
- (c) Hall Buttons
- (d) Group Indication panel.
- (e) Option for stainless steel

finishes 5A408.34 Safety Aspects and Procedures

5A408.34.1 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.

5A408.34.2 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.

5A408.34.3 If during erection any safety or protection device is inoperative, special care must be taken to avoid accidents on this account

5A408.34.4 Wherever possible, the lifts (in use) adjacent to the one under erection / test / repair shall be shut down. Otherwise caution shall be exercised so that accidental contact of his body is avoided from the adjoining lift / lifts by suitable partition barriers. The contractor shall ensure that all safety practices and procedures are followed during all phases of installation, operations and maintenance.

5A408.34.5 The lift electrical panels shall be provided the with CO2/ inert gas flooding as per NBC-2016.

5A408.35 Equipment Schedule

S.NO.	DESCRIPTION	Elevator L-1	Elevator L-2	Elevator L-2
1	TYPE OF ELEVATOR	PASSENGER	SERVICE	FIRE
2	QUANTITY	26	18	18
3	OPERATION	DUPLEX SELECTIVE COLLECTIVE CONTROLLER	DUPLEX SELECTIVE COLLECTIVE CONTROLLER	SIMPLEX SELECTIVE COLLECTIVE CONTROLLER
4	CONTROL	AC VVVF	AC VVVF	AC VVVF
5	OPERATION W/WO ATTENDANT	W/WO	W/WO	W/WO
6	CAPACITY			
A	RATED LOAD (KG)	884 KGS	1020 KGS	680 KGS
B	WEIGHT OF MATERIAL FOR INTERIOR OF THE CAR	BY LIFT SUPPLIER	BY LIFT SUPPLIER	BY LIFT SUPPLIER
C	NO. OF PERSONS	13 PERSONS	15 PERSONS	10 PERSONS
7	MACHINE	GEARLESS	GEARLESS	GEARLESS
8	SPEED (MPS) RATED	1.5 MTR / SEC	1.5 MTR / SEC	1.5 MTR / SEC
9	TRAVEL	As per Lift Schedule	As per Lift Schedule	As per Lift Schedule

S.NO.	DESCRIPTION	Elevator L-1	Elevator L-2	Elevator L-2
10	RISE IN METERS	As per architectural sections	As per architectural sections	As per architectural sections
11	STOPS AND OPENINGS			
A	NO. OF STOPS	As per Lift Schedule	As per Lift Schedule	As per Lift Schedule
B	NO. OF OPENINGS	As per Lift Schedule	As per Lift Schedule	As per Lift Schedule
C	SAME SIDE	ALL SAME SIDE	ALL SAME SIDE	ALL SAME SIDE
D	OPPOSITE SIDE	-	-	-
12	CAR SIZE IN (MM) (INSIDE DIMENSIONS)	AS PER OEM STANDARD	AS PER OEM STANDARD	AS PER OEM STANDARD
13	HOIST WAY SIZE (MM) (W x D) INSIDE DIMENSIONS)	2100 W x 3000 D	2300 W x 3000 D	2050 W x 1920 D
14	DOOR OPERATION	AUTOMATE WITH DOOR MONITOR	AUTOMATE WITH DOOR MONITOR	AUTOMATE WITH DOOR MONITOR
15	CAR AND HOIST WAY ENTRANCE (MM)			
16	HEIGHT OF LIFT CAR IN MM	AS PER OEM STANDARD	AS PER OEM STANDARD	AS PER OEM STANDARD
17	MACHINE ROOM	MRL	MRL	MRL
18	PIT DEPTH IN MM	1600 MM	1600 MM	1600 MM
19	OVERHEAD IN MM	4000 MM	4000 MM	4000 MM
20	NOISE LEVEL IN CABIN (RUNNING CAR)	55db	55db	55db
21	INTERIOR FINISHES			
A	DOOR	Door - SS Hairline	Door - SS Hairline	Door - SS Hairline
B	WALL	SS Hairline	SS Hairline	SS Hairline
C	FLOORING	GRANITE OF SUPERIER FINISH WITH 16MM RECESS FOR FLOORING	GRANITE OF SUPERIER FINISH WITH 16MM RECESS FOR FLOORING	GRANITE OF SUPERIER FINISH WITH 16MM RECESS FOR FLOORING
D	CEILING	AS PER OEM STANDARD	AS PER OEM STANDARD	AS PER OEM STANDARD
22	COOLING IN ELEVATOR	AXIAL BLOWER	AXIAL BLOWER	AXIAL BLOWER
23	VENTILATION	AS PER OEM STANDARD	AS PER OEM STANDARD	AS PER OEM STANDARD
24	SIGNALS	-	-	-

S.NO.	DESCRIPTION	Elevator L-1	Elevator L-2	Elevator L-2

A	ILLUMINATED HALL BUTTON WITH DIGITAL CAR POSITION INDICATOR	YES	YES	YES
B	BATTERY OPERATED ALARM BELL & EMERGENCY LIGHT : MIN 30 MIN BACK UP	YES	YES	YES
C	OVERLOAD WARNING INDICATOR IN CAR	YES	YES	YES
D	BUILT-IN INTERCOM FOR 2 WAY COMMUNICATION	YES	YES	YES
E	FIREMAN'S SWITCH ON GROUND FLOOR : ONE PER GROUP	YES	YES	YES
F	INTERIOR HAND RAIL (3 sides)	YES	YES	YES
G	SUPERVISORY PANEL(WP) : A panel installed in a building's supervisory room, or so on, which monitors each elevator's status.	YES	YES	YES
H	ILLUMINATION IN THE CAR WITH LED LIGHT FITTING	YES	YES	YES
26	DOOR OPERATION FEATURE			
A	3 - Dimensional door Sensor - To Monitor Traffic Across the door	NO	NO	NO
	OTHER FEATURES			
B	PROVISION TO INTEGRATION WITH FIRE ALARM PANEL & BMS	YES	YES	YES
C	SPEAKER & PROVISION FOR MUSIC & PA SYSTEM	YES	YES	YES

5A409**Annexure –IV**

5A409.1 List of Act / Bye-Laws

5A409.1.1 The lift installations shall also be governed by the following Acts/Bye-laws/Codes as amended upto date in addition to the codes specified in the tender:

- (a) National Building Code of India-2016
- (b) ECBC 2017
- (c) Indian Electricity Act - 2003
- (d) Indian Electricity Rule - 1956
- (e) Local Lift Act
- (f) Building Bye-Laws
- (g) Local Fire Prevention and Fire Safety Rule

5A410**Annexure –V**

5A410.1 List of Indian Standards

BIS-14665 (Part 2) Sec-1 :2000	Code of Practice for installation, operation and maintenance of electric and goods lifts.
BIS-14665 (Part 2) Sec-2 :2000	Code of practice for installation, operation and maintenance of electric service lift.
BIS-14665 (Part 3) Sec-1 :2000	Safety Rules Section-1 and Good Fits.
BIS-14665 (Part 3) Sec-2 :2000	Safety Rules Section-2– Service Lifts
BIS-14665 (Part-1) : 2000	Outline dimension for electric
lifts. BIS-14665 (Part 5) : 1999	Inspection Manual for Electric Lifts
BIS-14665 (Part 4) Sec-1 to 9 : 2001	Electric Traction Lifts-Components
BIS-4289-(Par-1)-1984 Reaffirmed 1991	Specification for lifts cables.
BIS-1173-1978-Reaffirmed 1987	Specification for hot rolled and slit steel tee bars.
BIS-7443-1974-Reaffirmed 1991	Method of loading rating of worm gear.
BIS-7403-1974-Reaffirmed 1991	Code of practice for selection of standard worn and helical gear box.
BIS-4218-(Part-II)1976-Reaffirmed 1996	Isometrics screw threads.
BIS-2147-1962	Degree of protection provided by enclosure for low voltage switchgear and control gear.
BIS-1271-1985-Reaffirmed 1990	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.

BIS-3043-2018	Code of practice for earthing.
BIS-1646-1997	Electrical installation Fire Safety of Building.
BIS-694-1990	PVC insulated electric cable for working voltage upto and including 1100 volts.
BIS-732-1989	Code of practice for electrical wiring and installation
BIS-1554-1988 (Part-1)	PVC insulated (Heavy Duty) electric cables for working voltage upto and including 1100 volts.
BIS-3480-1966	Flexible steel conduits for electrical wiring
BIS-3837-1976	Accessories for rigid steel conduit for electrical
wiring BIS-5133-1969 (Part 1)	Boxes for the enclosure of electrical accessories
BIS-5216-1982 (Part-1)	Guide for safety procedures and practices in electrical work. BIS-5578 and 11353-1985 Marking and arrangement of bus bars
BIS-8130-1984	Conductors for insulated electric cables and flexible cords
BIS-8623-1977 (Part-1)	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200 VDC.
BIS-8828-1996	Miniature Circuit Breakers
BIS-9537-1981	Rigid steel conduits for electrical wiring (Second
revisions) BIS-10810-1998	Methods of test for cables
BIS-12640-1988	Earth Leakage Circuit Breakers.
BIS-13947-1993	Moulded Case Circuit Breakers
BIS-13947-1993	General requirement for switchgear and control gear for voltage not exceeding 1000 volts.
BIS-2332-1972	Nomenclature of floor and story
BIS-14671-1999	Inspection Manual

Note: Latest edition of above mentioned codes shall be referred

Annexure VI

All elevators shall be procured, installed, operate and maintained by OEM. Contactor shall be submit the memorandum of understanding (MOU) between OEM & Contactor before placing the order for procurement.

Internal Plumbing

General

The Plumbing, Sanitary and Drainage Systems for all facilities to be constructed under the residential block, at all of the various sites/locations, shall be fully and competently designed by the contractor keeping in view the following:

Compliances with local regulations and Relevant Bureau of Indian standards.

Adequate and uniform pressure availability of cold (domestic & flushing for toilet only) and hot water lines in all Toilets, Kitchen and all designated areas are achieved.

Hostel & Residential Block shall have dedicated room for PHE & FS including stand

by equipment. The domestic & flushing water supply will be supplied by the overhead respective tanks by gravity system and will fill the OH water tanks through transfer pump located in STP /plant room area.

Concept of the System

The following services are envisaged for this project

Potable water supply will be provided through a gravity system from respective over head tanks and these tanks have dedicated transfer pump in the residential and hostel plant room. The maximum pressure at the inlet of fixture shall be limited to 3.0 kg/cm² unless otherwise stated.

A Hot water system comprising of electric geysers of adequate capacity to cater for hot water requirement in toilets, kitchens & pantries if any for domestic purpose. Hot water requirement in kitchen and pantry is for dish wash only. The geysers capacity shall be mentioned as under area wise:-

S. No.	Description	Capacity of the Geyser	No. of Geyser
1	Flat-I/II/IV/V/VI	15 LTS	1 No in each toilet
2	Flat-I/II/IV/V/VI	5 LTS	1 No in each Kitchen
3	Hostel room with Single accommodation	25 LTS	4 Nos. in each common toilets
4	Hostel block Type B	15 LTS	1 No in each toilet
5	Mess	25 LTS	4 Nos. in each mess
Note:- Mess Geyser quantity shall be increased as per the kitchen vendor.			

Sewage and Sullage collection system based on BIS: 1742 standards for domestic drainage.

Storm / Rain water drainage system from various levels of the building and disposal to external storm water disposal drain lines.

The treated effluent shall be used for flushing water requirement and for gardening / irrigation purpose.

Water Storage and Distribution

System **Water**

Requirement

The estimated requirement of water demand per day for the developments shall be based on the number of users.

Source of Water

The daily domestic and flushing water requirement for the project shall be met through roof top tanks.

Water Quality

Domestic Water Requirement: The domestic water required for the project will be from the external source of water supply.

Recycled Water from STP: Water recovered from sewage treatment plant shall be used for flushing water supply and it shall be drawn from roof top tanks.

Water Distribution

The water distribution for hot and cold water supply for the developments shall be designed to ensure availability of adequate residual head at user outlets. Provision of pressure reducing station and non-return valve shall be made for effective and efficient water distribution in the designated areas. Design should be such that the hot and cold water pressure and flow shall be fairly equal to avoid reversal of flow from one service to another.

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 backflow prevention.
- (c) Automatic air vent at each of the high points.
- (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) Water meters for all towers will be installed by the Contractor and these water meters will be connected to SCADA installed in the pump house by the Contractor.
- (h) Water Sprinklers shall be provided by the Contractor for Garbage Chute cleaning and drainage.

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 syphonage pipe vertical vent shall also be made for hygiene, safety consideration and to avoid foul smell entering through traps in WC and Urinals.

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) Provision of adequate slope for horizontal header pipes for achieving self-cleaning velocity in the pipes.
- (d) Provision of cleanout plugs and Rodding eyes.

(e) Minimum diameter of Soil and Waste pipe as 100

mm. 5A412.5 Workmanship

5A412.5.1.1 The workmanship shall be best of its kind, shall conform to the specifications, as below or Bureau of Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Engineer. All materials and/or Workmanship, which in the opinion of the Engineer is defective or unsuitable, shall be removed immediately from the site and to be substituted with proper materials and/or workmanship forthwith.

5A412.6 Materials

5A412.6.1.1 All materials shall be best of their kind and shall conform to the latest Bureau of Indian Standards.

5A412.6.1.2 All materials shall be of approved quality as per technical submittals, samples and origins approved by the Engineer.

5A412.6.1.3 As and when required by the Engineer, the Contractor 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 is found defective or unsound by the Engineer, the Contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Engineer. To prove that the materials used are as specified the Contractor shall furnish to Engineer with original vouchers on demand.

5A413 Sanitary Fixtures and Chromium Plated Fittings

5A413.1

5A413.1.1 Fitti

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Scope

5A413.1.1.1 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 e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.
- (e) Hand driers etc.
- (f) Towel racks
- (g) Other accessories

5A413.1.1.2 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 functional and complete facility and meeting all Employer's requirements. provide a fully

5A413.1.1.3 All exposed pipes within toilets and near appliances/fixtures shall be of chromium plated brass unless otherwise specified.

5A413.2 General Requirement

5A413.2.1 Sanitary appliances and fixtures for toilets shall be 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. The selection of all the sanitary fixtures shall be covered in the architectural specification.

- 5A413.2.2 All appliances, fixtures and fittings shall be provided with all such accessories are required to ensure that all accessories, equipment and amenities, 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.
- 5A413.2.3 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.
- 5A413.2.4 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.
- 5A413.2.5 Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.
- 5A413.2.6 Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.
- 5A413.2.7 All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to height 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.
- 5A413.2.8 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.
- 5A413.2.9 All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.
- 5A413.2.10 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.
- 5A413.2.11 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) The appliances shall be placed in correct position or marked out in order that pipe work can 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) The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust-proofed fixings shall be used. Fixing shall 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) Pipe connections shall be made with permanent unions. Pipe work shall not be

fixed in a 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 vary 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 Contractor shall fix all plumbing fittings such as water faucets, shower fittings, mixing valves 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, 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.

5A413.3 Water Closet

5A413.3.1 Water Closet shall be wash down or symphonic wash down type floor or wall mounted set, as approved by Engineer, designed for low volume dual flushing from 3-6 litres of water, flushed by means of a flushing cistern or an exposed or concealed 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.

5A413.3.2 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.

5A413.3.3 Each WC shall be provided with 110 mm dia. (OD) PVC Pan Connector connecting the ceramic outlet of WC to CI pipe.

5A413.3.4 Orissa W.C

- (a) Orissa W.C shall be in glazed vitreous chinaware 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 CI pipe.

5A413.3.5 Anglo Indian W.C

- (a) Anglo Indian W.C shall be in glazed vitreous chinaware white or colour 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 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 CI pipe.

5A413.3.6

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 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.

5A413.3.7

Urinal Partitions

- (a) Urinal partitions shall be white glazed vitreous china.
- (b) Porcelain partitions shall be fixed at proper heights with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer.

5A413.3.8

Cisterns

- (c) 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.

5A413.3.9

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 cold water mixing fitting in wash basins shall be provided as required.

5A413.3.10

Kitchen Sinks

- (a) Kitchen Sinks shall be stainless steel .

5A413.3.11

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 40 mm 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 colour as approved by the Engineer.

- (a) 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.

5A413.3.12

Shower Set

Shower set shall comprise of two CP brass concealed stop cocks, four/five way auto-diverter, adjustable type over-head shower with CP shower arm, all the CP wall flanges of approved quality. Bath spout , hand showers and pop up 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.

5A413.3.13

Flow Control Device

Approved / rated flow control fitment in brass body, chrome outer cover, rated for flow / discharge of the fixture.

5A413.3.14

Toilet Paper Holder

- (a) Toilet paper holder shall be white glazed vitreous china or chrome plated.
- (b) Porcelain toilet paper holder shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.
- (c) The latter (chrome) shall be fixed by means of screws/capping having finish similar to the toilet paper holder in wall/temper partitions with rawl plugs or nylonsleeves.
- (d) Towel Rail
- (e) Towel rail shall be chromium plated brass or of stainless steel or powder coated brass.
- (f) 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.

5A413.3.15

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.

5A413.3.16

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.

5A413.3.17

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.

5A413.3.18

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 fitting or dismantling of the fixtures.

5A413.3.19

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 plated or 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.

5A413.3.20

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 unions and 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. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

5A413.3.21

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.

5A413.3.22

Electrical Geyser

- (a) Electrical Geyser shall be of Polymer Protective coating for inner container of corrosion resistance material. The container shall withstand the capacity of 8 kg/cm² Pressure. The geyser shall be vertical / horizontal installation as per the site requirement and space availability. Geyser shall be with complete thermostat, Temperature controller etc.
- (b) The geyser shall be with copper container with multi-function safety valve for high pressure operation without additional pressure reducing valve, glass wool insulation, stove enamelled M.S jacket, thermostatically controlled inner heater with pilot neon lamps, angle valve on inlet connection, 15 mm dia. C.P flexible connection pipe in inlet and outlet complete as required.
- (c) The tank consists of an inner rod which has stainless steel core that shall be

to fight these elements and thus prolong the life of the geyser.

	designed to protect the tank from corrosive elements. The anode rod uses a special cathodic action
	(d) If the water temperature exceeds the highest preset level, the thermal cutout cuts off the power supply to assure safety.
	(e) The safety valve shall be designed to automatically relieve and discharge water, in case the pressure overshoots the preset limits. The geyser shall be BEE 5-star rated.
5A413.3.23	Testing and acceptance
	(a) All appliances, fixtures and fittings shall be tested before 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) Each fixture shall be inspected for scratches or chippings and alignment before acceptance.
	(c) All tests shall be conducted at each and every fixture which shall be at the lowest and highest test connections to be made on each riser/down take. The Contractor shall make the temporary valve connections which shall be plugged with a brass plug after validation.
5A414	WATER SUPPLY (COLD AND HOT)
5A414.1	Scope
5A414.1.1	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 Water Supply
5A414.1.2	The Contractor shall make all necessary application and arrangements for their work to be inspected as required by the Local Authorities.
5A414.1.3	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.
5A414.1.4	Hot water supply shall be made available in kitchen through the nearest bathroom geyser and sink mixer shall be provided
5A414.2	Piping Materials
5A414.2.1	Piping system shall consist of the following:
5A414.2.2	Heavy class Galvanized Iron pipes and fittings conforming to BIS: 1239. In the underground, plantroom and basement.
5A414.2.3	CPVC SDR 11.0 piping from 15 mm to 25/32/40 mm dia in chase/ceiling and Schedule 40 from 65 mm to 150 mm for water supply shaft.
5A414.3	CPVC Pipes and Fittings
5A414.3.1	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 adapters conforming to IS: 12846 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.

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/Cm ²)			
(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 23°C PSI	Max. work Pre. At 23°C (kg/cm ²)
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

CPVC PIPE DETAILS

The outside diameters and wall thickness for CPVC schedule 40 shall be as per ASTM F441- Joining Pipes and Fittings.

5A414.3.2 Cutting:

5A414.3.2.1 Pipes shall be cut either by hand using pipe cutting or hacksaw blade and care

shall be taken to make a square cut which provides optimal bonding area within a joint.

5A414.3.3 Deburring / Beveling:

5A414.3.3.1 Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.

5A414.3.4 Fitting preparation:

5A414.3.4.1 Clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

5A414.3.5 Solvent Cement Application:

5A414.3.5.1 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 a thin coat inside the fitting socket, otherwise too much of cement solvent can cause clogged water ways.

5A414.3.6 Assembly:

5A414.3.6.1 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 set up.

5A414.3.6.2 An even bead of cement should be evident around the joint and if this bead is not continues remake the joint to avoid potential leaks.

5A414.3.7 Set and Cure times:

5A414.3.7.1 Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table. 5A414.3.7.2 Minimum Cure prior to pressure testing at 150 PSI

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.

SOLVENT CEMENT CURE TIME

5A414.3.7.3 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.

5A414.3.8 Testing

5A414.3.8.1 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.

5A414.3.9 Transition of CPVC to Metals

5A414.3.9.1 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 torqued Hard tight puts one half turn should be adequate.

5A414.3.10 Threaded Sealants

Teflon tape shall be used to make threaded connections leak proof.

5A414.3.11 Solvent Cement

Only CPVC solvent cement conforming to ASTM F 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 within 30 days after opening the company's seal and tightly close the seal after using in order solvent should be used

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:

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

NO OF JOINTS FROM CEMENT

5A414.3.12 Hangers and supports

- (a) 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.
- (b) Hangers should not have rough or sharp edges which come in contact with the tubing. Supports should be as per the below mentioned table:

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(in feet)				
Nom. Pipe Size		Temperature °C		
(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

HANGER SUPPORT DISTANCE

5A414.4 Galvanised Iron Pipes and Fittings

5A414.4.1 The pipes shall be galvanized mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of BIS: 1239.

5A414.4.2 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.

5A414.4.3 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 BIS554. Each tube shall be supplied with one socket.

5A414.4.4 Length: The tubes shall be supplied in random lengths of 3 to 6 m.

- 5A414.4.5 Galvanizing: When tubes are required to be galvanized, the Zinc coating shall conform to BIS 4736. (Hot dip zinc coatings on steel tubes).
- 5A414.4.6 Manufacturing Process: Tubes are made from tested quality of steel manufactured by any approved process Electric Resistance Welded (ERW),
- 5A414.4.7 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.
- 5A414.4.8 The fittings shall be malleable iron and comply with all the requirements of the pipes.
- 5A414.4.9 Hydraulic test: Each pipe shall be hydraulically tested at manufacturer's work to withstand a test Pressure of 5 Mpa.
- 5A414.4.10 Marking: The different classes of pipes shall have 75 mm color bands when arrived on site.
- 5A414.4.11 The following color bands shall be provided.
- | | | |
|--------|-------|--------|
| Light | ----- | Yellow |
| Medium | ----- | Blue |
| Heavy | ----- | Red |
- 5A414.4.12 The fittings shall be malleable iron screwed fittings and shall conform to BIS: 1879.
- 5A414.4.13 The fittings are classified as Light, Medium and Heavy. The sizes of pipes and fitting are specified in the drawings.
- 5A414.4.14 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)
- 5A414.4.15 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.

N.B. of pipe mm	Working Pressure					
	Light		Medium		Heavy	
	lbs/sq.in	Kg.cm ²	lbs/sq.in	Kg.cm ²	Lbs/sq.in	Kg.cm ²
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

PERMISSIBLE WORKING PRESSURE OF M S TUBE

Pipe Flanges

Pipe Flanges shall conform to British Standards 10 (Specification for flanges and bolting for pipes, valves and fittings). Following table gives specification of Pipe Flanges and Sleeves.

S. No	M S Sleeve			M. S. Flange		Boltin g			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

S. No	M S Sleeve			M. S. Flange		Boltin g			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
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

M S PIPE SLEEVE AND FLANGE DETAILS

5A414.5 Laying and Jointing of GI Pipes

5A414.5.1 The galvanized pipes and fittings shall run in underground 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 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. Cost shall be inclusive of excavation, dewatering, backfilling, ramming and providing thrust block at each bend or at 45m distance. (Pipe shall be provided with anticorrosive protective treatment confirming to AWWA C 203 / IS 10221 standard complete as per specification) 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.

5A414.5.2 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 the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. make shall be used, according to

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. .

5A414.5.3 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.

5A414.5.4 The Joints shall be a) Plain or bevelled ends for field butt welding and b) Joints with sleeve joints or swelled and plain ends for welding.

5A414.6 Piping Installation Support (Valid for GI Piping Only)

5A414.6.1 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.

5A414.6.2 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.

5A414.6.3 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.

5A414.6.4 Pipe hangers shall be provided at the following maximum spacing:

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

PIPE HANGERS SUPPORT DISTANCE

5A414.6.5 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.

5A414.6.6 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.

5A414.6.7 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.

- 5A414.6.8 The Contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.
- 5A414.6.9 All pipes shall be accurately cut by 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 reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.
- 5A414.6.10 All buried pipes for cold water supply shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating.
- 5A414.6.11 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.
- 5A414.6.12 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.
- 5A414.6.13 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.
- 5A414.6.14 Air release valve shall be installed as required and shall be reflected in the shop drawing.
- 5A414.6.15 Table for Commonly Adopted Size of Air Valves

Size of Main mm	Type of Valve	Size of Air Valve mm
80	Single air valve	20
100	Double air valve	40

AIR RELEASE VALVE SIZE

- 5A414.6.16 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.
- 5A414.6.17 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.
- 5A414.6.18 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.
- (a) Swing Check-Type Valves (Cast Iron):
- (b) (Non-return valves) Single Door Pattern (BIS: 5312 (Part I))
- 5A414.6.19 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.

- 5A414.6.20 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.
- 5A414.6.21 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 20 kg/cm² for body and 17.5 kg/cm² for seat.
- 5A414.6.22 Pressure Relief Valves:
- Pipe lines shall be provided to withstand the maximum pressure likely to develop in it under 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.
- 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.
- 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 (10.54 kg/cm²).
- These shall be with screwed or flanged ends. Screwed valves are threaded male at inlet and female at outlet. Valves for flanged construction are as per BS-10, table H.
- 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 upright position.
- 5A414.6.23 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.
- 5A414.7 Piping Arrangements (Layout)
- 5A414.7.1 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.
- 5A414.7.2 All piping equipment requiring regular attention of the operating and maintenance personnel should be readily accessible.

- 5A414.8 Water Meters
- 5A414.8.1 Water meters of approved make and design shall be supplied for installation at water supply entry of each tower and municipal inlet. 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.
- 5A414.8.2 The meters shall conform to Indian Standard BIS: 779 and BIS: 2373. Calibration certificate shall be obtained and submitted for each water meter.
- 5A414.8.3 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.
- 5A414.8.4 Installation of Water Meter and Stop Cock
- 5A414.8.4.1 The G.I. 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.
- 5A414.9 Testing
- 5A414.9.1 The Contractor shall notify the three days in advance of any test so that the Engineer can witness the tests if he so wishes.
- 5A414.9.2 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.
- 5A414.9.3 The system may be tested in sections and such sections and shall be entirely retested as a system on completion.
- 5A414.9.4 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.
- 5A414.9.5 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.
- 5A414.9.6 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.

- 5A414.9.7 A test register shall be maintained and all entries shall be signed and dated by the Contractor and Engineer.
- 5A414.10 Disinfection of Piping System
- 5A414.10.1 Before commissioning the water supply system, the Contractor shall arrange to disinfect the entire system as described below.
- 5A414.10.2 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.
- 5A414.10.3 If ordinary bleaching powder is used, the proportions will be 150 gm of power to 1000 liters 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.
- 5A414.10.4 The pipe work shall be thoroughly flushed before supply is restored.
- 5A414.11 Sterilization of Main
- 5A414.11.1 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.
- 5A414.12 Cutting Chases in Masonry Walls
- 5A414.12.1 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.
- 5A414.12.2 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 chiselling 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.
- 5A414.12.3 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.
- 5A414.13 Valves
- 5A414.13.1 All valves (gate, globe, check, safety) shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. 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.
- 5A414.13.2 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.

- 5A414.13.3 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 to 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 elastomer or nitrile rubber. 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.
 - (d) 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.
- 5A414.13.4 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.
- 5A414.13.5 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.
- 5A414.13.6 Non-return valve
- (a) Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to BIS: 5312.
- 5A414.13.7 Pressure Reducing Valve Set
- (a) Each pressure reducing valve set shall be complete with pressure reducing or pressure regulating valve including stand by, isolating valves, pressure gauges (fix with symphonic check) on inlet 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 on each inlet to a pressure reducing valve shall be of replaceable porous sintered metal type.
- 5A414.13.8 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.
- 5A414.13.9 Pressure Gauge
- (a) The pressure gauge shall be constructed of die cast aluminium and stove enamelled. 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 0 to 16 kg / 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.
- 5A414.14 Water Fittings
- 5A414.14.1 Unless otherwise specified all Gunmetal fittings such as gate, globe, check and safety valves shall be fitted in pipe line in workman 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
- 5A414.15 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 150 g/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) Acrolin
 - (g) Acrylonitrile
 - (h) Antimony
 - (i) Benzene
 - (j) Butyl benzyl phthalate
 - (k) Cadmium

- (l) Di (2-ethylhexyl) phthalate
 - (m) Di-n-butyl phthalate
 - (n) Di-n-octyl phthalate
 - (o) 1,2-dichlorobenzene
 - (p) Diethyl phthalate
 - (q) Dimethyl phthalate
 - (r) Ethyl
- 5A414.15.1 benzene Painting:
- (a) Water supply pipes in exposed, in shafts shall be painted with two or more coats of ready mix Low-VOC oil paint to give an even shade before painting all dust and extraneous 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 colour 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 extraneous matter.
 - (d) Water supply pipes below ground and covered in cement concrete shall not be painted.
- 5A414.16 Pipe Protection (for Cold 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 pypcoat / coatek insulation for protection of pipe would also be acceptable as per final approval of Engineer.
- 5A414.17 Thrust Blocks
- (a) 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.
- 5A414.18 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.

5A415	Internal Drainage (Soil, Waste, Vent And Rainwater Pipes)
5A415.1	Scope
5A415.1.1	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.
5A415.1.2	Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required.
5A415.2	Basic Piping System
5A415.2.1	Soil, waste and vent pipes in shafts and in concealed areas i.e. false ceilings etc. shall consist of cast iron pipes and fittings as called for. In general wastes and vents up to 50 mm dia. or smaller shall be of heavy class GI.
5A415.2.2	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.
5A415.2.3	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. Joints throughout shall be made with molten lead as described under jointing of cast iron pipes. Soil pipes shall be painted as provided under 'painting'. The soil pipes shall be covered on top with cast iron terminal outlets as directed and approved. 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 cast iron or galvanized mild steel pipes. Pipes shall be fixed, jointed and painted as described in installation of soil, waste and vent pipes.
5A415.2.4	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 cast iron or galvanized mild steel pipes, conforming to the requirements laid down earlier. Anti-syphon vent pipes/relief vent pipes where called for on the drawings shall be of cast iron or galvanized mild steel pipes as specified. The pipes shall be of the diameter shown on the drawings.
5A415.2.5	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.
5A415.2.6	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.
5A415.2.7	All the fittings used for connections between soil, waste and ventilation pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. The doors shall be provided with 3mm thick rubber insertion packing and when closed and bolted shall be air and water tight.

- 5A415.2.8 Where soil, waste and ventilating pipes are accommodated in shafts ducts, adequate access to cleaning eyes shall be provided
- 5A415.2.9 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.
- 5A415.3 Piping
- Materials Cast
- Iron Pipes
- Cast iron pipes and fittings shall be of good and tough quality and dark grey on fracture. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and nicely cast, shall be free from cracks, taps, pinholes and other manufacturing defects.
- The pipes and fittings shall conform to BIS: 3989 as called for. Fittings shall be of required degree with or without access door. All access doors shall be made up with 3mm thick insertion rubber gasket of white lead and tightly bolted to make the fittings air and water tight. The fittings shall be of the same manufacture as the pipes used for soil and waste.
- All CI pipes and fittings shall bear the manufacturer's name and ISI specification to which it conforms.
- All pipes and fittings shall be coated internally and externally with the same material at the factory, the fittings being preheated prior to total immersion in a bath containing a uniformly heated composition having a tar/other suitable base. The coating material shall have good adherence and shall not scale off. The coating shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree C but not so brittle at a temperature of '0' degree C as to chip off when scratched lightly with a pen knife.
- All pipes and fittings before installation at site shall be tested hydrostatically to a pressure of 0.45 kg/sq.cm without showing any sign of leakage, sweating or other defects of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 minutes. All these tests shall be carried out in the presence of the representative of the Engineer. Alternatively a test certificate from manufacturers be obtained before dispatch of material to site.
- Cast Iron Specialties
- Required, Cast iron specialty items such as drip seal floor traps, urinal traps, trap integral pieces with integral inlet/outlet connections, manhole cover with frame, chamber cover etc. shall be fabricated to suit individual location requirements. The Contractor shall arrange the fabrication of these items from an approved source.
- 5A415.4 Pipe Joint Sealant:
- Pipe joint sealant shall be used for joining various diameters of C.I. pipes and specials. This sealant replaces the standard lead caulked joints. The application is by homogenously mixing the two pack system in cold condition.
- 5A415.5 Application Procedure:
- Clean the pipe joints thoroughly to ensure it is free from any traces of oil, dirt or any other foreign body. Mix two parts of Drip Seal thoroughly with an iron flat to get a homogenous compound. * Place Spun yarn in the pipe joint as a filler and then take the required quantity of the compound and push it in the joint with a caulking tool, MS flat / damp finger uniformly all over to obtain a smooth and uniform joint. Dip the fingers in water every often to ensure the compound does not stick to the hands of the workmen, but this will ensure perfect sealing and the smooth surface for the joint cement. (* The compound prepared from the two mixtures is to be used within 30 minutes) Precaution to be taken to wash hands thoroughly with soap before and after use. Preferably use disposable gloves for application.

5A415.6 Galvanised Iron Pipes

Waste pipes of 50 mm dia. and below and where called for shall be galvanised iron pipes screwed and socketed conforming to the requirements of BIS: 1239 of heavy grade. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws, laminations and other defects. All screw thread shall be clean and well cut. All pipes and fittings shall bear manufacturer's trade mark and conform to the BIS as specified.

5A415.7 UPVC Pipes and Fittings for vertical rain water pipes

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.

Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to BIS: 14735.

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.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal and 'O' rubber gaskets 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.

Supports

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC 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 their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

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.

5A415.8 Cast Iron Class (LA) pipes for soil, waste & RWP (Connection from building to manhole and basement ceiling)

All drainage passing under building floor and passing through retaining wall shall be cast iron class (LA) pipes (BIS : 1536)

Cast iron class (LA) pipe shall be such that they could be cut, drilled or machined. Pipe centrifugally cast in unlined water cooled moulds shall be heat treated in order to achieve the necessary mechanical properties and to relieve casing stress; provided that the specified mechanical properties are satisfied.

Material

Cast iron pipe shall be centrifugally spun cast iron pipe and conforming to BIS: 1536-1976 Fittings

Fittings shall be used for cast iron class (LA pipes shall conform to BIS: 1538-1976). Whenever possible junction from branch pipe shall be made by wyes.

All cast iron water main pipes and fittings shall be manufactured to BIS: 1536 of tested quality. The pipes and fittings shall either be spigot or socket type or as called for. The pipes and fittings shall be of uniform material throughout and shall be free from all manufacturing defects.

Joints

Cast iron class (LA) pipe used for soil and waste pipes shall be jointed with sealant joints sufficient skein of jute rope shall be caulked to leave minimum space of 25 mm for the Sealant. Pipe to pipe tyton joints and pipe to fittings spun yann and drip seal.

Laying

Fittings used for CI drainage pipe shall conform to BIS: 1538-1976. Wherever possible junction from branch pipes shall be made by a Y/tee.

Drip Seal Joints:

Pipe joint sealant shall be used for joining various diameters of C.I. pipes and specials. This sealant replaces the standard lead caulked joints. The application is by homogenously mixing the two pack system in cold condition.

Application Procedure:

Clean the pipe joints thoroughly to ensure it is free from any traces of oil, dirt or any other foreign body. Mix two parts of sealant thoroughly with an iron flat to get a homogenous compound. * Place Spun yarn in the pipe joint as a filler and then take the required quantity of the compound and push it in the joint with a caulking tool, MS flat / damp finger uniformly all over to obtain a smooth and uniform joint. Dip the fingers in water every often to ensure the compound does not stick to the hands of the workmen, but this will ensure perfect sealing and the smooth surface for the joint cement. (* The compound prepared from the two mixtures is to be used within 30 minutes) Precaution to be taken to wash hands thoroughly with soap before and after use. Preferably use disposable gloves for hand application.

The spigot of pipe of fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gasket shall be given to leave a depth of 45 mm when the gasket has been caulked tightly home. Joining ring shall be placed round the barrel and against the face of the socket. CI solvent shall then be pushed to the remainder of the socket.

Laying and Jointing System of Cast Iron Pipes:

Conforming to BIS 3114/1985 (Code of Practice for laying of Cast Iron

Pipes) 5A415.9 Excavation and Preparation of Trenches

General: The trench shall be so dug that the pipe may be laid to the required alignment and at a required depth. When the pipeline is under roadway, a minimum cover of 1.0 m is recommended for adoption but it may be modified to suit local conditions.

Width of Trench: The width of trench at the bottom shall be such as to provide not less than 20 cm clearance on the either side of pipe.

Additional width shall be provided at positions of sockets and flanges for jointing to be made properly. Depth of pits at such places shall also be sufficient to permit finishing of joints.

Boulders and large stones shall be removed to provide a clearance of at least 15 cm below and on each side of pipe, valves and fittings for pipes upto 600 mm in dia.

Trimming of Trench Bottom: Before laying the pipe, bottom of pipe trench shall be properly trimmed off to present a plain surface and all irregularities shall be levelled. Where rock or boulders are encountered, the trench shall be trimmed to a depth of at least 8 cms. Below the level at which the bottom of barrel of the pipe is to be laid, and filled to a like depth with stones broken to pass through a sieve of 12.5 mm aperture size and well rammed to form a fair and clean bed for pipes.

Laying of Pipes

- a. Unloading of Pipes: While unloading, pipes shall not be thrown down from the trucks on hard roads. In order to avoid damage to the pipes and especially to the spigot ends, pipes should not be dragged along concrete and similar pavements with hard surfaces.
- b. Lowering of Pipes and Fittings: All pipes, fittings, valves shall be carefully lowered into trench, piece by piece by means of a derrick, or ropes or other suitable tools or equipment so as to prevent damage to pipes, fittings, protective coatings and linings. Pipes over 300 mm dia. shall be handled and lowered into trenches with the help of chain pulley blocks.
- c. Detection of Cracks in Pipes: Any negligence during unloading and handling of pipes results in damage to the pipes and development of hair cracks, which if during hydraulic testing causing havoc particularly in severe in habituated area of hilly regions with population on valley side.
- d. The pipes, therefore, shall be inspected for defects, by ringing with a light hammer preferably while suspended to detect cracks. If doubt persists further confirmation may be obtained by passing a little kerosene which seeps through and shown on the outer surface. Any pipe found the unsuitable after inspection before lying shall be rejected.
- e. Cleaning of Pipes and Fittings: The outside of the spigot and inside of the socket shall be wire brushed and wiped clean and dry and free from oil and greese before pipe is laid.
- f. Laying Pipe: Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operation, no debris, tools, clothing or other materials shall be placed in the pipe.
- g. After placing a length of pipe in the trench, the spigot shall be centered in the socket and the pipe forced home and aligned to the gradients.
- h. At times when pipe laying is not in progress, the open ends of the pipes shall be closed by water tight plugs.
- i. Cutting of Pipes: The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workman like manner, so as to leave a smooth and a right angle to the axis of the pipe. For this purpose use of pipe cutting method may be permitted using a carbon or steel rod. Flame cutting by means of an oxyacetylene torch shall not be followed.
- j. Direction of Laying of Socket End: On level ground, the socket ends should face upstream. When the line runs uphill, the socket ends should face the upgrade.

- k. Permissible Deflection in Joints: The deflection allowed at joints shall not exceed 2.50 for lead joints and incase of rubber joints for 80-300 mm dia. 50 and 450 mm to 750 mm dia. 40.
- l. Usage of Anchor and Thrust Blocks in Pipeline: Thrust blocks suitably designed shall be provided wherever necessary to transmit hydraulic pressure. Where hydraulic thrust is in an upward direction, anchor blocks of sufficient height shall be provided to which the pipes shall be secured with steel straps.

Jointing System:

- m. Following are the type of joints employed in cast iron pipes.
- n. Spigot and Socket Joints
- o. Indian Standard 3114, Code of Practice for Laying of Cast Iron Pipes provided the following types of joints:
- p. Molten lead (under dry conditions).
- q. Cement Joints.
- r. Lead Wool (under wet conditions).
- s. Tyton joints.
- t. Push-tite joints.

5A415.10

Pipes Hangers, Supports and 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 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 rest on them.

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.

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.

Clamps shall be of approved design and fabricated from MS flats (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.

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.

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.

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.

5A415.11 Installation of Soil, Waste and Vent Pipes (This is GI pipe for FD,WB,UT & etc drainage)

Soil, waste and vent pipes 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 GI pipes and fittings.

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 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.

All cast iron pipes and fittings shall be jointed with drip seal free from impurities confirming to BIS: 27.

Before jointing, the interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of threaded spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment. The remainder of the socket is left for the lead caulking. Where the gasket has been tightly held, a jointing ring shall be placed round the barrel against the face of the socket. Molten Lead shall be poured to the remainder of the socket.

The joint shall not be covered till the pipe line has been tested under pressure. Rest of pipe line shall be covered so as to prevent the expansion and contraction due to variation in temperature.

5A415.12 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.

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.

Traps

Floor Traps

- a. Floor traps where specified shall be siphon type full before P or S type cast iron 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).
- b. 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.

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 CI inlet socket shall be drip connected to a CI "P" trap. Floor trap inlet and the traps shall be set in cement concrete blocks seal/Lead Caulked. Inlet shall be 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.

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

Cleanout Plugs

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 drain pipes.

Cleanout on Drainage Pipes

Cleanout plugs shall be provided on head of each drain and in between at locations indicated on plans or directed by Engineer. Cleanout plugs shall be of size matching the full bore of the pipe but no exceeding 150 mm dia. CO plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

Floor cleanout plugs shall be cast brass.

Cleanouts provided at ceiling level pipe shall be fixed to a CI 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.

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 prevent any foreign matter.

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 his/her 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 (1 cement: 2 coarse sand: 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.

Drainage Pipe Painting

Used paint and coatings that comply with the following limits for VOC content and the following chemical restrictions:

- Non-Flat Paints and Coatings: VOC not more than 150 g/L.
- Anti-Corrosive Coatings VOC not more than 250 g/L
- 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).
- Paints and coatings shall not contain any of the following:
 - Acrolin
 - Acrylonitrile
 - Antimony
 - Benzene
 - Butyl benzyl phthalate
 - Cadmium
 - Di (2-ethylhexyl) phthalate
 - Di-n-butyl phthalate
 - Di-n-octyl phthalate
 - 1,2-dichlorobenzene
 - Diethyl phthalate
 - Dimethyl phthalate
 - Ethyl benzene
- Soil, waste, vent and rain water drainage pipes in exposed location, in shafts shall be painted with two or more coats of ready mix Low-VOC oil paint to give an even shade. Before painting all dust and extraneous matter shall be removed.
- Paint shall be of approved quality and shade. The pipes shall be painted in accordance with approved pipe colour code.

- 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 extraneous matter.
- C.I. Soil and waste pipes below ground and covered in cement concrete shall not be painted.

5A415.13

Testing

Testing of drainage pipes shall be done in accordance with BIS: 1172 and BIS: 5329 except as may be modified herein under.

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,

All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

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.

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.

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.

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.

A test register shall be maintained and all entries shall be signed and dated by the Contractor and the Engineer.

All drainage pipes in wall chase or meant to be encased or buried shall be hydro tested before the chase is plastered or the pipe encased or buried.

5A415.14

Piping Material

Testing shall be done in accordance with BIS: 1172 and BIS: 5329 except as may be modified herein under.

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,

All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

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.

5A416 **EXTERNAL SEWAGE AND STORM WATER DRAINAGE:**

5A416.1 **SCOPE**

The scope of this section comprises the supply, installation, testing and commissioning of external drainage & sewage disposal services.

5A416.2 **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 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.

5A416.3 **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 materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

5A416.4 **Piping Material**

UPVC IS 15328 (SN 8) /Eco Flow Pipes and Fittings

UPVC Eco flow pipes IS 15328 (SN 8) shall be used for External sewage system.

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 external diameter. Eco Flow pipes shall be used for the load bearing areas.

5A416.5 Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

5A416.6 Laying in Trenches

UPVC 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 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 pipeline.

5A416.7 PIPING MATERIAL

RCC pipes (For storm water drain)

All pipes shall be centrifugally spun RCC pipes NP2. 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, prior to use on site, a certificate to that effect from the manufacturer.

The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to IS:458-1971.

All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Laying

RCC spun pipes shall be laid on cement concrete bed of cradles as specified and shown on the detailed drawings. 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 and 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 boning rods, etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.

Jointing

Semi flexible type collar joint.

Hemp rope soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added and rammed home. Cement mortar with one part of cement and two part of sand and with minimum water content but on no account soft or sloppy, shall be carefully inserted, punched and caulked into the collar and more cement mortar added until the space of the collar has been filled completely with tightly caulked mortar. Provision of rubber sealing ring in the collar joint shall also be made. The joint shall then be finished off neatly outside the socket at an angle of 45 deg.

Curing:

The joint shall be cured for at least seven days. Refilling at joints will be permitted only on satisfactory completion of curing period.

Cement Concrete for Pipe Supports:

- a. Unless otherwise directed by the Project Manager cement concrete for bed, all round or in haunches shall be as follows:

	upto 1.5 m depth	upto 3 m depth	beyond 3 m depth
RCC or SW in sub soil water	All round (1:3:6)	In Haunches (1:3:6)	In Haunches (1:3:6)
PVC / HDPE pipe	All round (1:2:4)	In Haunches (1:3:6)	In Haunches (1:3:6)
CI Pipes (in all conditions)	All round (1:4:8)	In Haunches (1:4:8)	In Haunches (1:4:8)
All pipes under building	All round (1:2:4)	All round (1:2:4)	All round (1:2:4)

- b. Pipes may be supported on brick masonry or precast RCC or in situ cradles. Cradles shall be as shown on the drawings.
- c. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

5A416.8 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).

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 65cm square and not less than 10cm 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.

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.

5A416.9 Construction of Manhole

Where manholes are to be constructed, the excavation, filling back and ramming, disposal of surplus 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 diameter 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 poly propylene coated steel reinforced footrest. The polypropylene shall confirm to ASTM D-4101 specification, injection moulded around 12 mm dia IS-1786 grade FE-415 steel reinforcing bar. These rungs shall be set at 30cms interval in two vertical runs at 380mm apart horizontally. The top rung shall be 450mm below the manhole cover. Unless otherwise mentioned, manholes shall 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 lodgement 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 and manhole size 560 mm dia Heavy Duty.

Manhole cover for sewer application is D.I cover size 560 mm dia Heavy duty.

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 depth greater than specified under the main item shall be paid for under 'Extra Depth' and shall with

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 as directed by Project Manager.
- viii. Curing.
- ix Cost of angle frame and embedding the frame in concrete
- bed. x Testing.
- xi De-watering of chambers.

5A416.10 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 nominal size) on top. The size of the chamber shall be taken as the clear internal dimension. The brick walls on the top of the bed concrete 1:4:8 (1 cement: 4 coarse sand: 8 hard stone ballast 40 mm and down gauge) of the chamber shall be plastered with 12mm thick cement plaster 1:3 (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.

5A416.11 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.

All brick masonry covered drains shall be provided with SFRC grating H.D and size is 600 mm 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.

5A416.12 Making Connections

General Contractor shall connect the new sewer line to the existing manhole by cutting the walls 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.

5A416.13 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 from manhole to manhole. All pipes shall be subject to a test pressure of 1.5-meter head of water. The test 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.

5A416.14 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.

5A417 SECTION-6:-WATER TREATMENT PLANT

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 inlet parameters for water are as follows:

S. No.	Characteristic	Tolerance
1	PH value	8.3
2	Total Dissolved Solids mg/l	300
3	Total hardness as CaCo3 mg/l	250
4	Total Alkalinity mg/l	250
5	Total Nitrates mg/l	5
6	Chloride (as Cl), mg/1, Max	20
7	Sulphates (as SO4), mg/1, Max	18
8	Calcium hardness as Ca mg/l	60
9	Magnesium hardness as Mg mg/l	40
10	Silica as Sio2 mg/l	ND
11	Iron as Fe mg/l	<0.01

The outlet parameters for water are as follows:

S. No.	Characteristic	Tolerance
1	PH value	7.5
2	Total Dissolved Solids mg/l	150-200
3	Total hardness as CaCo3 mg/l	80

Water required by various departments shall be further treated by their water treatment systems respectively as per their requirement. Contractor has to comply with IS 10500.

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 below or Schedule of Quantities.

5A417.1.2

CONCEPT OF THE SYSTEM

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 completefiltration.

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.

5A417.1.3 WATER STORAGE & DISTRIBUTION SYSTEM

5A417.1.4 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.

5A417.1.5 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. Provision of tanker water fill feasibility shall

also be made.

5A417.1.6 Water Storage

The total water storage in raw & domestic water tanks is approx. 2 days however 1.5 day is as underground, and .5 day is over head water tanks

5A417.1.7 Water Quality

Domestic Water Requirement: . The basic water treatment plant shall comprise of activated carbon finlet & dual media filter 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.

5A417.1.8 Appurtenant

Following components shall be included in the water treatment system for efficient functioning:

- i. Automatic air vent at each of the high point.
- ii. Drain valve at each of the low point.
- iii. Pressure Release valve where abnormally high pressure is to be reduced.
- iv. Flow meter.
- v. Pressure Gauge.
- vi Anchor block / thrust block.

5A417.1.9 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 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.

5A417.1.10 MATERIALS

All materials shall be best of their kind and shall conform to the latest Indian

All materials shall be of approved quality as per samples and origins approved by the Client's Standards. 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 by the Client's Site Representative / Consultant, the tenderer shall remove the defective material unsound 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 following details:

5A417.1.11 WATER TREATMENT SYSTEM & ACCESSORIES

Scope

This section of the contract involves the design, supply, installation, testing and commissioning of the complete Water Treatment plant for domestic water.

All installation work shall comply with the latest rules and regulations.

The work embraced by this 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) & IS 10500.
- 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 for domestic water, PH automatic control and monitoring system, electrical panels, cabling, etc.
- All the pipework between the raw water tanks, treated water tanks and all the interconnecting pipework amongst the Water Treatment pumps and other equipment.
- Electrical equipment and installation work including the necessary wiring etc. in Control panel.
- 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 breakdown 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.

5A417.1.12 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.

5A417.1.13 Filtration

5A417.1.14 Scope

The scope of this section comprises the supply, installation and commissioning of FRP vessel filter.

5A417.1.15 FRP Vessel Filter

The filter shall be constructed of FRP 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 provide 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.

5A417.1.16 Face Piping

Each filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash complete with valves.

5A417.1.17 Accessories

Each filter shall be provided with following accessories :-

- a. Air release valve with connecting piping.
- b. 100 mm dia dial bourden type gunmetal pressure gauges with brass isolation ball valve 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 fullway ball valve for each

filter. 5A417.1.18 Filter Media

The filter media shall comprise of gravel / silica 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.

5A417.1.19 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 tender.

5A417.1.20 UV UNIT

UV unit shall be complete with reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lampout 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.

5A417.1.21 WATER QUALITY

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.

The inlet parameters for water are as follows:

S.No.	Characteristi c	Toleranc e
i.	PH value	8.3
ii.	Total Dissolved Solids mg/l	300
iii.	Total hardness as CaCo3 mg/l	250

iv.	Total Alkalinity mg/l	250
v.	Total Nitrates mg/l	5
vi.	Chloride (as Cl), mg/1, Max	20
vii.	Sulphates (as SO ₄), mg/1, Max	18
viii.	Calcium hardness as Ca mg/l	60
ix.	Magnesium hardness as Mg mg/l	40
x.	Silica as SiO ₂ mg/l	ND
xi.	Iron as Fe mg/l	<0.01

5A417.1.22 FLOATLESS TYPE LEVEL SWITCH IN WATER TANKS

The Contractor shall supply and install floatless 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 centralised control cubicles inside pump room. The necessary length of control cable shall be included.

5A417.1.23 MOTORIZED BUTTERFLY VALVE WITH ACTUATOR

The butterfly valve shall consist of cast iron body preferably in two piece construction. The disc 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.

5A417.1.24 CONTROL OF DUTY / STANDBY PUMPS

Operation of the duty and standby pumps shall be carried out by the following method:

- a. Manually by means of a local start/stop push buttons on pump local motor control panel and emergency stop switch.
- b. 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.
- c. Automatic controls shall be operated by electronic, floatless type level

switches. 5A417.1.25 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.

5A424 ***Hand Held Fire Extinguishers***

5A424.1 Hand

5A424.1.1 Appliances

Scope

5A424.1.2 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.

5A424.1.3 Without restricting to the generality of the foregoing, the work shall consist of the following:

5A424.1.4 Installation of fully charged and tested fire extinguishing hand appliances of A B C powder type as required.

5A424.1.5 General Requirements

5A424.1.5.1 Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners.

5A424.1.5.2 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

5A424.1.5.3 All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

5A424.1.5.4 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 2016 recommend more than that the contractor shall provide the same without extra cost to employer. Each LV room shall be provided adequate number CO Fire Extinguisher.

5A424.1.6 ABC Type Dry Powder Extinguisher

5A424.1.6.1 The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer.

5A424.1.6.2 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%.

5A424.1.6.3 The distribution of fire extinguishers in to be as per BIS 2190.

5A424.1.6.4 It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15Kg/cm²

5A424.1.6.5 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, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

5A424.1.6.6 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 assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle 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 2 minutes.

5A424.2 Water Type Extinguisher (Gas Pressure Type)

5A424.2.1 The Extinguishing medium shall be primarily water stored under normal pressure, the discharge being affected by release of Carbon Dioxide Gas from a 120 gm cylinder.

5A424.2.2 The capacity of Extinguisher, when filled up to the indicated level, shall be 9 ltr +/- 5%.

5A424.2.3 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.

5A424.2.4 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 shall be of leaded tin bronze. The discharge hose shall be braided

nylon, of 10 mm dia. and 600 mmlong, with a nozzle of brass fitted at end.

5A424.2.5 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. The cartridge 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).

5A424.3 Carbon Dioxide Extinguisher

5A424.3.1 The Carbon Dioxide Extinguisher shall be as per BIS: 15683.

5A424.3.2 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.

5A424.3.3 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.

5A424.3.4 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.

5A424.3.5 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.

5A424.3.6 The extinguisher shall fulfill the following test pressures:

5A424.3.7 Cylinder: 236 Kg/cm²

5A424.3.8 Control Valve: 125 Kg/cm²

5A424.3.9 Burst Pressure of Hose: 140 Kg/cm² minimum

5A424.3.10 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.

5A424.3.11 The Extinguisher including components shall be BIS marked.

5A425 Drencher System

5A425.1 Electrically Operated Deluge System

5A425.1.1 Electrically operated Deluge System shall be supplied and installed.

5A425.1.2 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.

5A425.1.3 An electric solenoid valve shall be utilized to release the priming chamber water pressure. The solenoid valve shall be 24VDC.\

5A425.1.4 Deluge system shall be fitted with open window sprinklers or open nozzles and provided with a manual release. The automatic release shall be

operated by a fire detection system opening deluge valve.

- 5A425.1.5 Drencher/Water Curtain system Installation
- 5A425.1.6 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.
- 5A425.1.7 Drencher/Water curtain system shall be designed to provide a minimum flow of 43 lpm at 1.4 kg/cm² pressure to the farthest and hydraulically remotest nozzle.
- 5A425.1.8 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.
- 5A425.1.9 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 Engineer in Charge, 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.
- 5A425.1.10 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.
- 5A425.1.11 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.
- 5A425.1.12 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.
- 5A425.1.13 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.
- 5A425.1.14 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.

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- 5A426.5.4 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.
- 5A426.5.5 The pump casing shall be designed to withstand 1.5 times the working pressure.
- 5A426.5.6 Bearing of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.
- 5A426.5.7 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, aircooled, 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.
- 5A426.6 Engine Accessories - The engine shall be complete with the following accessories:-
- 5A426.6.1 Fly wheel dynamically balanced.
- 5A426.6.2 Direct coupling for pump and coupling
- 5A426.6.3 guard. Corrosion Resistor.
- 5A426.6.4 Air cleaner.
- 5A426.6.5 Fuel service tank support, and fuel oil filter with necessary pipe work.
- 5A426.6.6 Elect. starting battery (2X12 v).
- 5A426.6.7 Exhaust silencer with necessary pipe work.
- 5A426.6.8 Governor.
- 5A426.6.9 Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).
- 5A426.6.10 Necessary safety controls.
- 5A426.7 Fuel System—
- 5A426.7.1 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.
- 5A426.7.2 All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.
- 5A426.7.3 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.

- 5A426.7.4 As semi rotaryhand 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.
- 5A426.7.5 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.
- 5A426.7.6 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.
- 5A426.7.7 The capacity of the battery shall be suitable for meeting the needs of the starting system.
- 5A426.7.8 The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.
- 5A426.7.9 The scope shall cover all cabling, terminals, initial charging etc.
- 5A426.7.10 Operation Logic Fire Fighting Panel shall have operation in Auto/ Manual mode.
- 5A426.7.11 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 energise the Diesel Pump control module.
- 5A426.7.12 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.
- 5A426.7.13 In Manual Mode Starting and Stopping process shall be done through push buttons only. 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 energise Hooter with indication on annunciator. Fails to start fault shall be accepted by operator manually and reset by push button mounted on panel.
- 5A426.7.14 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
- 5A426.8 Exhaust System-
- 5A426.8.1 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.
- 5A426.8.2 Engine shut down mechanism- This shall be auto/ manually operated and shall return automatically to the starting position after use.
- 5A426.8.3 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.
- 5A426.8.4 Engine Instrumentation- Engine instrumentation shall include the following:-

- ii) Lub. oil temperature gauge.
 - iii) Water pressure gauge.
 - iv) Water temperature gauge.
 - v) Tachometer.
 - vi) Hour meter.
- 5A426.8.5 The instrumentation panel shall be suitably resident mounted on the engine.
- 5A426.8.6 Engine Protection Devices- Following engine protection and automatic shut down facilities shall be provided:-
- i) Low lub.oil pressure.
 - ii) High cooling water temp.
 - iii) High lub.oil temperature.
 - iv) Over speed shut down.
- 5A426.8.7 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.
- 5A426.8.8 Anti Vibration Mounting- Suitable vibration mounting duly approved by Project Manager shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.
- 5A426.8.9 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.
- 5A426.9 Interlocking
- 5A426.9.1 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.
- 5A426.9.2 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.
- 5A426.9.3 Note: The operation logic of Fire 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.
- 5A426.10 General
- 5A426.10.1 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.
- 5A426.10.2 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.

- 5A426.10.3 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.
- 5A426.10.4 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.
- 5A426.11 Final Acceptance Tests
- 5A426.11.1 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.
- 5A426.11.2 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.
- 5A426.11.3 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.
- 5A426.12 Rejection of Installation
- 5A426.12.1 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.
- 5A426.12.2 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.
- 5A426.13 Handing Over of Documents
- 5A426.13.1 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.
- 5A426.13.2 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.

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5A427.1 Abbreviations

ACT	Air Cushion Tank
ARV	Air Release Valve
B.V.	Ball Valve
B.F.V.	Butterfly Valve
C.P.	Controlled Percolated
FHC	Fire Hose Cabinet
F.D.	Fire Door
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
U.L.	Underwriters Laboratories

5A428

ANNEXURE-XI

5A428.1

List of Bureau of Indian Standards and Other Codes

Pipes and Fittings

BIS : 1239 (Part 1)	Mild steel, tubes, tubulars and other wrought steel fittings: Part 1 Mild Steel tubes.
BIS : 1239 (Part 2)	Mild Steel tubes, tubulars and other wrought steel fittings: Part 2 Mild Steel tubulars and other wrought steel pipe fittings.
BIS : 3468	Pipe nuts.
BIS : 4346	Specifications for washers for use with fittings for water 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	Specification for copper alloy gage, globe and check valves for water works purposes.
BIS : 14846	Specification for sluice valves for water works purposes. BIS : 3950
BIS : 5312 (Part 1)	Specification for swing check type reflux (non-return) valves: part 2 Multi door pattern.
BIS : 5312 (Part 2)	Specification for swing check type reflux (non-return) valves: part 2 Multi door pattern.
BIS : 12992 (Part 1)	Safety relief valves, spring loaded :
Design BIS : 13095	Butterfly valves for general purposes.

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 Life
Safety BIS : 636	Non-percolating flexible firefighting delivery hose.
BIS : 884	Specification for first aid hose reel for firefighting.
BIS : 901	Specification for couplings, double male and double female, instantaneous pattern for firefighting.
BIS : 902	Suction hose couplings for firefighting purposes.
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 firefighting 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 of practice.
BIS : 2871	Specification for branch pipe, universal, for firefighting purposes.
BIS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
BIS : 5290	Specification for landing valves.
BIS 5714	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for firefighting.
BIS : 3488	Code of practice for fire safety of installation and maintenance of Internal fire hydrant and hose reels on premises.

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TECHNICAL SPECIFICATION OF ELECTRICAL & ELV SYSTEM

1.0 INTERNAL ELECTRICAL WIRING

A. Scope:

The specification covers guidelines for execution of work of internal electrification. The specification covers system of distribution and wiring, Metallic and Non-metallic conduit wiring system, PPI DBs, Medium Voltage Panels, etc. The work is to be executed conforming to National Electric Code, IE Rules and BIS.

Sr. no	Standards	Code Description
A	Ring Main Unit (RMU) /	High voltage Switchgear (HVS)
1	IS: 13118, IEC: 56	Circuit Breakers
2	IS:3427, IEC:298, IEC:694	Metal enclosed Switchgear
3	IS: 2705 IEC: 44	Current Transformers
4	IS: 3156 IEC: 186	Potential Transformers
5	IS: 5578, IS: 11353	Guide for Marking Busbars, Main Connection and auxiliary wiring
6	IS: 2544, IEC: 273	Busbar support insulators
7	IS:13947, IS:3427, IEC: 947	Degree of Protection
8	IS: 3231, IEC: 255	Electrical relays for Power System Protection
9	IS: 1248, IEC: 51	Electrical Indicating Instruments
10	IS: 9385, IEC: 282	High Voltage Fuses
11	IS: 722	AC Electricity Meters
12	IS: 4171, IEC: 694	Copper Busbars
13	IEC: 129	Off load isolators
14	IS: 6005	IS: 4171, IEC: 694
15	IS: 9224	HRC Fuses
B	Transformer	
1	IS 2026 Part I IV	Power transformer
2	IS 3639	Fittings & accessories
3	IS 2147	Degree of protection
4	IS 2026	Tests
5	IS 2026	Tolerance on guaranteed particulars
6	IS 1271	Electrical insulation classified by Thermal stability
7	IS 335	Insulating oil
8	IS 8468	OLTC
9	IS 10028 Part II	Installation and maintenance of transformer
10	IS 6600	Guide for loading of oil immersed Transformer
C	Low Voltage Switchgear (LVS)	
1	IS 4237, IEC 947	Switchgear General Requirements
2	IS 13118, IEC 56	AC Circuit Breakers
3	IS 8623, IEC 439	Factory built assemblies of switchgear and control gear for voltages upto and including 1000V AC and 1200V DC
4	IS 13947(Part3), IEC 947-3	Air brake switches
5	IS 8828, IEC 898	Miniature circuit breakers
6	IS 9224, IEC-269	HRC cartridge fuses
7	IS 8187	D Type fuses
8	IS 13947(Part4), IEC 947	Contactors
9	IS 13947(Part 4), IEC 947	Starters
10	IS 6875	Control switches / push buttons
11	IS 2705, IEC 44-1	Current transformers
12	IS 3156, IEC 186	Voltage transformers

Sr. no	Standards	Code Description
13	IS 3231, IEC 255	Relays
14	IS 1248, IEC 51	Indicating instruments
15	IS 11353 / IS 5578	Arrangement for busbars main connections and accessories
16	IS 722	AC electricity meters
17	IS13947(Part1), IEC947-1	Degree of protection
18	IS 10118	Code of practice for installation and maintenance of switchgear
19	IS 6005	Code of practice for phosphating iron and steel
20	IS 5082, IEC 114	Wrought Aluminium & Aluminium alloys for electrical purposes
21	IS 12021, IEC947	Control transformer for switchgear and control gear for voltage not exceeding 1000VAC
D	Lighting	
1	IS 1913 (Pt 1): 1978	General and safety requirements for luminaries: Part-1 Tubular fluorescent Lamps (Second revision).
2	IS 2206 (Pt.1): 1984	Flameproof electric lighting fittings: Part-1 Well-glass and bulkhead types (first revision).
3	IS 3528: 1966	Waterproof electric lighting fittings
4	IS 5077: 1969	Decorative lighting outfits
5	IS 9583: 1981	Emergency lighting units.
6	IS 10322 (Pt.4): 1984	Luminaries: Part-4 Methods of tests
7	IS 10322 (Pt.5/Sec2): 1985	Luminaries: Part-5 Particular requirements, Section-2 Recessed luminaries.
8	IS 2418	Tubular fluorescent lamps
9	IS 1777: 1978	Industrial Luminaire with metal reflectors and its Amendments
10	IS 4012: 1967	Dust-proof electric lighting fittings.
11	IS 4347: 1967	Code of practice for hospital lighting
E	Cables	
1	IS: 7098-Part-1 1998, IEC:502 1983	11KV Cables
2	IS:1554 - Part - I (1988)	433 V Cables
F	UPS	
1	IS 589	Basic climatic & mechanical durability tests for Components for electronic and electrical equipment
2	IS 9000	Environmental tests for electronic & Electrical equipment
3	IS 5921	Metal clad base material for printed circuits for use in electronic and telecommunication equipment.
4	IS 6297	Transformer and inductors (power, audio, pulse & switching) for electronic equipment
5	IS 7405	Printed wiring boards
6	IS 6553	Environmental requirements for semiconductor Devices & integrated circuits
7	IS 4007	Terminals for electronic equipment
8	IS 8623	Factory built assemblies of switchgear and control gear for voltages upto and including 1000V AC and 1200V DC
9	IS 13947-3	Air brake switches
10	IS 9224	HRC Cartridge fuses
11	IS13947-4	Contactors
12	IS 6875	Control switches / push buttons

Sr. no	Standards	Code Description
13	IS1248	Indicating instruments
14	IS 2147	Degree of protection
15	IEC 146	Semiconductor converters
16	IS 6619	Semiconductor rectifier equipment code
17	IS 3700	Thyristors converters
18	IEEE 446	Emergency power systems
19	IEEE 472	Surge withstand capability test
G	EARTHING	
1	IS 3043	Earthing
2	IEC 62305	Lightning Protection System

B. System of Distribution and Wiring:

The distribution system starts from the main panel board and comprises of main and floor panels, distribution boards and connection between them. The connection from main panel to floor panel or main distribution board is taken through cables. In the present day the distribution system has become complicated because of different types of supply, i.e Essential/ Non-Essential/ UPS etc. The distribution system for each type of supply shall be distinctly different and kept separated down to the last point.

C. Sub-main wiring:

The sub-main wiring shall mean connection from main panel board to distribution board. The sub-main wiring is generally done either with recessed or surface conduit or through channels or cable tray if so required. The sub-main wiring when laid in conduit should not be mixed with any other wiring including circuit wiring. Single phase sub-main wiring shall constitute phase, neutral and earth conductor. Three phase sub-main wiring shall constitute three phase conductors, one neutral conductor and two earth conductors. When drawn through a conduit, all conductors of a sub-main shall be drawn through single conduit to ensure minimum electromagnetic effect. The sub-main connection shall be controlled through a MCCB/ MCB of suitable current carrying and fault with stand capacity. Measurement of sub-main wiring shall be done on linear basis from end to end along the run of the conduit/ channels including bends/ accessories as required but does not include interconnection inside the panel/ distribution board. Sub-main wiring drawn through cable shall be measured on linear basis from termination to termination as applicable for cables.

D. Circuit wiring:

The circuit wiring shall mean wiring between Distribution board to switch board laid in surface or recessed conduit. Circuit wirings are single phase wiring constituting phase, neutral and earth conductor. The circuit wiring shall not be mixed with sub-main or point wiring. Circuit wiring shall be controlled through MCB of minimum 10 KA fault withstand capacity. Only C curve MCBs should be used. The circuit wiring is of two types i.e light circuit and power circuit. The load of a light circuit should be limited to 800 Watt. The load of power circuit may vary from 1000 Watt to 2000 Watt depending on the type of load. Linear measurement shall be done for light as well as power circuit from Distribution Board upto the switch board.

E. Point Wiring:

The point wirings are of two types i.e light points and plug points. Light points would constitute light/ fan/ exhaust fan/ call bell points. Individual control should be provided for each point. However, in some cases i.e common areas, toilets, shops, etc more than one light point may be controlled from one switch/ MCB. Wiring of light points shall constitute provision switch board with switches, conduit including wiring, ceiling rose/ connector and other accessories including earthing. The measurement of light points shall be measured in numbers based on classification.

The light points are classified as Group A, B or C depending on the type of building. Point wiring in Type I, II and III quarters are classified as Group A and those in higher type are classified as Group B. Wiring in non residential buildings like office/ hospital/ laboratories/ educational buildings and barracks are classified as Group C. Plug point may be of 6A/16A/20A/25A. 6A/16A outlets have load of 100/1000 Watt respectively. 6A outlets are called light plugs and 16A outlets as power plugs. Light plugs can be provided on switch board controlling light points and connected to light circuit. 6A plug points shall be controlled by 6A switch and 16A plugs by 16A switch. 20/25 Amp outlets should be controlled by MCB/ Starter (When used for controlling ACs). More than one light plugs or power plug or a combination of the two can be connected to one power circuit but the number of such outlets to be connected to one circuit should be decided by considering type of use and diversity of load. 16/20/25A power outlet when used for controlling Air-conditioners or any equipment having load more than 1000 Watt, only one outlet should be connected to one circuit. The plug points shall be measured in numbers.

F. Conduit Wiring System :

PVC Conduits are to be used in the work. The wall thickness shall not be less than 2mm (14 SWG) for those above 32mm dia. Only heavy gauge rigid PVC conduit having wall thickness of 2 mm (14 SWG) shall be used. Flexible conduit can be used only for interconnection between termination of point wiring and light fittings/ interconnection of switchgear and DBs.

GI switch boxes are to be used in the work. The wall thickness shall not be less than 1.2 mm. Earth terminal with stud and metal washer should be provided in the box. Only modular plug in type switch and socket shall be used.

In case of conduits laid in surface, saddles shall be provided at an interval of not more than 1 meter and at a distance of 30 cm from centre of fittings like bends/ junction box etc. In case of metallic conduit saddle thickness shall not be less than 0.55 mm (24 SWG) for conduits up to 25mm dia and 0.9 mm (20 SWG) for larger diameter. Heavy gauge non-metallic saddle with base should be used for PVC conduit.

In case of laying of conduit is recess in wall, chase of appropriate size shall be made by using chase cutting machine and finished to match with the surface after fixing conduits. The conduits should be fixed by staples/ J hooks/ saddles fixed not more than 60 cm apart.

In case of laying of conduit in roof slab, conduits shall be laid in position and fixed firmly to the reinforcement bars by steel binding wire to avoid dislocation during pouring of concrete. To facilitate subsequent drawing of wire suitable fish wire shall be provided along with laying of conduit in the roof slab.

Maximum number of PVC insulated 650/ 1100 Volt grade Aluminium/ Copper conductor cable confirming to IS 694: 1990 to be drawn in conduit of different size are as below.

Conductor Crossection	20 mm dia conduit		25 mm dia conduit		32 mm dia conduit	
	Straight	Bend	Straight	Bend	Straight	Bend
1.5 sqmm	5	4	10	8	18	12
2.5 sqmm	5	3	8	6	12	10
4.0 sqmm	3	2	6	5	10	8
6.0 sqmm	2	-	5	4	8	7
10 sqmm	2	-	4	3	6	5
16 sqmm	-	-	2	2	3	3

G. Wires & Wiring System:

Wires shall be single core multi-strand PVC insulated FRLS type and shall be of 1100 Volt grade. Wires of different colours shall be used for quick identification of phase wire / neutral wire etc. All wires shall comply with the requirements regarding the manufacture and testing etc as specified in India Standard Specification IS: 1567/4064 and IS: 694. Termination of wires on switches/ MCBs/ Connectors shall be done by providing crimped lugs.

Joints will not be permitted in wiring anywhere except in switch box or point outlet where jointing of wires will be allowed with suitable connectors. The wiring throughout the installation shall be such that there is no break in neutral wire except in the form of linked switchgear.

H. Ceiling Fan:

Ceiling fans shall conform to IS: 374-1960. All (1200 mm/1400mm) ceiling fans shall be 5 star rated BLDC fan. In case of any other sweep the star rating shall be highest as available in the market. Only electronic type regulator shall be used. The fans shall be with double ball bearing and shall be supplied with all standard accessories like down rod, capacitors etc.

I. Exhaust Fans:

The exhaust fans shall conform to IS 2312. Exhaust fans shall be robust in design and construction and shall be supplied complete with wall brackets / clamps/ louvers etc. Exhaust fans of diameter 380mm and above should be of low RPM. In case of single use toilets fresh air fans may be used.

J. Light Fittings:

Keeping in view the importance of energy conservation LED fittings should be used wherever possible. Use of CFL and Incandescent lamps should be avoided. All fittings supplied should confirm to relevant IS and shall be complete with all standard accessories like driver, heat sink, 4 KV surge protector in case of LED fittings and electronic ballast in case of fluorescent fittings as per BOQ.

K. Distribution Boards:

We consider Segment DB, VTPN DB, TPN Horizontal double door, & SPN DB. All distribution boards shall be of double door design fabricated out of 1.2 mm thick CRCA sheet and finished with powder coated paint, IK-09. The distribution board shall be provided with earth terminals for earthing of metal body. The DB shall be provided with insulated copper busbar, isolated neutral bar and connector for termination of earth wires.

Distribution Board with single phase outgoings requirement shall be Horizontal type. Distribution Board with three phase outgoings requirement shall be Vertical type. Distribution Board installed in indoor dry locations shall conform

to IP-42. Distribution Board installed in outdoor & wet locations shall conform to IP- 65.

L. MCB:

MCBs shall be suitable for DIN mounting type and quick make and break type. MCBs shall be provided with magnetic thermal release for over current and short circuit protection. Only C curve MCBs should be used except for capacitor duty application. The breaking capacity shall not be less than 10KA. In case of DP, SPN, TPN or Four pole MCBs there should be a common trip bar.

M. MCCB:

MCCBs in AC circuits shall be of Four Pole/TPN (Triple pole with neutral) construction arranged for simultaneous closing and opening of contacts. Operating mechanism shall be quick make, quick break and trip free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator. Unless otherwise specified the MCCBs shall be manually operated type with handle of appropriate size.

All MCCBs of rating 250 A & above shall be provided with microprocessor based trip unit for protection against overload, short circuit & earth faults. MCCBs below 250 A shall be provided with Thermal Magnetic Releases. The instantaneous short circuit release shall be chosen as to operate at a current in excess of pick up motor inrush current & a range of setting shall be provided for selection. Necessary NO+NC contacts should be provided for ON/OFF indication.

MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes suitable to circuit ratings. The breaking capacity of MCCB's shall be as per the design requirements. The breaking capacities shall be for ICU=ICS as per IEC-60947-2,1989/IS 13947-2,1993. The MCCB shall be made of halogen free high strength heat resisting and flame retardant thermosetting insulating material. MCCB release shall be EMI/EMC compatible.

MCCB shall be provided with rotary handle and door interlock to prevent door being opened when the breaker is in ON position. It should be possible to defeat the interlock in ON position, while taking up maintenance work. It should be possible to provide castle key interlock if required.

N. ELCB/RCCB:

Earth Leakage Circuit Breaker (ELCB) shall work on the principle of core balance transformer. ELCB/RCCB(Residual Current Circuit Breaker) shall be current operated independent of the line voltage. Current sensitivity shall be between 30 mA and 300 mA at 240/415 volts AC & shall confirm to IS-12640.

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. The closing/opening of all the three phases shall occur simultaneously.

The neutral moving contacts shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact before the phases; and at the time of opening, the neutral shall break after the phases to position.

2.0 INTERNAL LIGHTING SYSTEM:

Energy efficient Lighting with LED Lamp Light Fixtures in all areas have been proposed, the details specification has been supplied in the BOQ. The pattern of fixtures has been taken tentatively; however it will base on the ceiling design at all floor levels. Modified list of fittings along with specification will be submitted. Manufacturer shall have inhouse lab approved by NABL or ministry of science of govt of India. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters. Compliance to Indian Standards of IS10322 Part 5 / Sect 5:1967; 16105 : 2012; IS 16106 : 2012; IS 15885 (Part2/Sec13) : 2012; IS 16108 : 2012.

Suitable type fixtures shall be selected for asymmetric distribution of light. Special emphasis shall be made on low energy consumption light fittings LED shall be provided in all the available areas. Considering the benefits of LED light fixture over the conventional fluorescent fixture, the use of LED light fixture is recommended.

Lighting shall be designed for various areas on an illumination level recommended by B.I.S. and as per the specific requirement of that particular area. The lighting of the Yard and Building shall be designed in accordance with Energy Conservation Building code (ECBC) 2017 & CPWD Internal Electrical specification-2023. Lighting power density as specified in ECBC 2017 for the building is given as here in under or as approved by Engineer in charge. The efficacy of LED fixtures has been considered as 120 lumen/watt or more.

Technical Specification for Light Fixture:

Lumen out put-	120 Lumen/W
Total harmonic distortion (THD) -	<10%,
Surge protection minimum -	3 KV for indoor lighting & 10KV for outdoor lighting
Color Temperature Control CCT -	4000K/5700K,
Color Rendering Index(CRI)-	>80,
Standard Deviation Colour Matching(SDCM)-	<5,
Power Factor-	≥0.95,
Driver Efficiency > 85% & 3 KV internal surge protection, Power factor greater than 0.95 and total harmonic distortion (THD)	

of less than 10% should be integral to the luminaire.

Digital Addressable Lighting Interface (DALI):

In this section the bidder should provide design, drawing Supply, installation, Testing & Commissioning of DALI need of lighting control system should be provision for Jatrinivas, Toilet, interpretation center ,food plaza area and such a huge application area involves a number of lighting fixtures to be controlled efficiently. Lighting control systems not only provide the flexibility of controlling the light as per the design and layout in such area, but also enhance the important aspects of energy conservation leading to reduced electricity consumption.

A ceiling mounted wireless Occupancy sensor will be suggested which will switch all the dimmable lights as per the circuits and will also save energy by dimming the lights on the basis of desired lux level in these areas. It should also have a provision to manually override and control the settings through a wall mounted 5 & 8 button keypad/Wall station for separated controlling station.

SAMPLES:

The Engineer-In-Charge reserves the right to ask for all light fixtures(internal & External), facade light fixture samples for the specified product/ luminaries and final approval is subject to the approval of mock-up. The requested sample shall be delivered to site much earlier for the Engineer In-Charge to coordinate the mock activity prior to the approval.

Workmanship

Good workmanship is an essential requirement to be complied with the entire work of manufacture/ fabrication, assembly and installation shall conform to sound engineering practice.

The work shall be carried out under the direct supervision of an engineer, employed by the contractor, who shall rectify then and there the defects pointed out by the Engineer-In-Charge during the progress of work. The qualification of engineer or supervisor for overall supervision and to take instructions from the Engineer-In- Charge shall be as specified in the special conditions.

TESTING OF INSTALLATION

All the completed installations shall be tested as per specification for "Testing of Installation".

COMMISSIONING OF COMPLETION

Before the workman leaves the work finally, he must make sure that the installation is commissioned, after due testing.

Completion Plan and Completion Certificate

- I. For all work completion certificate after completion of work as required by AAI shall be submitted to the Engineer-In-Charge.
- II. Completion plan drawn to a suitable scale in tracing sheet with three blue print copies of the same shall also be submitted.
- III. General Layout of the building.
- IV. Locations of main switchboard and distribution boards.
- V. Position of all points and their controls indicating the circuit numbers controlled by them.
- VI. Types of fittings, viz. fluorescent, pendants, brackets, bulkhead, fans and exhaust fans etc.
- VII. Name of work, job number, accepted tender reference, actual date of completion, names of Division/Sub-Division, and name of the firm who executed the work with their signature.

3.0 Medium Voltage & Low Voltage Panel:

Main LT PANEL:

Cubicle type sectionalised, front operated top/bottom entry dust and vermin proof M.V Panel Boards suitable for operation at 415V, 3 phase, 4 wire, 50Hz distribution system fabricated out of CRCA sheet, insulated busbar with heat shrinkable PVC sleeve, base channel, complete with all accessories including interconnections, earthing etc

as required. Panel should be constructed accordance with IEC 61439-1&2 (TTA). (Party should submit copy of all Type test certificates during offer submitting).

SUB PANEL:

Supply, delivery, installation, testing and commissioning of indoor floor mounted type distribution boards for common area made out of high quality polycarbonate (shock proof, rust free, corrosion free, acid and chemical resistant, fire retardant, having high impact, made of halogen and silica free recyclable material), UV resistant, having high grade gasket made of polyurethane, should withstand glow wire test at 9600C, should be flame retardant, the cabinet should have test certificate in accordance with IEC 60 439-1 (IS8623), IEC 60 439-2, CPRI (ASTA) (Party should submit copy of all test certificates during offer submitting) The panel should have hinged door with provision for cable entry, earthing studs as per specification mentioned below duly factory wired conforming to the relevant ISS and as per special conditions of contract making good the damages caused complete including necessary civil / fabrication work as required as per the direction of Engineer-incharge. Functional units such as circuit breakers shall be arranged in multi-tier formation. Cable entry for various feeders shall be from the front through cable alley located in between two circuit sections. All cable entries shall be through glands plates. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuit when new feeders are added. Gland plate shall be 3 mm thick.

The panel board shall be suitable for operation on 3 phase 415 Volt 4 wire 50 Hz system. The busbar shall be designed for 45°C rise in temperature over ambient of 40°C or as specified in additional condition if any. The busbar shall be insulated and shall have short circuit withstand capacity as specified in the BOQ. Current density shall not exceed 130 Amp/Sq.cm for aluminium and 160 Amp/Sq.cm for copper. Neutral bars shall be of same rating as phase for bus bar rating up to 400 Amp. For bus bar rated above 400 Amp, the neutral shall be rated 50% of phase. Bus support insulators shall be of high strength, good quality fibre reinforced plastic or SMC (sheet moulding compound) with high anti-tracking index and non-hygroscopic.

3.1 Metal Treatment & Finish:

All steel work used in the construction of the Main & Sub Distribution Boards should have undergone a rigorous metal treatment process (7-tank process) & RAIL-7032/7035 as follows:-

- Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
- A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
- Passivating to retain and augment the effects of phosphating.
- Drying with compressed air in a dust free atmosphere.
- A finishing coat of Powder coating of Siemens gray colour.

The panel board shall be provided with 2 Nos earth terminal at both ends and a continuous earth bus of appropriate size shall be provided inside the panel board ensuring earth integrity of the complete panel board. All openable doors shall be earthed by providing flexible copper earth connection between door and the body of the panel board.

The panel board shall accommodate all accessories like circuit breakers, MCCBs, MCBs, switch disconnect or fuse units with HRC fuses, starters, necessary meters, relays, indicating lamps etc. as required and shown on drawings and arranged in suitable tiers.

The switch board shall be fully compartmentalized in vertical tiers housing the feeder switches in different totally enclosed independent compartments. Each feeder must terminate in an independent labelled terminal block. Strip type terminal block accommodating several feeders together is not acceptable. All terminations shall be shrouded in an appropriate manner. The entire enclosure shall meet with IS-2147. For feeders rated more than 100 Amp, the connection between busbar and feeder shall be of solid bar and for those upto 100 Amp shall be with copper cable/ wire with necessary ferrules. Internal wiring, bus bar markings etc. shall conform to IS-375. Internal wiring shall have terminal ferrules. Main switch should be at easily accessible height and the highest switch operating handle should not be over 1.75 M from floor level.

Anti-condensation heaters and inspection lamp shall be fitted in each cubicle together with an ON/OFF isolating switch. As a general rule, the heaters shall be placed at bottom of the cubicle.

3.2 Name Plate:

Suitable anodized Aluminium engraved nameplate of 1.6 mm thick shall be provided on all the switchboards and individual panels. The colour of lettering shall be white letters on black background. The identification of equipment

mounted inside panel shall be through yellow stickers with black letters. The feeder's name plant & plate numbering shall be on Front of the panel. Cable details name plate shall be provided at the back side of the panel Laminated drawing, explaining clearly the power control schematic, to be pasted on the panel board.

INSPECTION:

The contractor shall provide facilities to Visual inspection including witnessing routine tests shall be carried out by Engineer- in-Charge or his authorised representative without any cost to the owners.

Contractor shall notify Engineer-in-Charge or his authorized representatives in writing at least fifteen (15) days prior to Contractor's scheduled inspection test.

4.0 Power Factor Improvement (APFC):

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor up to 0.98 lagging from initial power factor. Capacitor panel shall be provided with day/ night mode selector switch and double ratio C.Ts, for day/ night mode. Day/ night mode shall be selected based on estimated day / night load requirement. The panel shall include all the specified capacitor banks, switchgears, controller, filter reactors, control gears, busbars, meters, earthing, interconnections etc.

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors. The panel shall be indoor, floor mounted and free standing type with IP-42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure and shall be finished with powder coating in the approved colour shade. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided. The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors (14%). The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

APFC Relay Microprocessor based APFC relay, (intelligent VAR controller) of suitable steps as mentioned in the BOQ, shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or bank to achieve the preset target PF. The controller shall have digital settings of parameters like PF, switching time delay, step limit etc, indication of PF, preset parameter, minimum threshold setting of 1% of CT current.

The capacitor shall generally confirm to IS: 13585:1994 and IEC 60931:2002 General specification: three phase, delta connected, 50 Hz.

Voltage: Must be designed to withstand system over voltage, increased voltage due to series reactor and harmonics. It should be rated for 525V for 14% detuned reactor.

The KVAR of Capacitor banks should be increased proportionately for combination of Capacitor + reactor. ii.

Capacitor type: The capacitor unit shall be Heavy Duty MPP resin filled, copper wound type.

The dielectric should be made of polypropylene. Capacitor Impregnation shall be Oil Type. Capacitor should be fitted with safety device for each capacitor units. The capacitor should be low loss type (total losses should not exceed 0.45 W/ KVAR).

Temperature category: -25 degree C to 70 degree C. iv. Over voltage +10% (12h in 24 hours), +15% (30 minutes in 24 hours), +20% (5 minutes) and 30% for 1 minute .

Over current: 2.5x In

Peak inrush current withstand: 400 x In

Capacitor shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.

Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for AYFY cable as specified. Separate earthing terminal shall be provided for earth connection of each bank.

Detuned filter reactor shall be used along with power capacitors to mitigate harmonics, improve power factor and to avoid electrical resonance in LV electrical networks.

The low voltage filter Copper reactor shall be series type having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 60076.

The permitted tolerance of inductance shall be + 3% of rated inductance value.

The limit of linearity of inductance of the filter reactor shall be as follows $1.8 \times I_n$ with $L=0.95 \times L_N$.

The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuits in case of high operating temperatures

5.0 TRANSFORMER & DP STRUCTURE:

Supply, installation, Commissioning & testing of the distribution of power supply to the buildings is worked out in the following sequences.

The transformer should be configuration of 11KV to 0.433V complete outdoor type ONAN type Dyn11, Oil Type Transformer with off circuit tap links 5% to -5% @ 2.5% on HT side of transformer as per BIS energy efficiency Level-2/STAR 2 Copper wound distribution transformer along with OFTC & RTCC Panel , Buchholz relay, WTI, OTI, Marshalling Box & standard fitting with fast filling of oil as per IS:1180 amendment.

- 11KV receiving substation with HT cabling of Power supply will be tapped from the nearby Electricity Board substation through HT Cable or overhead line by the local Electricity board scope against the Statutory payments.
- 11KV to 0.433KV transformer, LT panel, cable interconnection etc to the Main distribution substation board by bus trunking/cabling system, substation earthing & safety equipment's.
- 11KV HT Cables proposed for HT Metering cubicle and Transformer through underground trench / Hume pipe.
- 11KV HT Metering Cubicle to be provided as per local EB requirements.
- Statutory clearances wherever required will have to be taken by the contractor.
- Contractor should follow the guideline for substation & power distribution system pf building -2019.

Construction:

The specification covers ONAN transformers suitable for 11/33 KV on primary side and 415 Volt secondary. The Transformer shall be designed and constructed to withstand capability of minimum 50KA for 3 sec without damage to the thermal and dynamic effects of external short circuits between phases or between phase and ground. The transformer shall be ONAN (Oil Natural & Air Natural) cooled suitable for outdoor installations. Transformer shall be housed in, freestanding enclosures of welded sheet steel frames. Transformer enclosure shall be suitably reinforced to prevent distortion during handling. Base channels shall be provided with skids and pulling eyes to facilitate handling.

The core clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly. The core assembly of the transformer enclosure shall be electrically connected to the transformer tank for effective core earthing. Lifting lugs and rollers shall be provided. The transformer shall be of protection class IP-55. The tank thickness shall be as under: `

Sl No	Rating	Transformer tank thickness (mm)		
		Bottom	Side	Top
1	100 KVA to 250 KVA	4	3	5
2	315 KVA to 1250 KVA	5	4	6

Transformer Losses: The no load and full load losses shall be as level-3 and star-3 as per state Govt approved standard. The transformer shall be capable of withstanding the following power frequency and impulse (1.2/50 microsecond) voltage for 1 Sec.

Sl No	Description	11 KV	33KV
1	Power Frequency withstand for 1 Sec (KV)	28	70
2	Impulse withstand capacity (KVp) (1.2/50)	75	170

Impedance Voltage:

For the purpose of protection against short circuit stresses, the minimum value of impedance voltage at 75 degrees Celsius rated current shall be as per IS 2026.

Noise: -

The audible sound level measured at one foot (30 cm) from the external surface of the transformer shall be as per IS or NEMA standard.

Type Tests: -

Transformer shall have necessary certificate of Fault withstand capacity, Impulse and Heat run test issued by Govt. /NABL (National Accreditation Board for Laboratories) Lab. furnished.

TRANSFORMER TESTING

Prior to acceptance and despatch of the transformer, the Department reserves the right to witness the routine tests at manufacturers works.

The transformer shall be subjected to the following tests as per IS 2026 with upto date amendments at the manufacturers Works. The test certificates shall be submitted to the Department for approval prior to dispatch.

ROUTINE TEST:

- Measurement of Winding Resistance
- Ratio polarity and phase relationship
- No load and load losses
- Impedance voltage
- No load and load current
- Insulation resistance
- Induced over voltage withstand (DVDF)
- Separate source voltage withstands.

TYPE TESTS:

Type test certificate of CPRI of similar rating of transformer to be submitted along with approval of drawings.

- Temperature Rise
- Impulse voltage withstands.

Test Certificate: - Copies of type test certificates and routine test carried out at the premises of the manufacturer shall be furnished to the user department along with the supply of equipment's.

6.0 TECHNICAL SPECIFICATION OF DG SET:

The scope of this specification covers design, manufacture, testing and commission, 415 Volt 50 Hz diesel generator in accordance with the requirement laid down in relevant IS codes and IE rules as per the following technical specification.

The DG set shall be 415 Volt self-excited, star connected, silent type with AMF panel.

It shall adhere to all mandatory noise and emission regulation norms as laid down under Environmental (Protection) Rules in-force & under NTP conditions of BS:5514 ISO8528, with an overload capacity of 10% for one hour in every 12 hours of Operation confirming to latest CPCB-IV+ Norms.

The DG Set should be capable of voltage buildup within 15 to 20 seconds after receiving start command and it should be ready to take first step load within 15 to 20 seconds after receiving start command on voltage buildup. Also, wherever DG set have required special insulation/ventilation/smoke exhaust stack has need to provide as per CPWD guideline.

1) DIESEL ENGINE:

The Engine shall be complete with the following accessories:

- The total No. of Cylinders is 6 Nos, In-line 4 Stroke, radiator cooled engine.
- Engine cubic capacity should be as per Standard manufacturer.
- Full authority electronic engine
- Common rail Electronic Injection fuel system or better
- Radiator with blower fan
- Corrosion inhibitor / liquid coolant
- Spin-on filters-fuel & lube oil
- Plate type lube oil cooler
- Service Interval – 500 Hrs/1 Year, whichever is earlier
- Flywheel housing and flywheel to suit single bearing alternator
- Dry type and replaceable paper element air cleaner with restriction indicator
- Standard integral set-mounted radiator system, designed and tested for 50°C ambient temperature
- Optimized turbocharger for increase altitude capabilities
- Hospital Grade silencer
- Stainless steel exhaust flexible bellows
- Electric starters with soft start engagement features
- Battery charging alternator
- Anti-vibration mounts of reputed make.
- Protective guards for all rotating parts.
- Remote Monitoring System with static battery charger
- Common electronic management system for DEF & Diesel.

The Engine shall be capable of delivering specified prime power rating at variable loads for PF of 0.8 lag with 10% overload available in excess of specified output for one hour in every 12 hours of operation. The average load factor of the engine over period of 24 hours shall be 0.85 (85%) for prime power output. Principal Engine Manufacturer should give in writing the prime power net output considering the site ambient temperature (50 Deg C) & altitude of site considering its height from MSL.

2) ALTERNATOR:

Alternator, suitably rated at 0.8 PF, 415 Volts, 3 Phase, 4 wires, 50 cycles/sec., 1500 RPM, self-excited and self-regulated, with brushless excitation, Band of Voltage Regulation +/- 1% of rated voltage, from no load to full load, Insulation Class “H”. The Alternator generally conforms to BS:5000/IS:4722.

- Brushless type, Screen protected, Revolving field, Self-excited alternator conforming to IS/IEC 60034-1
- Better motor starting capability
- Best in class efficiency
- Compact design with sealed bearings for longer life and lesser maintenance
- Impregnation on all wound components for better mechanical strength
- Digital AVR

3) INTEGRATED DG CONTROLLER:

- Microprocessor based generator set monitoring, metering and control system with LCD display
- AMF Functionality
- Electronic Governing
- CAN (J1939) Compatible
- Sync Compatible (Capable to accept external speed signal from 3rd party sync controller)
- Intuitive operator interface which includes LED backlit 128X64 pixel graphic display with tactile feel soft-switches & generator set status LED lamps.
- Remote Start-Stop
- Engine Metering: Oil pressure, Engine temperature, battery voltage, Engine running hours
- AC Alternator Metering: L-L Voltage and L-N Voltage, Current (phase and total), kVA (phase and total), Frequency, kWh, kW and kVA (phase and total), PF, Utility Voltage and Freq.
- Engine Protection: Low lube oil pressure, High/ Low coolant temperature, Battery Over/ Under/ Weak Volts, Fail to Crank/ Start, Sensor failure, Cranking lockout.
- AC Alternator Protection: Over/ Under Voltage, Over/ Under Frequency, Loss of AC Sensing, Over speed, Over Current, kW Overload.
- Data Logging: Engine Hours, Control Hours and upto 5 recent fault codes
- Configurable glow plug control
- 12/24 Volt DC operation
- Sleep mode
- Mod bus interface (RS485 RTU)
- In Power compatible (PC based service tool)
- Certifications - meets the requirement of relevant ISO, EN, Mil Std. and CE standards
- Maintenance due alarm based on Engine Run Time and due date
- Exerciser scheduler

4) BASE FRAME:

Sturdy, fabricated, welded construction, channel iron Base Frame for mounting the above Engine and Alternator. Required number of anti-vibration mounting pads, charged battery, battery stand, battery charger and leads etc.,

5) FUEL TANK:

As per standard manufacturer fuel tank capacity design & capacity sub-base Fuel Tank complete with level indicator, fuel inlet and outlet, air vent, drain plug, inlet arrangement for direct filling.

6) Acoustic Enclosure

- Specially designed to meet stringent MoEF/CPCB norms of 75dBA@1mtr load under free field conditions.
- The Acoustic enclosure is made CRCA sheet in munsell green shade and a structural/sheet metal base frame painted in black.
- 11 Tank pretreatment process and UV resistance powder coating of all parts to withstand extreme

environment.

- High quality noise absorbent and fire retardant grade acoustic insulation material complying to IS 8183.
- Top lifting for easy handling.
- External Fuel & DEF filling Provision.

7) Automatic Voltage Regulators(AVR) :

The AVR shall regulate the output voltage from generator current/voltage signals. The automatic voltage regulator (AVR) shall be high speed dead band type with automatic and manual control and mounted on alternator.

Necessary equipment for field suppression and surge protection shall be provided. The response time of the exciter and the generator shall be matched to avoid hunting.

All routine tests shall be carried out as per the various Indian standards for engine, alternator and the coupled DG system. The vendor shall be given 2 weeks' notice for the inspection.

Suitable measures shall be taken for field failure protection. The manufacture should specify the method adopted for the same with proper equipment specification and schemes. Alternate method for achieving field failure protection can also be included as an optional item with all required diagrams and component specification.

8) Mounting & Foundations:

The engine and directly coupled alternator shall be rigidly secured to a common rigid base frame fabricated from MS/GI sections. The DG set shall be placed on the RCC base with anti vibration mountings. A lifting hook of required capacity shall be provided above the finalized location of the DG set to facilitate installation and subsequent maintenance of the DG set. The Design of mounting arrangements with ant vibration mounting shall be as recommended by the DG manufactures and shall be such that a maximum of 5% vibrations are transmitted to the building structure. The tender shall confirm the type and make of mounting offered and the vibration isolation efficiency in the tender. All rigid pipe/Bus bar connections to the DG set shall be made through flexible couplings.

Note: The contractor shall provide facilities to Visual inspection including witnessing of any factory testing. All material like consumable stores, fuel, oil, grease, lubricating oil etc. required for the tests shall be arranged by the DG Set Supplier / Manufacturer & deemed to be included in quoted rates.

7.0 HT Cable& LT Cable:

ISI marked XLPE insulated cables rated for continuous operation shall be used. At maximum rating capacity, the conductor temperature shall not exceed 90°C under normal operating conditions and 250°C under short circuit. The cable shall be suitable for laying in trays, trenches, ducts and conduits and for underground buried installation. Cable used in external or open areas shall be ultra violet radiation stabilized. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one-meter. The embossing shall be legible and indelible. PVC/Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand-meter length. In addition, ends of the cable shall be properly sealed with caps to avoid ingress of water during transportation and storage.

7.1 HT CABLE:-

All 33/11 KV cables shall be XLPE type and insulation screen shall all be extruded in one operation by "Triple Extrusion" process to ensure perfect bonding between the layers. The core identification shall be by colour stripes or by printed numerals. The insulating shielding shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic screening of copper. The copper screen shall be capable of carrying the single line to ground fault current.

The conductor shall be of stranded, high conductivity annealed Aluminium wire. Conductor shall be smooth, uniform in quality, free from scale, spills, Splits and any other defects there shall be no joints in individual standards expect those made in the base rod or wire before final drawing. The conductor shall be AL, 'stranded' and compacted circular for all cables. Cables shall be heavy-duty type.

The colour of outer sheath of all XLPE cables shall be as per Specific requirement and pigment added shall be such

that they don't fade even when exposed to direct sunlight. In addition, suitable chemical shall be added into the PVC compounds of the outer sheath to protect the cable against rodent and termite attack.

SI No	XLPE Cable in Sqmm	Short circuit rating for 1 Sec (11KV)	Short circuit rating for 1 Sec (33KV)
1	185	17.30 KA	17.30 KA
2	240	22.60 KA	22.60 KA
3	300	28.20 KA	28.20 KA

Cables shall be dispatched in wooden drums of suitable barrel, securely battened, with the take – off end full protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defect. Wool preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage. Each drum shall bear a distinguishing number, either printed or nearly chiselled on the outside of one flange.

7.2 SPECIFICATION FOR L.T CABLES:

GENERAL:

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

MATERIALS:

The L.T. Power cables shall be XLPE insulated PVC sheathed type aluminium conductor armoured cable conforming to IS : 7098 : 1988 (Part-I) with upto date amendments whereas control cable shall be XLPE insulated and PVC sheathed copper conductor armoured/ unarmoured cable conforming to IS:7098 (Part-I) 1988.

8.0 INSTALLATION OF CABLES:

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer- In-Charge. Cable laying shall be carried out as per CPWD specifications.

INSPECTION:

All cables shall be inspected at site and checked for any damage during transit.

JOINTS IN CABLES:

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer- In-Charge before the cables are cut to lengths.

LAYING CABLES IN GROUND:

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

PROTECTION OF CABLES:

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable.

Where more than one cables is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size.

EXCAVATION & BACK FILL:

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surface, roadways, side walks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer- In-Charge.

LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING:

Cable shall be laid on perforated M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

CABLES ON HANGERS OR RACKS:

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

CABLES TAGS:

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia., 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

CABLE GLANDS AND TERMINATION:

Cable shall be terminated using double compression type cable glands for entries into Panel Enclosures. All cable glands and adaptors are made up of nickel plated brass and are fitted with soft sealing nylon washer.

Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected. Cables to be terminated – Unarmored HT power cables, Armoured and Unarmored LT power cables, unarmored Control cables and unarmored Screened (instrumentation) cables

Cable transit frames are to be fitted where cables pass from outdoor trays / trenches to indoor areas or vice-versa. Such cable transit frames are designed to include 25 % spare capacity for future use. Cable transit frames are to be supplied with test certificates from an accredited independent test authority to confirm adequate fire rating for areas where they are to be installed.

TESTING OF CABLES AT SITE:

Prior to installation, burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

- Before laying.
- After laying.
- After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer-In-Charge

Insulation Resistance Test (Sectional and overall).

Continuity Resistance Test.

9.0 EARTHING

GENERAL:

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD Specifications amended up to date.

SCOPE:

This section covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS : 3043-1987) shall be referred.

APPLICATION:

The electrical distribution system is with earthed neutral (i.e. neutral earthed at the transformer/ generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipment and non-current carrying metallic components in the substation, as well as in the internal/ external electrical installations. Earthing system is also required for lightning protection, computer installations etc. for function reasons. Earthing requirements are laid down in Indian Electricity Rules, 1956 as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with IEC standard.

MATERIALS:

The material of earth and earth conductor shall be GI/ Copper as per Standards.

EARTH ELECTRODES:

The type of earth electrode shall be any of the following:

Plate/ Pipe earth electrode or Chemical Earthing as per Standards.

Plate Earthing:- For plate earthing, a copper or galvanized iron (GI) plate, typically 600mm x 600mm, is buried vertically in the earth, surrounded by alternating layers of charcoal and salt, at a depth of at least 3 meters below ground level.

- **Material:** Either copper or galvanized iron (GI).
- **Dimensions:**
 - **GI Plate:** Minimum size of 600mm x 600mm and thickness of 6.3 mm.
 - **Copper Plate:** Minimum size of 600mm x 600mm and thickness of 3.15mm.
- **Placement:** Buried vertically in the earth.
- **Depth:** At least 3 meters (10 feet) below ground level.
- **Surrounding Material:** Alternating layers of charcoal and salt.
- **Water Connection:** A pipe is fixed at the top to maintain moist conditions around the earth plate.

For Pipe earthing: - a galvanized iron (GI) pipe, typically 40-50mm in diameter and 2-3 meters long, is buried vertically in a pit, with the top end connected to the electrical system and the bottom end surrounded by charcoal and salt to enhance conductivity.

- **Pipe Material:** Galvanized iron (GI) pipe is commonly used.
- **Pipe Diameter:** Typically 40-50mm (1.5-2 inches).
- **Pipe Length:** Generally 2-3 meters (around 6.5-10 feet).
- **Holes:** Some specifications recommend drilling 12mm diameter holes at equal intervals along the pipe's length, especially in dry or rocky soil, to improve contact with the earth.
- **Thickness:** The pipe wall thickness should be adequate for strength and durability, often 3-4.5mm.

The resistance of the earth electrode should be as low as possible, typically under **1 ohm**. The lower the resistance, the better the grounding.

Pipe Earth Electrode shall be copper or copper bonded steel with dia min range from 25mm to 50mm & 2mtr -3mtr

long as per actual design requirement. The length may need to be increased depending on the soil conditions (high resistivity soils may require longer pipes).

EARTHING CONDUCTOR:

The earthing conductor (protective conductor from earth electrode upto the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductor shall be as specified based on designed calculation.

HARDWARE ITEMS:

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrode and forged tinned brass in case of copper plate electrodes.

PROTECTIVE (EARTH CONTINUITY/ LOOP EARTHING) CONDUCTOR:

The material and size of protective conductors shall be as specified.

Unless otherwise specified, GI conductor should not be ordinarily used as protective conductor within any circuit beyond a Distribution Board downstream.

LOCATION FOR EARTH ELECTRODES:

Normally an earth electrodes shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the Engineering-In-Charge.

VARIOUS TYPES OF ELECTRODES:

Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in drawing.

In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be reduced length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the Engineer-In-Charge. Pipe electrodes may also be installed in horizontal formation in such exceptional cases.

Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as shown in drawing.

When more than one electrode (plate/ pipe) is to be installed, a separate of not less than 2m shall be maintained between adjacent electrodes.

ARTIFICIAL TREATMENT OF SOIL:

When artificial treatment of soil is to be resorted to, the electrode shall be surrounded by charcoal/ coke and salt and as indicated in enclosed drawings. In such cases, excavation for earth electrode shall be increased as per the dimensions indicated in these figures.

WATERING ARRANGEMENT:

In the case of plate earth electrodes, a watering pipe of 20mm dia. medium class GI pipe shall be provided and attached to the electrodes as shown in the drawing and a funnel with mesh shall be provided on the top of this pipe for watering the earth.

- In the case of pipe electrodes, a 40mm x 20mm reducer shall be used for fixing the funnel with mesh. The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm x 30 cm x 30 cm.
- A cast iron/MS frame with MS cover of 6mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

EARTH CONDUCTOR

In the case of plate earth electrodes, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

In the case of pipe earth electrodes, wire type earthing conductor shall be secured as indicated in drawing using a through bolts, nuts and washers and terminating socket.

The earthing conductor from the electrode upto the building shall be protected from mechanical injury by a medium class, 15mm dia. GI pipe in the case or wire, and by a minimum of 40mm dia., medium class GI pipe in the case of

strip. The protection.

pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements).

The portion within the building shall be fixed on walls.

The earthing conductor shall be securely connected at the other end to the earth stud/ earth bar provided on the switch board by; Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and, Bolt nut and washer in case of strip conductor.

EARTH BUS AND MAIN EARTHING TERMINAL:

In all installations, main earthing terminal shall be provided at the main switchboard. This may be in the form of earth stud or single earth bar depending on the type of the switchboard.

Following conductors shall be terminated on to the main earthing terminal. Earth connection from electric supply company (where provided) Earthing conductor from electrode. Protective conductors

Equipotential bonding conductors

PROTECTIVE (LOOP EARTHING/ EARTH CONTINUITY) CONDUCTOR:

Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/ terminal of the upstream switchboard by protective conductors.

Two protective conductors shall be provided for a switchboard carrying a 3 phase switchgear thereon.

EARTH RESISTANCE:

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode (s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the Engineer-In-Charge, at additional cost as per the provisions of the contract.

MARKING:

Earth bars/ terminals at all switch board shall be marked permanently, as 'E'

Main earthing terminal shall be marked 'SAFETY EARTH- DO NOT DISCONNECT'.

10.0 UNINTERRUPTED POWER SUPPLY (UPS) :

Supply installation, testing and commissioning of 30 Min backup UPS connected parallel redundancy system with including batteries will be installed for the ELV system and floor wise common area light fixtures room wise and power points as required.

The UPS shall be designed to meet the following specification:

Technology	The UPS shall be based on IGBT technology for all the power converters i.e. rectifier, charger and inverter with built-in thermal monitoring and a high frequency chopping mode to dynamically optimize efficiency and power quality.
Rating	The UPS shall be sized to continuously supply specified KVA at 0.9pf
Rated apparent output power ratings	Upto 5KVA, 1 phase, 230 Volt Above 5KVA, 3 Phase, 415 Volt
Total Harmonic distortion (THDi)	≤ 3 %
Power Walk-in duration	Programmable from 1 to 125 sec. in steps of 1 sec.
Nominal voltage	380/400/415 VAC
Frequency	45-65 Hz ± 1%
Power factor	0.99
BACK UP TIME	30 min back up
Total Battery Qty. OR VAH	To be designed to meet the specified backup time.
TYPE	12V SMF-VRLA of Exide/AR-Quanta/GY-Rocket

BYPASS	Yes
Bypass input frequency range	$\pm 5\%$ (adjustable from 0,25 to 10%)
Switching from by-pass to Inverter	2 ms typical
SYSTEM AC/AC Efficiency (On line)	Full load – 94.0 (INCLUDING INBUILT OUTPUT ISOLATION TRANSFORMER)
DESCRIPTION& PRINCIPLE OF OPERATION	The UPS can be operated in four main operating modes: ON-LINE, FREQUENCY CONVERTER, ECO MODE and SMART ACTIVE and in their main variants described below.
Mode: ON-LINE	Normal Operation Emergency Operation Operation from By-pass
Mode: ECO	The load is normally powered from the emergency bypass supply and the rectifier maintains battery charge.
Mode: SMART ACTIVE	When the UPS is configured to operate in SMART ACTIVE mode, it automatically selects whether to operate in ON-LINE or ECO mode.
PFC CONVERTER (ZERO IMPACT SOURCE)	The PFC Converter converts the AC voltage into a DC supply to power the Inverter; if the mains or alternative power supply fails, the Converter will raise the battery voltage to a value suitable with which to power the Inverter.
BATTERY CHARGER (Battery Care System)	The "Battery Care System" is a set of functions arranged to help extend the working life the battery set and optimize its performance. The functions are: Battery recharging Battery test Protection against slow discharges Ripple current Battery recharge limit current Cold-Start UPS without batteries.
INVERTER	Voltage adjustment in static condition &dynamic condition. Frequency adjustment of Frequency stability & Frequency variation speed. Distortion of the output voltage. Overload. Short circuit capacity. Phase shift angle.
STATIC SWITCH (Automatic Bypass)	A static switch is an electronic device that can automatically transfer the loads connected to the UPS to the bypass supply in case of: Inverter overload limits are exceeded. Internal over temperature limits are exceeded. The Inverter fails. DC voltage goes outside the permitted range. UPS is equipped with a Redundant Auxiliary Power Supply for the Automatic Bypass

CONTROL PANEL	The UPS control panel consists of a graphical display, 6 visual warning LEDs and 4 function keys such as: GENERAL INFORMATION, DATA DISPLAY/NAVIGATION MENU, UPS STATE ERRORS – FAILURES, EVENT LOG FUNCTIONS
OTHERS	EMERGENCY SHUTDOWN (R.E.P.O.) EXTERNAL SYNCHRONISATION MONITORING AND CONTROL SOFTWARE CONFIGURATION SOFTWARE
GALVANIC ISOLATION	An internal transformer is connected to the output to guarantee galvanic isolation.
UPS CABINET	The cabinet is made of galvanized steel with an IP20 rating (degree of Ingress Protection), even with the front door open. Ventilation is forced and is guaranteed by ventilators located on the back; air intake is front to rear, output is on the back. The main assemblies (including the power module) are temperature monitored.

11.0 Lightning Protection System:

The 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.

The materials of lightning conductor, down conductors, earth termination etc., are aluminium and conform to BIS/IEC 62305.

Each down conductor has an independent earth termination. All the earth termination interconnected and shall be capable of isolation for testing using test links.

Earth pits will be installed in accordance with BIS: 3043. The resistance of earthing system shall not exceed 1 ohm.

12.0 External Illumination:

PATHWAY/ROAD LIGHTING ILLUMINATION:

- Lux level -30-50 lux at all places except parking area.
- Lux level-10-20Lux at outdoor parking area.
- Luminous efficacy shall be 120 lumen/watt or more.
- This plays an important role in providing the bridge a sound aesthetical look from outside.
- The proposed Landscaping lighting design will through LED flood light, Street light pole, led profile light etc as per BOQ..
- Suitable Astronomical time switch will be provided inside the feeder pillar to make auto switch ON /OFF of the circuit as per ECBC norms .
- The Landscape design will be carried out as per architectural requirements.
- All other public movement area light arrangement has been proposed through LED light with Octagonal GI piles/ Swaged type MS pole.

1) Design Considerations

- **Lighting Concept:**
 - The design should highlight architectural elements such as columns, windows, entrance, and other distinctive features.
 - Emphasis on creating a visually pleasing effect, considering the surroundings and building function.
 - Daytime and nighttime visual impact.

➤ **Light Distribution:**

- Uniform lighting to avoid hotspots or overly bright spots.
- Use of specific beam angles for accent lighting or grazing effects.
- Suitable luminance levels in relation to the type of building (commercial, residential, historical).

➤ **Light Color and Temperature:**

- **Color Temperature:** Specify the desired colour temperature, for example:
 - 1) Warm White (2700K-3000K)
 - 2) Neutral White (4000K)
 - 3) Cool White (5000K-6000K)
- **Color Rendering Index (CRI):** Typically, a minimum of 80 CRI for color accuracy.
- **RGB or Dynamic Color Effects (if applicable):** Ability to change color for events or holidays.

2) Lighting Equipment

I. Type of Fixture

- a) **Streetlights:** Context sensitive lighting is proposed within the project area. The design of the light pole is a derivation of the form of the temple and provides the required heritage looks and design language. The streetlights would be 7000mm long with 114mm dia cast iron pole with single arm bracket, LED 45-watt post top light and must comply with all necessary statutory requirements and approvals.
- b) **Solar Light:** Solar Lights of 40W LED All in one integrated solar streetlight are installed, which executes a compact and aesthetic look as well act as an environment friendly alternative for the site and must comply with all necessary statutory requirements and approvals.
- c) **Linear Profile Lighting:** LED linear lighting allowed for continuous light lines without any dark spots (previously left where one fluorescent tube finished and another started). Since the introduction of the LED into linear lighting the product type has grown from strength to strength with aesthetical and performance advances being constantly driven by ever-increasing demand.
- d) **Floodlights:** For large-area lighting or washing walls.
- e) **Spotlights:** For highlighting specific features or details.
- f) **Linear Fixtures:** For continuous light, suitable for grazing or contour lighting.
- g) **Recessed Fixtures:** For concealed lighting, creating subtle effects.
- h) **RGB or LED Systems:** If dynamic effects or color-changing features are required.

II. Fixture Mounting Type:

- a) Surface-mounted, flush-mounted, or pendant-mounted fixtures.
- b) Adjustable mounting brackets or structures for aiming the lights.
- c) Pole mounted, Floor Mounted fixtures.

III. Material and Finish:

- a) Durable, weather-resistant materials such as aluminium, stainless steel, or corrosion-resistant coatings.
- b) Matching the finish with the building's aesthetic (e.g., matte, polished, or anodized).

IV. Power Supply:

- a) Type of power supply (e.g., 110V, 230V, low voltage)
- b) Integration with existing electrical infrastructure.
- c) Remote transformers or drivers (for low-voltage lighting systems).
- d) Energy-efficient power supplies (e.g., LED drivers).

3) Electrical Specifications

- **Power Consumption:** Provide wattage and energy usage details per fixture or system.
- **Voltage and Current Ratings:**

Operating voltage (e.g., 120V, 230V).
Max current ratings for each lighting fixture.

- **Control Protocols:**

DALI (Digital Addressable Lighting Interface) or DMX for RGB or dynamic control.
Integration with BMS for automatic dimming and scheduling.

- **Circuiting:**

Design of electrical circuits for powering the fixtures.
Circuit protection (e.g., fuses, circuit breakers).
Power distribution panel details.

4) 5. Installation Details

- **Mounting and Positioning:** Specify the location for each light fixture, including heights, distances from the ground, and angles for optimal coverage.
- **Wiring and Cabling:**
 - a) Weatherproof cables and connectors.
 - b) Low-voltage cable installation if required.
 - c) Use of appropriate conduits for protection against external elements (e.g., UV resistance, waterproofing).
- **Safety and Compliance:**
 - a) All installations should adhere to local electrical codes and regulations.
 - b) Lighting fixtures should be rated for outdoor use (IP rating) and extreme weather conditions (e.g., waterproof or dustproof IP65, IP67).
 - c) Safety factors such as anti-vibration mounting, tamper-proof fixtures, etc.
- **Accessibility and Maintenance:** Ensure that fixtures are easily accessible for maintenance and lamp replacement (e.g., via ladders, lifts, or removable panels).

5) Performance Specifications

- **Lumen Output:**
 - a) Provide lumen output per fixture or total system output.
 - b) Ensure the lighting level complies with desired illuminance standards (lux) for the building facade.
- **Beam Angle and Spread:**
 - a) Specify beam angles (e.g., 30°, 60°, 120°) for different lighting effects.
 - b) Light distribution characteristics based on fixture type (e.g., flood, spot, narrow).
- **Lifetime and Warranty:**
 - a) Expected lifetime of light sources (e.g., LEDs typically 50,000+ hours).
 - b) Warranty period for fixtures and electrical components (usually 3–5 years).

6) Energy Efficiency and Sustainability

- **LED Technology:** Ensure all lighting fixtures use energy-efficient LED technology.
- **Energy Consumption Calculations:** Provide expected wattage, energy savings compared to traditional lighting systems.
- **Sustainability Features:** Use of recyclable materials, eco-friendly finishes, and low-impact light pollution.

7) Testing and Commissioning

- **System Testing:** Ensure proper installation and operation of all fixtures.
- **Light Level Measurements:** Verify uniformity of illumination and correct illuminance levels using a lux meter.
- **Control System Setup:** Test and configure lighting control systems to ensure proper function.

8) Maintenance and Support

- **Maintenance Schedule:** Outline the frequency of routine inspections and cleaning of fixtures.
- **Replacement Parts:** Specify any critical spare parts or components to have on hand for maintenance.

Following are the type of fixture & Description, which are required for external lighting & Façade Lighting.

- 1) Supply, Installation, Testing & Commissioning of 196mm Dia X 158mm Height RGBW Circular **Flood light** with Non-integral driver & completely made in India luminaire. Luminaire must use Single LED of RGBW ChIP and not discrete individual LEDs of each colour for colour effect. The luminaire's shall be made of Extruded aluminum housing powder coated in grey. The complete luminaire has IP66 & IK08 protection and it comprises of high purity integrated poly carbonate Lens. The LEDs shall have minimum CRI ≥ 80 (White LED) & shall have SDCM ≤ 5 . The luminaire shall have wattage 24W and shall deliver 1320 lumens. Beam angle of the Luminaire shall be 30 deg. Fixture shall operating temperature range of 0°C to 45°C. Input Voltage Range of 24V DC, Integrated DMX Decoder, No need to additional external decoder. The luminaire shall have declared life of 50,000 burning hours at L70. The luminaire shall be compatible with DMX controller. The luminaire shall automatically addressable using hand-held addressing device. The luminaire shall be capable of 8-bit control of RED, Green, Blue & White (W=4000K) to produce 16.7 million colours. Luminaire and Driver must be made in India with same brand. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79. The successful bidder must submit the NABL accreditation certificate for Luminaire manufacturer along with technical bid. LM80, RoHS compliance issued by LED luminaire manufacturer, BIS certificate for LED Luminaire. Brand name shall be embossed / engraved on each and every light fixtures. Luminaire and Driver should be Made in India. Luminaire, Driver and controller should be with same. (For lighting of Mandira, Pilgrim Centre, Interpretation Centre, watch tower & Parking area)
- 2) Supply, installation, testing & commissioning of Hot dip galvanised, polygonal raising lowering type **16M high masts** (Top Dia: 150mm, Bottom Dia: 410mm, PCD: 490mm) with fixed head frame suitable for mounting 6 nos. of 250W LED flood light fixtures complete with all accessories as required including foundation bolt manufactured from special steel along with nuts, washers, anchor plate and common template. OEM should provide test report of sheet, wire rope, Zinc Test Report. (For Parking area lighting)
- 3) Supply of 250W LED floodlight High performance floodlight luminaire with pressure die-cast housing, toughened glass and individual LEDs with secondary lens optics with IP66 ingress protection. 4 kV in-built and 10 kV external surge protection. Efficacy 120 lm/W. (For Parking area lighting)
- 4) supply, installation, testing & commissioning of Hot dip galvanised, polygonal raising lowering type **12M high masts** (Top Dia: 100mm, Bottom Dia: 360mm, PCD: 445mm) with fixed head frame suitable for mounting 6 nos. of 200W LED flood light fixtures complete with all accessories as required including foundation bolt manufactured from special steel along with nuts, washers, anchor plate and common template. OEM should provide test report of sheet, wire rope, Zinc Test Report. (For Parking area lighting)
- 5) Supply of 200W LED floodlight High performance floodlight luminaire with pressure die-cast housing, toughened glass and individual LEDs with secondary lens optics with IP66 ingress protection. 4 kV in-built and 10 kV external surge protection. Efficacy 120 lm/W. (For Parking area lighting)
- 6) Supply & installation 40W Hybrid AIO Smart **Integrated Solar Street Light** (150 lm/W) with built in Mono Crystalline Panel, Lithium Ferro Phosphate (LiFePO₄) Battery, MPPT Charge Controller and PIR Sensor with Colour Temperature 6000-6500K. 2 days autonomy with dimming profile with 5 meter long decorative lighting pole made up of Mild Steel Body with decorative cast aluminium base on the bottom of height 500mm. Pole shall be coated with zinc rich primer & pure polyester powder coating of black with gold embellishment finish. Pole having dia of $\varnothing 88.9$ mm and having base Plate of size 200×12 mm thick with provision for foundation bolt. Pole is Compatible for $\varnothing 70$ mm size for cable entry & exist. Junction Box service door is

made up cast aluminium and the control gear tray, aesthetic, ecofriendly & modern look in extruded aluminium construction with high efficiency monocrystalline silicon photo voltaic panel, high efficiency SMD LED 5700K having secondary lens optics for street lighting distribution, high performance lithium battery, MPPT charger controller and intelligent control module/sensor with higher reliability, long service life. The cost including installation with RCC foundation and all accessories. (For Landscape Area & Pathway Area)

- 7) Supply, Installation, testing & commissioning of Elegant look 80 W AIO LED **Solar Street lights** having extruded aluminium housing, 180Wp or more Mono Crystalline Panel/Laminates fixed on the top of the luminaire housing, maintenance free 12.8 volts 96 Ah or more LiFePO4 battery (BIS certified), BMS, MPPT charge controller, PIR sensor to provide 2 days (24 hrs) back up. The luminaire is having IP 65 protection for critical components, IK 07 and having lumen output of > 15000 (Min 150 LPW) lumen as LM 79 report of third party NABL lab. The solar street light must be having hybrid charge controller so that the light can work with AC power when the battery back up will not be available in the night time. Lenses should be provided on the LED chip for better lighting distribution to avoid glare on human eyes. Both the luminaire and Mono Crystalline Panel must be manufactured in India. The Solar lighting company must submit the third party NABL lab reports to justify the lumen efficacy, luminaire output, IK 07 and IP 65 protection. (For Street Lighting)

CCTV

The CCTV and Surveillance System shall control and monitor internal and outside area in the Campus as per NBC2016/relevant IS codes/Local by laws. The Bidder shall be responsible for Complete Design, Engineering, Supply, Installation, integration, Testing & Commissioning of CCTV Surveillance System.

Dome camera:-

These cameras shall be minimum 4MP Dome IR Network Camera (1/3" CMOS sensor, Mini. Pixel of 2688*1520 or higher video quality, frame rate of Up to 25fps, Ultra 265, H.265, H.264 & MJPEG video compression, 2.8mm Fixed lens, physical ICR filter of both day and night, 30mtr IR Distance, 120dB WDR, 3Streams Supported, WDR, 3D-DNR for noise reduction, BLC, ICR, EXIR, Audio In and Out, Alarm in and Out. IPv4/IPv6 network supported, IP67, IK10 rated for weatherproofing, ONVIF ver 2.2 or higher, PoE IEEE 802.3af (UL, FCC, CE, BIS certified.) with accessories as required. line crossing, perimeter intrusion, face detector.

Bullet camera:-

These cameras shall be minimum 4MP Motorised Verifocal Bullet IR Network Camera (1/3" CMOS sensor, Mini. Pixel of 2688*1520 or higher video quality, frame rate of Up to 25fps, Ultra 265, H.265, H.264 & MJPEG video compression, 2.8-12mm Fixed lens, physical ICR filter of both day and night, 50mtr IR Distance, 120dB WDR, 3Streams Supported, WDR, 3D-DNR for noise reduction, BLC, ICR, EXIR, Audio In and Out, Alarm in and Out. IPv4/IPv6 network supported, IP67, IK10 rated for weatherproofing, ONVIF ver 2.2 or higher, PoE IEEE 802.3af (UL, FCC, CE, BIS certified.) with accessories as required. Edge analytics: line crossing, perimeter intrusion, face detector.

PTZ camera:-

These cameras shall be UI Listed 5 MP PTZ Camera, ONVIF profile S&G, UL 1/2.8" CMOS, 2.14mp signal format (SDI): 1080P60, 1080P50, 1080P30, 1080P25, 1080I60, 1080I50, 720P60, 720P50, FOCAL LENGTH: 3.9MM-46.8MM Iris: F1.6-F2.8 Optical Zoom: 12x Digital Zoom: 12x field of view: 72.5 degree-6.3 degree focus: Auto, Manual, PTZ PUSH, One Push Min. ILLUMINATION: 0.5 Lux (Color), 0.1 lux (B/W) Shutter Speed: 1/25-1/10,000s. AGC: Auto/Manual White Balance: Auto, Indoor, Outdoor, One Push Manual, Auto Track AE Control: Auto, Manual, Shutter Priority, Iris. Video compression: H.265, H.264 frame rate 30 fps @ 3MP. Edge analytics: line crossing, perimeter intrusion, face detection, cross counting, LED IR distance upto 30 mtrs. IK 10 vandal proof, IP 66. POE specifications, with 3 mtr poll

stand and author accessories.

All the cameras shall be operative on automotive manual & scheduled mode. The cameras shall be UL/FM Listed. RJ-45 Cable connectors will be used for Network/POE connectivity. Cameras shall have inbuilt slot for memory card for local storage.

PRESENTER TRACKING CAMERA

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 & RoHS Certified with Test Lab Reports.

MEDIA PROCESSOR CAPTURE VISION STATION:

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. Quoted model should be CE, FCC & RoHS Certified with Test Lab Reports.

WIRELESS PRESENTER:

A surface mounted Wireless Presentation system, should support secure wired and wireless presentation from laptops, smartphones, and tablet devices using the existing Wi-Fi® wireless network for BYOD connectivity. Should support Miracast. Should have 1xHDMI input or more, Should have 1xHDMI output supporting 3840x2160@60Hz. support minimum of four simultaneous device to be displayed on a single screen. Should have built-in native integration with Microsoft® Office 365® and Outlook® calendaring applications via Microsoft Exchange, for Displaying space availability, meeting details, and other messaging on the connected room display, or a suitable external room scheduling panel should be provided. Should have native integration with content management application for digital signage which allows the wireless presentation unit to show content on a connected display when a space is not in use, or a suitable external digital signage unit should be provided. Should have option to share the 4K content wirelessly with separate dongle and should have option to pair the dongle with wireless presentation device. Should be capable of Powered via PoE+ compliant Ethernet switch or a PoE+ Injector Should be UL Listed for US and Canada, CE, IC, FCC Part 15 Class B digital device compliant Should have an option of Cloud management via IoT based platform for remotely provisioning, monitoring, and managing devices across an enterprise or an entire client base by the same OEM.

HDMI SWITCHER:

4x1 4K60 4:4:4 HDR AV Switcher with Input: 4 HDMI, Output: 1 HDMI, Video format support: HDR (High Dynamic Range) and Dolby Vision®, Deep Color, 4K60 4:4:4, Automatic switching of HDMI inputs, Advanced EDID management, Enterprise-grade security: Yes, Copy Protection: HDCP 2.3, Communications: Ethernet: 100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP, Web browser setup and control, IEEE 802.1X, Secure CIP, Authentication, SSH/SSL, TLS.

NETWORK VIDEO RECORDER:

General Requirement

The Network Video Recorder having internal memory 64Ch Network Video Recorder, Support Ultra H.265/H.265/H.264 video formats Supports mainstream cameras of ONVIF conformance (Profile S, Profile G, Profile T

and RTSP protocols. Support 2-ch HDMI, 1-ch VGA. HDMI1 and HDMI2 up to 4K (3840x2160) resolution Up to 12 Megapixels resolution recording. Support RAID 0, 1, 5, 6, 10, 8 SATA HDDs, Up to 10TB for each HDD. Support cloud upgrade compression shall Supports upto 5 MP Cameras with HDMI interface, 1 RJ 45 - 10/100/1000 M port for communication, 6 ch Alarm Input and 1 Output client Support. As actual engineering required hard disc store data as per client required. H.264 Video Compression, function as part of the video surveillance CCTV system. It shall also allow for search and management of the stored video data at a remote site via a LAN network. The VR shall have powerful Pentaplex Function, which includes simultaneous functions such as recording, playback, backup, remote surveillance and remote playback. When connected to the LAN, operator shall be able to view live camera images, and review playback footage as well as remotely configure the VR on which he has access rights. The controls software shall be easily to operate, but provide the necessary controls for the operator. It shall be possible to operate the VR through the front panel, USB mouse, IR remote controller or via the LAN connection.

Display:

- 55" UHD IPS Commercial Digital Display for Small Size Discussion & Chambers: Brightness (330 nits or higher), Dynamic Contrast Ratio (Dynamic MCI (Hz)):1000000:1, 1000000:1, Static (Panel) Contrast Ratio-1200:1, Response Time (G to G)-8 ms, Refresh Rate.-60 Hz, Life span (hrs)-30,000, Speaker (Sound Output):10W + 10W, Speaker System: 2.0 ch, DVB-T2/C Broadcasting System, Commercial Smart UX, webOS version (webOS 6.0).
- The live display output from the VR shall have live frame rate display for each split screen output. There shall be various modes of displays, including 1(Full Screen), 4, 9 and 16 splits.

Record:

- The VR shall start/stop recording by manual, schedule, or events (motion, sensor) triggered.
- For motion triggered recording, it shall be possible to define/configure the motion area and sensitivity.
- It shall be possible to enable or disable sensor alarm pre-recording function when the VR is set to event recording.
- The recorded video shall have encrypted digital signature so as to ensure security and prevention of tampering of the recorded images.
- It shall be possible to enable automatic file deletion so that the hard disk shall allow for FIFO management of the hard disk storage. It shall also be possible to configure the duration of the storage, so that older files outside the duration can be automatically deleted.
- The system shall have internal HDD capacity 8 TB and shall be support up to 64TB capacity.
- For easy and instant copy of files, the VR is capable to support backup via USB compact flash memory devices.

Search/Playback

- The VR shall allow for different search modes: Time/Date, Channel Search; Event Search; Time/Date, Channel Search: A single channel with a time bar would be displayed for selection. When using the event search, it shall be possible to list the events (alarms) based on the time of occurrence of the alarms. Once selected, the VR shall begin playback at that particular time, together with the pre-record video if this has been predefined.
- The VR shall allow for Multi-Channel playback in single mode or split modes.
- If audio is recorded, the VR shall allow for Audio playback when single video playback is selected.
- The Forward/Backward playback speed shall be adjustable.
- The VR should playback forward Frame by Frame via toggle operation.

Ethernet

- The VR shall be connected to a LAN network for Remote Surveillance, Remote Playback via a work station.
- It shall be possible to perform VR Status/Event Checking and Remote Control Setup via the remote workstation.
- Fixed IP can be defined when a LAN is connected.
- The VR shall have an integrated management capability via its PC management software of VCS. When connected, the integrated management capability allows control of the VRs both locally and remotely.

Operations

It shall be possible to operate the equipment using the following means: Front Panel, Integrated Management Software, IR controller and USB mouse.

USB mouse Controls

Insert a USB mouse to VR, the VR shall display a mouse cursor, and shall be operated by the mouse.

Remote Access Software

It shall be possible to access the VR remotely using the remote access software provided. Each VR shall be able to connect up to minimum of 10 remote users at any time. The user shall be granted access rights according to the configurations of the VR. The remote access software shall have the following features:

- Real-time surveillance function
- Remote search function
- Simultaneous video data search and surveillance function
- Remote VB control function
- E-map function
- Save video function (Download function)
- Convenient user interface
- Remote system control function
- Sensor Viewer function
- Real-time/File Search video function
- Remote Control Configuration File Load/Save function
- System/ Event Log Viewer function

TELEPHONE DISTRIBUTION BOARD

Telephone Tag Block shall be fabricated from 1.63 mm thick M.S. Sheet duly powder coated after metal treatment. Telephone Distribution Board shall be equipped with krone type tag block of size as per Standard. Tag block shall be double jumpering type and shall be suitable for termination of extra pair provided in wiring/ cabling of each outlet. Box shall have hinged cover and finish shall match with aesthetic finish of the building.

COMPUTER DATA NETWORKING SYSTEM

CABLES:

AWG (0.6mm), 4 Pair, solid bare copper, polyethylene insulated cable having diameter of 1.22mm maximum, sheathing for PVC <6.6mm overall & Four pairs twisted together unscreened Data Cable Giga-speed (CAT6).

JACK PANEL:

Port Powersum Jack Panel meeting all the requirements of T568A & ISO 118001 & have been tested & verified by Elektronik Centralen.

INFORMATION OUTLET:

Information Outlet RJ45 with shutter for dust protection & should be colour coded for T568A/B wiring configuration with IDC's & compatible to 110 tools.

Simplex Faceplates with provision for single information outlet & with complete gang boxassembly.

RACK:

19 inches standard 9/12 U Racks with see through lockable door, cable management accessories, power distribution box, fans for heat dissipation with fan tray & switch trays.

TECHNICAL SPECIFICATIONS OF P.H. PORTION OF WORK

(Internal & External PH Engg. Works)

1.1 : GENERAL INSTRUCTIONS: The detailed specifications given hereinafter are for the items of works described herein, and shall be guidance for proper execution of work to the required standards. The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

Unless specifically otherwise mentioned, all the applicable latest codes and standards published by the Indian Standard Institution and all other standards shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued there to or revisions thereof, if any. In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, and requirements of the Engineer-in-Charge. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust etc. under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each phase.

The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

The contractor shall clear the site thoroughly of all debris, surplus excavated materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.

In case any difference or discrepancy between the specifications and the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specifications and drawing, the specifications shall take precedence. In case any difference or discrepancy between the specifications for Civil works and specification for Public Health Engg. works, specifications for Civil works shall take precedence.

1.2 LIST OF INDIAN STANDARDS

The following IS codes shall be referred in execution of PH Engineering works.

Indian Standard	Reaffirmation	Subject

27 - 1992	Reaffirmed 2002	Specifications for Pig Lead
269- 1989	Reaffirmed 2004	Specifications for 33 grade Ordinary Portland Cement
407- 1981	Reaffirmed 2001	Brass tubes for General purposes
456- 2000	--	Code of practice for Plain & Reinforced concrete.
458- 2003	--	Specifications for Concrete Pipes.
554- 1999	--	Dimensions for pipe thread where pressure tight joints are required.
636- 1988	Reaffirmed 2003	Fire fighting hose ,rubber lined or fabric reinforced rubber lined woven -jacketed
638- 1979	Reaffirmed 2003	Sheet rubber jointing & rubber insertion jointing
651- 1992	Reaffirmed 2003	Specifications for Salt glazed stoneware pipes & fittings.
771 (Pt. I & VII)		Glazed Fire Clay Sanitary Appliances.
771- 1979 (Pt. I)	Reaffirmed 2003	General requirements
771- 1985 (Pt. II)	Reaffirmed 2003	Specific requirements of kitchen & laboratory sinks
771- 1979 (Pt. III/ Sec 1)	Reaffirmed 2003	Specific requirements of urinals (section 1- Slab urinals)
771- 1985 (Pt. III/ Sec2)	Reaffirmed 2000	Specific requirements of urinals (section 2- Stall urinals)
771- 1979(Pt. IV)	Reaffirmed 2003	Specific requirements of postmortem slabs.
771- 1979 (Pt. V)	Reaffirmed 2003	Specific requirements of shower trays
771- 1979 (Pt. VI)	Reaffirmed 2003	Specific requirements of bed pan sinks
771- 1981 (Pt. VII)	Reaffirmed 2003	Specific requirements of slop sinks
774- 1984	Reaffirmed 2000	Flushing cistern for water closet and urinals.
775- 1970	Reaffirmed 2000	Cast iron brackets and supports for wash basin and sink.
778- 1984	Reaffirmed 2000	Specifications for copper alloy gate & Globe check valves for water works
Indian Standard	Reaffirmation	Subject
779- 1994	Reaffirmed 2004	Water meters (domestic type)
781- 1984	Reaffirmed 2001	Specifications for cast copper alloy screw down bib taps & stop cocks for water services
782- 1978	Reaffirmed 2003	Specification for Caulking lead.
783- 1985	Reaffirmed 2001	Code of practice for laying concrete pipes.
784- 2001	Reaffirmed 2002	Pre-stressed concrete pipes.
884- 1985	Reaffirmed 2000	Fire aid hose reel for firefighting (for fixed installation)
901 – 1988	Reaffirmed 2003	Specification for couplings, double males & double female, instantaneous pattern for Fire Fighting
902 – 1992	--	Specification for suction hose couplings for Fire Fighting purposes.
903 – 1993	Reaffirmed 2003	Couplings for fire hose delivery, branch pipe, nozzles specification
904 – 1983	Reaffirmed 2000	Specification for 2 way and 3 way suction collecting heads for Fire Fighting purposes.
905 - 1980	Reaffirmed 2002	Specification for delivery breechings, dividing and collecting instantaneous pattern for Fire Fighting
906 – 1988	Reaffirmed 2000	Specification for revolving branch pipe for Fire Fighting
907 – 1984	Reaffirmed 2000	Specification for suction strainer, cyclindrical type for Fire Fighting purposes.
908- 1975	Reaffirmed 2000	Fire Hydrants, Stand post type
909- 1992	Reaffirmed 2002	Specifications for underground fire hydrants, sluice valve

		type
940 – 1989	--	Portable Fire Extinguisher, water Type (Gas Cartridge) – Specification
941- 1985	Reaffirmed 2000	Specification for Blower and Exhauster for Fire Fighting.
1172- 1993	Reaffirmed 2002	Code of basic requirements for water supply, drainage and sanitation
1200-1979 (Pt. 16)	Reaffirmed 2002	Method of measurements for Laying of water and sewer lines including appurtenant items.
1200-1981 (Pt. 19)	Reaffirmed 2002	Method of measurements for Water supply, plumbing and drains.
1239- 2004 (Pt I)		Specifications for Mild steel tubes
1239- 1992 (Pt. II)	Reaffirmed 2002	Specifications for Mild steel Tubular & other wrought steel pipe fittings
1300- 1994	Reaffirmed 2000	Phenolic moulding material specification
1536- 2001	--	Specifications for Centrifugally cast iron (spun) pressure pipes for water, gas and sewage
1537- 1976	Reaffirmed 2000	Specifications for Vertically cast iron pressure pipes for water, gas and sewage
1538 -1993	Reaffirmed 1999	Cast iron fittings for pressure pipes for water, gas and sewage
1700- 1973	Reaffirmed 2003	Drinking fountains
1701- 1960	Reaffirmed 2003	Combination valve , mixing valves
1703- 2000		Ball valve (horizontal plunger type) including floats for water supply.
1711- 1984	Reaffirmed 2000	Self closing taps.
1726- 1991	Reaffirmed 2003	Cast iron manhole covers and Frames.
1729- 2002	--	Cast iron/ductile iron drainage pipes and fittings for over ground NP pipeline S/S series.
1742- 1983	Reaffirmed 2002	Code of practice for building drainage
1795- 1982	Reaffirmed 2000	Pillar taps for water supply purposes
1978- 1982	Reaffirmed 2002	Specification for line pipe (M S Seamless)
1979- 1985	Reaffirmed 2002	Specification for high test line pipe
2065- 1983	Reaffirmed 2001	Code of practice for water supply in buildings.
2097 – 1983	Reaffirmed 2000	Specification for foam making branch pipe.
2104- 1981	Reaffirmed 2003	Water meter boxes (domestic type)
2171 – 1999	--	Specification for portable fire extinguisher, dry powder (Cartridge Type)
2190- 1992	Reaffirmed 2002	Code of practice for selection ,installation & maintenance of portable first-aid fire extinguishers
2267- 1995	Reaffirmed 2000	Polystyrene moulding and extension materials – specification
2326- 1987	Reaffirmed 03	Automatic flushing cistern for urinals
2379- 1990	Reaffirmed 2000	Colour code for identification of pipe lines.
2401- 1973	Reaffirmed 2003	Code of practice for selection, installation & maintenance of domestic water meters

2470 (Pt. I to II)	--	Code of practice for installation of septic tanks
2470- 1985 (Pt.I)	Reaffirmed 2001	Design criteria & construction
2470- 1985 (Pt.II)	Reaffirmed 2001	Secondary Treatment & disposal of septic tank effluent
2527- 1984	Reaffirmed 2000	Code of practice for fixing rain water gutters and down pipes for roof drainage.
2546 – 1974	Reaffirmed 2000	Specification for galvanized Mild Steel Fire bucket.
2548- 1996(Pt. I)	Reaffirmed 2002	Plastic water closet seats and covers.
2548- 1996(Pt. II)	Reaffirmed 2002	Plastic water closet seats and covers.
2556 (Pt. 1 to XV)	--	Specification for Vitreous (Vitreous China) sanitary appliances.
2556-1994 (Pt.1)	Reaffirmed 2004	General requirements
2556-1994 (Pt.2)	Reaffirmed 1999	Specific requirements of wash down water- closets
2556- 2004 (Pt.3)	--	Specific requirements of squatting pans
2556- 2004 (Pt.3)	--	Specific requirements of squatting pans
2556- 2004 (Pt. 4)	--	Specific requirements of wash basins
2556- 1994 (Pt.5)	Reaffirmed 2004	Specific requirements of laboratory sinks
2556- 1995(Pt.6)	Reaffirmed 2003	Specific requirements of urinals & partition plate
2556- 1995 (Pt.7)	Reaffirmed 2003	Specific requirements of accessories for sanitary appliances
2556- 1995 (Pt.8)	Reaffirmed 1998	Specific requirements of pedestal close coupled & wash down and siphonic water closets
2556- 2004 (Pt.9)	--	Specific requirements of pedestal type bidets
2643 -1999	--	Type Threads where pressure tight joints are not made on the threads – dimension, tolerances and designation
2692- 1989	Reaffirmed 2003	Specification for Ferrules for water services.
2871- 1983	Reaffirmed 2000	Specification for Branch pipe, universal, for firefighting purposes
2878 – 2004	--	Fire Extinguisher, Carbon Dioxide Type (Portable and Trolley Mounted) – Specification.
2951 (Pt. I to II)	--	Recommendation for estimate of flow of liquids in closed conduits.
2951- 1965 (Pt. I)	Reaffirmed 2003	Head loss in straight pipes due to frictional resistance
2951- 1965 (Pt. II)	Reaffirmed 2003	Head loss in valves & fittings.
3006- 1979	Reaffirmed 2003	Specification for Chemically resistant glazed S.W. pipes and Fitting
3076- 1985	Reaffirmed 2003	Low density polyethylene pipes for potable water supply
3114- 1994	Reaffirmed 2004	Code of practice for laying of Cast Iron pipes.
3311- 1979	Reaffirmed 2003	Waste plug & its accessories for sinks & wash basins.
3328- 1993	Reaffirmed 2003	Quality tolerances for water for reservoir
3389- 1994	Reaffirmed 2000	Urea formaldehyde moulding materials
3486- 1966	Reaffirmed 2000	Specification for Cast iron spigot and socket drain pipes

3489- 1985	Reaffirmed 2000	Specifications for enameled steel bath tubs
3589- 2001	--	Specifications for steel pipes for water & sewage (168.3 to 2540 mm outside dia.)
3597- 1998	--	Method of test for concrete pipes.
3844- 1989	Reaffirmed 2000	Code of practice for installation and maintenance of internal fire hydrants Hose Reels in premises.
3950- 1979	Reaffirmed 03	Specification for Surface boxes for sluice valve.
3989- 1984	Reaffirmed 2000	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings & accessories.
4038- 1986	Reaffirmed 2000	Foot valves for water works purposes.
4111 (Pt. I to V)		Code of practice for ancillary structures in sewage system.
4111- 1986 (Pt. I)	Reaffirmed 2001	Manholes
4111- 1985 (Pt. II)	Reaffirmed 2001	Flushing tanks
4111- 1985 (Pt. III)	Reaffirmed 2001	Inverted siphon
4111- 1968 (Pt. IV)	Reaffirmed 2001	Pumping stations & pumping mains (rising mains)
4111- 1993 (Pt. V)	Reaffirmed 2004	Tidal out-falls
4120- 1967	Reaffirmed 2000	Tubs and baths.
4127- 1983	Reaffirmed 2001	Code of practice of laying of glazed stone ware pipes.
4308 – 2003	--	Dry Chemical Powder for Fighting B & C class Fires– Specification.
4350- 1967	Reaffirmed 2001	Specification for concrete porous pipes for under drainage.
4733- 1972	Reaffirmed 1992	Methods of sampling & test for sewage effluents
4736- 1986	Reaffirmed 2001	Specification for hot –dip zinc coating on mild stele tubes.
4854 (Pt. I to III)		Glossary terms for valves and their parts
4854- 1969 (Pt. I)	Reaffirmed 1999	Screw down stop, check & gate valves & their parts
4854- 1968 (Pt. II)	Reaffirmed 1999	Plug valves & cocks & their parts
4854- 1974 (Pt. III)	Reaffirmed 1999	Butterfly valves
4927- 1992	Reaffirmed 2002	Unlined flax canvass hose for fire fighting
4947 – 1985	Reaffirmed 2000	Specification for gas cartridge for use in Fire extinguishers.
4984- 1995	Reaffirmed 2002	Specifications for HDPE pipes for water supply
4985- 2000	--	Specifications for unplasticised PVC pipes for potable water supplies
5290- 1993	Reaffirmed 2003	Specifications for Landing valves.
5312 (Pt. I)		Swing check type reflux (non return) valves
5312- 1984 (Pt. I)	Reaffirmed 2000	Reflux (non return) valves – single door pattern
5329- 1983	Reaffirmed 2001	Code of Practice for sanitary pipe work above ground for building
5330- 1984	Reaffirmed 2000	Criteria for design for anchor blocks for pen- stocks with expansions joints.

5382- 1985	Reaffirmed 2003	Specifications for rubber sealing rings for water, gas & sewer mains
5455- 1969	Reaffirmed 2003	Cast iron steps for manholes
5600- 2002	--	Specifications for Sewage and drainage pumps
5611- 1987	Reaffirmed 2002	Code of Practice for waste stabilization ponds (Facultative type)
5714- 1981	Reaffirmed 2002	Specifications for Hydrant stand-pipe for firefighting
5822- 1994	Reaffirmed 2004	Code of Practice for laying of welded steel pipes for water supply
5961- 1970	Reaffirmed 2003	Specifications for Cast Iron grating for drainage purposes
6234-2003	----	Portable fire Extinguisher water Type (Stored Pressure) – Specification
6279- 1971	Reaffirmed 2001	Equipment for grit removal
6280- 1971	Reaffirmed 2001	Sewage screens
6295- 1986	Reaffirmed 2001	Code of practice for water supply & drainage in high altitude & / or sub-zero region
6392- 1971	Reaffirmed 1998	Steel pipe flanges
6411- 1985	Reaffirmed 2000	Specifications for gel coated glass fiber reinforced polyester resin bath tubs
6418- 1971	Reaffirmed 2000	Cast Iron & malleable flanges for general engg. Purpose
6494- 1988	Reaffirmed 2000	Code of Practice for water proofing of under ground water tanks
6587- 1987	Reaffirmed 2003	Specifications for Spun hemp yarn
7181- 1986	Reaffirmed 2000	Horizontally Cast Iron Double Flanged pipe for water, gas & sewage.
7231- 1994	Reaffirmed 2004	Specifications for Plastic Flushing Cisterns for w.c. & urinals
7558- 1974	Reaffirmed 2001	Code of Practice for domestic hot water installations
7634 (Pt. I to III)		Code of Practice for Plastic pipe work for potable water supplies
7634- 1975 (Pt. I)	Reaffirmed 2002	Choice of materials & general recommendations
7634- 1975 (Pt. II)	Reaffirmed 2002	Laying & jointing polyethylene (PE) pipes
7634- 2003 (Pt. III)	--	Laying & jointing unplasticised PVC pipes
7740- 1985	Reaffirmed 2001	Code of Practice for road gullies
7834 (Pt. I to VIII)		Injection moulded PVC socket fittings with solvent cement joints for water supplies
7834 – 1987(Pt.I)	Reaffirmed 2003	General requirements
7834- 1987 (Pt.II)	Reaffirmed 2003	Specific requirements for 45 elbows 0
7834- 1987 (Pt. III)	Reaffirmed 2003	Specific requirements for 90 elbows 0
7834- 1987 (Pt. IV)	Reaffirmed 2003	Specific requirements for 90 tees 0
7834- 1987(Pt.V)	Reaffirmed 2003	Specific requirements for 45 tees 0
7834- 1987 (Pt. VI)	Reaffirmed 2003	Specific requirements for sockets

7834- 1987(Pt. VII)	Reaffirmed 2003	Specific requirements for unions
7834- 1987 (Pt. VIII)	Reaffirmed 03	Specific requirements for caps
8008 (Pt. I toVII)		Injection moulded HDPE fittings for potable water supplies
8008- 2003 (Pt. I)	--	General requirements for fittings
8008- 1976 (Pt. II)	Reaffirmed 1997	Specific requirements for 90 bends 0
8008- 2003 (Pt. III)	--	Specific requirements for 90 tees 0
8008- 2003 (Pt. IV)	--	Specific requirements for reducers
8008- 2003 (Pt. V)	--	Specific requirements for ferrule reducers
8008- 2003 (Pt. VI)	--	Specific requirements for pipe ends
8008- 2003 (Pt. VII)	--	Specific requirements for sandwich flanges
8090 – 1976	Reaffirmed 2000	Coupling, branch pipe, nozzle used in hose reel tubing for fire fighting
8329- 2000	--	Centrifugally cast (spun) ductile iron pressure pipes and fittings for water, gas & sewage
8413 (Pt. I)		Requirements for biological treatment equipment
8413- 1977 (Pt. I)	Reaffirmed 2001	Trickling Filter
8718- 1978	Reaffirmed 2000	Specifications for vitreous enameled steel kitchen sinks
8727- 1978	Reaffirmed 2000	Specifications for vitreous enameled steel wash basin
8835- 1978	Reaffirmed 1999	Guideline for planning and design of surface drains.
8931- 1993	Reaffirmed 2003	Specifications for copper alloys Fancy single taps, combination tap assembly & stop valves for water services
9140- 1996	Reaffirmed 2002	Method of sampling of vitreous & fire clay sanitary appliances
9293- 1991	Reaffirmed 1996	Specifications for flax canvas
9338- 1984	Reaffirmed 2000	Specifications for Cast Iron screw down stop valves and stop & check valves for water works purposes
9668- 1990	Reaffirmed 2000	Code of practice for provision & maintenance of water supplies for Fire Fighting
9739- 1981	Reaffirmed 2003	Specifications for Pressure reducing valves for Domestic water supply system.
9758- 1981	Reaffirmed 2003	Flush valves and Fittings for water closets and urinals
9762- 1994	Reaffirmed 2004	Specifications for polyethylene floats for float valves
9763- 2000	--	Specifications for Plastic Bib taps, pillar taps, angle valves and stop valves for hot & cold water service.
9972 – 2002	--	Specification for Automatic sprinkler Heads for Fire Protection Service.
10221- 1982	Reaffirmed 1997	Code of practice for coating and wrapping of underground M.S. steel pipeline,
11108 - 1984	Reaffirmed 2000	Specification for portable fire Extinguisher Halon 1211 Type.
11606 – 1986	Reaffirmed 2000	Method for sampling of cast iron pipes and fittings.

12183- 1987 (Pt. I)	Reaffirmed 2004	Code of practice for Plumbing in multi- storied buildings (for water supply)
12231 – 1987	Reaffirmed 2003	UPVC pipes for section & delivery lines of agricultural pumps– Specification.
12235 – 1986	Reaffirmed 1998	Method of test for UPVC pipe for potable water supply
12288 – 1987	Reaffirmed 2002	Code of practice for use and laying of Ductile Iron pipes
12469 – 1988	Reaffirmed 2002	Specifications for pumps
12592- 2002	--	Precast concrete frame & cover (SFRC frame & cover)
12701-1996	Reaffirmed 2002	Specifications for rotational moulded polyethylene water storage tanks
12709 - 1994	Reaffirmed 2004	Glassfiber reinforce plastic(GRP) pipes, joints & fittings for use for potable water supply – Specification.
12820 – 1989	Reaffirmed 1999	Dimensional Requirements of Rubber Gaskets for Mechanical Joints & push in joints for use with Cast Iron Pipes & fittings for carrying water, Gas & sewerage.
13095 – 1991	Reaffirmed 2003	Butterfly valves for general purposes
13382-2004	-	Cast Iron specials for mechanical & push-on flexible joints for pressure pipelines for water, gas & sewage
13592- 1992	Reaffirmed 2002	Specifications for PVC soil, waste & rain water (SWR) including ventilation pipes
13593 - 1992	Reaffirmed 2002	UPVC pipes fittings for use with section and delivery lines for Agricultural pumps – Specification.
13916 – 1994	Reaffirmed 2004	Code of practice for installation of GRP piping system.
13983-1994	Reaffirmed 2004	Specifications for stainless steel kitchen sinks & drain boards for domestic purpose
14333-1996	Reaffirmed 2001	Specification for HDPE pipes for sewerage system.
14402-1996	Reaffirmed 2001	GRP pipes, joints & fittings – Specification.
14735-1999	Reaffirmed 2004	UPVC injection moulded fittings for UPVC – SWR pipes – Specifications.
14845- 2000	Reaffirmed 2004	Resilient seated cast iron air relief valves for water works purposes – Spn
14846- 2000	--	Specifications for sluice valve for water works purposes (50 to 1200 mm size)
15265 – 2003	--	Specifications for flexible PVC pipes or polymer reinforcement thermo plastic hoses for suction and delivery lines for Agricultural pumps.
15328 – 2003	--	UPVC non pressure pipes for use in underground drainage and sewerage system – Specifications.
15450- 2004	--	Polyethylene/Aluminium/Polyethylene composite pressure pipes for hot and cold water supplies – Specifications.

1.3 MINIMUM WEIGHT OF MOST COMMONLY USED SANITARY APPLIANCES & WATER FITTINGS:

The minimum unit weight of each fitting shall not be less than as given in the following table and tolerance for weight shall be as per relevant IS code.

S.N.	Description of items	Nominal size/ thickness	IS code	Minimum Unit Weight
1	Brass non-fancy type Bib Tap Please see Table under relevant item for other sizes.	15mm	781- 1984	400 Grams
2	C.P. brass fancy type Bib Tap	15mm	8931- 1993	550 Grams
3a	Brass non-fancy types Stop cock– Internally threaded	15mm	781- 1984	330 Grams
3b	Brass non-fancy types Stop cock– Externally threaded	15mm	781- 1984	400 Grams
4	C.P. brass fancy types Stop cock	15mm	8931- 1993	550 Grams
5	C.P. brass concealed typed Stop cock	15mm	8931- 1993	750 Grams
6	C.P. brass fancy Pillar Tap	15mm	1795- 1982	650 Grams
7	C.P. brass waste coupling	32mm	3311- 1979	200 Grams
8	C.P. brass waste coupling	40mm	3311- 1979	250 Grams
9 a	C.I. Nahani Trap 165mm inlet	75mm (outlet)	1729-2002 / 3989- 1984	6.50 Kg. dia.
9 b	C.I. Floor Trap 100 mm inlet dia.	75mm (outlet)	1729-2002 / 3989- 1984	4.80 Kg.
9 c	C.I. Nahani Trap with 20 mm water seal	65mm (outlet)	non ISI	4.50 Kg.
10	Cast Iron surface box for sluice valve (rectangular shape)		3950-1979	33 kg.

The minimum unit weight of each fitting shall not be less than as given in the following table, which are used in General practice.

S.N.	Description of items	Nominal size / thickness	Minimum Unit Weight
1	C.P. brass fancy Shower rose	15mm	125 Grams
2	C.P. brass bottle trap	32mm.	500 Grams
3	C.P. brass bottle trap	40mm	550 Grams
4	C.P. brass Liquid soap dispenser		250 Grams
5	C.P. brass coat and hat hook		150 Grams
6	C.P. brass Towel rod bracket [pair]		100 Grams

7	C.P. brass Towel rod [600 mm long]	20mm	150 Grams
8	G.I. Clamps thickness for GI piping	2 MM	
9	MS Clamps thickness for CI piping	3 MM	
10	Rain water lead sheet flashing		38.00 kg/sqm
11	C.I. frame and cover for Gully Trap		7.50 kg.
12	S.S. grating for Nahani Trap		50 Grams
13	C.P. brass grating for Nahani Trap		190 Grams
14	C.P. Brass Dome shape grating		275 Grams
15	Cast Iron surface box for sluice valve (circular shape)		14 kg.

1.4 MANDATORY TESTS / OPTIONAL TESTS :-

1. The following mandatory tests shall be carried out when the qty. of materials to be incorporated in the work exceeds the minimum qty. specified in col.5 of the table below irrespective of whether the materials are with I.S. mark, or otherwise.
2. Optional tests specified or any other tests shall be carried out in case of specialized work/ important structure at Department's discretion.
3. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for all mandatory tests.
4. Testing charges for optional tests shall be paid by the Dept. However, the incidental charges and cost of sample for testing shall be borne by the contractor.
5. In case of non-I.S. materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant I.S. specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for such tests.

1.4.1 Mandatory tests for P.H.E. works :

Material	Test	Field/lab test	Test Procedure	Minimum quantity of material / work for carrying out the test 5	Frequency of sampling	Remarks
1	2	3	4	5	6	7
Cement Bricks	As per Civil specification					
Precast concrete man hole frame & covers / gratings	Dimension Load test	Lab	IS 12592 (Part I)	> 20 frame & covers / gratings	Sampling as per IS 12592 (Part-I)	
CI man	Dimension	Lab	IS 1726	>50 frame	Sampling	

hole frame & covers	Load test			& covers / gratings	as per IS 1726	
Hume pipe NP class	Dimension Hydrostatic test Three-edge bearing Absorption test	Lab/field Lab Lab Lab	IS 458 IS 3597 IS 3597 IS 3597	>50 pipes	As per IS 458	
Sanitary fittings	Manufacture's Test certificate to be produced IS mark materials.					
CP brass fittings Bib taps / stop cocks	Manufacture's Test certificate to be produced IS mark materials.					

3.0 SANITARY INSTALLATIONS

3.1 INDIAN WATER CLOSET

3.1.01 GENERAL : The item pertains for providing white or colour glazed vitreous chinaware Indian water closet of size and colour as specified in the schedule including fixing.

3.1.02 MATERIAL : Squatting Pan (Orissa Pattern) is of white or colour glazed vitreous China conforming IS 2556 Part III. Pan shall have flushing rim and are inlet of self draining type. It shall have weep hole at the following inlet to the Pan. The flushing inlet shall be in front unless otherwise specified. The inside of the bottom of the pan shall have sufficient slope from the front to the outlet and surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have groove at right angle to the axis of the outlet. In all the cases pan shall have be provided with 100 mm Glazed Vitreous China 'P' or 'S' trap with 50 mm water seal and 40 mm size vent harm.

3.1.03 FIXING : The water closet pan shall be placed in position as shown. The IWC shall be supported on brick masonry in CM 1:4 or as directed by the Engineer-in-charge. The pan shall be fixed slightly lower than the floor level. If the pan or trap is damaged during handling of fixing, it shall be replaced by the contractor at his own cost. The pan, trap and C.I. pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and floor shall be finished with white/matching cement as directed.

3.1.04 PROTECTION AND FINAL CLEANING : The IWC shall be covered with husk and sand till all the civil and electrical works are completed and shall be removed and cleaned on completion of civil and electrical works prior to testing and handing over. However the contractor should ensure that the out let is plugged with gunny bags or similar materials to avoid the pipe getting blocked.

3.2 EUROPEAN/ ANGLO INDIA WATER CLOSET :

3.2.01 GENERAL : The item pertains for providing white or colour glazed vitreous chinaware European or Anglo Indian water closet with seat and cover of size and colour as specified in the schedule including fixing.

3.2.02 MATERIAL : European type water closet shall be wash down pattern unless otherwise

specified. Water closet shall be vitreous china conforming to IS 2556 (Part-I & II). The closet shall be of one piece construction and shall have minimum two hole of 6.5 mm diameter for fixing closet to floor. Closet shall have an integral flushing rims of self draining type. Each water closet shall have an integral trap with either 'S' or 'P' outlet with and trap shall be uniform and smooth in order to enable an efficient flush. Plastic seat and cover shall be of black colour or as specified, they shall have conformity to IS2548 Part I & II.

3.2.03 FIXING : The water closet pan shall be placed in position. If the pan trap is damaged during handling or fixing, it shall be replaced by the contractor at his own cost. The pan, soil pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and floor shall be finished with white/matching cement and sand as directed. Seat and cover shall be fixed to the Pan by two corrosion resistance hinge with 65 mm shank and threaded to within 25 mm from of flange. Seat shall be fixed in level by providing the washers of rubber with non ferrous or stainless steel washer to bolt.

3.3 WASH BASIN :

3.3.01 GENERAL The item pertains for providing colour or white glazed vitreous chinaware wash basin with or without pedestal of size and colour as specified in the schedule including fixing.

3.3.02 MATERIAL : . Wash basins shall be of vitreous china conforming to IS : 2556(Part-IV) of flat back or angle back as specified shall be of one piece construction including combined over flow, basin shall be provided with single or double tap holes of size 28 mm square or 30 mm rounded. Each basin shall have circular waste hole, or 5 sq.cm slot type over flow. Pedestals for wash basin shall be exactly same glazing that of basin. Pedestal shall be capable of supporting the basin and completely recessed at the back to accommodate supply and waste pipes and fittings. The basin shall be supported on pan of C.I cantilever brackets conforming to IS 775. Use of MS angle or Tee Section as bracket is not permitted.

3.3.03 FIXING The wash basin shall be fixed in position as indicated in the drawing. Basin shall be supported on a pair of C.I brackets which is embedded in cement concrete (1:2:4) block 100 x 75 x 150 mm. Oval shape or round shape wash basins are required to be fixed in RCC platform with stone tapping either fully sunk in stone top or flush with stone topping. The wall plaster on seat shall be cut to rest over the top edge of the basin so as not to leave any gap for water seepage through between wall plaster & skirting of basin. The gap between basin and wall shall be finished with white matching cement.

3.4 URINAL :

3.4.01 GENERAL : The item pertains for providing colour or white glazed vitreous chinaware urinal in single or range (1,2 & 3) and size as specified in the schedule with necessary fittings and appliances including fixing.

3.4.02 MATERIAL :

3.4.02.1 BOWL TYPE (WITH FLUSHING RIM) : Urinal basin shall be flat back or corner wall type lipped in front. The vitreous china conforming to IS 2556 (Part VI). Urinal shall have and integral flushing rim and inlet or supply horn for connecting flush pipe. Flushing rim and inlet shall be of the self draining type. At bottom of basin and outlet horn for connecting outlet shall be provided. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing.

3.4.02.2 BOWL TYPE FLAT BACK WITHOUT FLUSHING RIM : They shall be of vitreous china conforming to IS:2556 (Part-VI) constructed in one piece with providing slot or alternative fixing

arrangement at flat back and where the integral flushing rim is not provided, they shall be provided with ridges inside the bowl to divert towards the front line of the urinal.

3.4.02.3 STALL URINALS : The stall urinal and its screen shall be glazed fire clay conforming IS :771 (Part-III, Sec-2). The inside surface of stall and screen shall be regular and smooth throughout to ensure efficient flushing.

3.4.02.4 CP BRASS FLUSH PIPE : The flushing arrangement to urinals for single or in range shall be of CP brass with CP brass spreader of 15 mm dia conforming to IS : 407. The capacity of flush pipe for urinal in a range shall be as follows :

Nos. of urinals in range	Capacity of flush tank	Size of C.P. brass Flush pipe	
		Main	Distribution
One	5 litres	15mm	15 mm
Two	10 litres	20 mm	15 mm
Three	10 litres	25 mm	15 mm

3.4.03 FIXING :

3.4.03.1 BOWL TYPE FLAT BACK URINAL WITHOUT FLUSHING RIM (Single or Range): Urinal shall be fixed in position by using rawl plug, wooden plug, C.P screws etc. It shall be fixed at height of 65 cm from the standing level to the top of the lip of urinal or as directed by the Engineer-in-charge. Each urinal shall be connected with 32 mm size waste pipe which shall discharge into channel or a floor trap.

3.4.03.2 STALL URINALS: The lip of the stall urinal shall be flush with the finished floor level. The stall urinal shall be laid over a fine sand cushion on average 25 mm thickness. The gap between wall surface, finished floor level and urinals shall not be more than 3mm and filled with water proofing plastic compound.

3.4.03.3 CP BRASS FLUSHING ARRANGEMENT: The flushing arrangement to urinal in single or range shall be of CP brass from 25 mm dia to 15 mm dia and CP brass spreader of 15 mm size to each urinal including the cost of CP brass elbows, tees, coupling, crosses, clamps, clips, union CP brass check nut and screws etc. CP brass

3.5 URINAL SQUATTING PLATE:

3.5.01 Material: The squatting plates shall be of white vitreous china conforming to IS : 2556 (Part-I), IS : 2556 (Part-VI) with internal flushing rim with front or side inlet. Each squatting plat shall have integral longitudinal flush pipe. There shall be of 100 mm dia white glaze vitreous china channel with slope and outlet piece in front.

3.5.02 FIXING: The plate shall be fixed in position. The top edge of squatting plate shall be flush with the finished floor level adjacent to it. It shall be embedded on a layer of 25 mm thick cement mortar 1:6 laid over a bed of cement concrete 1:3:6. Gap between wall, floor etc. shall be finished with white/matching cement.

3.7 DIVISION PLATE / PARTITION PLATE :

3.7.01 GENERAL : The item pertains for providing white or colour HPL division plate of size and colour as specified in the schedule including fixing.

3.7.02 MATERIAL : Division plate shall be white or colour glazed of size as specified in the schedule.

3.7.03 FIXING : Division plate shall be fixed vertically in position at proper height with expandable anchor fasteners, CP brass screws, wooden plugs etc.

3.9 GLAZED FLOOR TRAP WITH DOME SHAPED GRATING :

3.9.01 GENERAL : The item pertains for providing white glazed vitreous chinaware floor trap with dome shaped C.P. Brass grating of size as specified in the schedule including fixing.

3.9.02 MATERIAL : The trap shape be of white vitreous chinaware of 100 mm dia. or as specified in the schedule with hinged type dome shaped grating of chromium plated brass or stainless steel as specified.

3.9.03 FIXING : The trap shall be laid to the correct alignment and to required slope. The trap shall be fixed on 80 mm thick bed or 1:2:4 cement concrete. The caulking shall be done using 1:1 cement concrete. The caulking shall be done using 1:1 cement mortar and hemp yarn.

3.10 TOILET PAPER ROLL HOLDER :

3.10.01 GENERAL : The item includes providing white or colour glazed vitreous chinaware toilet roll holder of size as mentioned in the schedule including fixing.

3.10.02 MATERIAL : The toilet paper roll holder shall be of CP brass or vitreous china on specified and of size and design as approved by the Engineer-in-charge. Toilet paper roll holder shall conform as per IS standard and should have ISI mark.

3.10.03 FIXING : Toilet paper roll holder shall be fixed in position by means of C.P brass covers and rawl plug embedded in the wall. Vitreous china toilet paper roll holder shall fixed into the wall with 1:2 cement mortar. The pocket shall be cut in wall for toilet paper roll holder if not left finishing the gap with white/matching cement.

3.11 PVC WATER INLET CONNECTION :

3.11.01 GENERAL : The item pertains to providing colour or white PVC water inlet connection for cistern and wash basins.

3.11.02 MATERIAL : PVC water inlet connection shall conform to IS specifications and shall be of standard pattern with nylon insulation of minimum 450 mm long with CP brass check nut at both the end and shall be able to withstand the testing pressure of 1 MPa (10 kg/sq.cm.)

3.11.03 FIXING : The PVC water inlet connection shall be fixed in position as indicated in the drawing or as directed by the Engineer-in-charge for flushing cistern and wash basins.

3.13 STAINLESS STEEL SINK :

3.13.01 GENERAL : Item includes providing the stainless steel sink with or without drain board of size as specified in the schedule including fixing.

3.13.02 MATERIAL The sink shall be manufactured from stainless steel of Salem or equivalent steel conforming to IS: 13983. Stainless steel sink shall be of one piece construction moulded out of 19 SWG (1mm) stainless steel sheet of grade AISI 304 (18/8) with stainless steel choke – stop strainer (waste coupling) checknuts conforming to IS 13983.

3.13.03 FIXING : The sink shall be fixed in position as indicated in the drawing. The sink shall be placed over the brackets or on the platform. Gap between sink and platform / wall shall be finished with white / matching cement.

3.14 SINK DRAIN BOARD :

3.14.01 GENERAL : The item includes providing white or colour glazed / fire clay drain board of size mentioned in the schedule fixing.

3.14.02 MATERIAL : The drain board shall be manufactured from stainless steel of Salem or equivalent steel conforming to IS: 13983. Stainless steel sink shall be of one piece construction and its thickness not less than 1 mm.

3.14.03 FIXING : The drain board shall be fixed in the position as indicated in the drawing. It shall be place over the brackets or on the platform. Gap between board and platform / wall shall be finished with white /matching cement.

3.15 SOAP DISH :

3.15.01 GENERAL : The item includes providing white or colour glazed chinaware type soap dish of size as mentioned in the schedule including fixing.

3.15.02 MATERIAL : . Soap Dish shall be of CP brass or vitreous China on specified and of size, design as approved by the Engineer-in-charge. Soap Dish shall conform to relevant IS standard and should have ISI certification mark.

3.15.03 FIXING : Soap Dish shall be fixed in position by means of C.P brass covers and rawl plug embedded in the wall. Vitreous china Soap Dish shall fixed into the wall with 1:2 cement mortar. The pocket shall be cut in wall, if not left, finishing the gap with white/matching cement.

3.16 GLASS MIRROR :

3.16.01 GENERAL : The item providing beveled or plain edges mirror with or without frame of size as mentioned in the schedule including fixing.

3.16.02 MATERIAL : The mirror shall be of superior sheet glass with edges rounded off or beveled, size 600 x 450 mm unless specified in the schedule. It shall be free from flaws, specks or bubbles and thickness plated and should not be less than 5.0 mm. The back of mirror shall be uniformly silver plated and should be free from silvering defects. Silvering shall now have a protective uniform covering of red lid paint, where beveled edge mirror are not available. Fancy looking mirrors with PVC beading/border or aluminum beading on stainless steel beading/border based on manufacturer's specification, provided nothing extra shall be paid on this account. The backing of mirror shall be provided with 6mm thick marine plywood or environmentally friendly material other than asbestos cement sheet.

3.16.03 FIXING : Mirror shall be fixed in position with 6mm thick marine ply wood backing. It shall be fixed by means of 4 nos. of CP brass screws & caps over rubber washers and rawl plug or as per the manufacturer's specification unless specified otherwise the longer side shall be fixed horizontally.

3.17 GLASS SHELF :

3.17.01 GENERAL : The item includes providing glass shelf of size as mentioned in the schedule including fixing.

3.17.02 MATERIAL : Glass shelf shall consist of an assembly of glass shelf frame of size 600 x 125 mm or as specified in the schedule. It shall be with a pair of CP Brass brackets fixed to the wall with CP screws and CP brass rails around with guard bar of 6 mm diameter fixed to the glass shelf frame with five numbers CP brass brackets. . The glass shall not be less than 5 mm thick. PVC stainless steel shelf or as per manufacturer's specification and size as specified in the schedule of work shall be provided.

3.17.03 FIXING : The complete accessories shall be fixed to proper line and level as indicated in drawing with 40 mm long CP brass screws, wooden rawl plug, drilling hole and making good the wall to original condition after fixing the glass shelf.

3.18 LIQUID SOAP DISPENSER :

3.18.01 GENERAL: The item includes prdgs. CP liquid soap dispenser of shape as mentioned in the schedule including fixing.

3.18.02 MATERIAL : Liquid Soap Dispenser shall be of C.P brass of heavy quality and from list of approved make.

3.18.03 FIXING : The liquid soap dispenser shall be fixed to proper height and level as indicated in

drawing with 40 mm long CP brass screws, wooden rawl plug, drilling hole etc. and making good the wall to original condition after fixing.

3.19 TOWEL ROD/TOWEL RING :

3.19.01 GENERAL : The item includes providing Towel rod / towel ring of size as mentioned in the schedule including fixing.

3.19.02 MATERIAL : Towel rail shall be of C.P brass with two CP brass bracket coated with chromium plating of thickness not less than grade No.2 of IS 4827. The size of rail shall be 600 mm x 20 mm dia unless otherwise specified in the schedule. Towel ring of CP brass with one CP brass bracket with thickness not less than Grade No.2 of IS 4827. The diameter of the ring shall be 175 mm unless otherwise specified in the schedule. The diameter of ring rod shall not be less than 8 mm.

3.19.03 FIXING : The towel rod/ ring shall be fixed to proper line and level as indicated in drawing with CP brass screws, wooden raw plug, drilling hole etc. and making good the wall to original condition after fixing the towel rod.

3.20 SHOWER ROSE :

3.20.01 GENERAL : The item pertains to provide chromium plated brass shower rose of specified diameter with accessories including fixing.

3.20.02 MATERIAL : The shower rose shall be CP brass of approved and heavy quality. It's accessories shall conform to IS 1239 Part II.

3.20.03 FIXING : Shower rose shall be fixed to be water supply pipe line with necessary G.I fittings etc. as required by the Engineer-in-charge. Jointing shall be done with the zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof at his risk & cost.

3.21 BIB TAP, STOP COCK & ANGLE STOP COCKS :

3.21.01 GENERAL : The item pertains to provide chromium plated brass bib tap and stop cock and angle stop cocks, free flanges (if joined to concealed pipe) including fixing

3.21.02 MATERIAL : Bib cock (Bib tap) is drawn off tap with a horizontal inlet and free out let and a stop cock is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. These shall be of size 15 mm size or as specified and shall be of screw down type. The closing device shall work by means of disc. carrying a renewable non-metallic washer with shuts against the water pressure on a seating right angles to the axis of the threaded spindle which operates it. The handle shall be crutch, butterfly or fancy design type securely fixed to the spindle. The tap shall open anti clock wise direction. Brass bib taps and stop cocks and angle stop cocks shall conform to IS 781, they shall be polished bright. The minimum finished weight of different sizes of bib tap weight of 15 mm size bib tap and stop cock shall be as per table given below. They shall be sound and free from taps, blow hole and fitting. Internal & External surface shall be clean, smooth and free from sand and neatly dressed. Taps shall be nickel chromium plated and thickness of coating shall not be less than service grade No.2 of IS 4827 and plating shall be capable of taking high polish which shall not be easily tarnished.

MINIMUM FINISHED MASS OF BIB TAPS AND STOP VALVES AS PER IS 781:1984 (Reaffirmed 2001)

Size	Minimum Finished Mass

	bib taps	Stop Valves		
		Internally threaded	Externally threaded	Mixed end
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Mm	Kg	Kg	Kg	Kg
8	0.250	0.220	0.250	0.235
10	0.330	0.330	0.350	0.325
15	0.400	0.330	0.400	0.365
20	0.750	0.675	0.750	0.710
25	1.250	1.180	1.300	1.250
32	-	1.680	1.800	1.750
40	-	2.090	2.250	2.170
50	-	3.700	3.850	3.750

Every tap complete with its component shall stand an internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) maintained for a period of 2 minutes during the period it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from contractor.

3.21.04 FIXING: Bib tap stop cock shall be fixed to the pipe line with C.P. brass or G.I. specials, if required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.22 COMBINATION TAP ASSEMBLY (WALL / PILLAR MOUNTED) :

3.22.01 GENERAL: The item pertains to provide chromium plated brass combination tap assembly, wall mounted hot & cold mixing for bath ,pillar mounted hot & cold mixing for sink ,basin, tub etc. including free flanges and fixing.

3.22.02 MATERIAL : The combination tap assembly shall be 15 mm nominal size or as specified in the schedule. It shall be of C.P. brass approved and heavy quality, and shall conform to I.S. 8931. Combination tap assembly shall be chromium plated-brass and shall conform to IS 8931. The nominal size of combination tap assembly shall be 15 mm nominal size or as specified. Casting of combination tap assembly shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.

3.22.03 TESTING : Combination tap assembly shall withstand an internally applied hydraulic pressure of 1.6Mpa (16 kg/ sq.cm) for period of 1 minutes during which, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof.

3.22.04 FIXING : Combination tap assembly shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.23 PILLAR TAP : (Non fancy & Fancy Type)

3.23.01 GENERAL : The item pertains to provide chromium plated brass pillar tap including fixing.

3.23.02 MATERIAL : The pillar tap shall be 15 mm nominal size or as specified in the schedule. Fancy type pillar tap shall be of C.P. brass approved quality and shall conform to I.S. 8931. Non fancy pillar tap shall be chromium plated-brass and shall conform to IS 1795. The nominal size of Pillar tap shall be 15 mm

or as specified.

Casting of Pillar tap shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. The minimum of finish weight of Pillar tap shall not be less than 650 grams (body weight 250 gms, washer plate loose valve 150 gms and back nut 40 gms. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.

3.23.03 TESTING: Pillar tap shall withstand and internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) for period of 2 minutes during which period, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from the contractor.

3.23.04 FIXING: Pillar tap shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.27 WASTE COUPLING :

3.27.01 GENERAL : The item pertains to provide chromium plated brass waste coupling including fixing.

3.27.02 MATERIAL : Waste Coupling shall conform to IS 3311. Waste fittings shall be of CP with thickness of CP coating not less than service Grade No.2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed. The waste fitting for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

3.27.03 FIXING : Waste coupling shall be fixed to wash basin, sink or urinal as ordered with necessary specials. Jointing shall be done with white zinc, yarn etc. A few turns of fine hemp yarn dipped in the linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof

3.28 BOTTLE TRAP :

3.28.01 GENERAL : The item pertains to provide chromium plated brass bottle trap including fixing.

3.28.02 MATERIAL : Bottle trap shall be of C.P with thickness of CP coating not less than service grade No. 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect of IS 2963 and shall be sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed and be truly machined so that nut smoothly moves on the body. The Bottle trap for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

3.28.03 FIXING : Bottle trap shall be fixed to wash basin, sink or urinal as indicated in the drawing with necessary specials or as ordered by the Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall remade to make it leak proof.

3.29 COAT AND HAT HOOK :

3.29.01 GENERAL : The item pertains to provide chromium plated brass coat and hat hook including fixing

3.29.02 MATERIAL : Coat & Hook shall be of three way type of approved and heavy quality. Coat & Hat Hook shall be CP brass and three way hook type or minimum six way patti type of 125 mm x 30 mm x 6mm size. CP coating shall not be less than service grade No.2 of IS 4827.

3.29.03 FIXING : The Coat and hat hook shall be fixed to proper line & level as indicated in drawing with CP brass screws.

3.30 FLUSHING CISTERN :

3.30.01 GENERAL : The item pertains to provide white or colour glazed chinaware / PVC flushing cistern with all inside syphonic fitting including fixing.

3.30.02 MATERIAL : The flushing cistern shall be automatic or manually of rates high level or low level as specified for water closets.

Cisterns shall be of cast iron, vitreous china, enamelled pressed steel conforming to IS 774 for Flushing Type and IS 2326 for Automatic flushing cistern and Plastic (IS 7231). Cistern shall be mosquito proof. All working parts shall be designed to operate smoothly and efficiently. the cistern shall have removable covers which shall fit closely on it and be screwed against top displacement where operating mechanism is attached to the cover. This may be made in two section, but the section supporting the mechanism shall be securely fitted or screwed to the body. The outlet fitting of the cistern shall be securely connected to the cistern. The nominal internal diameter of the cistern outlet shall not be less than 32 mm and 38 mm for high level and low level respectively. Length of outlet cistern shall be 37 +/- 2 mm. Ball valve shall be screwed type 15 mm in diameter and shall confirm of IS 1703. The flat shall be made of polyethylene as specified in IS 9762. A high level cistern is intended to operate with minimum height of 125 cm and a low level cistern with maximum height of 30 cm between the top of the pan and under side of the cistern. A G.I chain strong enough to sustain a sudden applied pull of 10 kg or a dead load of 50 kg without any apparent or permanent deformation of the chain rings shall be attached to the ring or hook of the level manually operated high level C.I cistern. In case of low level cistern handle shall be of CP brass. In case of Plastic cistern, operation of cistern shall be through Push Button at the top for dual system and beyond plastic handle.

The discharge rate of the cistern as per IS 774 shall be 10 +/- .5 litres 6 second and 5 +/- .5 litres in 3 second for cistern capacity 10 ltrs. and 5 ltrs. respectively. Flush pipe shall be of class `B` G.I pipe of 32 +/- mm diameter for high level. Polyethylene flush pipe shall be low density confirming to IS 3076 or high density confirming to IS 4984 or UPVC pipe confirming to IS 4965 of 40 mm outer diameter.

Over flow pipe shall not be less than +/- 5mm `B` diameter. It shall be of G.I valve with mosquito proof jalli of 1.25 mm dia.

3.30.03 FIXING: The chinaware flushing cistern shall be placed over a pair of C.I. brackets. C.P. brass flush pipe shall be fixed to cistern and W.C. pan using check nut, spun yarn, cement mortar etc.

The cast iron flushing cistern shall be placed over a pair of C.I. or G.I. or PVC flush pipe of specified diameter shall be fixed to cistern and W.C. pan by using check nut, white zinc, spun yarn, cement mortar etc.

The PVC flushing cistern shall be placed or fixed as recommended by the manufacturer, PVC flush pipe of specified diameter shall be fixed to cistern and W.C. pan by using check nut, white zinc, spun yarn, cement mortar etc.

3.31 BRACKET :

3.31.01 GENERAL : The item pertains to provide a pair of bracket for wash basin, sink, Flushing, cistern etc. including fixing.

3.31.02 GENERAL : The item pertains to provide a pair of bracket for wash basin, sink, cistern etc, including fixing.

3.31.03 FIXING : Brackets shall be embedded into or fixed to the wall with plugs, screws, nails etc. Hole shall be made in the wall, if they are not left for fixing the brackets and shall be made good after fixing. The gap shall be filled with 1:2 cement mortar and finishing shall be done with white / matching colour cement.

4.0 : WATER SUPPLY SYSTEM:

4.5 PVC PIPING WORK FOR WATER SUPPLY :

4.5.01 GENERAL : The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

4.5.02 MATERIAL : The pipes and fittings shall conform to series IV of IS 4985-1978, PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule of quantities.

4.5.03 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

4.5.04 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

4.5.05 TRENCHES : The trench bottom shall be carefully examined for the presence of hard objects such as flints, rock projection or tree roots etc. Pipe shall be embedded in sand or soft soil, free from rock & gravel, back fill 150mm above the pipe shall also be of fine sand or soft soil. Pipe shall not be painted. The width of trench shall not be less than out side diameter of pipe plus 300 mm in case of gravel soils. Pipe shall be laid at-least 900 mm below the ground level (measured from the surface of the ground to the top of pipe).

4.5.06 LAYING : The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. The entire length of pipe shall be evenly supported on bed of the trench through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

4.5.07 FIXING : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The pipe shall be fixed with G.I. clamps not less than 2 mm thick or with suitable PVC clamps, The clamps shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties.

Spacing between clamps for fixing internal piping shall be as given below :

Pipe dia	For Horizontal Runs	For Vertical Runs
20 mm	700 mm	1050 mm
25 mm	750 mm	1125 mm
32 mm	825 mm	1240 mm
40 mm	975 mm	1460 mm
50 mm	975 mm	1460 mm

4.5.08 MAKING JOINT : The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough. The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

4.5.09 DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

4.5.10 PAINTING : If mentioned in schedule of work, the exposed pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer. Underground pipe line shall not be painted.

4.5.11 DEWATERING : In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

4.5.12 TESTING : Please refer clause No.4.4.09**4.6 GUN METAL/ BRASS FULL WAY VALVE :**

4.6.01 GENERAL : The item includes provision of full way (gate or globe) valve of specified diameter as mentioned in the schedule including fixing. Full way valve is a valve suitable for controlling or stopping the flow in water supply lines.

4.6.02 MATERIAL :

Full way valve shall be of either Brass fitted with a cast iron hand wheel or Gun metal fitted with a C.I. hand wheel as the case may be and shall be of Gate valve type opening full way and of the size as specified conforming to IS 778. The weight of the full way gate valve shall be as per the table given below with a tolerance of 5 percent.

Diameter in mm	Flanged arch (Kg)	Screwed arch (Kg)
15	1.021	0.567
20	1.503	0.680
25	2.495	1.077
32	3.232	1.559
40	4.082	2.268
50	6.691	3.232
65	10.149	6.804
80	13.381	8.845

4.6.03 FIXING : The valves shall be fixed in position in the pipeline as shown in the drawing or as directed with necessary socket or union, nuts etc. The screwed, flanged joint shall be made with few turns of fine hemp yarn dipped in linseed oil taken over the threaded ends to obtain complete water tightness.

4.6.04 TESTING : The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm²) along with the testing of pipe line.

4.8 PRESSURE REDUCING VALVE :

4.8.01 GENERAL : The item includes provision of pressure reducing valve of specified diameter as mentioned in the schedule including fixing.

4.8.02 MATERIAL: Pressure reducing valve is a device with suitable means of connection for insertion in a vertical pipe line for controlling the water pressure. Valve shall be of brass and shall be vertical flow type, conforming to IS 9739-1981.

4.8.03 FIXING : The valve shall be fixed in position on the pipe line as shown in the drawing or as directed. The screwed or flanged joint shall be made to obtain complete water tight joint.

4.8.04 TESTING : The joints shall be tested to a hydraulic pressure of 1MPa (10 kg/cm²) along with testing of pipe line for a minimum duration of 2 hrs.

4.12.04 RCC PRECAST/CAST IRON COVERS

4.12.04.1 RCC PRECAST COVER (for chambers of size upto 600 x 600 mm) : Chamber cover shall be casted as shown in the drawing having minimum 75 mm thick in cement concrete 1:2:4 or as specified in the schedule by using nominal reinforcement 100 kg/ Cum of concrete including shuttering, finishing, curing, placing in position etc.

4.12.04.2 CAST IRON/ M.S COVER : Cast iron/M.S cover of specified size and weight shall be supplied and placed over the chamber as directed. The cover shall be painted with 3 coats of black bitumastic paint.

4.12.05 DEWATERING : The water accumulated in the pit due to rain, seepage, springs or any other cause during the progress of work shall be pumped/bailed out till the completion of work.

4.13 C.I. SLUICE VALVE CHAMBER :

4.13.01 GENERAL : The item includes construction of brick masonry valve chamber of size as specified in this schedule including providing M.S./G.I. frame and cover over R.C.C pre-cast cover with or without surface box.

4.13.02 MATERIAL : Brick work, plastering, concreting etc. shall be as per general specification . Precast RCC cover slab, surface box, C.I./M.S frame and cover etc. shall be size and weight as specified in the schedule.

4.13.03 CONSTRUCTION :

- a) Foundation concrete of mix 1:4:8 shall be of 150 mm thick with 150 mm offset around or as specified in the schedule.
- b) Brick masonry in cement mortar 1:4 as specified.
- c) Plastering inside and outside surfaces of walls in two courses using cement mortar 1:3 of thickness as specified mixed with water proofing compound of specified Quality including inner surfaces finished smooth with neat cement punning.

4.13.04 RCC PRECAST/CAST IRON COVERS

4.13.04.01 RCC PRECAST COVER (for chambers of size above 1000 x 1000 mm) Chamber cover shall be coated in minimum three equal parts or more as directed with lifting hooks as shown in the drawing. RCC slab shall be casted alongwith galvanised M.S. angle iron frame with stiffness and anchors made out of the sizes as specified in the schedule. The exposed portion of the angle frame shall be painted with the coats of silver paint over a coat of primer.

RCC pre-cast slab shall be of 100 mm thick (unless otherwise specified) in cement concrete 1:2:4 of size as specified in the drawing schedule by using nominal reinforcement 100 kg/ Cum of concrete including shuttering, curing etc. and shall be placed in position as directed. cast iron road surface of prescribed weight shall be fixed to the cover slab during casting the slab for key rod operation.

Road surface box shall be of size 100x125x150 mm conforming to IS 3950 having hinged and weighting not less than 14 kg. The surface box shall be fixed on top of the RCC cover slab during the casting of slab for key rod operation. The surface box shall be painted with 3 coats of black bitumastic paint.

4.13.04.2 CAST IRON/ M.S COVER : Cast iron/M.S cover of specified size and weight shall be supplied and placed over the chamber as directed. The cover shall be painted with 3 coats of black bitumastic paint.

4.13.05 DEWATERING : The water accumulated in the pit due to rain, seepage, springs or any other cause during the progress of work shall be pumped/bailed out till the completion of work.

4.14 FLANGES & FLANGED JOINT : (Screwed or welded Flanges)

4.14.01 GENERAL : The item includes supplying flanges and providing flanged joint for G.I./ M.S./ C.I pipes, fittings and specials including testing.

4.14.02 MATERIAL : The CI flanges shall be confirming to IS 3516 or IS 1536. The heavy quality G.I./ M.S. flanges shall be conforming to I.S.6392 having thickness not less than 20 mm for pipes having diameter beyond 80 mm and 12 mm for pipes having diameter below 80 mm including drilling holes in new flanges, jointing with the pipe by means of welding or screwed joint. Rubber insertion shall be of three ply not less than 3 mm thick of approved make or fiber board impregnated with chemically neutral mineral oil having

smooth & hard surface weighing not less than 112 gm/mm thickness. Bolts, nuts and washers used shall be of good quality.

4.14.03 MAKING JOINT : Flanged joints shall be made by jointing the facing of the flange with the packing of rubber insertion and boiling up evenly on all sides. A thin layer of lead wool shall be provided for making the joints water tight where facing of the pipe is not true. The packing shall be of rubber insertion of three ply and of approved make and thickness. The packing should be of full diameter of the flange with proper pipe hole and bolt hole; cut even at both the inner and outer edges.

4.14.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.14.05 TESTING : The joints shall be tested along with pipe line after the pipe line is laid and jointed. The testing shall be as per the clause of testing of the pipe line

4.15 FLEXIBLE PUSH-ON JOINT (TYTON/ RING JOINT)

4.15.1 GENERAL : The item includes push-on joint with rubber ring for C.I. pipes, fittings and including testing.

4.15.2 MATERIAL : Rubber ring shall be moulded or tubular natural or synthetic rubber gasket conforming IS 12820.

4.15.3 JOINTING : The groove and the socket shall be thoroughly cleaned before inserting the rubber gasket while inserting the gasket it shall be made sure that it faces the proper direction and that it is correctly seated in the groove. After cleaning dirt or foreign materials from the plain end, non petroleum lubricant shall be applied in accordance with the pipe manufacturer's recommendations. The plain end of the pipe is pushed into the socket of the pipe and while pushing, the pipe shall be kept straight. If any deflections are to be made in the alignment, it may be made after the joint is assembled. The permissible ° deflection shall not be exceeded as per IS 3114 for socket and spigot rubber joint is 5 for 80 to 300 mm nom. bore, 4 ° for 350 to 400 mm nom bore and 3 ° for 450 to 750 mm nom bore pipe. A timber header shall be used between the pipe and crowbar or jack to avoid damage to the pipe while the plain end of the pipe is pushed into the socket either with a crowbar or jack or lever pulle

4.15.4 TESTING : The joints shall be tested along with pipe line after the pipe line is laid and jointed. The testing shall be as per the clause of testing of the pipe line

4.15.5 DEWATERING : The contract rate shall include bailing out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.18 FOOT-VALVE :

4.18.01 GENERAL : The item includes supplying of C.I. body. Foot-Valve of specified diameter as mentioned in the schedule including fixing.

4.18.02 MATERIAL : Foot-Valve shall be conforming to IS 4038 and with C.I. body not less than of grade FG200 and strainer with internal gun metal working parts. The valve shall be screwed end (25 to 150 mm size), flanged end (50 to 450 mm size), single disc type (up to 150 mm size), two disc type (exceeding 150 mm size), lift type (up to 100 mm size) The valve shall be tested for housing 0.6 MPa (6 kg/cm²) and for seat 0.2 MPa (2 kg/cm²) for 2 minutes as per IS 4038. The ball type foot valve with nitrile rubber ball and with bronze seat may be used as specified in the schedule of quantities. The defective Foot-Valve shall be replaced by the contractor at his own cost.

4.18.03 FIXING : Foot-valve shall be fixed in position as shown in the drawing or as directed. They shall be fitted by means of flange joints.

4.18.04 TESTING : The C.I. Foot-Valve and the joints shall be tested hydraulically to a minimum pressure

as per testing clause of piping work .The testing shall be done along with the testing of pipe line.

4.19 AIR VALVE :

4.19.01 GENERAL : The item includes supplying of single, double action or kinetic air Valve of specified diameter as mentioned in the schedule including fixing.

4.19.02 MATERIAL : The Air Valve shall be of heavy quality conforming to IS 14845 with IS certification mark and isolation valve.. The body, domes, covers, stuffing box, thrust plates, wedges, gland and cap shall be of cast iron not less than of grade 20 and inside working parts should be of any non-ferrous or ferrous materials.

4.19.03 FIXING : The Air Valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted by means of flange joints or screwed joint to the pipe line.

4.19.04 TESTING : The Air Valve and the joints shall be tested hydraulically to a minimum pressure as per testing clause of piping work. The testing shall be done along with the testing of pipe line.

4.20 BUTTER FLY VALVE :

4.20.01 GENERAL : The item includes supplying and fixing of butterfly valve of specified diameter as mentioned in the schedule.

4.20.02 MATERIAL : The butterfly valve shall be flanged type or as specified conforming to IS 13095 & BS - 5155. The valve shall be bubble tight, resilient sealed suitable for flow in either direction with accompanying flanges and steel handle.

4.20.03 FIXING : The butterfly valve shall be fixed to the pipe line in position as indicated in the drawing and as directed by the Engineer-In-Charge.

4.20.04 TESTING : The valve and the joints shall be tested to a minimum hydraulically pressure of 10kg/sqcm for a duration of two hours or as per testing clause of piping work. The testing shall be done along with the testing of pipe line. The leaky joints shall be rectified to the satisfaction of the Engineer-in-Charge.

5.0 DRAINAGE SYSTEM

5.2 UPVC- SWR PIPING WORK :

5.2.01 GENERAL : The item includes supplying of UPVC soil, waste and rain water (SWR) and ventilation pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting if required etc.

5.2.02 MATERIAL : The pipes shall conforming to IS 13592, UPVC - SWR and fittings conforming to IS 13591 shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule of work. Rubber sealing rings conforming to IS 5382 with lubricant for sliding socket joints as mentioned in the schedule of work.

5.2.03 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.2.04 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

5.2.05 LAYING : The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. The entire length of pipe shall be evenly supported on bed of the trench through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

5.2.06 FIXING : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The pipe shall be fixed with G.I. clamps not less than 2.0 mm thick of with suitable UPVC clamps/clips, The clamps/clips shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties keeping the pipe about 15 mm clear of the wall.

5.2.07 MAKING JOINT : The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough or rubber sealing rings with lubricant for sliding socket joints . The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

5.2.08 DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

5.2.09 PAINTING : In case of underground piping, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

5.2.10 DEWATERING : In case of underground pipes ,the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.3.10 TESTING : The joints shall be tested by either smoke test for vertical stacks or 2.5 m head of water at the highest point of the section under test for horizontal drainage pipes. Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a below and burner .The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell, if there is leak at any point of the drain. The water head test shall be carried out by suitably plugging the lower end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed to it so as to provide required test head , or the top may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation. The leaky joints shall be remade and section re-tested at no extra cost.

5.4 PVC PIPING WORK :

5.4.01 GENERAL : The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

5.4.02 MATERIAL : The pipes and fittings shall conform to series IV of IS 4985, PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule.

5.4.03 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.4.04 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

5.4.05 LAYING Please refer clause 4.5.05

5.4.06 FIXING : Please refer clause 4.5.06

5.4.07 MAKING JOINT : . Please refer clause 4.5.07

5.4.08 DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

5.4.09 PAINTING : If mentioned in schedule of work, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

5.4.10 DEWATERING : In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.4.11 TESTING : The joints shall be tested hydraulically to a pressure as specified in the schedule. The leaky joints shall be remade and section re-tested at no extra cost. The period of test shall be for maximum 2 (two) hours.

5.5 GULLY TRAP :

5.5.01 GENERAL : The item includes provision of S.W. Gully trap with C.I. frame including construction of Gully Trap Chamber.

5.5.02 MATERIAL : The Gully Trap shall be of salt glazed stoneware with 150 mm nominal square inlet or as specified in the schedule with 100mm diameter outlet. Brick work, plastering, concreting shall be as per general specifications under section-II.

5.5.03 CONSTRUCTION :

1. Internal dimension of the Gully trap chamber shall be as specified in the schedule.
2. Foundation of 1:4:8 concrete shall be 150 mm thick, and shall have 100mm offset.
3. Brick masonry shall be of 230 mm thick in cement mortar 1:6 and masonry shall be plastered with 15mm thick plaster in 1:3 cement mortars inside and outside surface with smooth finish.

5.5.04 C.I. FRAME AND COVER : C.I. frame and cover shall be fixed with the cement concrete 1:2:4 at the top of Gully trap chamber, the weight of frame and cover shall not be less than 7.5 kg. and they shall be painted with two coats of black bitumastic paint.

5.5.05 DEWATERING : The contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.6 FLOOR TRAP :

5.6.01 GENERAL : The item includes supplying of floor trap with CP brass/stainless steel grating of specified diameter with fittings and fixtures including fixing and jointing with the pipe line.

5.6.02 MATERIAL : 65 mm nominal outlet dia C I Nahani trap weighing not less than 4.5 kg with an effective water seal of 20 mm or 75mm nom. outlet dia. floor trap (100mm inlet dia.)/ nahani trap (165mm inlet dia.) conforming to IS 3989 or IS1729 shall be provided as specified in the schedule of quantities. Top grating shall be of CP brass or stainless steel of heavy quality of size and shape to suit the trap.

5.6.03 FIXING : C.I. nahani/ floor trap with the bend and pipe piece shall be fixed in position over the bed of 1:2:4 cement concrete. The jointing trap and pipe shall be caulked with 1:1 cement mortar. The grating shall be fixed over the nahani / floor trap flush with the floor level and the gap finished with matching cement.

5.7 RAIN WATER GRATING :

5.7.01 GENERAL : The item includes supplying of cast iron grating of specified diameter including fixing and painting.

5.7.02 MATERIAL : The rain water grating shall be Cast Iron with closed grained without any casting defects. The thickness should be uniform throughout, one shaped C.I. grating.

5.7.03 FIXING : C.I. rain water grating shall be fixed in position with 1:1 cement mortar.

5.8 LEAD SHEET FLASHING :

5.8.01 GENERAL : The item includes supplying lead sheet flashing of specified size including laying, fixing, cutting, jointing and laying.

5.8.02 MATERIAL : Lead sheet flashing shall not be less than 3 mm thick & weight should not be less than 38 Kg. per sqm.

5.8.03 FIXING : The lead sheet shall be fixed all around the rain water pipe. The sheet shall project one diameter of socket all-round beyond the outer face of the socket & shall project inside the socket at least half the diameter of the rain water pipe socket. It shall be fixed by bending & breaking the sheet to shape, placing, tucking below waterproofing courses etc.

5.9 RAIN WATER G.I. SPOUT :

5.9.01 GENERAL : The item include supplying of G.I. rain water spouts of specified diameter with or without fitting at outlet including fixing. Cutting and painting.

5.9.02 MATERIAL : The rain water spout shall be of heavy quality G.I. pipe of approximate 400 mm length or as specified in the schedule of work. The 'T' of same diameter shall be fixed at the out let of spout. G.I. Pipe and fitting shall be as per specifications under section IV.

5.9.03 FIXING : G.I. rain water spout shall be fixed in the position as shown in the drawing including breaking, cutting RCC pardi, brick wall, RCC floor etc. It shall be fixed with 1:1 cement mortar and 1:2:4 cement concrete.

5.9.04 PAINTING : The exposed part of spout shall be painted with two coats of approved flat oil paint over a coat of primer.

5.10 RAIN WATER C.I. SPOUT :

5.10.01 GENERAL : The item include supplying of C.I. spouts of specified diameter including fixing, cutting, and painting,

5.10.02 MATERIAL : The spout shall be of heavy quality C.I. pipe of approximate 600 mm long or as specified in the schedule of work. Pipe shall be as per specifications of C.I. piping work under Section-V.

5.10.03 FIXING : C.I. rain water spout shall be fixed in the position including breaking, cutting RCC/ brick structure etc. It shall be fixed with 1:1 cement mortar and 1:2:4 cement concrete.

5.10.04 PAINTING : The exposed part of spout shall be painted with two coats of anticorrosive black bitumastic paint over a coat of primer.

5.12 INSPECTION CHAMBER :

5.12.01 GENERAL : The item includes provision of brick masonry Inspection Chamber of internal size as specified in the schedule.

5.12.02 MATERIAL : Concreting, Brick work, plastering etc, shall be as per specification as given in general specification.

5.12.03 CONSTRUCTION :

1. Internal dimensions and initial depth shall be as specified in the schedule or as shown in the drawing.
2. Foundation of 1:2:4 concrete shall be 150 mm thick and shall have 150 mm offset.
3. The concrete 1:2:4 shall be laid to necessary shapes to form the channel for the pipe being received in the channel. It shall be of appropriate diameter and shall be half round. The sides shall be kept sloping towards the channel.
4. Brick masonry shall be 230 mm thick in cement mortar 1:2 or as specified in the schedule of work, making

brick tapering for longitudinal wall 450 mm from top of cover of the chamber.

5. Brick masonry shall be rendered with 20 mm thick plaster in cement mortar 1:1 or as specified in the schedule of work inside and outside surfaces in two courses and inside surface finished smooth with neat cement punning.

5.12.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.13 CIRCULAR MANHOLE :

5.13.01 GENERAL : The item includes provision of brick masonry Circular manhole of internal size as specified in the schedule.

5.13.02 MATERIAL : Concreting, Brick work, plastering etc. shall be as per specification as given in general specification.

5.13.03 CONSTRUCTION :

1. Internal dimensions and initial depth shall be as specified in the schedule of work or as shown in the drawing.

2. Foundation of 1:2:4 concrete shall be 300 mm thick and shall have 300 mm offset.

3. The concrete 1:2:4 shall be laid to necessary shapes to form the channel for the pipe being received in the channel. It shall be of appropriate diameter and shall be half round. The sides shall be kept sloping towards the channel.

4. Brick masonry shall be in cement mortar 1:2 or as specified in the schedule of work. One meter height from top shall be conical in shape and shall be constructed in 230 mm thick brick masonry and remaining height shall be 345mm thick in cylindrical shape.

5. Brick masonry shall be rendered with 20 mm thick plaster in cement mortar 1:1 or as specified in the schedule of work inside and outside surfaces in two courses and inside surface finished smooth with neat cement punning.

5.13.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.15 DROP CONNECTION :

5.15.01 GENERAL : The item includes provision of drop connection of salt glazed of nominal diameters as specified in schedule of quantities including 1:2:4 cement concrete encased to pipe all round.

5.15.02 MATERIAL : Concreting, mortar for jointing the pipes, hemp yarn, salt glazed stoneware pipes and specials like bends, tees, crosses (double tees), plugs caps etc. of specified diameter shall be of grade 'A' or 'AA' conforming to IS 651. All the pipes and fitting shall be free from pin holes, cracks and other imperfections and should have the glossy finish in salt glazing, necessary form work for encasing the pipe.

5.15.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work and contractor has to replace the same from the site at his own cost and charges.

5.15.04 LAYING, FIXING, JOINTING, CLEANING, TESTING : Above shall be done as specified in clause 5.18.00 i.e. salt glazed stone ware piping work.

5.15.05 ENCASING THE PIPE LINE : After the joints and pipes have been proved to be water tight then pipe line shall be embedded in cement concrete as specified in the schedule of quantities and as shown in drawings including necessary form work.

5.15.06 DEWATERING : The contractor rate shall include bailing or pumping out all the water if

accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.17 DROP PIPE CLEANING CHAMBER :

5.17.01 GENERAL : The item includes construction of brick masonry valve chamber of size as specified in this schedule including providing M.S./G.I. frame and cover over R.C.C pre-cast cover with or without surface box.

5.17.02 MATERIAL : Brick work, plastering, concreting etc. shall be as per general specification . Precast RCC cover slab, surface box, C.I./M.S frame and cover etc. shall be size and weight as specified in the schedule.

5.17.03 CONSTRUCTION :

a) Foundation concrete of mix 1:2:4 shall be of 150 mm thick with 150 mm offset around or as specified in the schedule.

b) Brick masonry in cement mortar 1:2 as specified.

c) Plastering inside and outside surfaces of walls in two courses using cement mortar 1:1 of thickness as specified mixed with water proofing compound of specified Quality including inner surfaces finished smooth with neat cement punning.

5.17.04 RCC PRECAST/CAST IRON COVERS

5.17.04.1 RCC PRECAST COVER (for chambers of size upto 600 x 600 mm) :

Chamber cover shall be casted as shown in the drawing having minimum 75 mm thick in cement concrete 1:2:4 or as specified in the schedule by using nominal reinforcement @ 100 kg/ Cum. of concrete including shuttering, finishing, curing, placing the cover in position as directed by Engineer-in-charge.

5.17.04.2 CAST IRON/ M.S COVER : Cast iron/ M.S cover of specified size and weight shall be supplied and placed over the chamber as directed. The cover shall be painted with 3 coats of black bitumastic paint.

5.17.05 DEWATERING : The water accumulated in the pit due to rain, seepage, springs or any other cause during the progress of work shall be pumped/bailed out till the completion of work.

5.18 C.I. FRAME AND COVER FOR MANHOLES :

5.18.01 GENERAL : The item includes supply LD/MD/HD/EHD/C.I. frame and cover as specified in schedule including fixing and painting.

5.18.02 MATERIAL : C.I. Frame and cover shall conform to IS 1720 and shall have IS certification mark with grade LD/MD/HD/EHD and the weight of frame and cover shall not be less than as specified in the schedule.

5.18.03 FIXING : Frame shall be fixed in the cement concrete 1:2:4 for bearing course and capping on the brick masonry wall of the chamber of manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

5.18.04 PAINTING : The frame and cover shall be painted with two coats of approved black bitumastic anticorrosive paint over a coat of primer.

5.19 PRECAST CONCRETE FRAME AND COVER FOR MANHOLES :

5.19.01 GENERAL : The item includes supply LD/ MD/ HD/ EHD factory made precast steel fiber reinforced concrete (SFRC) frame and cover as specified in schedule including fixing and placing.

5.19.02 MATERIAL : The precast frame and cover shall be of steel fiber reinforced concrete (SFRC)

conforming to IS 12592 and shall be of approved make. The frame and cover shall be of LD/ MD/ HD/ EHD grade, size and thickness as mentioned in the description of the item. The defective Frame and cover shall be replaced by the contractor at his own cost and charges.

5.19.03 FIXING : Frame shall be fixed in cement concrete 1:2:4 for bearing course & capping on the top of masonry wall of chamber or manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

5.20 CAST IRON STEPS / RUNGS :

5.20.01 GENERAL : The item includes supplying of cast iron steps including fixing and Painting

5.20.02 MATERIAL : The steps shall be of cast iron and minimum 150 mm wide. The minimum weight of each step shall not be less than 5 kg or as specified in the schedule.

5.20.03 FIXING : The steps shall be fixed in brick masonry wall with 1:2:4 cement concrete with 75 mm cement concrete cover at all around the step. The first step shall be 450 mm below from top surface of structure and next shall be fixed 300 mm centre to centre in two rows at 300 mm distance or as shown in the drawing.

5.20.04 PAINTING : The projected portion of the cast iron step shall be painted with two coats of approved black bitumastic anti corrosive paint over a coat of primer.

5.20.05 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.22 SEWER TRAP :

5.22.01 GENERAL : The item includes supplying, laying and fixing the Stone ware sewer trap of specified diameter including fixing, jointing and embedding.

5.22.02 MATERIAL : Sewer trap shall be salt glazed of stoneware of specified diameter and shall be of grade "A" or "AA" conforming to IS 651. Sewer trap should be free from pin holes, cracks and other imperfections and should have the glossy finish of salt glazing.

5.22.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work and contractor has to replace the same from the site at his own cost and charge.

5.22.04 FIXING : Sewer trap shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other free material into the trap during laying. The trap shall be on bedded in CC 1:2:4 including necessary form work.

5.22.05 TESTING : The testing shall be done along the testing of sewer line with the same specification.

5.22.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.23 CONNECTION WITH DOMESTIC SEWER :

5.23.01 GENERAL : The item includes the provisions of connecting sewer line with existing sewer line chamber or manhole including cutting, breaking of masonry, road surface and making good to the original condition of the damages.

5.23.02 MATERIAL : Concreting, Brick work, plastering etc. shall be as per specification as given in general specification of section II.

5.23.03 MAKING CONNECTION :

1. Breaking or cutting the road surface for sewer connection.

2. Restoring all the excavated items in proper manner as directed by the Engineer-in-charge
3. Cutting the brick masonry wall to required size of existing manhole or inspection chamber.
4. Connecting the sewer line to the chamber or manhole.
5. Making good to the original condition all the damages after completion of sewer connection.
6. Disposing off all the superfluous material as directed.

5.23.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.24 CONNECTION WITH MUNICIPAL SEWER LINE :

5.24.01 GENERAL : The item includes the provisions of connecting sewer line with existing municipal sewer line chamber or manhole including cutting, breaking of masonry, road surface and making good to the original condition of the damages.

5.24.02 MATERIAL : Concreting, brick work, plastering etc. shall be as per specification as given in general specification.

5.24.03 MAKING CONNECTION:

1. Breaking or cutting the road surface for sewer connection.
2. Restoring all the excavated items in proper manner as directed by the Engineer-in-charge.
3. Cutting the brick masonry wall to required size of municipal manhole or inspection chamber.
4. Connecting the sewer line to the chamber or manhole of Municipal sewer line.
5. Making good to the original condition all the damages after completion of sewer connection.
6. Disposing off all the superfluous materials as directed.
7. All necessary labour, materials and use of tools.

5.24.04 DEWATERING: The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.24.05 MUNICIPAL CHARGES: The contractor shall obtain the necessary permission for connecting the sewer line to the municipal sewer from the concerned authorities. He shall pay all necessary charges towards the connection given by the municipality.

6.0 WATER TANK, SEPTIC TANK, UPFLOW FILTER & SOAK PIT

6.1 FRAME AND COVER :

6.1.01 GENERAL : The item includes supplying of M.S. or C.I. frame with cover of size as specified in the schedule including fixing and painting. The frame and cover shall be of mosquito proof condition and approved by the Municipality

6.1.02 MATERIAL : The frame and cover shall be of mild steel or cast iron as specified in the schedule. The weight of frame and cover shall not be less than 50 kilogram's. They should have locking arrangement.

6.1.03 FIXING : The frame shall be fixed in the roof slab of tank or built with hold fast to R.C.C. slab by chasing or cutting slab and grouting with 1:2 cement mortar.

6.1.04 PAINTING : The frame and cover shall be painted with two coats of approved anti corrosive black bitumastic paint over a coat of approved quality primer.

6.4 BALL VALVE :

6.4.01 GENERAL : The item includes providing horizontal type ball valve with PVC or copper float of size as mentioned in the schedule including fixing.

6.4.02 MATERIAL : Horizontal plunger type ball valve with PVC or copper float shall be conforming to IS 1703. The lever shall be of brass and may be made in one piece and the diameter of the lever rod shall not be less than the diameter of the thread for boss of ball. Float shall be watertight and non-absorbent and shall not contaminate water. Adhesives for joining the part shall not be used. The minimum thickness for copper sheet of copper float shall be 0.45 mm up to 115 mm diameter and 0.55 mm for ball over 115 mm diameter. Valve shall be tested in closed position to the hydraulic pressure of 2 MPa for a minimum period of 2 minutes without leakage and sweating.

6.4.03 MINIMUM MASS : The minimum mass of finished ball valve and float of different size and class shall be as per Table No. 8 of IS 1703.

6.4.04 FIXING : Valve shall be fixed in position as indicated in the drawing with necessary socket, union nuts etc. as per site requirements. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint. Leaking joint if any shall be rectified to make it leak proof.

6.4.05 TESTING : Testing shall be done along with the testing of pipe line, Separate testing if required shall be done as per ISI norms.

6.6 POLYETHYLENE WATER TANK :

6.6.01 GENERAL : The item includes providing polyethylene plastic water tank with cover of capacity as mentioned in the schedule including fixing and making connections such as inlet, outlet, scour, overflow etc.

6.6.02 MATERIAL : The water tank shall be made out of best moulded Polyethylene plastic. It shall be vertical or horizontal type as specified, watertight and non-absorbent and shall not contaminate water. Adhesives shall not be used in joints. The cover shall be of polyethylene / M.S. / C.I. as approved.

6.6.03 FIXING : The plastic water tank with cover shall be installed and fixed as per the manufacturer's specification. The connections such as inlet, outlets, over flow, scour etc. of specified diameter shall be made as mentioned in the schedule including the cost of fittings, fixtures and pipe of approximate 400 mm long.

6.8 GENERAL SPECIFICATIONS FOR WATER TANK AND SEPTIC TANK :

6.8.01 GENERAL : Construction of water tank, septic tank and up flow filter is required to be done very carefully with good quality materials. Dense, well compacted concrete of required strength has to be achieved in order to make water tight compartment. The slope in the bed of tank, invert levels of insert, and also the levels of partition and baffle walls should be properly maintained for proper flow of liquid.

6.8.02 TESTING OF WATER TANK AND SEPTIC TANK : After construction of tank, it shall be tested for leak proof ness. The tank shall be first filled with water up to the top of wall. The water level should not drop more than 50 mm within 48 hours. If the drop of water level is found more than 50 mm the defective and leakage point shall be rectified to the full satisfaction of the Engineer-in-charge.

6.8.03 COMMISSIONING OF SEPTIC TANK : Before commissioning the septic tank, a little quantity of digested sludge, horse or cow dung may be added as a seed sludge to start functioning of bacterial activity in sewage.

6.8.04 BACK FILLING : The back filling shall be done as per specification after satisfactory testing of the tanks. Back filling shall be done in layers all around the tank and above the roof slab of the tank up to the height / depth as directed by the Engineer-in-charge.

6.8.05 CLEANING OF WATER TANK : The cleaning of the tank shall be done by manually or by Hydro dynamic mechanism with low or high pressure as directed. Potable water, approved disinfectant etc. shall be used for cleaning of water tank before use.

6.8.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if any accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

6.10 SOAK PIT :

6.10.01 GENERAL : The item pertains to providing Soak pit of specified size as mentioned in the schedule of quantities including filling with brick bats and coarse sand filling around the honey comb brick wall.

6.10.02 MATERIAL : The brick bats shall be from properly burnt bricks and not from over burnt bricks, Coarse sand filling. Brick work and plastering shall be as per general specifications .

6.10.03 CONSTRUCTION : Brick masonry shall be in cement mortar and its size and type shall be as specified in the schedule. The pit shall be filled with loosely packed brick bats. The coarse sand shall be filled around the honey comb brick wall of specified thickness.

6.10.04 DEWATERING : The contract rate includes bailing or pumping out all the water. If accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

**SECTION 6:
SECURITIES AND OTHER FORMS**

BID SECURITY (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	Union Bank of India
3	Account No	127511100001024
4	IFSC Code	UBIN0812757

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, ... 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 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	Union Bank of India
3	Account No	127511100001024
4	IFSC Code	UBIN0812757

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	Union Bank of India
3	Account No	127511100001024
4	IFSC Code	UBIN0812757

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: LIST OF DRAWINGS

DRAWINGS		
SL	DRAWING TITLE	DRAWING NO
1	TOPOGRAPHICAL SURVEY DRAWING	SMCPL/ARCH/FB/SUV/2024/00
2	MASTER LAYOUT PLAN	SMCPL/ARCH/FB/MP/2024/01
3	SITE SECTION & CRICKET FIELD SECTION	SMCPL/ARCH/SEC/CF/2024/02
4	CRICKET FIELD PLAN	SMCPL/ARCH/FP/CF/2024/03
5	CRICKET FACILITY BUILDING FLOOR PLAN	SMCPL/ARCH/FB/FP/2024/04
6	CRICKET FACILITY BUILDING SECTION & ELEVATION	SMCPL/ARCH/FB/SEC/ELE/2024/05
7	ATHELETIC TRACK & FOOTBALL FIELD SECTION AND DRAIN DETAIL	SMCPL/ARCH/FF/SEC/2024/06
8	FOOTBALL FIELD FACILITY BUILDING FLOOR PLAN	SMCPL/ARCH/FF/FB/2024/07
9	FOOTBALL FIELD FACILITY BUILDING ELEVATION AND SECTION	SMCPL/ARCH/FF/FB/ELE/SEC/2024/08
10	MPH BUILDING FLOOR PLAN	SMCPL/ARCH/MPH/ FF /2024/09
11	MPH BUILDING ELEVATION	SMCPL/ARCH/MPH/ ELE /2024/10
12	MPH BUILDING SECTION	SMCPL/ARCH/MPH/ SEC/2024/11
13	SWIMMING POOL	SMCPL/ARCH/SP/FP/2024/12
14	SWIMMING POOL ELEVATION AND SECTION	SMCPL/ARCH/SP/ELV/SEC/2024/13
15	BOYS HOSTEL FLOOR PLAN	SMCPL/ARCH/BH/FP/2024/14
16	BOYS HOSTEL ELEVATION	SMCPL/ARCH/BH/ELE./2024/15
17	BOYS HOSTEL SECTION	SMCPL/ARCH/BH/SEC/2024/16
18	GIRLS HOSTEL FLOOR PLAN	SMCPL/ARCH/GH/FP/2024/17
20	GIRLS HOSTEL ELEVATION	SMCPL/ARCH/GH/ELE/2024/18
21	GIRLS HOSTEL SECTION	SMCPL/ARCH/GH/SEC/2024/19
22	SERVICE BUILDING FLOOR PLAN	SMCPL/ARCH/SB/FP/2024/20
23	SERVICE BUILDING ELEVATION & SECTION	SMCPL/ARCH/SB/FP/ELE/SEC/2024/21
24	KHO-KHO PLAN	SMCPL/ARCH/KK/FP/2024/22
25	BASKETBALL PLAN ELEVATION	SMCPL/ARCH/BB/FP/2024/23
26	VOLLYBALL PLAN	SMCPL/ARCH/VB/FP/2024/24
27	KABBADI COURT PLAN	SMCPL/ARCH/KB/FP/2024/25
28	GATE COMPLEX WITH GUARD ROOM	SMCPL/ARCH/GC/FP/ELE/SEC/2024/26
29	COMPOUND WALL	SMCPL/ARCH/BW/FP/ELE/SEC/2024/27
30	CRICKET PRACTICE PITCH	SMCPL/ARCH/DN.CPF/2025/03A
31	3D VIEWS	-

The indicative tender drawings & 3D Views may be downloaded in PDF and CAD formats from the link:

https://OBCC-NAS.quickconnect.to/d/s/18waJjne7CuFyliX7X0QQNCddksaePvF/UMSVXQAdX8HEDOIFFespryCiO1IIZA1N-Cb_gYnn9Uw0

SECTION 8

TERMS OF REFERENCE

DESIGN BRIEF & SCOPE OF WORK

**“Proposed Regional Sports Hub in Dhamnagar, Bhadrak,
Odisha on Turnkey basis.”**

A. General Information

The project shall be executed on a Lump Sum Turnkey basis, scope consisting of the survey, planning & design (architectural, structural and non-structural), 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 Contract. 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.”

Government of Odisha through OB&CC Ltd intends to construct a Regional Sports Hub at Dhamnagar as a multi-disciplinary sports complex.

Site –

The proposed Multidisciplinary Sports Complex is planned at Dhamnagar on a site identified measuring approx. minimum area of 24.27 acres, having access provided through an existing village road.

The entire project area of 24.27 acres shall be enclosed by a compound wall. Site development shall include filling to achieve a minimum average finished ground level of 0.60 m above the existing ground level, with required site grading and drainage as per the approval.

The entire campus shall be planned and developed in compliance with the requirements for a GRIHA 3-Star rated green campus. The Contractor shall be solely responsible for planning all buildings, infrastructure, landscape, and site development works to meet the prescribed GRIHA criteria. The scope of work shall also include registration of the project with GRIHA, preparation and submission of all required documentation, coordination with the certifying authority, and obtaining the GRIHA 3-Star Certification upon completion of the project.

Planned facilities:

The proposed Sports Complex campus shall comprise the following facilities:

1. Football Ground

A standard football field shall be developed in accordance with the latest FIFA guidelines and relevant Indian Standards. The scope includes site preparation, construction of a natural turf playing field having minimum area of 8256 Sqm, provision of an efficient drainage and irrigation system, installation of floodlighting for training and competitive matches, LED Video wall display and development of associated infrastructure including fencing, player amenities & equipment, pathways, landscaping, and utility services along with provision for 5 years of maintenance services.

2. Football Stadium Building

A Football Stadium Building shall be constructed with minimum area of 1160 sqm in ground floor and 830 sqm in first floor with an upper tier providing minimum seating capacity for 790 spectators. The building shall accommodate all amenities including interior works, plumbing, electrical, and HVAC services, etc required for the operation of the football stadium in compliance with applicable standards.

3. Cricket Ground

A standard cricket ground with a minimum dimension of 75 m playing radius shall be developed with the latest guidelines and relevant Indian Standards, comprising a centrally located natural turf pitch with multiple practice strips, a professionally developed outfield, and a defined boundary. Dedicated 5nos of cricket practice pitch (having minimum area of 474sqm) with nets & lighting arrangement for day & night purpose shall be provided adjacent to the playing field having minimum runup area of 479sqm & warm-up area of 4038sqm is also to be developed. The scope includes site grading, turf development, pitch preparation (natural turf/wicket system), drainage and irrigation systems, floodlighting for day and night matches along with 5 years of maintenance services. Ancillary facilities such as spectator seating, player pavilions, practice nets, and circulation, and all associated infrastructure.

4. Cricket Stadium Building

A Cricket Stadium Building shall be constructed with minimum area of 1250 sqm in ground floor and 910 sqm in first floor with an upper tier providing minimum seating capacity for 950 spectators. The facility shall accommodate all amenities such as locker rooms, toilets, coaches' rooms, offices, equipment storage, multi-gym with all gym equipments, entrance lobby with circulation corridors including interior works, plumbing, electrical, and HVAC services, etc required for the operation of the cricket ground in compliance with applicable standards.

5. Synthetic Athletic Track

A 9-lane, 400 m synthetic athletic track shall be constructed surrounding the football field in accordance with the latest World Athletics standards and relevant Indian specifications. The scope shall include sub-base preparation, drainage system, synthetic PU/EPDM track surfacing, lane markings, supply and installation of all required competition equipment, and development of field event areas for athletics. The athletic track shall be accompanied by a minimum 2.0 m wide pedestrian/jogging pathway along its outer periphery, with a minimum area of 837 sq.m, complete with appropriate paving, drainage, and associated site development works.

6. Multipurpose Indoor Sports Hall

A modern Multipurpose Indoor Sports Hall shall be constructed with minimum built-up area of 1200 sqm in ground floor and 338 sqm in first floor with a central multipurpose sports arena accommodating two badminton courts, designed in accordance with the latest guidelines & standards. The facility shall accommodate all amenities such as an entrance lobby, administrative offices, male and female changing rooms, toilets, equipment storage, multi-gym with all gym equipments, utility and service rooms, and other ancillary spaces including sports flooring, lighting, ventilation, electrical, plumbing, HVAC, fire safety systems, interiors & furnitures with all allied services required for the operations in compliance with applicable standards.

7. Swimming Pool Complex

A swimming pool complex shall be constructed with minimum built-up area of 3050 sqm be comprising a minimum 50.0 m × 25.0 m competition swimming pool, together with surrounding pool deck, circulation areas, pool edge treatment, overflow drainage channels, and associated finishes. The facility shall accommodate all amenities such as an entrance lobby, administrative office, first aid room, visitors' room, coaches' room, lifeguard room, store room, male and female changing rooms, toilets, electrical room, filtration plant room, balancing tanks, and all associated mechanical, electrical, plumbing, water treatment, HVAC, fire protection, and utility systems and all allied services required necessary for the complete operations of the facility in compliance with applicable standards.

8. Outdoor Basketball Court

A day-night outdoor basketball court with lighting arrangements having minimum area of 642 Sqm shall be constructed, including the playing surface, surrounding margins, court markings, and basketball goal post assemblies. The scope shall include earthwork, granular sub-base & base preparation, with Bituminous base & wearing course, sports flooring or finished court surface, drainage arrangements, line marking, supply and installation of goal posts, backboards, rings, nets, foundations, steel support frames, protective fencing/mesh, and all painting and finishing works. All structural members, supports, and fixtures shall be fabricated and installed as per approved drawings and specifications, with proper alignment, anchoring, corrosion protection, and finishing. The playing surface shall be true to line and level, with adequate slope for surface water drainage. Stepped seating arrangements minimum 75m long & 4m wide is to be provided.

9. Kho-Kho Court

A standard day-night Kho-Kho court with lighting arrangements having minimum area of 620 Sqm shall be constructed, including the playing field, lobby areas, free zones, post lines, side lines, centre line, cross lanes, sitting squares, and all required court markings. The scope shall include earthwork, sub-base preparation, finished sports surface, drainage arrangements, line marking, installation of Kho-Kho posts, painting, and all allied works. The playing surface shall be smooth, level, and suitable for competitive play.

10. Boys' and Girls' Hostel Buildings

Separate G+2 hostel buildings shall be constructed for boys and girls, each having a minimum built-up area of 1800sqm with capacity of 102 beds. Each hostel shall comprise minimum 17 dormitory rooms accommodating 6 beds per room, along with all necessary ancillary facilities. The facility shall accommodate all amenities such as dining hall, kitchen, pantry, store, wash area, drinking water station, warden's room, laundry, gymnasium, weightlifting room, changing rooms, toilets, entrance lobby, corridors, staircases, and other support spaces including architectural, plumbing, sanitary, electrical, HVAC, fire protection, drainage, waterproofing, interior finishing, and allied works required for a fully functional facility in compliance with applicable standards.

11. Volleyball Court

A standard day-night volleyball court with lighting arrangements having minimum area of 432 Sqm shall be constructed, including the required playing area, court markings, net post foundations, scorer's area, and reserve zone with protective fencing/mesh & drainage arrangements. The scope shall include earthwork, sub-base preparation, finished sports surface, drainage arrangements, supply and installation of volleyball posts and net system, painting, and all associated finishing works. Stepped seating arrangements minimum 24m long need to be provided.

12. Skating Rink

A skating rink of minimum 1200sqm shall be developed, including the skating surface, edge protection, drainage system, line markings, and associated infrastructure. The scope shall include site grading, granular base preparation, VDF Flooring with finished skating surface i.e. 4-layered Skirting Acrylic Synthetic Flooring (Deco Turf ITF Approved), kerbs, drainage, painting, and all allied works required for a complete facility.

13. Kabaddi Court

A standard day-night Kabaddi court with lighting arrangements having minimum area of 304 Sqm including free space, shall be constructed. The scope shall include earthwork, site levelling, sub-base preparation, RCC base course with finished sports surface i.e. 1000mm x 1000mm x 35MM Thk. Multi Layer EVA Foam kabbadi matts, drainage arrangements, court markings, painting, and all associated finishing works in accordance with applicable standards.

14. Site Development

The project shall include comprehensive site development comprising minimum filling of 600mm to achieve required site grading and drainage as per the approval, internal roads (Cement Concrete), pedestrian pathways, landscaped areas, parking facilities, rainwater harvesting systems, storm water drainage, external lighting, utility corridors, street furniture, signage, plantation, and all associated external development works.

15. Compound Wall and Gates

The project includes construction of a compound wall of minimum 1,640 m length enclosing the entire campus, comprising a 1.65 m high front boundary wall with 0.90 m high MS grill and a 2.40 m high boundary wall with concertina wire fencing along the remaining sides, in accordance with the approved architectural drawings.

The scope shall also include construction of a minimum of two architecturally designed entry/exit gate complexes, or additional gates as required for functional accessibility, each with a minimum clear width of 10.50 m and minimum height of 5.50 m, integrated with **double-leaf vehicular swing/sliding gates**, & 2.30 m wide pedestrian wicket gates, security cabins with Entry Inspection (EI) and Pedestrian Holding (PH) facilities, access control systems, lighting, signage, and all associated civil, electrical, plumbing, ICT, and allied works required for complete functionality.

16. Common Services and External Infrastructure

The project shall include the complete construction and commissioning of all buildings, sports infrastructure, sports equipment, and common utility services, including Sewage Treatment Plant (STP), pump room, underground water sump, overhead water tank (if required), internal water supply, sewerage network, storm water drainage, electrical distribution system, fire-fighting system, external illumination, ICT infrastructure, landscaping, and all associated external development works required for a fully functional Multidisciplinary Sports Complex.

General Design & Statutory Requirements

- The campus with buildings to be planned to achieve minimum GRIHA 3 star rating

- The building shall be planned to be fire compliant and facilities in the campus shall include security surveillance system, first aid facility and other required services as per statutory norms.
- Power load calculation to be done by the bidder but the quantity mentioned in the project details are the minimum requirement, keeping in view the load requirement and reliability of power. Supply shall be taken as 33 KV/11KV or as available from the grid based on the assessed load.
- DG set shall cater to all common areas, emergency facilities, community halls etc. The load calculation to be done by the bidder but the quantity mentioned in the project details is the minimum requirement
- The Agency is responsible to obtain all approvals of all drawings, environmental clearance (if required), fire clearance, development authority approvals and all other statutory clearances from the competent authorities as may be required for the project.
- The Agency shall obtain the approval of the drawings from the Engineer in charge before execution
- The Contractor shall study the drawings, visualizations, specifications, material finishes indicated in the contract document and understand all parameters of the design including the architectural look & feel intent. The contractor shall clarify any doubts / discrepancies during the technical discussions with Employer. The contractor is bound to maintain and deliver the core and shell of the structures as per the design intent. The final elevation, look and feel of all structures shall merge with each other. Any value addition to refine the functional aspects are to be undertaken by the agency. The minimum unit areas are to be as per CPWD GPRA norms.
- The fire safety requirement shall be as per NBCS 2026 and obtaining NOC and clearance certificate from the relevant authority is the responsibility of the contractor.
- Service area with structures for placing the HT/LT panels, pump houses, service block, transformer, DG, STP etc shall be provided by the Agency.
- One number of vehicle Innova Crysta/Mahindra ScorpioN is to be provided by the Agency/Contractor with driver 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 year old.
- The scope of the contractor is to design and construct an office for the client with a minimum area of 200 Sqft with attached toilet facilities and necessary electrical lighting, air conditioning, water supply provisions and furniture to accommodate minimum 5 (five) personnel at a time.
- The Agency shall also provide 5 nos of Laptops HP ZBook Firefly having minimum 3 years warranty.
- The agency shall also provide 01 No of A3 color laser photocopier printer having a minimum speed of min. 30 PPM with features included ADF, Duplex and Network with regular supply of the cartridges during the contract and water cooler (as required) etc.

a. Special Conditions

(i) Construction Documents/ Documents

The Contractor shall provide multiple options of the design of necessary element of the Work for the Employers Representative/ engineer/ PGM/C to review along with Employer/ OBCC and shall proceed further only after its approval and sign off. And related Construction activities shall not commence prior to approval of the same. Any minor modification or alteration to one design shall not be construed as “option of the design”.

The drawings issued along with the tender are based on the applicable statutory regulations and guidelines. In due course of time OBCC shall issue the drawings approved by the statutory authorities for "commencement of works at site", and these shall become the basis for preparation of the GFC drawings by the contractor. All development works shall confirm to, shall be designed and constructed / executed in compliance with the applicable statutory regulations and guidelines and comments received from the concerned statutory agencies.

(ii) Approval Drawings / Documents for Subsequent Approvals

Contractor shall prepare and submit approval drawings, documents, calculations, certificates, etc, as may be necessary by the statutory authorities, at the relevant stages. The contractor shall prepare and modify the GFC drawings based on the drawings approved by the statutory authorities.

(iii) Construction Drawings / Documents Approval Process

Contractor shall submit at least following number of sets for approval of Employer's Representative.

1. Construction Documents- 07 sets
2. Samples, datasheets etc - 07 sets

Each of the submission should clearly identify the Work, purpose of the submission, document number etc. as approved in the procedure referred above. Upon review of the said submission Employers Representative shall review and revert with relevant codes for revision, approval, conditional approval, etc.

Although Work may proceed on receipt of a drawing with conditional approval, Contractor must resolve the comments indicated, resubmit and obtain final approval before release for shipment or completion of the affected Work.

Employer/ Employer's Representative and Consultant/OBCC's review and permission to proceed does not constitute acceptance or approval of submittals including, but not limited to, design details, calculations, analyses, test methods, construction methods, plans, certificates or materials developed or selected by Contractor and does not relieve Contractor from full compliance with the Contract requirements.

(iv) Technical Standards and Regulations

Contractor shall refer and implement all relevant and all applicable codes, technical standards, regulations, as amended, required for performance of Work covered under this Contract. Also, all the conditions of statutory approval already taken by the Employer need to be complied during construction stage, the same need to be complied for future approval required if any.

(v) Samples

Submission of samples shall not be limited to the above, and the Employer/ Employer's Representative and Consultant/PgMC reserves the right to demand any sample of materials, as deemed necessary. Where samples are required, they shall be submitted by and at the expense of Contractor allowing at least fourteen (14) calendar days for review by Employer/ Employer's

Representative and Consultant/PgMC unless otherwise shown on the Contract Schedule. The materials represented by such samples shall not be manufactured, delivered to the Site or incorporated into the Work without Employer/ Employer's Representative and Consultant/PgMC review. Each sample shall bear a label showing Contractor's name, Work name, Contract number, name of the item, manufacturer's name, brand name, model number, supplier's name, and reference to the appropriate drawing number, technical specification section and paragraph number, all as applicable. Samples, which have been reviewed, may at Employer's option, are returned to Contractor for incorporation into the Work.

(vi) MOCK-UP

As deemed necessary by the Employer/Employer's Representative/PgMC, Contractor shall execute necessary mock-ups of all items/activities related to the Work performed required under this Contract as indicated below and the cost for the same shall be deemed to be included in the Contract price.

(vii) Scope of Firefighting and related Work:

- Fire Fighting: Planning. designing, supplying, installation, testing & commissioning of Firefighting System, comprising of main pump for wet-riser and sprinkler, Diesel engine pump, Jockey pump for wet-riser and sprinkler, MS pipe, valves, flanges, hydrant. down-comer system. Hose reel, Portable Fire Extinguishers, compartmentalization as and where required, in compliance to NBCS :2026. local body by laws and local fire authority. Statutory clearances wherever required will have to be taken by the firm.
- Fire Safety Recommendation must be provided before submission of firefighting drawing and final NOC shall be provided at the completion of the project to EIC.
- All firefighting related work including Underground tank and overhead tank should be in compliance with fire safety recommendation provided by local fire authority and NBCS 2026.

THE FOLLOWING MOCK-UPS SHALL BE EXECUTED BY THE CONTRACTOR:

Item	Extent/Size
1.flooring	Hard & soft finishes-approx.50sft, including all typical interfaces and details.
2.All finishing items including but not limited to flooring, wall cladding, etc.	Toilets-01moduleincludingallfittings, fixtures and modular partitions
3. Railings and other metal fabrication work.	Min2.0RMincludingalltypesofdetails [turns, bends, ends, etc.]
4.Facade Work	Approximate 50 Sqft

Any Mock-Up as per architecture requirement of Client.

b. Design Intent

The design considerations suggested are indicative and minimal. The agency shall improve upon them and provide the best possible technology and materials to get the state-of-the-art output.

- (i) The construction work shall be executed in high temperature and humidity conditions. Average annual rainfall to be considered as per IMD data, and the maximum cyclonic wind speed to be

taken as per IS 875:2015. The site is situated in the Seismic Zone-III. The design wind speed to be as per IS 875: 2015

- (ii) The agency needs to consider the dewatering aspect (if required), which shall critically affect the structural design, construction, and waterproofing of the structures as well as the construction time.
- (iii) General provisions, stipulations, guidelines, and rules laid down in the National Building Code 2016 and other relevant codes as applicable, shall be adopted for all structural, waterproofing, fire, functional, legal, regulatory, obligatory, safety requirements for the buildings and the building services including plumbing and solid waste management with a view to deliver an integrated facility for the intended purpose, considering the design parameters well.
- (iv) All the amenities, facilities, and provisions regarding the scope of work shall be provided as per the norms and guidelines of NBCS 2026 norms. In addition, other provisions of the NBCS shall be applicable for Fire and life safety of the building and amenities for differently abled persons.
- (v) Requirements and stipulations of relevant Planning and Building Standards Regulations must be adhered to.
- (vi) Prepare detailed designs and drawings for architectural floor plans, elevations, sections and detailing thereof drawings for structural works, fire and life safety and building services such as electrical works, MEP, Information & Communication Enabled ELV Installations, plumbing services, landscaping, signage and outer display structures/ installations as per scope, following the latest BIS/IRC codes for materials, design and construction, relevant CPWD/OPWD Specifications, NBCS and IRC-SP-12-2015.

Note : In the absence of any definite provision in the technical specifications contained herein, reference may be made to the latest CPWD, MORTH, IRC, CPCB, GRIHA, NBC and IS codes, in that order. Wherever these are silent, the construction and completion of the works shall conform to sound engineering practice and in case of any dispute arising out of the interpretation of the above, the decision of the Engineer-in- Charge shall be final and binding on the Contractor.

- (vii) Toilet requirement with WC, Urinal, Wash basins, Cleaners Sink, drinking water facilities shall be based on the applicable standards.
- (viii) Recycled waste and rain water for use in flushing and gardening

B. TIMELINE FOR SUBMISSIONS

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.

The time period for the design stage is 15 days from the date of commencement.

Sl No	Description	Schedule for completion
A.1	a) Inception report* b) Submission of application of Statutory Approval/NOC from development Authority	7 days from the date of commencement
A.2	Details of all Survey including laboratory test report for Construction Materials and design Mixes	15 days from the date of commencement
A.3	Draft Architectural Drawings with detailed Engineering Designs and technical specifications & methodology along with Design Basis Report	30 days from the date of commencement
A.4	Quality Management Plan & Environment, Health and Safety Manual.	15 days from the date of commencement
A.5	Final Architectural Drawings with detailed Engineering Designs and technical specifications & methodology	60 days from the date of commencement
A.5	Changes during Construction	As and when referred by the Department
A.6	Monthly Progress Report	10th day of Succeeding Month
A.7	As Built Drawing	As provided in the Contract Data
A.8	Consolidated Booklet Containing All Approvals, Clearances, NOCs in connection with the Project	With as built Drawings
A.9	Inventories with Warranties and User's Manual	With as built Drawings

*Note: * Inception report will broadly contain Site Appreciation, Identification of Secondary Data Requirements, Detailed, Breakdown of Investigations and Surveys to be carried out and a work program.*

C. SERVICES TO BE PROVIDED BY THE EMPLOYER

The Employer will provide the following data to the Bidder on request. If available.

- Indicative Sub-soil report and other associated data.
- Site plan
- Soil bore log and test result.
- Any other relevant secondary data, to the extent available in comprehensive manner.

- Application for all statutory approval shall be made by the employer. However, contractor will conduct relevant survey, prepare all drawings, documents, presentations and will facilitate to get all statutory approvals from competent authority.

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.

D. 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 there of & extracts there from 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 may be, without written permission of the Employer, any time afterwards, 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.

E. APPENDIX

1. Appendix- I: SCOPE OF WORKS

The bidder shall submit his Design Basis Report covering all aspects as given below or more with specific details and not generically.

a. General

The project shall be executed on a Turnkey basis. General scope of the work of the project shall include but not limited to the following:

1. The contractor shall undertake, at its own cost, the Soil testing & Geo-technical study, Total Station Survey of the project area and additional area as may be required and GPRS Survey with approval of the Engineer In-charge. The contractor shall, at its own cost, procure Rainwater data for the last 25 years for analysis. Wind Load data,

Hydraulic data of River Mahanadi, HFL study of the River Mahanadi shall also be procured by the contractor at its own cost. The contractor shall also perform all necessary tests before and during construction with approval of the Engineer- In charge and submit necessary reports to the employer for review and approval within a time so as to not delay the progress of the project. The contractor must also take into account seismic load, wind load etc. while developing structural and MEPF designs conforming to all statutory norms and standards after getting approval for the architectural design from the employer.

2. Development of architectural drawings including preparation of architectural brief, design concept, concept for services etc. It may be noted that the concept plans forming part of the Bid documents shall be the basis for this. This would also include high resolution renderings as may be required and a walkthrough not exceeding 3 mins with voice over (bi-lingual) and suitable sub-titles.
3. Carrying out field surveys and detailed engineering design, and development of drawings considering the architectural design and construction documents, structural engineering, electrical engineering, heating ventilation and air conditioning plans, communication and networking plan, fire detection and protection plan, landscape design both horizontally and vertically exterior and interior.
4. Preparation of services plans to include all details of plans, elevations, and sections with details of electrical works, ventilation, water supply, drainage & sewage disposal system and rainwater harvesting system.
5. Carrying out Geotechnical Investigations and Sub-Soil Exploration at each proposed built structures and conduct all relevant laboratory and field tests on soil and rock samples. Soil bores 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.
6. Preparation of Key map (at relevant scale) showing the location of the buildings investigated and rejected and the important structures, in the vicinity. The reference to the position of the benchmark, location of the trial pits or bore-holes giving identification number for each bore connected to the datum and location of all nullahs, buildings.
7. Procurement, installation, testing and commissioning of requisite equipment as per specifications provided. Samples of all materials required for testing is included in the cost of work. Expenditure for all mandatory tests and those to be conducted as per

direction of Engineer In-charge shall be borne by the contractor. All testing in house or through external laboratory shall be completely borne by the contractor including cost of transportation of samples to the testing locations or laboratories.

8. Contractor shall establish an advanced in-house laboratory with adequate facility for carrying out all routine field tests required during execution of work at their own expense.
9. The approved manufacturers of various finishing items, fittings/ fixtures/ equipment/ components/ accessories have been mentioned in the List of Approved Manufacturers at Subsection F of Section The Contractor shall get the samples of these items approved by the Employer before their use/ utilization in the works. A higher or equivalent make can be utilized after obtaining prior approval of "Engineer-In-Charge" in writing.

b. Green Building Practice

1. The contractor shall ensure that adequate measures are taken for the prevention of erosion of the topsoil during the construction phase.
2. The Contractor shall arrange to work so as to minimize site disturbance such as soil pollution due to spilling and use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site.
3. The contractor shall not carry out any work which results in the blockage of natural drainage.
4. The contractor shall ensure that existing grades of soil shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the Engineer
5. Contractor shall reduce pollution and land development impacts from automobiles use during construction. 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.
6. 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.
7. 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.
8. The Scope of work for Contractor, Architect, Electrical and PH consultants for adoption of GRIHA are as follows:

a. Scope of Contractor

- (i) Demonstrate that the project team implements tree preservation measures at site.
(Protect or Transplant or Replant in 1:3 ratio).
- (ii) Ensure that 90% of fertile topsoil from disturbed area (including building footprint vehicular pathways and material storage areas) is preserved.
- (iii) Adopt following construction management measures at site.
 - a) Provide 3 m high continuous barricading along the site boundary.
 - b) Provide wheel washing facility/gravel bed at all vehicular entrances and exits of the site.
 - c) Ensure diesel generator sets are in compliance with CPCB norms and have an exhaust with stack height of at least 2 m from the top of the generator with a cap.
 - d) Implement a spill prevention plan for storage of diesel, admixtures, curing compounds, bitumen, and other hazardous material.
 - e) Ensure that fine aggregate, excavated earth, and other construction material with a tendency to get airborne are covered or are sprinkled regularly with non-potable STP water.
 - f) Ensure sprinkling of water on unpaved pathways on the site with non-potable water in order to mitigate air pollution.
 - g) Limit the speed of vehicular movement on site to 10 km/h.
 - h) Ensure that vehicles carrying waste materials out of the site are covered.
 - i) Ensure that the soil erosion channels are constructed, and they are connected to a sedimentation tank in order to reduce movement of soil outside the site.
 - j) Adopt staging during construction on site.
 - k) Adopt following strategies to manage water during construction. such as-
 - a. Using gunny bags for curing and using ponding for curing
 - b. Monitoring to avoid leaks and water wastage
 - c. Use of additives to reduce water requirements during curing
 - d. Use of treated wastewater/captured storm water
 - l) A construction waste management plan for segregation of construction waste, its safe storage and on-site/off-site recycling is developed and implemented in the project – 1 point.
 - m) Ensure compliance with the requirements of NBC, 2016 for all of the following:

- a. Provision of necessary safety equipment and safety measures for construction workers.
 - b. Provision of clean drinking water, hygienic working and living conditions, and sanitation facilities for the workers.
 - c. Provision of crèche facility for children of construction workers in case their families are allowed to work/live at the construction site.
- n) Adopt the following for the construction workers on-site:
- d. Provide a grocery store/canteen within the site premises.
 - e. Organizes at least two events during the entire construction phase to create environmental awareness among the construction workers.
- (iv) Ensure minimum replacement of OPC with BIS recommended waste materials (such as fly ash, slag, etc.) by weight of cement used in structural concrete.
- (v) Ensure minimum 5% replacement of natural aggregate with RCA/RA by weight of that category of aggregate in structural concrete.
- (vi) Ensure that all internal and external, load bearing, non-load-bearing and partition walls are constructed with - Concrete blocks (hollow, solid or AAC) with minimum 40% fly ash content by weight And/ Or Porotherm blocks And/ Or Adobe bricks/CSEB And/ Or Rammed earth walls And/ Or Stones from India (not including stone cladding) And/ Or Bamboo/any other rapidly renewable material (not including bamboo cladding).
- (vii) Monolithic concrete wall demonstrating minimum 30% replacement of OPC with BIS recommended waste material by weight of cement.
C&D waste blocks containing minimum 30% C&D waste material by weight.
- (viii) Ensure minimum 30% replacement of OPC with BIS-recommended waste by weight of cement used in masonry mortar and plaster.
- (ix) Ensure that at least 70% of all roads and vehicular pathways within site premises are constructed with -
- a. Bituminous road with minimum 6% plastic waste content by weight of bitumen and / Or
 - b. Cast in situ cement concrete road with minimum 30% fly ash content by weight of total cementitious material and / Or
 - c. Concrete blocks with minimum 40% fly ash content by weight of block and / Or

- d. Paver blocks containing minimum 10% C&D waste content by weight of block and / Or
 - e. Stones from India and / Or
 - f. Any other manufactured product with minimum 10% recycled content by weight.
- (x) Ensure that 100% of the pavement/footpath including kerbstone constructed on-site are constructed with -
- a. Bituminous pavement with minimum 6% plastic waste by weight of bitumen and / Or
 - b. Cast in situ concrete with minimum 30% fly ash content by weight of total cementitious material and / Or
 - c. Concrete blocks with minimum 40% fly ash content by weight of block and / Or
 - d. Paver blocks containing minimum 10% C&D waste content by weight of material and / Or
 - e. Stones from India and / Or
 - f. Any other manufactured product with minimum 10% recycled content by weight.
- (xi) Ensure that all interior wall and ceiling finishes such as primers, paints, putty, etc. have low VOC content and are lead free.
- (xii) Ensure that all adhesives and sealants used have low VOC content and that interior composite wood products do not have urea-formaldehyde as a bonding resin.
- (xiii) Ensure that tobacco smoking is prohibited on-site during the entire construction phase.
- (xiv) Adopt sustainable transportation within the site premises, such as -
 Provide at least four designated number of parking spaces for informal modes of transport within the site premises. And/Or Provide NMT vehicle with at least 10% of the total parking space designated to them onsite along with charging facility. Additionally, provide designated vehicular tracks for NMT vehicles. And/Or Provide bicycle users with at least 10% of the total parking space designated to them along with changing rooms, showers, lockers within the site premises.

b. Scope of Architect

- (i) The building plan and site layout should adopt solar passive building design strategies to ensure adequate daylight in each living space.
- (ii) Demonstrate that the exterior fenestration is designed taking into consideration the window orientation, size, placement, and shading design to facilitate wind flow into the interior spaces.
- (iii) Provide adequate thermal insulation on Roof & Wall and Energy Efficient Glazing for Windows in order to reduce the heat gain through building envelope.
- (iv) Ensure that the WWR (Window to Wall Ratio) and SRR (Skylight to Roof Ratio) does not exceed the recommended value by ECBC-2017/ GRIHA.
- (v) Ensure that the windows meet the SHGC (Solar Heat Gain Coefficient) for each orientation should follow ECBC 2017, Clause 4.3.3, and Tables 4–10.
- (vi) The VLT (Visible Light Transmittance) of Skylight and Windows should comply with recommended VLT value as per ECBC-2017 & GRIHA.
- (vii) Ensure that the project complies with the provisions of Harmonised Guidelines and Space Standards for Barrier Free Built Environment for Persons with Disability and Elderly Persons as per NBC-2016.
- (viii) Ensure provision of dedicated rooms (for resting) for service staff and toilets for the service staff on-site as per NBC-2016 (Volume 2, Part 9, Section 2, and Clause 4.2).
- (ix) Ensure the indoor noise levels as per NBC 2016, Volume 2, Part 8, Section 4, Clause 3.4.3.3 by adopting following strategies -
 - a. Interposing buffer zones in building plan
 - b. Protection of habitable spaces by introduction of green belts (greater than 30 m with broadleaved evergreen trees), public gardens, etc.
 - c. Positioning a less vulnerable building closer to the noise sources than the vulnerable buildings.
 - d. Shading and screening by providing a solid barrier such as a wall.
 - e. Provision of adequate sound insulation in building envelope (walls and roofs)
- (x) Ensure that designated smoking zone/s is/are provided and the smoke is managed within a controlled environment.
- (xi) Demonstrate reduction in landscape water demand by adopting efficient landscape design strategies, such as - Minimize the lawn area, Maximize the tree plantation, Maximum incorporation of native vegetation (Drought Tolerant Trees, Shrubs and other plants), Grouping of plant species as per the water

requirement, Xeriscaping - Plants which are xero-phytic (palm) and minimize the water fountain concept in landscape plan etc.

c. Scope of Electrical Consultant

- (i) Ensure that the project meets the mandatory requirements of ECBC-2017.
- (ii) Demonstrate that 100% of outdoor lighting fixtures (lamps + ballast) meet the luminous efficacy of 80 lm/W.
- (iii) Demonstrate energy efficient lighting and air-conditioning system designing as per ECBC-2017 norms in order to reduce the EPI (kWh/m²) from GRIHA benchmark.
- (iv) Ensure that the equipment installed within the project is either BEE-Star labelled or of equivalent performance.
- (v) Ensure installation of On-site & Off-site renewable energy system to off-set a part of the annual energy consumption of internal artificial lighting and domestic hot water system (if any).
- (vi) The fire suppression systems and fire extinguishers installed in the building are free of Halon.
- (vii) All the insulation used in the building envelope and for HVAC systems; refrigerant used in the HVAC systems and refrigeration equipment are HFC free.
- (viii) Artificial lighting design to fall within limits (lower and higher range limits) as recommended space/task specific lighting levels as per NBC-2016 (part-8, Section-1, Table-4) and meet a minimum uniformity ratio of 0.4.
- (ix) Demonstrate that the spaces meet the thermal comfort requirements as per NBC 2016, ASHRAE 55, or the Indian Adaptive Comfort model, ensuring that the maximum number of unmet hours shall not exceed 300.
- (x) Meet the minimum requirements of CPCB National Ambient Air Quality Standard (NAAQS) for quality of fresh air; and ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata) Or NBC-2005 for quantity of fresh air. The clause shall cover treatment of outdoor air for predominantly PM 10 and PM 2.5.
- (xi) Ensure continuous monitoring of CO, CO₂, temperature, and RH levels such that they meet the permissible thresholds as per ASHRAE standard 10001:2016, Table 6, for all habitable areas either at space level or at AHUs by installation of sensor(s) deployed with feedback system as per GRIHA.
- (xii) Ensure improved indoor air quality by adopting Installation of indoor plants and/or Promoting use of carpets and mats at all entrances and/or Use of green

cleaning products for housekeeping and/or Installation of separate exhaust system for janitor/storage rooms for chemicals and/or Installation of air curtains and/or Air sanitization and/or Demand control ventilation.

- (xiii) Installing digital energy meters at Utility grid, on-site renewable energy system, DG set, gas genset and each building level etc.
- (xiv) Install digital water meters at Municipal supply, Borewell, treated water outlet from STP (Grey/Black), captured rainwater etc.
- (xv) Ensure the installation of smart metering system, which is capable of tracking energy & water consumption through a web hosted portal for all meters mentioned above.
- (xvi) All smart metering and monitoring systems should be capable of the following:
 - a. Hourly data reporting in near real-time (no more than 15-minute delay).
 - b. Energy mix breakdown and consumption patterns.
 - c. Water consumption patterns from various sources
 - d. Ability to set energy and water consumption targets, alarms, and pricing.
 - e. Ability to compare historical trends and benchmark data
 - f. Real-time monitoring with user interface that operates even on mobile devices

d. Scope of MEP Consultant

- (i) Use of water efficient plumbing fixtures, sensors, auto-control valves, and pressure reducing devices can result insignificant reduction in water consumption in a building. Once the type and number of fixtures and faucets have been decided as per NBC standards based on building typology, select the fixtures and faucets of low-flow rates (based on technology options available in the market).
- (ii) Adopt water efficient irrigation systems if any, that saves water loss due to run-off, deep percolation, and evaporation; (i.e Drip irrigation, Moisture control sensor etc.).
- (iii) Install dual plumbing system to separate piping systems for recycled water (non-potable quality) and potable water.
- (iv) Rainwater harvesting (tanks, ponds, rooftop rainwater harvesting) to rebuild local water aquifers wherever feasible and/or storage of harvested water for meeting the water requirement during the scarcity days.
- (v) Ensure that the project meets water quality norms as per the CPCB rules and BIS.

- (vi) Provide infrastructure (multi-coloured waste bins/different refuse chutes to store e- waste, biomedical waste, organic waste, plastic waste, paper waste, and other inorganic solid waste) for building occupants to ensure segregation of waste at the source.
- (vii) Ensure that dedicated segregated and hygienic storage spaces are provided within the project site before treatment/recycling.
- (viii) Provide contractual tie-ups with waste recyclers for safe handling and recycling of all types of inorganic waste generated on site.
- (ix) Ensure that at least 50% of inorganic waste is recovered/diverted (by means of recycling/processing through dedicated recyclers).
- (x) Ensure that the organic waste generated on-site [from the building and landscape] is quantified, and adopt strategies to treat 100% organic waste on site to convert it into useable resources (manure, biogas, etc.) such as – dump-pits, organic waste converter or vermicomposting etc.
- (xi) All the services to be planned considering highest flood level of the river into consideration.

F. Project Management, Clearances & Certification

The Contractor shall obtain approval to the design, drawings and specifications of all components of the building, from any institute of repute to be decided by the employer at its own cost. The Employer shall give clearance for construction on all sketches, drawings, reports and recommendations and other matters and proposals submitted for approval by the Contractor in such reasonable time as not to delay or disrupt the performance of the Contractor's services.

1. Planning of the project activities including work break down structure and their timelines thereof, in MS Projects/ Primavera and submit the same to the authority for progress monitoring throughout the span of the project.
2. Project Management to ensure completion of the Project as per the specified timelines
3. Obtaining NOC from Development Authority/ Municipality, PHEO, Fire authority, Environmental Clearance from SPCB (if applicable), and any other statutory approval required for the project.
4. Compliance with Environmental and Energy efficiency norms and obtaining at least 3-star GRIHA rating.
5. Handing over of the facilities after fulfilling all obligations of the Contractor and confirming to Employer's requirement

6. Taking up the works listed for Defects Liability Period and closing the project.
7. Submission of Daily Labour Report and Weekly / Monthly Labour Payment Report.

G. Scope of Work

The project shall be executed on a Lump Sum Turnkey Design and Build (D&B) basis. The scope of work shall include topographical survey, geotechnical investigations, master planning, architectural, structural, MEPF, landscape and allied engineering design, preparation of detailed drawings, obtaining all statutory approvals and clearances, construction, testing, commissioning, completion, and handing over of the project to the Employer. The Contractor shall also be responsible for obtaining all applicable completion certificates, occupancy certificates, and statutory NOCs from the competent authorities.

The project comprises the development of a Regional Sports Hub at Dhamnagar, Bhadrak, envisioned as a modern, integrated sports campus providing high-quality training, competition, residential, and support facilities for multiple sporting disciplines. The master plan shall be developed with the long-term vision of creating a world-class Olympic training centre, incorporating state-of-the-art sports infrastructure, athlete support facilities, advanced training environments, and modern amenities capable of nurturing athletes from across India.

The components are summarized below which are indicative & minimum project requirements: -

Sl no	Facilities proposed
1	Football field of minimum area of 8256Sqm of FIFA standard with 400 m length 9 lane synthetic athletic track with World Athletics guidelines and relevant Indian standards provision of proper drainage and irrigation systems, installation of floodlighting, and development of associated infrastructure such as fencing, player amenities, and landscaping
2	Football facility building of 1160 sqm in ground floor and 830 sqm in first floor with 790 seating capacity in upper floor
3	Multipurpose hall of 1200 sqm in ground floor and 338 sqm in first floor area, central arena with 2 nos badminton courts.
4	Cricket field of 75m radius play area with central pitch, practice strips, outfield, boundary and floodlighting.
5	Cricket facility building of 1250 sqm in ground floor and upper floor of area 910 sqm meant for 950 seating capacity. Practice pitch – 5 nos of area 474sqm, runup area of 479sqm & warm-up area of 4038sqm
6	Swimming pool complex of 3050 sqm with 50 m × 25 m competition swimming pool and allied facilities
7	Basketball court of 642sqm of PU based court with 1 no seating Gallery
8	Kho Kho court of size 620sqm m with clay based court and 1 no seating Gallery
9	G+2 hostel building (girls and boys hostel) of 1800 sqm each of capacity 102 beds each
10	Volleyball court of size 432 sqm with Acrylic based court and 1 no seating Gallery

11	Skating rink/track of 1200 sqm
12	Kabaddi court of playing area of 304sqm with PU based court and 1 no seating Gallery
13	Internal roads, parking, pathways, landscaping, drainage, rainwater harvesting and other external development works
14	1,640 m compound wall (including gate lengths), minimum 2 gate complexes, security cabins and associated security infrastructure
15	Service buildings and utility infrastructure including HT/LT systems, transformers, DG sets, STP, pump house, UG sump, firefighting, electrical, plumbing and other statutory services as per requirement
16	Supply, installation and commissioning of all indoor and outdoor sports & Gym equipment and accessories for the respective facilities

The above sub-components have been discussed in the following paragraphs for understanding of the prospective bidders. The bidders are advised to go through the scope in detail bearing in mind the following:

- i. The Scope of sub-components or works are minimum are indicative in nature. It is expected that the bidder shall undertake due diligence on their part by referring to scope herein, the associated drawings given in section 7 and corrigendum issue from time to time for arriving at the final estimate.
- ii. In case of disparity between the scope mentioned here under and the drawings given I section 7 the decision of the Engineer shall be final, unless explicitly mentioned otherwise.
- iii. All buildings shall have a minimum plinth height of 600 mm above the finished formation ground level. The minimum floor-to-floor height shall be 3.60 m, unless otherwise specified in the approved drawings, design requirements or technical specifications.
- iv. All the windows and ventilators shall have aluminium system windows (3 tracks) with Ms Grill, unless specified in the scope.
- v. Doors as mentioned in the scope shall be of minimum 32 mm thick flush door along with WPC chowkhats of size 65mm x 125mm (Minimum Density 900 Kg/M3).
- vi. For toilet door 30mm thick WPC Door with WPC chowkhats of size 65mm x 125mm (Minimum Density 900 Kg/M3).
- vii. Provisions of Putty and Painting for Ceilling, 12mm internal Plaster and 18mm external plaster (in 2 layers of 12mm & 6mm for aesthetic views) to be made in all structures.
- viii. In addition to the above; grading, external putty, internal putty, water proofing with ponding of waters rectifying the defects if any found, plinth protection, G.R.C, anti-termite treatment are to be done as per codal guideline.
- ix. All the internal surfaces, columns, roof ceiling to be coated with two coats of plastic Asian paints royal glitz emulsion or equivalent paint over a coat of water-based primer and exterior

surface except cladding area to be coated with two coats of weather coat of Apex ultima protek duralife of Asian paint or equivalent over a coat of water-based primer. Grills painted with two coats of enamel paint over a coat of primer.

- x. All the Vitrified tiles & Granite stone (minimum 20mm thickness), Kota stone slabs for flooring are laid over an under layer of 20 mm thick cement mortar (1:4) (1 cement: 4 coarse sand) ratio.
- xi. All the Industrial Vitrified tiles, Vitrified tiles & Granite stone for skirting are fixed over an under layer of 12 mm thick cement mortar (1:3) (1 cement: 3 coarse sand) ratio.
- xii. Provisions of ramps are to be provided in all buildings which is to be accessed by public.
- xiii. All stainless-steel works are 304 grade.
- xiv. All the structures have backfilling with excavated materials/ sand wherever needed with proper watering & compaction complete.
- xv. Provision of adequate rooftop solar photovoltaic panels for each building in accordance with the standards.
- xvi. The Contractor shall provide a comprehensive signage system covering all four categories of signage, namely Identification Signage, Directional/Wayfinding Signage, Informational Signage, and Regulatory & Safety Signage, for all buildings and campus facilities. The signage system shall include room identification, directional and campus maps, statutory, accessibility, emergency and fire exit signage, and all other signs required for safe and efficient operation of the facility, in accordance with the approved drawings and applicable standards.

1. FOOTBALL FIELD :

- i. The proposed football field shall have minimum total area of 8256 Sqm.
- ii. The total area has to be developed with proper filling, rolling & compacting to the required levels with providing anti-termite treatment.
- iii. 10-20mm Stone aggregates of required size and minimum 150mm thickness to be laid as per design.
- iv. Supply, stacking, mixing and laying of a 250 mm thick engineered root-zone growing medium comprising sand, well-decomposed manure, cocopeat, organic matter and basal fertilizer in the required proportions over the prepared stone aggregate layer, complete with grading to the required slopes, levelling and field line marking, as per the approved design and FIFA requirements.
- v. Design, supply and laying of the sub-surface drainage network by trench cutting of size 250mm x 300mm and laying minimum 1,760 m of 110 mm dia. UPVC corrugated perforated pipes and minimum 279 m of 160 mm dia. UPVC plain pipes, including fittings, inspection chambers, connections and all associated works, complete as per the approved design and the minimum drainage requirements of the football field.
- vi. Provision for plantation of Bermuda TIFWA 419/Variety grass with improved seeding at site by planting method and free from weed free on FOP area. (Minimum 8256 Sqm)

- vii. Providing and laying of Geotextile materials (200 GSM) for trenches & FOP with minimum area of 9479 sqm.
- viii. Two Goal post (7.32 m x 2.44 m) with 4 x 460 mm deep sockets, and net to be provided as per FIFA specifications.
- ix. The goal post with net made shall be of grayware nylon mesh (50 x 50 mm) of white colour as per FIFA specifications.
- x. Supplying and fixing of 1 set 4 nos. of corner flags at the corners of the field.
- xi. Provision of 1 pair of Dugout structures to be provided at both sides of the field as per FIFA Specification.
- xii. Maintenance of football field shall be done after planting the turf grass and manicure upto the full growth of turf including mowing, irrigation, fertilizing, fungicide application, weed management, aeration, maintaining levels, scarifying irrigation managements etc till handing over.
- xiii. Construction of periphery RCC Drain with perforated cover slab for minimum width of 300mm with varying height & length to cover entire football field as per standard with provision of adequate chambers for maintenance.
- xiv. **POP-UP SPRINKLER SYSTEM:**

Design, supply, installation, testing and commissioning of a fully automatic pop-up sprinkler irrigation system for the football field, designed in accordance with the manufacturer's recommendations, site conditions, FIFA requirements and the approved design. The system shall include preparation of shop drawings, hydraulic design and all works necessary for satisfactory operation. The scope shall include all materials, labour, piping, HDPE/UPVC pipelines, pop-up sprinklers with swing joints, valves, valve boxes, automatic control panel, controller, pumps (minimum 7.5 HP – one working and one standby), filtration unit, NRVs, clamps, fittings, electrical cabling with conduits, earthing, foundations, testing, commissioning and all accessories required for a complete and operational irrigation system.

Approved Makes (or equivalent):

- **Pipes & Valves:** Harit / Prince / Supreme
- **HDPE Pipes:** Duraline / Times Technoplast / Supreme
- **Sprinklers, Automation & Accessories:** Rain Bird / Toro
- **Filtration Unit:** Azud
- **Pumps:** Kirloskar / Crompton Greaves / KSB / Wilo

xv. UG Tank

Provision of providing 150 KLD UG tank for the purpose of internal and external PH work along with sprinkler work for field area. The tank shall be of RCC framed structure. Provision of water-proof coating on positive and negative side of the UG tank.

xvi. Fencing

Perimeter Fencing: Providing and fixing of fencing around the football field having minimum 3.0 m high perimeter on Touchlines (sidelines) of required length & 10.0m high perimeter on Goal Lines of required length using PVC-coated G.I. chain-link mesh (50 mm × 50 mm, 5 mm

dia. core wire) supported on rectangular hollow steel (RHS) sections, complete with foundations, bracing, corrosion protection, and 5 Nos. access gates, including all fittings and allied works required to restrict unauthorized entry onto the playing field. Fencing shall be provided at the surrounding of the cricket field to restrict audience for entering the field in order to avoid disturbances during matches.

xvii. Operation & Maintenance:

The Contractor shall be responsible for the comprehensive operation and maintenance of the football field, irrigation system, drainage system, sports infrastructure, turf, equipment, and all associated civil, electrical and mechanical installations for a period of 5 (five) years from the date of successful handing over. The maintenance scope shall include the supply of all consumables, materials, fertilizers, pesticides, fungicides, herbicides, grass replacement, irrigation components, spare parts, tools, lubricants, fuel (where applicable), manpower, machinery, equipment, utilities required for testing, and all preventive, routine and breakdown maintenance necessary to keep the facility in fully functional condition and in compliance with FIFA performance requirements. The Contractor shall prepare and submit a detailed Operation & Maintenance Manual, including Standard Operating Procedures (SOPs), preventive maintenance schedules, inspection checklists, equipment manuals, as-built drawings, warranties, troubleshooting procedures, and maintenance protocols for approval by the Engineer-in-Charge prior to handing over. The Contractor shall also provide training to the Employer's designated personnel for the operation and routine maintenance of the facility.

2. CRICKET FIELD :

The proposed project involves the design and development of a standard cricket ground comprising a centrally located natural turf wicket block with multiple practice strips, surrounded by a professionally developed outfield and boundary in accordance with the applicable standards. The scope shall include site grading, earthwork, turf development, preparation of natural turf wickets, installation of a comprehensive drainage and automated irrigation system, floodlighting for day and night play, and all associated civil and horticultural works. The project shall also include ancillary facilities such as practice nets, spectator seating, player pavilions, internal circulation pathways, fencing, landscaping, utility services, scoreboards, and all sports equipment required for a complete and fully functional cricket facility.

- i. A new cricket ground has been proposed for construction for a minimum radius of 75m playable area.
- ii. The total area has to be developed with proper filling, rolling & compacting to the required levels with providing anti-termite treatment.
- iii. 6-10mm Stone aggregates of required size and minimum 150mm thickness to be laid as per design.
- iv. Supply, stacking, mixing and laying of a 250 mm thick engineered root-zone growing medium comprising sand, well-decomposed manure, cocopeat, organic matter and basal fertilizer in the required proportions over the prepared stone aggregate layer, complete with grading to the required slopes, levelling and field line marking, as per the approved design and BCCI requirements.

- v. Design, supply and laying of the sub-surface drainage network by trench cutting of size 250mm x 300mm and laying minimum 2,187 m of 110 mm dia. UPVC corrugated perforated pipes and minimum 368 m of 160 mm dia. UPVC plain pipes, including fittings, inspection chambers, connections and all associated works, complete as per the approved design and the minimum drainage requirements of the cricket field.
- vi. Provision for plantation of Bermuda TIFWA 419/Variety grass with improved seeding at site by planting method and free from weed free on FOP area as per requirement.
- vii. Providing and laying of Geotextile materials (200 GSM) for trenches & FOP as per requirement.
- viii. Construction of 9 Nos. natural turf cricket pitches, each of 25.0 m × 3.05 m, including 100 mm thick fine sand layer, 250 mm thick approved Balangir soil, grassing with approved sports turf, rolling, compaction, and complete pitch preparation in accordance with the approved design and specifications.
- ix. Construction of bowling run-ups for the main cricket pitches, including spreading and compacting minimum 200 mm thick approved sandy soil over a minimum area of 988 sqm for the practice pitches on each side & sandy loam soil measuring 15.24 x 18 m (3 nos) for main pitches each at two ends of pitch square at North- South direction.
- x. Maintenance of cricket field shall be done after planting the turf grass and manicure upto the full growth of turf including mowing, irrigation, fertilizing, fungicide application, weed management, aeration, maintaining levels, scarifying irrigation managements till handover.
- xi. Construction of periphery RCC Drain with perforated cover slab for minimum width of 600mm with varying height & length to cover entire cricket field as per standard with provision of adequate chambers for maintenance.
- xii. Provision of Laying 150 mm concrete pipe of minimum length of 40 m for connecting inner to outer drain and 450 mm concrete pipe of minimum length of 100 m for connecting outer drain to drainage line.
- xiii. **POP-UP SPRINKLER SYSTEM:**
 - The work comprises the design, supply, installation, testing, and commissioning of a complete irrigation/sprinkler system in accordance with the manufacturer's specifications, site conditions, and project requirements. The system shall be designed to ensure efficient and smooth operation for the cricket field and shall be executed with due approval from the client/consultant. The scope also includes preparation of shop drawings and provision of all necessary components required for satisfactory performance of the system.
 - The pipeline network shall consist of uPVC pipes conforming to IS: 4985, using reputed makes such as Supreme or Finolex, including 75 mm, 63 mm, and 40 mm diameter pipes of 10 kg/cm² pressure rating.
 - The sprinkler system shall include pop-up type sports sprinklers (TORO T7 Series or equivalent) along with all associated fittings such as 1-inch swing joints with four elbows, service saddles (75 mm × 1", 63 mm × 1", and 40 mm × 1"), 2-inch PVC ball valves (PN16), air release valves, brass quick coupling valves (QCV) with keys, and brass swivel elbows. Suitable valve boxes of various sizes (rectangular and circular) shall also be provided as per system requirements.

- The pumping system shall include a monobloc pump capable of delivering 5.8 LPS at 58 m head, complete with pressure gauge, non-return valve (NRV), ball valves, suction and delivery piping, and fittings. The electrical control panel shall include MCB, indicating lamps, single phasing preventer, and star-delta starter. Necessary cabling (4 sq.mm, 3-core) and water level automation provisions shall also be included. Additionally, a 2 HP pump with starter and fittings shall be provided for hydrant operation, along with a 3-inch disc filter (Amiad make or equivalent).
- The automation system shall consist of a 16-station irrigation controller with rain sensor and stabilizer (TORO or equivalent), along with 2-inch solenoid valves (Irritrol/Toro make), direct burial control wires (14 AWG and 16 AWG), and jointing kits including DBR/Y splice kits (3M or equivalent).
- The scope further includes all necessary heavy-duty PVC fittings, saddles, accessories, and complete execution works such as trenching (up to 1.5 feet depth), backfilling, installation, testing, and commissioning of the entire system to ensure proper functioning.

xiv. UG Tank

Provision of providing 150 KLD UG tank for the purpose of internal and external PH work along with sprinkler work for field area. The tank shall be of RCC framed structure. Provision of water-proof coating on positive and negative side of the UG tank.

xv. Fencing

Perimeter Fencing: : Providing and fixing of fencing around the cricket field having minimum 2.0 m high perimeter of required length using PVC-coated G.I. chain-link mesh (50 mm × 50 mm, 5 mm dia. core wire) supported on rectangular hollow steel (RHS) sections, complete with foundations, bracing, corrosion protection, and 5 Nos. access gates, including all fittings and allied works required to restrict unauthorized entry onto the playing field. Fencing shall be provided at the surrounding of the cricket field to restrict audience for entering the field in order to avoid disturbances during matches.

xvi. Equipment

Cricket Ground Equipment: Supply, installation and commissioning of BCCI-compliant cricket ground equipment, including minimum 2 Nos. sight screens (6.0 m × 6.0 m), minimum 850 sqm pitch protection covers, minimum 2 Nos. water removal foam rollers (750 mm wide), 2 Nos. standard manual scoreboards, minimum 470 m boundary rope, and all other accessories required for a complete and operational cricket facility.

xviii. Operation & Maintenance:

The Contractor shall be responsible for the comprehensive operation and maintenance of the football field, irrigation system, drainage system, sports infrastructure, turf, equipment, and all associated civil, electrical and mechanical installations for a period of 5 (five) years from the date of successful handing over. The maintenance scope shall include the supply of all consumables, materials, fertilizers, pesticides, fungicides, herbicides, grass replacement, irrigation components, spare parts, tools, lubricants, fuel (where applicable), manpower, machinery, equipment, utilities required for testing, and all preventive, routine and breakdown maintenance necessary to keep the facility in fully functional condition and in compliance with FIFA performance requirements. The Contractor shall prepare and submit a detailed Operation & Maintenance Manual, including Standard Operating Procedures (SOPs), preventive maintenance schedules, inspection checklists, equipment manuals, as-built drawings, warranties, troubleshooting procedures, and maintenance protocols for approval by the Engineer-in-Charge

prior to handing over. The Contractor shall also provide training to the Employer's designated personnel for the operation and routine maintenance of the facility.

CRICKET PRACTICE FIELD:

- i. Development of a cricket practice facility comprising a minimum practice area of 1,120 sq.m and a warm-up area of 4,038 sq.m, complete with grading, levelling and surface development.
- ii. Construction of 5 Nos. practice pitches, comprising 2 Nos. concrete pitches, 1 No. synthetic pitch and 2 Nos. natural turf pitches, including all associated sub-base and surface preparation works.
- iii. Construction of the concrete and synthetic pitches with approved layers consisting of coarse sand, granular sub-base, concrete bed with finished playing surface each having minimum area of 94.86sq.m, complete in all respects.
- iv. Construction of 2 Nos. natural turf cricket pitches, each of minimum area of 94.86 sq.m, including 100 mm thick fine sand layer, 250 mm thick approved Balangir soil, grassing with Bermuda TIF419 Grass/ Evergreen Bermuda, rolling, compaction, and complete pitch preparation in accordance with the approved design and specifications.
- v. Construction of minimum 479 sq.m run-up area & 4038 sqm of warm up area with approved garden soil, & site dump manure, grassing with Bermuda TIF419 Grass/ Evergreen Bermuda, rolling, compaction, and complete preparation in accordance with the approved design and specifications.
- vi. Supply and installation of 13 mm pile height synthetic turf for the synthetic practice pitch from an FIH/FIFA Preferred Manufacturer (or equivalent approved), suitable for high-performance sports applications.
- vii. Supply and installation of practice nets with MS supporting structure, including foundations, netting, framing, protective padding (where required), and all associated fittings for all practice pitches.
- viii. The scope shall include all civil, structural, horticultural, drainage, electrical and allied works required for complete development, commissioning and operational readiness of the cricket practice facility.
- xvii. **Fencing**

Perimeter Fencing: : Providing and fixing of fencing around the Practice pitch area having minimum 2.0 m high perimeter of minimum length of 147m or as per requirement using PVC-coated G.I. chain-link mesh (50 mm × 50 mm, 4 mm dia. core wire) supported on rectangular hollow steel (RHS) sections, complete with foundations, bracing, corrosion protection, and 5 Nos. access gates, including all fittings and allied works required to restrict unauthorized entry onto the playing field. Fencing shall be provided at the surrounding of the cricket field to restrict audience for entering the field in order to avoid disturbances during matches.

3. ATHLETIC TRACK :

- Design and construction of a 9-lane, 400 m synthetic athletic track & D-type having minimum area of 8654sqm conforming to the latest World Athletics (WA) standards, IAAF, MoRTH and applicable BIS standards., complete with all track and field event areas.
- Design and construction of a Long Jump, High Jump & Water Jump having minimum area of 728sqm conforming to the latest standards.
- Construction of the track foundation comprising prepared subgrade, granular sub-base & base course each of minimum thickness of 150mm, minimum 60mm thick bituminous base course with minimum 40mm wearing course, and 15 mm full polyurethane (PU) synthetic surfacing consisting of 5mm PU with SBR granules (10mm total) and 5mm PU layer with EPDM granules, including lane markings and colour coding.
- Construction of the Long Jump, High Jump prepared subgrade, granular sub-base & base course each of minimum thickness of 150mm, minimum 60mm thick bituminous base course with minimum 40mm wearing course, and 20 mm full polyurethane (PU) synthetic surfacing.
- Construction of the Water Jump prepared subgrade, granular sub-base & base course each of minimum thickness of 150mm, minimum 60mm thick bituminous base course with minimum 40mm wearing course, and 25 mm full polyurethane (PU) synthetic surfacing.
- Provision of a 1% cross slope, with complete RCC inner drainage channel with perforated removable covers along the inner perimeter of the track with integration with the campus storm water drainage system.
- Supply and application of UV-resistant, weather-resistant, anti-skid, spike-resistant and colour-stable synthetic surfacing meeting the prescribed World Athletics performance criteria.
- The completed track shall comply with the minimum performance requirements of 15 mm thickness, Force Reduction (35–40%) (IAAF), Vertical Deformation (0.6–2.5 mm) (IAAF), Friction (>47 TRRL) (WA), Tensile Strength (>0.5 N/mm²) (WA) and Elongation at Break (>40%) (WA), or the latest World Athletics requirements.
- Quality control tests shall be carried out for sub-grade, WMM, bituminous layers and PU surfacing through approved laboratories.
- Surface level tolerance shall be maintained within ± 3 mm under a 3 m straight edge.
- No water ponding or surface irregularities shall be permitted after completion.
- Supply, installation and commissioning of World Athletics-approved field event equipment, including aluminium kerbing, discus and hammer throwing cages, discus and hammer rings, shot put ring and stop board, pole vault box with cover, long jump and triple jump take-off boards, steeplechase hurdles and all other standard field event accessories required for a complete athletics facility.
- Comprehensive maintenance of the synthetic track, field event areas and all athletics equipment during the Defect Liability Period/Operation & Maintenance period, including repair of defects, replacement of damaged components and periodic cleaning as per the manufacturer's recommendations.

- Construction of Long Jump and Triple Jump facilities, including take-off boards, sand pits with approved sand filling, drainage, edging and all associated civil works, in accordance with the latest World Athletics (WA) standards.
- Construction of a Steeplechase water jump pit within the athletic field, complete with RCC structure, waterproofing, drainage, finishes and all associated works, as per the latest World Athletics (WA) specifications.
- Construction of field event throwing areas for Shot Put, Discus Throw and Hammer Throw, including reinforced cement concrete base slabs, throwing circles, foundations, non-slip finishes, required gradients, and all associated civil works for installation of World Athletics-approved competition equipment, complete in accordance with the approved drawings and specifications.

PEDESTRIAN PATHWAY PERIPHERY OF TRACK, INNER SIDE OF TRACK

Construction of a 2.0 m wide pedestrian pathway along the inner periphery of the athletic track, having a minimum area of 838 sq.m, comprising minimum 150 mm thick granular base course, sand bedding, 60 mm thick M-40 concrete paver blocks, and precast concrete kerb stones, complete with grading, drainage, edging, and all allied works as per the approved design and specifications.

4. CRICKET FIELD FACILITY BUILDING

- The proposed facility building near cricket field ground which shall function as refreshment room, for resting purpose, equipment storing etc for players as well as spectators.
- Design and construction of a G+1 RCC framed Cricket Facility Building with a minimum built-up area of 1,250 sq.m on the Ground Floor and 910 sq.m on the First Floor, including a spectator gallery with minimum 950 seating capacity.
- The first floor slab level shall be a minimum of 4.20 m from Finished Floor Level (FFL) and shall comprise the spectator gallery, including minimum 8 stepped seating, access passages with 2nos of ramp of minimum length of 5.48m, guard rails, and all associated circulation facilities, with a minimum gallery height of 9.30 m from Finished Floor Level (FFL).
- The spectator gallery shall be covered with tensile fabric membrane for an area of minimum 1268Sqm designed over structural steel work with minimum height being 10.60m from Finished Floor Level (FFL).
- The building shall accommodate player and spectator support facilities including entrance lobby, 2nos of office rooms, 2nos of locker rooms for both teams, 2nos of coach rooms with attached toilets, 1no of equipment store, 1no of first aid room with attached toilet, multi-gym, 2nos of spectator toilets, 2nos PH accessible (Divyang-friendly) toilets, electrical/service rooms, circulation areas, 3nos of staircases, 1n of multi-gym, two wheelchair ramps each on entrance of building & beside staircase at both ends with corridor and all other ancillary spaces as per the approved architectural drawings.
- The flooring with skirtings shall be of vitrified flooring at staircase room, locker room, coach room, all toilets, first aid room, office, granite stone at staircase steps and landing, front steps, corridor, entrance lobby, ramp, verandah, lobby & passage and Kota Stone at electrical room &

equipment store, and anti-skid vitrified/ceramic flooring in toilets. Toilets shall be provided with glazed ceramic wall tiles up to 2.40 m height from finished floor level.

- The scope shall include 25 mm thick interlocking rubber tile flooring in the gymnasium.
- The scope shall include double-leaf pressed galvanized steel doors, aluminium glazed windows, 12 mm thick frameless toughened glass entrance doors and all other doors and windows as per the approved architectural drawings.
- The scope shall include provision of False ceiling works throughout the building.
- The scope shall include provision of GRC screens for achieving the desired elevation.
- The building shall include barrier-free access, including wheelchair ramps, stainless steel handrails at ramps & staircase, tactile provisions (where applicable), and other accessibility features in accordance with the latest statutory requirements.
- The scope shall include complete architectural finishes, waterproofing, doors, windows, glazing, flooring, wall finishes, false ceiling (where required), painting, internal and external plumbing, sanitary, electrical, HVAC, firefighting, ICT, public address system, lighting, drainage, and all allied building services as per the approval.
- Supply and installation of all furniture, gym equipment, fire-fighting equipment, signage, and other fixtures required for complete operational readiness of the facility.
- The facility shall be designed and constructed in compliance with the latest National Building Code (NBC), relevant BIS standards, accessibility norms, and fire safety requirements.
- The Contractor shall provide a comprehensive signage system covering all four categories of signage, namely Identification Signage, Directional/Wayfinding Signage, Informational Signage, and Regulatory & Safety Signage, for the building & surrounding. The signage system shall include room identification, directional and campus maps, statutory, accessibility, emergency and fire exit signage, and all other signs required for safe and efficient operation of the facility, in accordance with the approved drawings and applicable standards.
- The Contractor shall carry out complete testing, commissioning and performance testing of all civil, electrical, plumbing, HVAC, firefighting and building service installations and hand over the facility in fully operational condition. During the Defect Liability Period (DLP), the Contractor shall remain responsible for rectification of defects and satisfactory functioning of all installed systems in accordance with the Contract.
- The list of furniture enclosed are minimum and indicative in nature. The Contractor shall supply, install and commission all furniture required for the complete functionality of the Cricket Facility Building as per the approved design and standard requirements. In case any specified model, make or type of furniture has become obsolete, discontinued or is no longer in common use, the Contractor shall provide an equivalent or superior model of equal or better specifications, subject to the approval of the Engineer-in-Charge.

(i)	FURNITURE	Quantit y	Godrej Model	Geeken Model

1	Providing and Placing of Executive Desk of Size 1500 mm x 750 mm x 728 mm as per Picture (Make:Godrej/Geeken)	6.00		
2	Providing and Placing of Executive Chair Model Ventilo Mid Back - Black as per Picture (Make:Godrej/Geeken)	6.00		
3	Providing and Placing of visitor chair Model-1018 (Black) as per Picture (Make:Godrej/Geeken)	12.00		
4	Providing and Placing of Gain Storage 500 (Make:Godrej/Geeken)	6.00		
5	Providing and Placing of Wooden Bench (2400 mm long) with cushion. (Make:Godrej/Geeken)	8.00		
6	Providing and Placing of dining chair Model- Unwind ss as per Picture (Make:Godrej/Geeken)	2.00		
7	Providing and Placing of 2 Door PLU Lockers 1830Hx380Wx450D as per Picture. (Make:Godrej/Geeken)	46.00		

8	Providing and Placing of Dustbin as per Picture. (Make:Godrej/Geeken)	8.00		

FINISHING SCHEDULE LISTED BELOW:

The finishing schedule listed below is indicative in nature and shall be read in conjunction with, and shall conform to, the approved architectural drawings, detailed specifications, finishes schedule, and directions of the Engineer-in-Charge. In case of any discrepancy, the approved architectural drawings and detailed specifications shall prevail.

FINISHING SCHEDULE OF CRICKET FIELD FACILITY BUILDING							
Sl. No	FLOOR	LOCATION	FLOOR FINISH	SKIRTING	WALL FINISH-PAINTING	CEILING	JOINERY SCHEDULES
1	Ground Floor	Entrance Lobby	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	12mm Thick Frameless Toughened Glass Door
		Corridor	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Office	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Multi-Gym	Safelock 25 mm interlocking rubber tiles of sizes 50cm x 50cm	100mm Vinyl Skirting	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate

		Coach Room (2 Nos.)	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Coach Room Attached Toilet (2 Nos.)	Anti-Skid Full Body Vitrified Tiles (600x600)	Nil	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
		First Aid Room	Vitrified Tiles Matte Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		First Aid Room Attached Toilet	Anti-Skid Full Body Vitrified Tiles (600x600)	Nil	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
		Player's Locker Room (2 Nos.)	600mm x600mm Vitrified tiles	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Player's Toilet/ Shower (2 Nos.)	Anti-Skid Full Body Vitrified Tiles (600x600)	Nil	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
		Electric al Panel Room	Kota stone	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate

		Equipm ent Storage Room	Kota stone	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		PH Toilet (2 Nos.)	Anti-Skid Full Body Vitrified Tiles (600x600)	Nil	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
		Spectat ors Toilet Male	Anti-Skid Full Body Vitrified Tiles (600x600)	Nil	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
		Spectat ors Toilet Female	Anti-Skid Full Body Vitrified Tiles (600x600)	Nil	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
		Stage for VIP / Accessi ble seating	Vitrified Tiles Matte Finish (600x600)	100mm high Vitrified tiles	Nil	Nil	
		Ramps	19-20MM Thick Granite Stone	Nil	Nil	Nil	
		steps	19-20MM Thick Granite Stone	Nil	10mm Thick Granite Stone	Nil	
		Staircas e (2 Nos.)	20 mm thick granite stone slab in Tread & Landing	10mm thick granite stone slab in dado/skir ting	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	120 m fire door
2	Gallery				Premium Acrylic Smooth Exterior Paint with Silicon Additives		SS Railing

3	Exterior Paint				Premium Acrylic Smooth Exterior Paint with Silicon Additives		
4	Windows, Ventilators						Aluminium System Windows & Ventilators with MS Grill
5	Cladding				Glass Reinforced Concrete (G.R.C) Screens		
EXTERNAL FAÇADE FINISH							
• Putty with premium Acrylic smooth exterior paint with silicon additives • Glass Reinforced Concrete (G.R.C) Screens • Semi- Unitized DGU Glass (6mm glass-12mm gap- 6mm glass)							

5. FOOTBALL FIELD FACILITY BUILDING

- The football field facility building has been proposed for functioning as refreshment room, for resting purpose, equipment storing etc for players as well as spectators.
- Design and construction of a G+1 RCC framed Football Facility Building with a minimum built-up area of 1,160 sq.m on the Ground Floor and 830 sq.m on the First Floor, including a spectator gallery with minimum 790 seating capacity.
- The first floor shall comprise the spectator gallery with minimum 8 stepped seating rows, VIP seating area, accessible seating with 2nos of ramp of minimum length of 5.48m, access passages, guard rails, and all associated circulation facilities.
- The first-floor slab level shall be a minimum of 4.20 m from FFL, the Terrace top / gallery top height shall be a minimum of 6.75 m above FFL.
- The spectator gallery shall be covered with a tensile fabric membrane roofing system over a minimum area of 1,301 sq.m, supported on structural steel framework, complete with gutters, rainwater disposal system and all associated structural works.
- The building shall accommodate player, match official and spectator support facilities including entrance lobby, office room, first aid room with attached toilet, coach room with attached toilet, referee room with attached toilet, locker room, 2 Nos. players' toilets with shower facilities, PH accessible (Divyang-friendly) toilet, male and female spectator toilets, kit store, equipment store, drinking water room, electrical panel room, circulation areas, staircases, two wheelchair ramps each on entrance of building & beside staircase at both ends with corridor and all other ancillary spaces as per the approved architectural drawings.
- The flooring with skirting shall comprise vitrified tiles in offices, locker room, coach room, referee room, first aid room, drinking water room and toilets; granite stone flooring in

staircases, landings, entrance steps, corridors, ramps, verandah, lobby and passages; Kota stone flooring in the electrical room and equipment store, and anti-skid vitrified/ceramic flooring in toilets. Toilets shall be provided with glazed ceramic wall tiles up to 2.40 m height from finished floor level.

- The scope shall include double-leaf pressed galvanized steel doors, aluminium glazed windows, 12 mm thick frameless toughened glass entrance doors and all other doors and windows as per the approved architectural drawings.
- The scope shall include provision of False ceiling works throughout the building.
- The scope shall include provision of GRC screens for achieving the desired elevation.
- The building shall include barrier-free access, including wheelchair ramps, stainless steel handrails at ramps & staircase, tactile provisions (where applicable), and other accessibility features in accordance with the latest statutory requirements.
- The scope shall include complete architectural finishes, waterproofing, doors, windows, glazing, flooring, wall finishes, false ceiling (where required), painting, internal and external plumbing, sanitary, electrical, HVAC, firefighting, ICT, public address system, lighting, drainage, and all allied building services as per the approval.
- Supply and installation of all furniture, gym equipment, fire-fighting equipment, signage, and other fixtures required for complete operational readiness of the facility.
- The facility shall be designed and constructed in compliance with the latest National Building Code (NBC), relevant BIS standards, accessibility norms, and fire safety requirements.
- The Contractor shall provide a comprehensive signage system covering all four categories of signage, namely Identification Signage, Directional/Wayfinding Signage, Informational Signage, and Regulatory & Safety Signage, for the building & surrounding. The signage system shall include room identification, directional and campus maps, statutory, accessibility, emergency and fire exit signage, and all other signs required for safe and efficient operation of the facility, in accordance with the approved drawings and applicable standards.
- The Contractor shall carry out complete testing, commissioning and performance testing of all civil, electrical, plumbing, HVAC, firefighting and building service installations and hand over the facility in fully operational condition. During the Defect Liability Period (DLP), the Contractor shall remain responsible for rectification of defects and satisfactory functioning of all installed systems in accordance with the Contract.
- The list of furniture enclosed are minimum and indicative in nature. The Contractor shall supply, install and commission all furniture required for the complete functionality of the Cricket Facility Building as per the approved design and standard requirements. In case any specified model, make or type of furniture has become obsolete, discontinued or is no longer in common use, the Contractor shall provide an equivalent or superior model of equal or better specifications, subject to the approval of the Engineer-in-Charge.

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4	Providing and Placing of Gain Storage 500 (Make:Godrej/Geeken)	6.00		
5	Providing and Placing of Wooden Bench (2400 mm long) with cushion. (Make:Godrej/Geeken)	8.00		
6	Providing and Placing of dining chair Model-Unwind ss as per Picture (Make:Godrej/Geeken)	2.00		
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8	Providing and Placing of Dustbin as per Picture. (Make:Godrej/Geeken)	8.00		

FINISHING SCHEDULE LISTED BELOW:

The finishing schedule listed below is indicative in nature and shall be read in conjunction with, and shall conform to, the approved architectural drawings, detailed specifications, finishes schedule, and directions of the Engineer-in-Charge. In case of any discrepancy, the approved architectural drawings and detailed specifications shall prevail.

FINISHING SCHEDULE OF FOOTBALL FACILITY BUILDING							
Sl. No	FLOOR	LOCATI ON	FLOOR FINISH	SKIRTING/ DADO	WALL FINIS H-PAINT ING	CELI NG	JOINERY SCHEDULES
1	Ground Floor	Entrance Lobby	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsio n paint	12mm Thick Frameless Toughened Glass Door
		Corridor	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsio n paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Office	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsio n paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Kit Store	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsio n paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Referee Room	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsio n paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Referee Room Attached Toilet	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Putty with Plastic Emulsion Paint	Putty with plastic Emulsio n paint	WPC Choukath with WPC Door
		Coach Room (2 Nos.)	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Plastic Emulsion Paint	Putty with plastic Emulsio n paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both

					side 1mm thick laminate
Coach Room Attached Toilet (2 Nos.)	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
First Aid Room	Vitrified Tiles Matte Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
First Aid Room Attached Toilet	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Ceramic Glazed Wall tile (600x300) From FFL	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
Player's Locker Room (2 Nos.)	600mm x600mm Vitrified tiles	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
Player's Toilet/ Shower (2 Nos.)	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
Electrical Panel Room	Kota stone	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
Equipment Storage Room	Vitrified Tiles Matt Finish (600x600)	100mm high Vitrified tiles	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
PH Toilet (2 Nos.)	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
Spectators Toilet Male	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
Spectators Toilet Female	Anti-Skid Full Body Vitrified Tiles (600x600)	Ceramic Glazed Wall tile (600x300) From FFL	Putty with Plastic Emulsion Paint	Putty with plastic Emulsion paint	WPC Choukath with WPC Door
Stage for VIP / Accessible seating	19-20MM Thick Granite Stone	10 MM Thick Granite Stone	Nil	Nil	
Ramps	19-20MM Thick Granite Stone	Nil	Nil	Nil	

		steps	19-20MM Thick Granite Stone	Nil	10mm Thick Granite Stone	Nil	
		Staircase (2 Nos.)	20 mm thick granite stone slab in Tread & Landing	10mm thick granite stone slab in dado/skirting	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	120min. Fire door
2	Gallery				Premium Acrylic Smooth Exterior Paint with Silicon Additives	Tensile Fabric Roofing System	SS Railing
3	Exterior Paint				Premium Acrylic Smooth Exterior Paint with Silicon Additives		
4	Windows, Ventilators						Aluminium System Windows & Ventilators with MS Grill
5	Cladding				Glass Reinforced Concrete (G.R.C) Screens		
EXTERNAL FAÇADE FINISH							
• Putty with premium Acrylic smooth exterior paint with silicon additives • Glass Reinforced Concrete (G.R.C) Screens • Semi- Unitized DGU Glass (6mm glass-12mm gap- 6mm glass)							

6. MPH (MULTIPURPOSE HALL)

- The Multi-Purpose Hall (MPH) Building has been proposed for functioning as an Indoor Sports Facility for badminton, gymnasium, weightlifting and other indoor sports activities, along with ancillary facilities for players, officials and visitors.
- Design and construction of a RCC framed Multi-Purpose Hall (MPH) Building having a minimum built-up area of ground floor as 1,200 sq.m, complete with all architectural, structural and building services works.
- The building shall be a RCC framed structure with brick masonry infill walls, finished floor level as per approved drawings, with terrace minimum level being 5.40m from FFL & mummy level being 6.9m from FFL. Further provision of minimum clear playing height of 10.0 m with roof truss having ridge height of approximately 12.4 m from FFL, and overall building height including parapet being minimum 13.0 m.
- The building shall accommodate a central indoor arena of minimum 24.00 m × 24.15 m, suitable for two international-standard badminton courts in accordance with the approval building plan. Playing arena shall be provided with 6.5 mm thick 65 Vinyl Sheet With Grade-2 Maple Wooden Sports Flooring system with skirting.

- The terrace shall comprise a sloped RCC roof designed with suitable waterproofing and structural provisions for installation of rooftop solar photovoltaic panels.
- The building shall include a covered main entrance with barrier-free access through a wheelchair ramp, entrance lobby, staircase, circulation areas and all associated accessibility provisions.
- The roof shall be made of structural steel truss fixed with self-supported secret fix standing Roofing System in 0.9mm thick AA 3004 Aluminium alloy prepared in approved layers with provision of Gutters & Aluminium flash sheet
- The building shall accommodate all functional spaces including indoor badminton arena with 2 Nos. badminton courts, gymnasium, dedicated weightlifting room, administrative office, first aid room, male and female locker/changing rooms, male, female and Divyang-friendly toilets on both sides of the building, service areas, staircase, electrical/service rooms and all ancillary facilities as per the approved architectural drawings.
- The weightlifting room shall include minimum 3nos of dedicated 80mm thick lifting platform measuring 3.00 m × 2.50 m, comprising 50 mm thick African Teak Wood flooring overlaid with 25 mm thick black rubber flooring, complete as per approved specifications.
- The indoor badminton arena shall accommodate 2 Nos. international-standard badminton courts conforming to Badminton World Federation (BWF) requirements, each having a playing minimum area of 15.40 m × 7.10 m, with minimum lighting level of 750 lux, complete with all court markings and accessories.
- The playing area shall be provided with 6 mm thick closed-cell EVA Foam Cushion Layer beneath the sports flooring, having a minimum density of 140 kg/m³, Shore hardness of 40–45 Shore C, moisture-resistant, non-absorbent and dimensionally stable, fixed using approved polyurethane adhesive or equivalent, complete as per manufacturer's recommendations.
- The badminton playing courts shall be provided with 4.5 mm thick BWF-approved PVC Vinyl Sports Flooring, complying with EN 14904 and other applicable international standards, installed over the EVA cushion layer by the manufacturer's authorized applicator, complete with permanent court markings, approved adhesive system, testing, certification and minimum 5-year manufacturer's warranty.
- The non-playing (margin/play-off) area of the indoor arena shall be provided with 4.5 mm thick homogeneous Sports PVC Flooring, complying with EN 14904, having anti-bacterial, anti-viral, heavy metal-free and phthalate-free properties, impact sound insulation, shock absorption, fire classification, abrasion resistance and other performance characteristics as specified, complete with hot-welded joints, skirting, finishing accessories and minimum 10-year manufacturer's warranty.
- The flooring with skirting shall comprise vitrified tile flooring in Admin, Staircase Room, locker rooms, first aid room and other occupied spaces, granite stone flooring in entrance lobby, staircases, landings, corridors and ramps, Kota stone flooring in electrical and service rooms, and anti-skid vitrified/ceramic flooring in toilets. Toilet walls shall be provided with glazed ceramic wall tiles up to 2.40 m height above finished floor level.
- The scope shall include 25 mm thick interlocking rubber tile flooring in the gymnasium & weightlifting area.

- The scope shall include double-leaf pressed galvanized steel doors, aluminium glazed doors/windows, 12 mm thick frameless toughened glass entrance doors and all other doors and windows as per the approved architectural drawings.
- The scope shall include provision of false ceiling works in all rooms and circulation spaces wherever shown in the approved architectural drawings.
- The scope shall include provision of GRC screens & structural Glazing for achieving the desired elevation.
- The scope shall include provision of architectural façade treatment, external finishes and elevation features as per the approved architectural drawings.
- The building shall include complete barrier-free access comprising wheelchair ramps, stainless steel handrails, tactile indicators (where applicable), accessible toilets and all accessibility features in accordance with the latest statutory requirements.
- The scope shall include complete architectural finishes, waterproofing, doors, windows, glazing, sports flooring systems, wall finishes, false ceiling, painting, internal and external plumbing, sanitary installations, electrical works, HVAC, firefighting, ICT, public address system, sports lighting, lightning protection, drainage, rainwater disposal system and all allied building services required for complete operational readiness.
- The scope shall include supply, installation, testing and commissioning of all gym equipment, sports equipment, badminton posts and nets, furniture, fire-fighting equipment, signage, electrical fixtures and all other accessories required for complete functionality of the facility.
- The Contractor shall provide a comprehensive signage system covering all four categories of signage, namely Identification Signage, Directional/Wayfinding Signage, Informational Signage and Regulatory & Safety Signage, for the building and surrounding areas. The signage system shall include room identification, directional signage, campus maps, statutory signage, accessibility signage, emergency evacuation plans, fire exit signage and all other signs necessary for safe and efficient operation of the facility in accordance with the approved drawings and applicable standards.
- The facility shall be designed and constructed in compliance with the latest National Building Code (NBC), relevant BIS standards, Badminton World Federation (BWF) requirements, EN 14904 standards for sports flooring, accessibility guidelines, fire safety regulations and all other applicable statutory requirements.
- The Contractor shall carry out complete testing, commissioning and performance testing of all civil, electrical, plumbing, HVAC, firefighting and building service installations and hand over the facility in fully operational condition. During the Defect Liability Period (DLP), the Contractor shall remain responsible for rectification of defects and satisfactory functioning of all installed systems in accordance with the Contract.

Supply & Installation of EVA Foam Cushion Layer

1. Supply, installation, and fixing of **6 mm thick closed-cell EVA Foam Cushion Layer** beneath the PVC sports flooring.
2. EVA foam shall be specially designed to provide **shock absorption, player comfort, and impact cushioning** for indoor badminton courts.

3. The material shall be **closed-cell, non-absorbent, moisture-resistant, lightweight, flexible, and dimensionally stable.**
4. EVA foam shall have a **minimum density of 140 kg/m³.**
5. Shore hardness shall be **40–45 Shore C.**
6. The foam shall have a **smooth finish on both sides** and shall be suitable for cutting, shaping, and installation without deformation.
7. The material shall possess excellent **heat-forming and bonding properties.**
8. The cushion layer shall be fixed over the prepared concrete surface using **manufacturer-approved polyurethane adhesive** or equivalent.
9. Joints shall be properly butted and bonded to ensure a continuous, uniform cushioning layer.
10. Installation shall be carried out strictly in accordance with the manufacturer's recommendations before laying the PVC sports flooring.
11. The rate shall include all materials, labour, adhesives, tools & plants (T&P), transportation, loading, unloading, wastage, and all incidental works required for complete installation.

Supply & Installation of BWF Certified PVC Badminton Court Flooring

1. Supply, installation, testing, and commissioning of **BWF-approved PVC Vinyl Sports Flooring** for indoor badminton courts.
2. PVC sports flooring shall be **4.5 mm thick** and installed over the approved EVA foam cushion layer.
3. The flooring system shall comply with **BWF (Badminton World Federation) standards** for international competition.
4. Court size shall be **15.40 m × 7.10 m** for each badminton court.
5. The flooring system shall comply with **EN 14904** or equivalent international standards.
6. The flooring shall provide:
 - Minimum **Shock Absorption ≥11%**
 - Vertical Deformation and Force Reduction as per **DIN 18032-2 / EN 14904**
 - Excellent ball response, slip resistance, and player safety.
7. The flooring shall be installed using the manufacturer's approved adhesive/tape system over the EVA foam layer.
8. Court markings shall be factory finished or permanently line-marked in accordance with **BWF regulations.**
9. Playing area colour shall be **Green**, with surrounding area colour as approved by the Engineer-in-Charge/Architect.
10. Flooring shall be resistant to wear, indentation, moisture, fungal growth, and routine sports cleaning chemicals.
11. The contractor shall submit:
 - BWF Product Approval Certificate
 - EN 14904 Test Certificate
 - Manufacturer's Technical Data Sheet
 - Warranty Certificate
12. Installation shall be carried out by the **manufacturer's authorized applicator.**
13. The contractor shall provide a **minimum 5-year manufacturer's warranty** against manufacturing defects and installation defects.
14. The item rate shall include all materials, labour, adhesives, line marking, testing, transportation, loading, unloading, tools & plants, taxes, and all incidental works required for complete installation.
15. Approved makes shall be **Yonex, Gerflor, Mondo**, or other equivalent brands approved by the Engineer-in-Charge

Supply & Installation of Sports PVC Flooring for Non-Playing Area (Margin Area) – MPH Building / Badminton Arena

1. Supply, installation, testing, and commissioning of **4.5 mm thick homogeneous Sports PVC Flooring** for the **non-playing/margin area** of the Multipurpose Hall (MPH) Building / Badminton Arena.
2. Flooring shall conform to **EN 14904** and other relevant international standards applicable to indoor sports flooring.
3. Flooring shall be **anti-bacterial, anti-viral, heavy metal free, phthalate free**, and suitable for indoor sports facilities.
4. Minimum flooring weight shall be **3350 g/m² (±5%)** conforming to **EN 430**.
5. Flooring shall provide **impact sound insulation of 20–22 dB** as per **EN ISO 717-2** and **EN ISO 140-8**.
6. Flooring shall have a **Fire Classification of CFL-S1** in accordance with **EN 13501-1**.
7. The flooring shall be **FloorScore® Certified (SCS)** or equivalent for **low VOC emissions** and superior indoor air quality.
8. Minimum **impact resistance** shall be **greater than 8 N·m** as per **EN 1517**.
9. Flooring shall have **shock absorption between 16% and 20%** in accordance with **EN 14808**.
10. Surface finish shall have **specular gloss less than 30%** as per **EN 2813** to minimize glare under sports lighting.
11. Abrasion resistance shall be **less than 1000 mg/1000 cycles (H-18 Wheel)** as per **EN ISO 5470-1**.
12. Flooring surface shall be **non-slip, easy to clean, stain resistant, scratch resistant, and suitable for heavy pedestrian traffic**.
13. Flooring shall be supplied in **Green** or other colours as approved by the Engineer-in-Charge/Architect.
14. Installation shall include **surface preparation, approved adhesive, hot-welded joints, finishing accessories, skirting, and all necessary consumables** to complete the work.
15. The flooring shall be installed by the **manufacturer's authorized applicator** strictly in accordance with the manufacturer's specifications.
16. The contractor shall provide a **minimum 10-year manufacturer's warranty** against manufacturing defects and installation workmanship.
17. **Approved Makes: Responsive, Gerflor, Mondo**, or other equivalent brands approved by the Engineer-in-Charge
18. Supply & installation of 6 mm thickness EVA foam called “EVA Foam Soft”. This is specially designed to provide a cushioning system over the Concrete Badminton Arena. Suitable for Indoor Use. The mat is precise, flexible, closed-cell, non-absorbent in nature for any kind of liquid & has a smooth finish. This cushioning system is denser and softer, ultra-lightweight. Highly formable with a high density of 140 Kg/ Cubic Meter with a short hardening of 40-45. It has a smooth texture on both sides, is easy to cut, shape and paste with Adhesive, It is excellent for heat forming and scoring. The cushioning needs to be pasted on the concrete base with Adhesive & Heat Technology before laying the PVC Vinyl Sports Flooring.
19. Supply & Installation of BWF Certified PVC Badminton Court Mat of 4.5mm thickness for playing area, size 15.4m x 7.1m, EN/DN Tested (EN=14904: Shock Absorption>-11%. Vertical Deformation or DIN 18032.2:Force Reduction>=11%, Standard Deformation to be glued/ taped on top of the mat, including line marking. The cost includes all materials, labour, conveyance, taxes, loading, unloading, T&P, etc., complete as per drawing and as per relevant specification, including the following and as per the direction of the Engineer-in-charge.
20. (Mat Colour – Green for playing area)
21. Must be approved by BWF. Complete, including cost of all materials, labour, T&P etc., required for the work, all complete as per the direction of the Engineer-in-charge.

Supply & Installation of 4.5 mm sports PVC Flooring Mat for Play off Area/ Margin, EN428, Anti Virus, Anti Bacterial, Heavy Metal Free, Phthalate Free. Weight 3350G/Sq. Mtr EN 430. Impact Sound insulation 20-22 EN ISO 7172 & EN ISO 140-8, Flammability class CFL-S1 EN13501-1, VOC Indoor Air Quality Floorscore Certified (SCS-FS-04547). Impact Resistance >8 N · m. EN1517, Shock Absorption 16%-20% EN14808, Spectular Gloss <30 EN2813, Abrasion resistant (H 18 Wheel)<1000 mg/1000 Cycles EN ISO 5470-1. (Colour- Green.)

- The list of furniture, gym equipment and sports equipment enclosed are minimum and indicative in nature. The Contractor shall supply, install, test and commission all furniture, sports equipment, gym equipment and fixtures necessary for complete operational readiness of the multi-Purpose Hall. In case any specified make, model or type becomes obsolete, discontinued or unavailable, an equivalent or superior product of equal or better specifications shall be provided with the approval of the Engineer-in-Charge.

Item No	Items with Specifications	Image	Mini Qty
1	 HERCULES FITNESS 4 WAY OLYMPIC BENCH Model : AU 49 Size (inches) 91" x 64" x 60" Weight (kg) 103Kg		6
2	 HERCULES FITNESS OLYMPIC PLATES 51mm SIZES AVAILABLE 2.5X2,5X2,7.5X2,10X2,15X2,20X2,25X2		170
3	 HERCULES FITNESS HEAVY DUTY OLYMPIC BAR : 7'		4
4	 HERCULES FITNESS HEAVY DUTY OLYMPIC BAR :6'		4

5	 HERCULES FITNESS HEAVY DUTY OLYMPIC BAR: 5'		4
6	 HERCULES FITNESS STRAIGHT ROD: 4'		4
7	 HERCULES FITNESS DUMBBELL EDGE TPU • Made from high quality vergin rubber • High impact resistant rubberised material Sizes available 2.5X2,5X2,7.5X2,10X2,12.5X2,15X2,17.5X2,20X2,22.5X2,25X2,30X2,35X2,40X2,45X2,50X2		675
8	HERCULES FITNESS PVC YOGA MAT 6 MM • Durable PVC Material • Embossed Surface for excellent grip • Hand Washable Thickness 6mm 		10
9	HERCULES FITNESS HORIZONTAL ROMAN CHAIR Model: AZ 31 Size (inches) 63" × 36" × 39" Weight (kg) 70kg 		2
9a	 HERCULES FITNESS GLUTE HAM DEVELOPER Model : EC 02 Size (inches) 56" × 33" × 46" Weight (kg) 83kg		1

10	HERCULES FITNESS LIVE YOURS HERCULES FITNESS ANTI BURST GYM BALL WITH HAND PUMP Size Available : 75cm		5
11	INDOOR INTERLOCKING EVA MAT - 20 MM (RED / BLUE) Material:EVA Foam Thickness: 20 mm Size:1x1 ft Surface Finish: Smooth Color: Multicolor Usage Area: Kids Play, Home, Martial Arts, Yoga, Gym		10
12	HERCULES FITNESS LIVE YOURS HERCULES FITNESS ADJUSTABLE WEB BOARD Model: FU 34 Size (inches) 73" × 28" × 36" Weight (kg) 63kg		4
	HERCULES FITNESS LIVE YOURS HERCULES FITNESS ADJUSTABLE WEB BOARD Model: AU 33 Size (inches) 72" x 29" x 37" Weight (kg) 50kg		4
	HERCULES FITNESS LIVE YOURS HERCULES FITNESS MULTIPLE ADJUSTABLE BENCH Model: AU 34 Size (inches) 70" x 33" x 19" Weight (kg) 140kg		2

13	HERCULES FITNESS DUMBBELL RACK Model: FU 30 Size (inches) 92" × 33" × 34" Weight (kg) 32kg		2
14	HERCULES FITNESS DUMBBELL RACK Model: AU 42 Size (inches) 93" x 24" x 31" Weight (kg) 66kg		2
14	HERCULES FITNESS Barbell Rack Anti-corrosion black matte finish for lasting aesthetics Rubberized holders protect equipment and reduce noise Stable base with anti-slip feet for added safety Compatible with both straight and EZ fixed barbells		2
14a	HERCULES FITNESS THERCULES RIPLE STORAGE RACK Store upto 12 barbells, 24 weight plates and 8 pcs kettle bell.		1
15	HERCULES FITNESS Spin Bike Model: SB 35 Brush Brake Resistance Control Belt Drive Heavy duty 3 piece Crank Machine Floor Size: 52" x 22"x 44" Precise Bearing for smooth function High Strength steel frame & Ultra stable structure Super Quiet Poly V belt Drive for smooth function 23 Kgs Fly wheel Maximum User Weight: 150 Kgs Drive: Belt Drive		6

16	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Treadmill Model: TMA 64L 20 Km/hr. Max. Speed Machine Floor Size: 83" x 35" x 64" Running Area: 61" x 23" Unfoldable Structure Maximum User Weight: 200 Kgs Machine Weight: 160kg Rubber Cushion – Accept the shock & less impact on joints Display Reading: Speed, Time, Calories, Distance & Heart Rate Motor Power: 4.0 H.P / 8.0 H.P AC Motor		5
16a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Treadmill Model: TA 800 Display: Led Screen Machine Size: 87" x 36" x 64" Speed: 1-20km/h 20 Level Automatic Motorized Incline Running AREA: 60*23 Machine weight: 187kg Maximum user weight: 200kg Display Reading: Speed, Time, Calories, Distance & Heart Rate Motor Power: 4.0/8.0 HP Peak AC Motor		4
17	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Treadmill Model: TMA 64L 20 Km/hr. Max. Speed Machine Floor Size: 83" x 35" x 64" Running Area: 61" x 23" Unfoldable Structure Maximum User Weight: 200 Kgs Machine Weight: 160kg Display Reading: Speed, Time, Calories, Distance & Heart Rate Motor Power: 4.0 H.P / 8.0 H.P AC Motor		4
17a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Air Rower Model: AR 60 Display - Lcd Display Display Reading - Resistance Level, Time, Distance, Stroke Programs - 8 programs Max User Weight - 130kg Machine Weight - 45kg Machine Size - 91*20*26		3

18	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS PUSH UP BAR • Metal Construction • Ideal for fullbody workout		4
19	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS BATTLE ROPE Available Weights: 3.8×1200 CM, 3.8×1500 CM, 5.0×1200 CM, 5.0×1500 CM Size: 15 mtr		4
20	HERCULES FITNESS LIVE YOUNG HERCULES SKIP ROPE JUMP ROPE-FOAM HANDLE-2750 MM		15
21	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS STEP HURDLES 18" Available in 6", 9", 12" & 18" Size : 18"		20
22	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS Leg Press Model: AU 19 Size (inches) 95" x 64" x 57" Weight (kg) 232kg		2
22a	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS 45 DEGREE LEG PRESS Model: AB 56 Size (inches) 86" × 64" × 50" Weight (kg) 215kg		1

23	HERCULES FITNESS LIVE YOURS HERCULES FITNESS LATERAL LEG PRESS Frame Tube : High Tensile Steel Seat Cushion : PU Leaterized Paint : Two Round Powder Coating Size : 1989x1771x1545 mm Weight Stack : Plate Loaded N.W / G.W : 148 Kg. / 178 Kg.		2
24	HERCULES FITNESS LIVE YOURS HERCULES FITNESS PRONE LEG CURL Model: RA13A Size (inches) 59" × 37" × 55" Weight Stack (kg) 100kg Weight (kg) 219kg		2
24a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Prone Leg Curl Model: AU 07 Size (inches) 66" x 48" x 64" Weight Stack (kg) 100kg Weight (kg) 238kg		1
25	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Hack Squat Model: AU 17 Size (inches) 94" x 64" x 57" Weight (kg) 212kg		2
25a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS STANDNG OUTER THGH ABDUCTOR * Heavy duty 2.5mm thick steel square tube of size 50mm x 100mm * Black powder coated finish with strong double stitched upholstery		1

26	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Smith Machine Model: AB 63 Size (inches) 86" × 64" × 50" Weight (kg) 284kg		2
26a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Smith Machine Model: AB 87 Size (inches) 88" × 76" × 86" Weight (kg) 248kg		1

(i)	FURNITURE	Quantity	Godrej Model	Geeken Model
1	Providing and Placing of Executive Desk of Size 1500 mm x 750 mm x 728 mm as per Picture (Make:Godrej/Geeken)	3.00		
2	Providing and Placing of Executive Chair Model Ventilo Mid Back - Black as per Picture (Make:Godrej/Geeken)	3.00		
3	Providing and Placing of visitor chair Model-1018 (Black) as per Picture (Make:Godrej/Geeken)	8.00		

4	Providing and Placing of Gain Storage 500 (Make:Godrej/Geeken)	4.00		
5	Providing and Placing of Wooden Bench (2400 mm long) with cushion. (Make:Godrej/Geeken)	6.00		
6	Providing and Placing of dining chair Model–Unwind ss as per Picture (Make:Godrej/Geeken)	4.00		
7	Providing and Placing of 2 Door PLU Lockers 1830Hx380Wx450D as per Picture. (Make:Godrej/Geeken)	35.00		
8	Providing and Placing of Dustbin as per Picture. (Make:Godrej/Geeken)	10.00		

Sl. No.	Description of items	Quantity	Unit	Remark
(i)	SPORTS EQUIPMENTS			
1	Providing and Fixing of Yonex Make BADMINTON POLE (Portable & Movable) 50kg weight on each side Metal pipe 46mm, A very strong and durable portable unit .	2.00	Set	

2	BADMINTON NET (Tournament Quality)	4.00	Nos.	
3	Badminton racket Vector X	8.00	Nos.	
4	Nylon Shuttle Cock Tournament Vector X	12.00	Nos.	

FINISHING SCHEDULE LISTED BELOW:

The finishing schedule listed below is indicative in nature and shall be read in conjunction with, and shall conform to, the approved architectural drawings, detailed specifications, finishes schedule, and directions of the Engineer-in-Charge. In case of any discrepancy, the approved architectural drawings and detailed specifications shall prevail.

MPH (Multi Purpose Hall)							
SL NO.	FLOOR	ROOM NAME	FINISHING MATERIAL				
			FLOOR FINISH MATERIAL	SKIRTING / DADO MATERIAL	WALL PAINT MATERIAL	CELINING FINISH MATERIAL	JOINERY SCHEDULES
1	GROUND FLOOR PLAN	Entrance Lobby	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Corridor	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Male Locker Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Female Locker Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Admin	Vitrified Tiles Matt Finish (600X600)	100Mm High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		First Aid Room	Vitrified Tiles Matt Finish (600X600)	Ceramic Glazed Wall	Putty with Plastic	Putty with Plastic	Pressed Steel Door

				Tile(600X300) 2.4 Mtr From FFL	Emulsion Paint	Emulsion Paint	
		Toilet	Anti Skid Ceramic Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Arena (Badminton Court 2 Nos.)	6.5 mm thick 65 Vinyl Sheet With Maple Wooden Sports Flooring	Maple Wooden Sports Skirting	Putty with Plastic Emulsion Paint	Self supported” secret fix standing roofing system in 0.9mm thick aa 3004 Aluminium Alloy.	Pressed Steel Door
		Gym	7.5 mm thick vinyl sports flooring for Gym	7.5 mm thick vinyl sports flooring for Gym	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Weight Lifting	Safelock 25 mm interlocking rubber tiles of sizes 50*50 cm	Safelock 25 mm interlocking rubber tiles of sizes 50*50 cm	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	Pressed Steel Door
		Staircase	20 mm thick granite stone slab in Tread & Landing	10mm thick granite stone slab in dado/skirting	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	
EXTERNAL FAÇADE FINISH							
• Putty with premium Acrylic smooth exterior paint with silicon additives • Glass Reinforced Concrete (G.R.C) Screens & Structural Glazing • Semi- Unitized DGU Glass (6mm glass-12mm gap- 6mm glass)							

7. SWIMMING POOL

- The Swimming Pool Facility has been proposed for functioning as a standard competition and training swimming facility with all ancillary spaces required for swimmers, coaches, officials and visitors.
- Design and construction of a **RCC framed Swimming Pool Facility Building** having a minimum built-up area as 3,050 sq.m with brick masonry infill walls, complete with all architectural, structural and building services works as per the approved drawings.
- Design and construction of an RCC Swimming Pool measuring minimum **50.00 m × 25.00 m pool**, complete with a **6.00 m wide peripheral pool deck**, balancing tank of adequate capacity being minimum 150 cum or as per design requirements & approved capacity, plant room, filtration and circulation system, overflow and return water system, chemical dosing system, underwater lighting, drainage system and all associated civil, plumbing, electrical and mechanical works.
- The roof shall be made of structural steel truss fixed with self-supported secret fix standing Roofing System in 0.9mm thick AA 3004 Aluminium alloy prepared in approved layers with provision of Gutters & Aluminium flash sheet
- The swimming pool building shall comprise entrance lobby, staircase, administrative office, visitors' room, coach room, lifeguard room, first aid room, store room, electrical room, male and female changing rooms, male and female locker rooms, male, female and PH Divyang-

friendly toilets, circulation areas and all other ancillary spaces as per the approved architectural drawings.

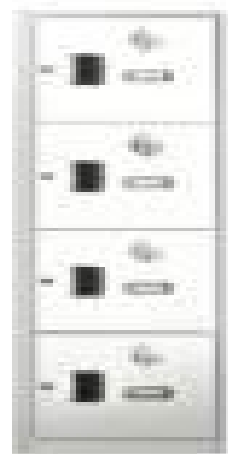
- The swimming pool shall be constructed in reinforced cement concrete with suitable waterproofing treatment, expansion joints, water stops and all necessary measures to ensure complete water tightness.
- The pool shall be provided with approved porcelain **pool-grade tiles of minimum 7mm thickness confirming to FINA standards**, complete with matching accessories, movement joints and waterproof grouting.
- The peripheral pool deck shall be finished with approved **anti-skid vitrified flooring with skirting of premium grade having minimum 10mm thickness**, complete with proper slopes towards drainage channels, deck drains, gratings and all associated drainage arrangements.
- The scope shall include complete **filtration, circulation and water treatment system** comprising balancing tank, filtration pumps, pressure sand filters, chemical dosing system, piping network, valves, strainers, return inlets, suction points, vacuum points, overflow channels and all accessories necessary for continuous operation of the swimming pool.
- The scope shall include underwater LED pool lighting, deck lighting, electrical distribution system, earthing, lightning protection, control panels, cabling and all associated electrical works required for safe operation of the facility.
- The flooring with skirting shall comprise vitrified tiles in office rooms, coach room, visitors' room, first aid room, lifeguard room, locker rooms, changing rooms and other occupied spaces; anti-skid ceramic/vitrified tiles in toilets, shower areas and wet spaces; granite stone flooring in entrance lobby, staircases, landings, corridors and ramps; and Kota stone flooring in the electrical room, plant room and store room. Toilet and shower walls shall be provided with glazed ceramic wall tiles up to **2.40 m height** above finished floor level.
- The scope shall include double-leaf pressed galvanized steel doors, aluminium glazed windows, 12 mm thick frameless toughened glass entrance doors and all other doors and windows as per the approved architectural drawings.
- The scope shall include provision of false ceiling works in all rooms wherever indicated in the approved architectural drawings.
- The scope shall include provision of GRC screens for achieving the desired elevation.
- The building shall include complete barrier-free access comprising wheelchair ramps, stainless steel handrails, tactile indicators (where applicable), accessible toilets and all accessibility features in accordance with the latest statutory requirements.
- The scope shall include complete architectural finishes, waterproofing, doors, windows, flooring, wall finishes, false ceiling, painting, internal and external plumbing, sanitary installations, electrical works, HVAC, firefighting, ICT, public address system, lighting, drainage, rainwater disposal system and all allied building services required for complete operational readiness.
- The scope shall include supply, installation, testing and commissioning of all pool equipment, lockers, benches, furniture, lifeguard chairs, first aid equipment, fire-fighting equipment, signage and all other fixtures required for complete functionality of the facility.

- The swimming pool shall undergo **water-tightness testing**, hydraulic testing, filtration system testing, trial operation and commissioning prior to handing over. The entire facility shall be delivered in fully operational condition.
- The facility shall be designed and constructed in compliance with the latest **National Building Code (NBC)**, relevant **BIS standards**, applicable swimming pool design standards, accessibility guidelines, fire safety requirements and all statutory regulations.
- The Contractor shall provide a comprehensive signage system covering all four categories of signage, namely **Identification Signage, Directional/Wayfinding Signage, Informational Signage and Regulatory & Safety Signage**, including room identification, pool safety rules, water depth markings, emergency instructions, accessibility signage, fire exit signage, statutory notices and all other signs necessary for safe and efficient operation of the facility.

Supply & Installation of Electro-Mechanical Unit i.e. Filtration Plant & Accessories

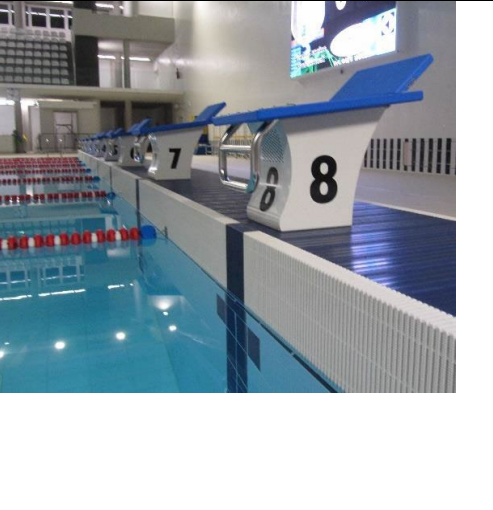
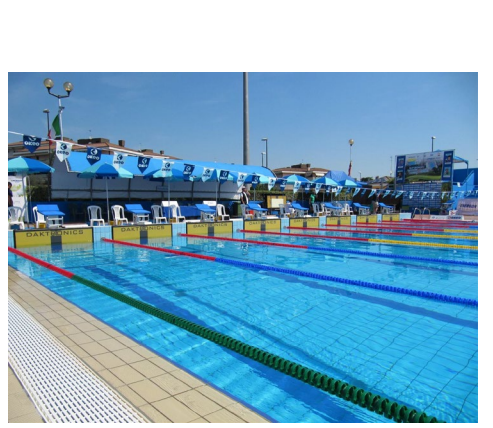
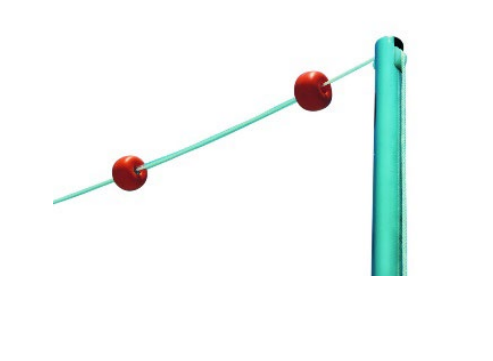
- The Contractor shall design, supply, install, test and commission the complete swimming pool filtration system, including bobbin/cartridge filters, as required. The number, capacity and diameter of the filters shall be based on the approved hydraulic design and shall conform to the latest National Building Code (NBC), relevant BIS standards and other applicable national/international guidelines to ensure the specified water turnover rate and performance requirements.
- The filtration system shall comprise high-efficiency circulation pumps with pre-filters, pressure sand filters with FRP construction, silica sand and graded gravel filter media, automatic motorized valve batteries, suction and delivery manifolds, balancing tank connections, isolation valves, non-return valves and all accessories necessary for continuous and efficient operation of the swimming pool.
- The scope shall include complete hydraulic piping works using pressure-rated uPVC pipes of suitable diameters, including all specials such as bends, tees, reducers, sockets, flanges, unions, expansion provisions, supports, anchors, solvent welding, testing and commissioning. The Contractor shall finalize the hydraulic design and pipe sizing based on approved design calculations.
- The Contractor shall provide all swimming pool basin fittings including floor inlets, main drains, overflow gutters, overflow gratings, SS-316 ladders, hair strainers, balancing tank connections, vacuum points and all embedded accessories required for complete operation of the pool.
- The water treatment system shall comprise automatic chlorine dosing equipment, automatic pH correction system, chemical storage tanks, dosing pumps, probes, sensors, controllers, piping and associated accessories for maintaining the prescribed swimming pool water quality in accordance with applicable standards.
- The scope shall include supply of complete swimming pool maintenance equipment comprising robotic pool cleaner, portable vacuum cleaning unit, vacuum hose, vacuum head, telescopic handle, leaf skimmers, algae brushes, wall brushes and all accessories required for routine maintenance of the swimming pool.
- The Contractor shall provide complete pool water testing equipment for regular monitoring of water quality parameters including pH, residual chlorine and other essential water quality characteristics.

- The scope shall include supply, installation and commissioning of SS-316 underwater LED lighting fixtures complete with niches, junction boxes, conduits, transformers, control panels, power cables and all accessories required for safe underwater illumination of the swimming pool.
- The electrical works shall include supply, installation, testing and commissioning of all electrical control panels for pumps, filtration equipment, chemical dosing system and underwater lighting, complete with starters, protection devices, transformers, cabling, cable trays, earthing, lightning protection, control wiring and all associated accessories.
- The Contractor shall carry out complete hydraulic testing, pressure testing, leak testing, electrical testing, functional testing, trial operation, balancing of the circulation system and performance testing of the entire swimming pool filtration and water treatment system prior to commissioning and handing over.
- Prior to handing over the facility, the Contractor shall commission the complete swimming pool system, train the designated personnel in the operation, maintenance and safety procedures of all equipment, and submit Operation & Maintenance Manuals, manufacturer's literature, warranty certificates, test reports, maintenance schedules and as-built drawings for all systems.
- The Contractor shall carry out complete testing, commissioning and performance testing of all civil, electrical, plumbing, HVAC, firefighting and building service installations and hand over the facility in fully operational condition. During the Defect Liability Period (DLP), the Contractor shall remain responsible for rectification of defects and satisfactory functioning of all installed systems in accordance with the Contract.
- The list of furniture, pool equipment and fixtures enclosed is minimum and indicative in nature. The Contractor shall supply, install, test and commission all furniture, pool equipment, changing room accessories, lockers, benches and other fixtures necessary for complete operational readiness of the Swimming Pool Facility. In case any specified make, model or type becomes obsolete, discontinued or unavailable, an equivalent or superior product of equal or better specifications shall be provided with the approval of the Engineer-in-Charge.

SL No.	DESCRIPTION	QNTY	VISUAL
1	4 Door PLU with stand (1830H x 380W x 450D) (Make:Godrej/Geeken/Eqv.)	15	

2	Chair unwind (Make:Godrej/Geeken/Eqv.)	8	
3	Chair 1018 (Make:Godrej/Geeken/Eqv.)	2	
4	High Back chair bravo (Make:Godrej/Geeken/Eqv.)	1	
5	Table (1200 x 600 x 728) (Make:Godrej/Geeken/Eqv.)	1	
6	Dustbin - Pedestal Dustbin (12X16) (Make:Godrej/Geeken/Eqv.)	3	
7	Registration Desk (1199 X 590 X 750) (Make:Godrej/Geeken/Eqv.)	4	

8	Glass door cupboard (1830 * 900 * 450) (Make:Godrej/Geeken/Eqv.)	1	
9	Writing Board Mgmt L:6' W:4'	3	
10	Notice Board L:6' W:4' Red	3	
11	Big wall Clock	3	
12	Headwall /Endwall platform for Podium, those platform suitable for Swimming Pool with water recirculation in four sides. It is composed of an AISI 304 stainless steel frame and plastic grating, Grating should be made of polypropylene composite to resist UV rays and chemical products present in the water, the grating should have free space of over 45% to facilitate water recirculation, platform can be used as Turning panel and it should include Anchors for Mounting and for Starting Blocks, Width - 2.5 m.	20	

13	Starting Blocks with mounting frames and foundation bolts - The starting block is manufactured using AISI-316L painted with epoxy resins or polished and dip of plate size 500 x 700 mm. high density polyethylene with no-slip machining Top platform, adjustable Angle of diving platform surface max 10°. Double handle horizontal and vertical for backstroke start. The starting block is provided to numbers standard in 4 sides. Made in according with FINA regulation in force.	20	
14	S.S. Float Lane Storage designed to transport and store the Float Line after use in the swimming pool. Easy to use and aesthetically discreet. The float line roller is manufactured using AISI-304 Stainless Steel and includes a PVC bag for collecting excess water from the float lines. bag's lower outlets, it is emptied in a controlled manner with no water spillage. The cart has four rotating wheels for maximum mobility. Two of these have a brake. Suitable for Storage of 1 No. of 50 m Long 150 mm Dia. Float lane.	9	
15	Float lane - 150 mm Dia. anti wave breaker lane ropes made made in polyethylene with anti-acid and anti UVA treatments with special feature for eliminate wave movement. Complete with spring tensioner all in stainless steel 316L and cover in silicon, in according with EN 13451-5 and FINA regulation in force. Suitable for high level competitions including SS 316L float line fixing post anchored on the deck.	9	
16	FALSE START INDICATOR POST-comprising of 2 nos. stainless steel 316L posts each of 48 mm dia and 1.8 m height provided on either side of the racing pool properly anchored in a suitable anchoring socket on the deck at specified location including one post provided with pulley and quick cord fixing and loosening device and including false start line comprising	1	

	of polyester cord and a float. as per FINA.		
17	d) BACK STROKE TURN INDICATOR POST - comprising of 2 no stainless steel SS 316L posts each of 48 mm dia and 1.8 m height provided on either side of the racing pool properly anchored in a suitable anchoring socket on the deck at specified location and shall span across the sides including set of flags as per specifications as per FINA.	2	
18	Water Polo Goal Post, The water polo goal post should be lightweight, floating and very resistant. It is built entirely from aluminium and is ovenpainted white. Manufacturing and measurements in accordance with FINA international swimming federation standards, Floating: Polyurethane foam-filled aluminium floats, Goal frame: aluminium tube, Net fastening: stainless steel round rod, Net side pipe: stainless steel round pipe with fastening in frame and float, Fastening for goal lines, Nets included. Made in according with FINA regulation in force.	1	
Life Saving Accesories			
	LIFE BUOY Made of Red & White color plastic, Dia. 24" complete with SS life belt holder and Post.	8	

	LIFE SAVING LOOP Made of stainless steel AISI –316L can be connected to telescopic handle by using butterfly nuts, complete with 5 m long telescopic pole.	4	
	Lifeguard Chair, 2155 mm High Made in 43 mm diameter, AISI-304 stainless steel. With demountable base plate. Includes treads, platform, and chair with parasol holder.	2	

FINISHING SCHEDULE LISTED BELOW:

The finishing schedule listed below is indicative in nature and shall be read in conjunction with, and shall conform to, the approved architectural drawings, detailed specifications, finishes schedule, and directions of the Engineer-in-Charge. In case of any discrepancy, the approved architectural drawings and detailed specifications shall prevail.

INDOOR SWIMMING POOL							
SL NO.	FLOOR	ROOM NAME	FINSHING MATERIAL				
			FLOOR FINISH MATERIAL	SKIRTING MATERIAL	WALL PAINT MATERIAL	CELINING FINISH MATERIAL	JOINERY SCHEDULES
1	GROUND FLOOR PLAN	Entrance Lobby	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	12mm Thick Frameless Toughened Glass Door
		Admin Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		First Aid room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Visitors room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Store room	Kota stone	100MM High kota stone	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard

							with both side 1mm thick laminate
		Coach room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Life Guard room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Female changing room	Vitrified Tiles Matt Finish (600X600)	100Mm High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Toilet/DA Toilet	Anti Skid Full Body Vitrified Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC CHOWKHAT WITH WPC DOOR
		Male changing room	Anti Skid Full Body Vitrified Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC CHOWKHAT WITH WPC DOOR
		Electrical room	Kota stone	100MM High kota stone	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 32mm thick flush door (30mm thick Blockboard with both side 1mm thick laminate
		Corridor	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	
		Swimming Pool	FINA standard porcelain swimming pool tiles of size 245 mm × 120 mm	FINA standard porcelain swimming pool tiles of size 245 mm × 120 mm including finger grip coping tiles	----	----	Self supported” secret fix standing roofing system in 0.9mm thick aa 3004 Aluminium Alloy
		Swimming Pool Deck Area	600 x 600 mm Anti-Skid Vitrified Floor tile	600 x 600 mm Anti-Skid Vitrified tile	----	----	Self supported” secret fix standing roofing system in 0.9mm thick aa 3004 Aluminium Alloy
EXTERNAL FAÇADE FINISH							
• Putty with premium Acrylic smooth exterior paint wiith silicon additives • Glass Reinforced Concrete (G.R.C) Screens • Semi- Unitized DGU Glass (6mm glass-12mm gap- 6mm glass). • Aluminium perforated sheet & Wire Mesh Cladding.							

8. Boys & Girls Hostel (2Nos)

- The Boys' & Girls Hostel Building has been proposed to provide safe, comfortable and functional residential accommodation for trainees/players, along with dining, administrative, recreational and support facilities.

- Design and construction of a G+2 RCC framed Boys' & Girl's Hostel Building each having a minimum built-up area as 1800 sq.m with brick masonry infill walls, complete with all architectural, structural and building services works as per the approved drawings.
- The building shall be designed with a symmetrical layout comprising left and right residential wings connected through a centrally located entrance lobby, staircase, lift and circulation core. Adequate circulation shall be provided through a centrally located corridor of minimum 1800 mm width along the longitudinal axis of the building.
- The hostel shall have an accommodation capacity of approximately 102 beds, comprising 17 dormitory rooms with a minimum capacity of 6 beds per dormitory, including 1 dormitory on the Ground Floor and 8 dormitories each on the First and Second Floors, complete with all associated furniture and fixtures.
- Ground Floor: The ground floor shall accommodate common facilities including entrance lobby, administrative office, In-charge room, DSO room, meeting room, smart classroom, warden room, dining hall, kitchen, pantry, store, wash area, hand wash area, drinking water room, laundry, gymnasium, weightlifting room, toilets, circulation areas, staircase, lift lobby and all other ancillary spaces as per the approved architectural drawings.
- Typical First & Second Floors: The upper floors shall function as dedicated residential zones comprising eight dormitory rooms on each floor (four in each wing), common room, shared toilet and bathroom blocks, internal corridors, staircase and lift lobby, and all associated circulation spaces. The sanitary blocks shall be strategically located between adjacent dormitories to ensure efficient plumbing layout and convenient access for occupants.
- The building shall include barrier-free access through entrance ramps, passenger lift, accessible circulation areas, PH Divyang-friendly toilets, stainless steel handrails, tactile indicators (where applicable) and all accessibility provisions in accordance with the latest statutory requirements.
- The flooring with skirting shall comprise vitrified tile flooring in dormitories, office rooms, meeting room, smart classroom, common room, warden room and other occupied spaces; granite stone flooring in entrance lobby, corridors, Dining Hall, staircases, landings, verandahs and ramps; Kota stone flooring in electrical and service rooms; minimum 16mm thick vitrified tiles in Kitchen & pantry, Laundry and anti-skid ceramic/vitrified flooring in toilets, bathrooms, kitchen, pantry, laundry and wash areas. Toilet and bathroom walls shall be provided with glazed ceramic wall tiles up to 2.40 m height above finished floor level.
- The weightlifting room shall include minimum 3nos of dedicated 80mm thick lifting platform measuring 3.00 m × 2.50 m, comprising 50 mm thick African Teak Wood flooring overlaid with 25 mm thick black rubber flooring, complete as per approved specifications.
- The scope shall include 25 mm thick interlocking rubber tile flooring in the gymnasium & weightlifting area over 100mm thick Tremix/VDF Flooring with M30 Plain concrete.
- The kitchen shall be provided with granite working platforms, stainless steel sinks, storage counters, exhaust arrangements, plumbing, drainage and all associated services required for efficient operation.
- The scope shall include aluminium glazed windows, 12 mm thick frameless toughened glass doors and all other doors and windows as per the approved architectural drawings.
- The scope shall include false ceiling works in all rooms and circulation spaces wherever specified in the approved architectural drawings.

- The scope shall include complete waterproofing, architectural finishes, external façade treatment, painting, internal and external plumbing, sanitary installations, electrical works, HVAC, firefighting system, ICT network, public address system, CCTV, access control, lighting, power distribution, drainage, rainwater disposal system and all allied building services required for complete operational readiness.
- The Contractor shall supply, install, test and commission all furniture, dormitory beds, mattresses, wardrobes, study tables, chairs, dining furniture, kitchen equipment, gym equipment, laundry equipment, office furniture, fire-fighting equipment, signage and all other fixtures necessary for complete functionality of the hostel.
- The Contractor shall provide a comprehensive signage system comprising Identification Signage, Directional/Wayfinding Signage, Informational Signage and Regulatory & Safety Signage, including room identification, floor directories, emergency evacuation plans, accessibility signage, statutory signage, fire exit signage and all other signs necessary for safe and efficient operation of the hostel.
- The building shall be designed and constructed in accordance with the latest National Building Code (NBC), relevant BIS Standards, accessibility guidelines, fire safety regulations and all other applicable statutory requirements.
- The Contractor shall carry out complete testing, commissioning and performance testing of all civil, electrical, plumbing, HVAC, firefighting and building service installations and hand over the facility in fully operational condition. During the Defect Liability Period (DLP), the Contractor shall remain responsible for rectification of defects and satisfactory functioning of all installed systems in accordance with the Contract.
- UGR:-

The scope shall include the design, construction, testing and commissioning of an **Underground Water Reservoir (UGR) of minimum 44 KLD capacity** dedicated to hostel buildings for storage and distribution of domestic water, catering to drinking, cooking, bathing, washing, laundry, kitchen and other residential requirements. The UGR shall be of RCC construction complete with excavation, waterproofing, inlet, outlet, overflow, scour arrangement, access manholes, ventilation, level indicators, piping connections, valves, ladders, pumping arrangements, instrumentation and all associated civil, electrical and mechanical works, in accordance with the approved drawings, relevant BIS standards, CPHEEO Manual and NBC provisions.

- The list of furniture, kitchen & laundry equipment, gym equipment and other fixtures are minimum and indicative in nature for each building. The Contractor shall supply, install and commission all furniture, equipment and accessories required for complete operational readiness of the Boys' & Girl's Hostel Building. In case any specified make, model or type becomes obsolete, discontinued or unavailable, an equivalent or superior product of equal or better specifications shall be provided, subject to the approval of the Engineer-in-Charge.

SL No.	DESCRIPTION	QNTY	VISUAL

1	1180 x 750 x 750 Sleek and functional canteen table with SS top and MS Powder coated Understructure	16	
2	Unwind Without Arm MS Powder Coated Understructure	64	
3	Finnesse Table-5026+ ERU 3616	1	
4	Elite Larger Seat Depth with Headrest Leatherette Quilted Upholstery for Back, Adjustable Armrests, Knee Tilt Synchro Mechanism Chrome Pedestal	1	
5	Beat Visitor (LC) MS Powder Coated U/S, Fixed Arm Rest	2	

6	Gain Storage with Overhead GAIN FLOOR UNIT 400 W MAIN 1 No. Size: 2025*400*500 GAIN FLOOR UNIT 400W ADDON 5 Nos Size: 2025*400*500 GAIN OH UNIT 400W MAIN 1 No. Size:650*400*500 OH UNIT 400W ADDON 5 No. Size:650*400*500 FLOOR UNIT 400W METAL DOOR 6nos. OH UNIT 400W METAL DOOR 6nos.	1	
7	6 Door PLU+Locker Main unit 1 + 6 Door PLU+Locker Addon unit 24 4 - Door PLU + Lkr (Base) 1830H x 380W x 450D	2	
8	EQ Metal Bed with slats Overall Size : Width : 205cm Depth : 97.3cm Bed Height : 41.2cm Bed with Headboard Height : 72cm	6	
9	MULTIPURPOSE-Cushioned Chair with Arm Cushioned Chair with Armrest	6	
10	EQ Study Table Overall Size : Width : 90cm Depth : 45cm Height : 75cm	6	

11	Slimline 4s Body Slimline 2 door pacific blue, Mirror for slimline Curvilinier Overall Size : Width : 90cm Depth : 50.7cm Height : 195cm	6	
12	Adriana Bed Overall Size : Length : 206cm Width : 173.3cm Bed Height : 41cm Bed with Headboard Height : 93cm	1	
13	Adriana Bed Side table Overall Size : Width : 44cm Depth : 45cm Height : 51cm	1	
14	Slimline 4s Body Slimline 2 door pacific blue, Mirror for slimline Curvilinier Overall Size : Width : 90cm Depth : 50.7cm Height : 195cm	1	
15	Timberland Corner Table Overall Size : Width : 60.5cm Depth : 60cm Height : 46cm	12	
16	Waves Pro Shoe Cabinet Brown Maple Overall Size : Width : 80cm Depth : 37cm Height : 103cm	2	
17	Conference Table Overall Size : Width : 24cm Depth : 12cm Height : 75cm	1	

18	Medium Back Chair Medium Back Chair, With Coat Hanger, PU Adjustable Arm, Synchro Tilt (3 Position), Seat Slide, Gas Lift, Aluminium Base, Seat and Back Net Tapestry	10	
FIRST FLOOR			
19	EQ Metal Bed with slats Overall Size : Width : 205cm Depth : 97.3cm Bed Height : 41.2cm Bed with Headboard Height : 72cm	48	
20	MULTIPURPOSE-Cushioned Chair with Arm Cushioned Chair with Armrest	48	
21	EQ Study Table Overall Size : Width : 90cm Depth : 45cm Height : 75cm	48	
22	Slimline 4s Body Slimline 2 door pacific blue, Mirror for slimline Curvilinier Overall Size : Width : 90cm Depth : 50.7cm Height : 195cm	48	
23	Slimline 4s Body Slimline 2 door pacific blue, Mirror for slimline Curvilinier Overall Size : Width : 90cm Depth : 50.7cm Height : 195cm	48	
24	Timberland Corner Table Overall Size : Width : 60.5cm Depth : 60cm Height : 46cm	48	

25	Waves Pro Shoe Cabinet Brown Maple Overall Size : Width : 80cm Depth : 37cm Height : 103cm	4	
26	Study Table, Particle Board Top, MS Powder Coated Legs Overall Size : Width : 13.5cm Depth : 60cm Height : 75cm	9	
27	Cafe Chair, Without Arm, SS Pipe Frame Chrome Finish, Leatherette Tapestry, Chrome Finish	18	
SECOND FLOOR			
28	EQ Metal Bed with slats Overall Size : Width : 205cm Depth : 97.3cm Bed Height : 41.2cm Bed with Headboard Height : 72cm	48	
29	MULTIPURPOSE-Cushioned Chair with Arm Cushioned Chair with Armrest	48	
30	EQ Study Table Overall Size : Width : 90cm Depth : 45cm Height : 75cm	48	
31	Slimline 4s Body Slimline 2 door pacific blue, Mirror for slimline Curvilinier Overall Size : Width : 90cm Depth : 50.7cm Height : 195cm	48	
32	Slimline 4s Body Slimline 2 door pacific blue, Mirror for slimline Curvilinier Overall Size : Width : 90cm Depth : 50.7cm Height : 195cm	48	

33	Timberland Corner Table Overall Size : Width : 60.5cm Depth : 60cm Height : 46cm	48	
34	Waves Pro Shoe Cabinet Brown Maple Overall Size : Width : 80cm Depth : 37cm Height : 103cm	4	
35	Study Table, Particle Board Top, MS Powder Coated Legs Overall Size : Width : 13.5cm Depth : 60cm Height : 75cm	9	
36	Cafe Chair, Without Arm, SS Pipe Frame Chrome Finish, Leatherette Tapestry, Chrome Finish	18	

Scope of Laundry Equipment Works in Hostel Buildings (2 Nos.)

- The scope shall include the supply, installation, testing, commissioning and handing over of all laundry equipment, appliances and accessories required for complete operational readiness of the laundry facilities in both hostel buildings.
- The Contractor shall provide all necessary supports, fittings, fasteners, plumbing, drainage, electrical connections, exhaust/ventilation arrangements and other ancillary items required for proper installation and operation of the laundry equipment.
- Necessary internal water supply, drainage, power and ventilation provisions shall be provided complete in all respects for smooth and efficient operation of the laundry facilities.
- All laundry equipment shall conform to the relevant BIS standards and applicable statutory requirements and shall be suitable for continuous institutional use.
- The Contractor shall carry out complete testing and commissioning, provide operation manuals and warranty documents, and ensure satisfactory performance of all laundry equipment during the Defect Liability Period (DLP).
- Any item or accessory not specifically mentioned but required for the complete, safe and efficient operation of the laundry facilities shall be deemed to be included in the Contractor's scope without any additional cost to the Employer.

LAUNDRY EQUIPMENTS FOR EACH HOSTEL BUILDING				
Sl No	Items Details	Size	Units	Qty
1	Weighing Scale.(Electric) 500 Kg. (600x600x900)	600x600x900	Nos.	2
2	Stiching Machine		Nos.	2
3	Washer Extractor (11 Kg)		Nos.	1
4	Tumble Dryer (11 kg)		Nos.	1

5	Storage Racks (Chemical Store) 1275x450x1500)	1275x450x1500	Nos.	4
6	Trolley : Wet		Nos.	2
7	Trolley : Dry		Nos.	2

Scope of Kitchen Equipment Works in Hostel Buildings (2Nos)

- The scope shall include the supply, installation, testing, commissioning and handing over of all kitchen equipment, appliances, stainless steel furniture and accessories required for complete operational readiness of the hostel kitchen.
- The Contractor shall provide all necessary supports, fittings, fasteners, plumbing, drainage, electrical connections, exhaust arrangements, utility connections and other ancillary items required for proper functioning of the kitchen equipment.
- Necessary internal water supply, drainage, power and ventilation provisions shall be made complete in all respects for smooth operation of the kitchen.
- All kitchen equipment shall be of food-grade SS-304 (unless otherwise specified) and shall conform to the relevant BIS standards, FSSAI guidelines and applicable statutory requirements.
- The Contractor shall carry out complete testing and commissioning, provide operation manuals and warranty documents, and ensure satisfactory performance of all kitchen equipment during the Defect Liability Period (DLP).
- Any item or accessory not specifically mentioned but required for the complete, safe and efficient operation of the kitchen shall be deemed to be included in the Contractor's scope without any additional cost to the Employer.

Sl. No.	Description of items	Quantity	Unit	Ref. Image
1	SS Dirty Dish Landing Table With Garbage Chute.(L.H.S) TOPS: Made of 20 Swg. 304 Quality, 20/8 Grade Stainless Steel duly 120 grit matt polished with all edges rounded with no bur or other excess material left. Top will be turned down 50mm The undersides will be suitably sound deadened by treating with silver paint. UNDERSHELVES: Undershelves wherever called for will be constructed of 304 Quality Grade,20 Swg. Stainless Steel Sheet uniformly matt polished with 120 grit and reinforced with 30mm x 30mm x 18 swg. St. steel square pipe Frame. All shelves will be turned down 38mm and 12mm underneath on all sides with resulting corners cutout to fit contour of legs. Shelves for hot case will be perforated. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	

2	SS Three Bowl Sink Unit. The top shall be made of 20 SWG SS 304 with 150mm high back splash. The Sink shall be made of 20 SWG SS 304. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet fit for adjustment Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
3	SS Work Table with 1 No.U/s. Top: Made of SS 304, 20 SWG Quality, Bottom Shelves: Constructed of 304 quality 18SWG. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet feet for adjustment. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
4	SS Dish Storage Rack. Made of 304 Quality, Shelves will be made of 304 Quality 20/8 Grade, 20 Swg. Shelves: 5 Nos, 20 Swg. Stainless Steel. Upright of 30 mm stainless steel square pipe fitted with nylon bullet fit. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	2	Nos	
5	Hot Water Geyser (Horizontal) 35 Litres. std Make : RACOLD /BAJAJ/LG	1	Nos	
6	SS Pot Racks. Made of Outer Frame 1.5" SS square Pipe 304 Grade With Mirror Finish, Inner Support 25mm Dia Pipe 304 Grade With Mirror Finish, Leg : 1.5" Ss 304 Grade Pipe With Adjustable Bullet Leg, No. of shelves 3. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
7	Chapati Making Machine 500 chapati / hours Weight of Chapati : 25 gm to 55 gm (Adjustable) 25 gm to 55 gm (Adjustable) : 4.5" to 7 " (Adjustable) Gas Consumption : 1.5 to 1.8 KG/H r Electric Consumption : 3 KW Motor : Single /Three Phase .5 HP Godrej / CG Weight of machine : 120 kg approx. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
8	work table 1u/s Top: Made of SS 304, 20 SWG Quality, Bottom Shelves: Constructed of 304 quality 18SWG. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet feet for adjustment. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	

9	Tandoor TOP: 18 Swg s.s. sheet,304 grade Covering 18 SWG SS 304 with castrol wheels Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
10	work table 1u/s Top: Made of SS 304, 20 SWG Quality, Bottom Shelves: Constructed of 304 quality 18SWG. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet feet for adjustment. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
11	Single range burner Made of Top & Splash 1.5mm Thick Ss 304 Grade With Matt Finish, Sides : 1.0 Mm Thick Ss 304 Grade With Mirror Finish, Leg: 1.5" & 1" Ss Square 304 Grade With Mirror Finish And Adjustable Bullet Leg. The gas Burner shall be of T-15 high pressure Burner with heavy duty Iron Casting square panspot Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD..	2	Nos	
12	Dosa Plate Top - 16 mm MS Plate Body: 16 SWG Stainless Steel Sheet Cladding with MS angle Frame Burner: 4 RV burner with center coupling, NC valve, and copper pipe with pilot lamp Shelves: (1) One Nos 18 SWG Stainless Steel Legs: (4) Four Nos 16 SWG Stainless Steel Square Pipes Bush: (4) Four Nos Adjustable Square Nylon Bush. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	2	Nos	
13	Two range burner Made of Top & Splash 1.5mm Thick Ss 304 Grade With Matt Finish, Sides : 1.0 Mm Thick Ss 304 Grade With Mirror Finish, Leg: 1.5" & 1" Ss Square 304 Grade With Mirror Finish And Adjustable Bullet Leg. The gas Burner shall be of T-15 high pressure Burner with heavy duty Iron Casting square panspot.Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
14	work table 1u/s Top: Made of SS 304, 20 SWG Quality, Bottom Shelves: Constructed of 304 quality 18SWG. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet feet for adjustment.Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	

15	Vegetable Cutting M/c VG 50 Pulverizing Chamber, Blades, Hopper & body in AISI 304 Grade Stainless Steel, Unit Monted on Stainless Steel AISI 304 Grade 40x40x16SWG Grade Pipe Uprights & Frame, Two Sets of Six nos. different mesh size sieves supplied with unit. Branded Single Phase Electrical Motor of 3 Hp, Machine Capacity-50 - 60 kg/hr, Speed-2800-3500 RPM, Mesh Size-100-300 mm, Cyclone Collector: Made for excellent and efficient separation, Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
16	Vegetable Cutting M/c VG 50 stainless steel 304 grade semi automatic sliceand dice and shred and mince and finger vegetable cutter, cutting blade thickness of 2.5 mm, cutting capacity 120 kg / hour with motor capacity of 0.5 HP Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
17	POTATO PEELER POTATO PILLER Comprising: 20 GA SS body, electrically operated with electric motor of Power : 1 HP, 220V of ISI mark, Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
18	WET GRINDER 15 KG Fitted with Frame, of Stainless steel 304. The grinding portion shall be made out of hard black granite. Bottom Body & Drum made out of stainless Steel of 18 gauge. The grinder shall be attached with single phase 2 HP motor Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD.	1	Nos	
19	WORK TABLE WITH SINK TOP- 20 SWG Stainless Steel 304 Grade 25 MM Deep with 150 MM Back slash With (2) two Nos. Full Sink 300 mm deep With Stainless Steel 40 mm Dia Sink Waste Coupling Body: Front apron 20 SWG Stainless Steel. LEGS: (4)FourNos 20 SWG Stainless Steel Square Pipes Bush: Adjustable Square Nylon Bush (4) Nos, Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	

20	4 Door vertical refrigerator The Outer Body Fabricated from 21SWG AISI 304 grade Stainless Steel Sheet. The Inner Lining and Shelves (Two nos in each compartment) Fabricated in 22SWG AISI 304 grade Stainless Steel Sheet. Each Compartment provided with 2 adjustable shelves. UPRIGHTS in 50 mm dia.X 16SWG thick Stainless Steel AISI 304 grade pipe fitted with White Nylon Bullet Leg with 25mm ht. adjustment. Total height 100mm from bottom of Unit. INTERNAL FRAMEWORK in 25X25X4mm thick MS angles. INSULATION 75mm thk. Polyurethane Foam, COMPRESSOR of suitable Capacity of Standard make like 'Emmerson' or Equivalent. Other Accessories Like Copper Tubing, Circulation Fan, etc. of Standard Quality. Coolant Gas of type. Doors Fabricated from 19SWG AISI 304 grade Stainless Steel Sheet. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
21	SS Work Table with 1 No.U/s. Top: Made of SS 304, 20 SWG Quality, Bottom Shelves: Constructed of 304 quality 18SWG. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet feet for adjustment. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
22	SS Work Table with 1 No.U/s. Top: Made of SS 304, 20 SWG Quality, Bottom Shelves: Constructed of 304 quality 18SWG. Frame work will be made of mild steel and dully painted rust proof. The legs will be made of 20 gauge ss 304 square 40 mm pipe. Nylon bullet feet for adjustment. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
23	Masala Trolley Top of trolley- 1.5mm Thick Ss 304 Grade With Matt Finish, Leg: 1.5" Ss 304 Grade With Mirror Finish And Movable Wheel, There shall be 1/6 GN Pan-6 Nos of required depth with proper individual lead in all 6 pans. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
24	WATER COLLERStorage Capacity (ltr.)- 80 Litres No of Cold water taps- 2 (Brass) Refrigerant- R-134a/R-22Compressor- Hermetic type or EMERSON with suction gas cooled motor, equipped with overload protector.Thermostat- Automatically controls temperature Power Supply- 230 volts+-10%, 50Hz Single phase. Make : JBEQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	

25	Dough Kneader. 20 Kg. Drum made of stainless steel 304 Capacity 20 kg. motor 2hp crompton. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
26	Sandwich griller double STD Make : IFB / PRESITIGE / HAVELLS	1	Nos	
27	Microwave oven STD Make : IFB / SUMSUNG / LG	1	Nos	
28	Juicer STD SUJATA / NIRALI / RUPALI	1	Nos	
29	WORK TABLE WITH SINK TOP- 20 SWG Stainless Steel 304 Grade 25 MM Deep with 150 MM Back slash With (2) two Nos. Full Sink 300 mm deep With Stainless Steel 40 mm Dia Sink Waste Coupling Body: Front apron 20 SWG Stainless Steel. LEGS: (4)FourNos 20 SWG Stainless Steel Square Pipes Bush: Adjustable Square Nylon Bush (4) Nos, Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
30	SS work Counter . Top- 20 SWG Polished SS 304, All sides Turned Down 50mm & In 12mm, Sound Deadned with coved corners. Angle frame : 30X30X3 mm SS 304 Undershelves : 2 Nos 18 Swg SS 304 undersheleves. All sides Turned Down 40mm & In 12mm with 16 swg ss stiffner. Legs : 4 nos. mads of square pipe of 1.5 mm 16 swg SS 304 with nylon Bullet Feet Surface Finish Mat Polish Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	2	Nos	
31	SS Hot Bain-marie [5 GN Pan] Top- 1.5mm Thick Ss 304 Grade With Matt Finish , Tank : 1.2mm Thick Ss 304 Grade With Matt Finish, Three Side & Bottom Shelf : 1.0 Mm Thick Ss 304 Grade With Mirror Finish, Leg: 1.5” Ss Square Pipe 304 Grade With Mirror Finish And Adjustable Bullet Leg Vessel : GN Pan 4 no. of 1/1 - 150mm deep (21x13x6 inches) 2NO. 1/2 GN PAN Electric Heater of 3kw Heater With Control Unit. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	

32	CLEAR DISH COLLECTION TROLLY Top should be 20 Gauge, SS 304 GRADE shelves should be made of 22 Gauge SS sheet, 38x38x3mm SS angle frame supported, noise free rubber castors to be provided with wheels Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
33	Weighing Scale.(Electric) 100 KgSTD	1	Nos	
34	SS Storage Rack Made of 304 Quality, Shelves will be made of 304 Quality 20/8 Grade, 20 Swg. Shelves: 5 Nos, 20 Swg. Stainless Steel. Upright of 30 mm stainless steel square pipe fitted with nylon bullet fit. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	5	Nos	
35	SS Onion, Potato & Coconut Bin with Castors. Made of stainless steel (304) WIRE MESS, Stainless Steel 3 mm wire mesh 25mm x 25mm size square, 16 Swg. Stainless Steel notched to keep free flow of Potato in front. Sides & Lids : Stainless Steel 3 mm wire mesh 25mm x 25mm size square, welded in 12 Swg Stainless Steel 25mm x 25mm flat channels. Front/Sides & Lids- Stainless Steel 3mm wire mesh 25mm x 25mm size square , welded in 12 Swg Stainless Steel 25mm x 25mm flat channels with liftable door at the bottom for first in first out issue. CASTORS-100mm dia. Rubberized castors, plate fitted castors wheel. Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	2	Nos	
36	SS Platform Trolley Fabricated from 18SWG Stainless Steel AISI 304 Grade Sheet, all sides turned up by 50mm & then 12mm for chipping bend. PUSH CART HANDLE in 25 mm dia.X 16SWG thick Stainless Steel AISI 304 grade pipe. UPRIGHTS in 38 mm dia.X 16SWG thick Stainless Steel AISI 304 grade pipe. CASTOR WHEELS: 2 Fixed & 2 Swiveling with Brake of 150mm dia x 30mm thick rubber tyres. WELDING: should be done by Argon Arc /Tig welding only. No Electrical Arc Welding should be used. All the welded edges, surfaces should be FINISH: All plain & pipe surfaces should be finished brush / satin finish, Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	

37	VISI COOLER SINGLE DOOR • Temperature Range: 2°C to 8°C • Cooling System: Ventilated cooling with automatic defrost • Exterior Finish: Powder-coated white body with transparent glass door • Door: Single glass door with lock • Shelving: 5 adjustable shelves • Interior Lighting: LED illumination for product visibility Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
38	Air Curtain. 4 feet. STD Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	2	Nos	
39	Insect o Killer. STD Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	5	S.F	
40	Garbage Trolley. 50 Litres STD Make : Sintex / Godrej / Nilkamal	4	Nos	
41	SS. Exhaust Hood with SS baffel filters (Wall Type) MADE OF 20 SWG. 304 GRADE S.S. SHEET, FILTER: FRAME OF 20 SWG.STAINLESS Steel BAFFLE TYPE GREASE FILTER Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	1	Nos	
42	SS. Exhaust Hood with SS baffel filters (Wall Type) MADE OF 20 SWG. 304 GRADE S.S. SHEET, FILTER: FRAME OF 20 SWG.STAINLESS Steel BAFFLE TYPE GREASE FILTER Make : JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD	2	Nos	

Scope of Gym Equipment Works in Hostel Buildings (2 Nos.)

- The scope shall include the supply, installation, testing, commissioning and handing over of all gym and fitness equipment, accessories and allied items required for complete operational readiness of the gymnasium.
- The Contractor shall provide all necessary supports, anchors, fittings, fasteners, electrical connections (where applicable), rubber flooring interfaces, safety accessories and other ancillary items required for proper installation and operation of the gym equipment.
- The Contractor shall ensure that the gym layout provides adequate clearance, safe circulation and proper installation in accordance with the manufacturer's recommendations and relevant safety standards.
- All gym equipment shall be of commercial/institutional grade, suitable for continuous use, and shall conform to relevant BIS standards and applicable statutory requirements.

- The Contractor shall carry out complete testing and commissioning, provide operation manuals, warranty documents and user training, and ensure satisfactory performance of all gym equipment during the Defect Liability Period (DLP).
- Any item or accessory not specifically mentioned but required for the complete, safe and efficient operation of the gymnasium shall be deemed to be included in the Contractor's scope without any additional cost to the Employer.

Item No	Items with Specifications	Image	Min i Qty
1	HERCULES FITNESS LIVE YOURS HERCULES FITNESS 4 WAY OLYMPIC BENCH Model : AU 49 Size (inches) 91" x 64" x 60" Weight (kg) 103Kg		6
2	HERCULES FITNESS LIVE YOURS HERCULES FITNESS OLYMPIC PLATES 51mm Sizes available 2.5X2,5X2,7.5X2,10X2,15X2,20X2,25X2		170
3	HERCULES FITNESS LIVE YOURS HERCULES FITNESS HEAVY DUTY OLYMPIC BAR : 7'		4
4	HERCULES FITNESS LIVE YOURS HERCULES FITNESS HEAVY DUTY OLYMPIC BAR :6'		4
5	HERCULES FITNESS LIVE YOURS HERCULES FITNESS HEAVY DUTY OLYMPIC BAR: 5'		4
6	HERCULES FITNESS STRAIGHT ROD: 4' HERCULES FITNESS LIVE YOURS		4

7	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS DUMBBELL EDGE TPU • Made from high quality vergin rubber • High impact resistant rubberised material Sizes available 2.5X2,5X2,7.5X2,10X2,12.5X2,15X2,17.5X2,20X2,22.5X2,25X2,30X2,35X2,40X2,45X2,50X2		675
8	HERCULES FITNESS PVC YOGA MAT 6 MM • Durable PVC Material • Embossed Surface for excellent grip • Hand Washable Thickness 6mm		10
9	HERCULES FITNESS HORIZONTAL ROMAN CHAIR Model: AZ 31 Size (inches) 63" × 36" × 39" Weight (kg) 70kg		2
9a	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS GLUTE HAM DEVELOPER Model : EC 02 Size (inches) 56" × 33" × 46" Weight (kg) 83kg		1
10	HERCULES FITNESS LIVE YOUNG HERCULES FITNESS ANTI BURST GYM BALL WITH HAND PUMP Size Available : 75cm		5

11	INDOOR INTERLOCKING EVA MAT - 20 MM (RED / BLUE) Material:EVA Foam Thickness: 20 mm Size:1x1 ft Surface Finish: Smooth Color: Multicolor Usage Area: Kids Play, Home, Martial Arts, Yoga, Gym		10
12	HERCULES FITNESS ADJUSTABLE WEB BOARD Model: FU 34 Size (inches) 73" × 28" × 36" Weight (kg) 63kg		4
	HERCULES FITNESS ADJUSTABLE WEB BOARD Model: AU 33 Size (inches) 72" x 29" x 37" Weight (kg) 50kg		4
12a	HERCULES FITNESS MULTIPURPOSE ADJUSTABLE BENCH Model: AU 34 Size (inches) 70" x 33" x 19" Weight (kg) 140kg		2
13	HERCULES FITNESS DUMBELLS RACK Model: FU 30 Size (inches) 92" × 33" × 34" Weight (kg) 32kg		2
	HERCULES FITNESS DUMBELLS RACK Model: AU 42 Size (inches) 93" x 24" x 31" Weight (kg) 66kg		2

14	HERCULES FITNESS LIVE YOUR HERCULES FITNESS Barbell Rack Anti-corrosion black matte finish for lasting aesthetics Rubberized holders protect equipment and reduce noise Stable base with anti-slip feet for added safety Compatible with both straight and EZ fixed barbells		2
14a	HERCULES FITNESS THERCULES RIPLE STORAGE RACK Store upto 12 barbells, 24 weight plates and 8 pcs kettle bell. HERCULES FITNESS LIVE YOUR		1
15	HERCULES FITNESS Spin Bike Model: SB 35 Brush Brake Resistance Control Belt Drive Heavy duty 3 piece Crank Machine Floor Size: 52" x 22" x 44" Precise Bearing for smooth function High Strength steel frame & Ultra stable structure Super Quiet Poly V belt Drive for smooth function 23 Kgs Fly wheel Maximum User Weight: 150 Kgs Drive: Belt Drive HERCULES FITNESS LIVE YOUR		6
16	HERCULES FITNESS Treadmill Model: TMA 64L 20 Km/hr. Max. Speed Machine Floor Size: 83" x 35" x 64" Running Area: 61" x 23" Unfoldable Structure Maximum User Weight: 200 Kgs Machine Weight: 160kg Rubber Cushion – Accept the shock & less impact on joints Display Reading: Speed, Time, Calories, Distance & Heart Rate Motor Power: 4.0 H.P / 8.0 H.P AC Motor HERCULES FITNESS LIVE YOUR		5

16a	HERCULES FITNESS HERCULES FITNESS Treauumii Model: TA 800 Display: Led Screen Machine Size: 87" × 36" × 64" Speed: 1-20km/h 20 Level Automatic Motorized Incline Running AREA: 60*23 Machine weight: 187kg Maximum user weight: 200kg Display Reading: Speed, Time, Calories, Distance & Heart Rate Motor Power: 4.0/8.0 HP Peak AC Motor		4
17	HERCULES FITNESS HERCULES FITNESS Tre Model: TMA 64L 20 Km/hr. Max. Speed Machine Floor Size: 83" x 35" x 64" Running Area: 61" x 23" Unfoldable Structure Maximum User Weight: 200 Kgs Machine Weight: 160kg Display Reading: Speed, Time, Calories, Distance & Heart Rate Motor Power: 4.0 H.P / 8.0 H.P AC Motor		4
17a	HERCULES FITNESS HERCULES FITNESS Air Rower Model: AR 60 Display - Lcd Display Display Reading - Resistance Level, Time, Distance, Stoke Programs - 8 programs Max User Weight - 130kg Machine Weight - 45kg Machine Size - 91*20*26		3
18	HERCULES FITNESS HERCULES FITNESS PUSH UP BAR • Metal Construction • Ideal for fullbody workout		4
19	HERCULES FITNESS		4

	HERCULES FITNESS BATTLE ROPE Available Weights: 3.8×1200 CM, 3.8×1500 CM, 5.0×1200 CM, 5.0×1500 CM Size: 15 mtr		
20	 HERCULES SKIP ROPE JUMP ROPE-FOAM HANDLE-2750 MM		15
21	HERCULES FITNESS STEP HURDLES 18" Available in 6", 9", 12" & 18" Size : 18"		20
22	 HERCULES FITNESS Leg Press Model: AU 19 Size (inches) 95" x 64" x 57" Weight (kg) 232kg		2
22a	 HERCULES FITNESS 45 DEGREE LEG PRESS Model: AB 56 Size (inches) 86" × 64" × 50" Weight (kg) 215kg		1
23	 HERCULES FITNESS LATERAL LEG PRESS Frame Tube : High Tensile Steel Seat Cushion : PU Leaterized Paint : Two Round Powder Coating Size : 1989x1771x1545 mm Weight Stack : Plate Loaded N.W / G.W : 148 Kg. / 178 Kg.		2

24	HERCULES FITNESS LIVE YOURS HERCULES FITNESS PRONE LEG CURL Model: RA13A Size (inches) 59" × 37" × 55" Weight Stack (kg) 100kg Weight (kg) 219kg		2
24a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Prone Leg Curl Model: AU 07 Size (inches) 66" x 48" x 64" Weight Stack (kg) 100kg Weight (kg) 238kg		1
25	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Hack Squat Model: AU 17 Size (inches) 94" x 64" x 57" Weight (kg) 212kg		2
25a	HERCULES FITNESS LIVE YOURS HERCULES FITNESS STANDING OUTER THIGH ABDUCTOR * Heavy duty 2.5mm thick steel square tube of size 50mm x 100mm * Black powder coated finish with strong double stitched upholstery		1
26	HERCULES FITNESS LIVE YOURS HERCULES FITNESS Smith Machine Model: AB 63 Size (inches) 86" × 64" × 50" Weight (kg) 284kg		2

26a

**HERCULES
FITNESS**
LIVE YOUNG
HERCULES FITNESS Smith Machine**Model: AB 87**

Size (inches) 88" × 76" × 86"

Weight (kg) 248kg



1

FINISHING SCHEDULE LISTED BELOW:

The finishing schedule listed below is indicative in nature and shall be read in conjunction with, and shall conform to, the approved architectural drawings, detailed specifications, finishes schedule, and directions of the Engineer-in-Charge. In case of any discrepancy, the approved architectural drawings and detailed specifications shall prevail.

Boys & Girls Hostel							
SL NO.	FLOOR	ROOM NAME	FINISHING MATERIAL				
			FLOOR FINISH MATERIAL	SKIRTING / DADO MATERIAL	WALL PAINT MATERIAL	CELING FINISH MATERIAL	JOINERY SCHEDULES
1	GROUND FLOOR PLAN	Entrance Lobby	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	12mm thick Clear Toughened Glass Frameless Door
		Corridor	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Admin	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Toilet	Anti Skid Ceramic Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 30 mm thick WPC door shutters
		Gym	Safelock 25 mm interlocking rubber tiles	Safelock 25 mm interlocking rubber tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Changing Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic	Plastic Emulsion Paint	WPC Choukath with 35 mm

			Emulsion Paint		thick flush door shutters
Loundary	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Warden Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Dormitory	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters laminate
Dining Hall	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Kitchen	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Wash area & Utensile store	Anti Skid Ceramic Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Serving area	Anti Skid Ceramic Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	
Store room	Kota tile	100MM High kota stone	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Office	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
Incharge room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
DSO	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters

		Meeting Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Smart class Room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Staircase	20 mm thick granite stone slab in Tread & Landing	10mm thick granite stone slab in dado/skirting	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	
Typical 1 st & 2 nd Floor		Corridor	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Lobby	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	
		Dormitory Room (6 bedded) 17nos	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Common room	Vitrified Tiles Matt Finish (600X600)	100MM High Vitrified Tiles	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 35 mm thick flush door shutters
		Toilet	Anti Skid Ceramic Tile (600X600)	Ceramic Glazed Wall Tile(600X300) 2.4 Mtr From FFL	Putty with Plastic Emulsion Paint	Putty with Plastic Emulsion Paint	WPC Choukath with 30 mm thick WPC door shutters
		Staircase	20 mm thick granite stone slab in Tread & Landing	10mm thick granite stone slab in dado/skirting	Putty with Plastic Emulsion Paint	Plastic Emulsion Paint	
EXTERNAL FAÇADE FINISH							
- Putty with premium Acrylic smooth exterior paint wiith silicon additives - Glass Reinforced Concrete (G.R.C) Screens							

9. KHO KHO COURT

General Scope of Work

- Scope of Work:** Supply of all materials, labour, equipment, and execution for the construction of an outdoor clay Kho-Kho playing field, complete in all respects as per approved drawings and the directions of the Engineer-in-Charge.
- Site Preparation:** Clearing, grubbing, removal of vegetation, debris, and unsuitable material, followed by excavation, filling, dressing, and levelling of the ground to the required levels.

- **Subgrade Preparation:** Preparation of a well-compacted subgrade to the required density, ensuring a stable and uniform foundation for the playing surface.
- **Base Layer:** Providing and laying approved moorum/base material in layers, each layer properly watered, rolled, and compacted to achieve the specified density and level.
- **Clay Topping:** Providing and laying minimum 200mm thick selected clay topping layer in uniform layers, free from stones, gravel, organic matter, and other deleterious materials.
- **Compaction:** Each layer of clay shall be adequately watered, rolled, and compacted using suitable rollers to achieve a smooth, firm, and uniform playing surface.
- **Surface Finish:** The finished surface shall be level, even, crack-free, and free from depressions, bumps, loose particles, or undulations that may affect play.
- **Drainage:** The court shall be finished with an appropriate slope to ensure efficient surface water drainage without affecting the playing characteristics.
- **Line Marking:** Providing and marking the Kho-Kho court lines with approved marking material as per the latest Kho-Kho Federation of India (KKFI) or relevant authority standards.
- **Dimensions:** The playing field and all markings shall conform to the latest approved dimensions and specifications for national-level Kho-Kho competitions.
- **Moisture Conditioning:** The contractor shall ensure proper watering, dressing, and moisture conditioning of the clay surface before handing over the field.
- **Quality of Materials:** All clay, moorum, and other construction materials shall be approved by the Engineer-in-Charge and shall conform to the relevant Indian Standards wherever applicable.
- **Workmanship:** All works shall be executed by experienced personnel using approved construction practices to ensure a durable, uniform, and high-quality playing surface.
- **Testing & Inspection:** Levels, compaction, slope, and surface finish shall be inspected and approved by the Engineer-in-Charge before completion.
- **Completion:** The work shall include all incidental items, finishing, dressing, curing, cleaning, and preparation of the field ready for use, complete in all respects.
- **Equipment:** Supply & installation of 1 set of 100mm dia steel poles as per standards.
- **Dimensional Specifications**

Component	Minimum Dimensions (mm)	Minimum Dimensions (m)	Description
Total Area (incl. Lobby)	31000 x 20000	31.0 x 20.0	The complete footprint required for the court and safety buffer.
Playfield Area	27000 x 16000	27.0 x 16.0	The primary active playing area, bounded by the outer thick lines.
Lobby (Buffer Zone)	2000 (Width)	2.0	A uniform clearance zone surrounding all four sides of the playfield.

Component	Minimum Dimensions (mm)	Minimum Dimensions (m)	Description
Free Zone	1500 x 16000	1.5 x 16.0	Located at both ends of the playfield, behind the post lines.
Cross Lanes	2300 (Width)	2.3	Intersecting lanes running perpendicular to the center line.
Cross Lane Length	7850	7.85	Distance measured from the edge of the center lane to the side line.
Chaser Squares	350 x 300	0.35 x 0.30	Intersections of the center line and cross lanes, marked accurately for chaser seating.

- Providing and laying outdoor clay surface for Kho-Kho court including clearing and levelling of ground, preparation of subgrade, laying and compacting approved moorum base layer, providing minimum 200 mm thick selected clay topping layer in layers, watering, rolling with suitable roller to obtain a smooth, compact and uniform playing surface, maintaining proper slope for drainage, including finishing, dressing, and marking of Kho-Kho court lines as per standard dimensions, complete in all respects as per direction of Engineer-in-Charge.

10. Basketball court (PU Based court)

- The scope shall include construction of an outdoor Basketball Court, complete in all respects, in accordance with the approved drawings, relevant BIS standards, FIBA guidelines (where applicable) and the directions of the Engineer-in-Charge.
- The Basketball Court shall be constructed over a minimum area of 642 sq.m, complete with subgrade preparation, minimum 150mm granular sub-base (GSB), minimum 200mm Wet Mix Macadam (WMM), minimum 50mm DBM base course and minimum 30 mm thick Bituminous Concrete wearing course, including all associated earthwork and pavement construction.
- The playing surface shall be provided with a 9 mm thick seamless point-elastic polyurethane (PU) synthetic sports flooring system, comprising 7 mm thick in-situ rubber granule elastic layer, 2 mm polyurethane system consisting of a two-component polyurethane pore sealer, followed by a two-component self-levelling polyurethane wear coat, and finished with a two-component aliphatic polyurethane topcoat providing high abrasion resistance, UV stability, weather resistance, stain resistance and long-term durability., and a high-performance aliphatic polyurethane top coat, complete with game line markings conforming to the latest EN, DIN and other relevant international standards.

- The Contractor shall provide precast M-30 grade kerb stones of approved size, shape and colour around the court, complete with bedding and haunching as per the approved drawings.
- The sports fence shall incorporate four integrated lighting poles of 8.0 m height, complete with foundations, brackets, sports lighting fixtures, cabling, earthing, control panel and all electrical accessories required for uniform illumination of the playing area.
- The Contractor shall supply, install, test and commission one pair of fixed outdoor basketball goal posts with 3.20 m umbrella projection, fabricated from 200 mm × 200 mm square mild steel sections, factory powder-coated for corrosion resistance. Each unit shall be complete with 30 mm thick transparent acrylic backboard of size 1800 mm × 1050 mm, international-standard double die-frame aluminum anodized/steel powder-coated frame with built-in mounting brackets, 20 mm thick solid steel dunking rim with triple spring mechanism, 5.5-inch-thick high-density blue foam safety padding, regulation-size (450 mm) heavy-duty white nylon basketball nets, anchor bolts and all accessories required for complete installation. The scope shall also include all excavation, PCC/RCC foundation, concrete, backfilling, installation labour, testing and commissioning, complete in all respects, conforming to the latest FIBA standards and as approved by the Engineer-in-Charge.
- Court markings shall be carried out using approved weather-resistant sports line marking materials strictly in accordance with the latest **FIBA** standards and the approved drawings.

- **FENCING:**

The scope shall include construction of a **3.0 m high sports fence** around the court with minimum length of 105m using PVC-coated GI chain-link fencing of minimum 4mm dia PVC coated to achieve outer dia not less than 5 mm and 2 mm dia wire or nuts, bolts and washers as required fixed to structural steel tubular posts, complete with desired access gate, foundations, fittings and all associated accessories.

- **SEATING AREA:**

The scope shall include construction of stepped spectator seating with adequate foundation for comprising **four stepped rows**, for a minimum length of **32.0 m**, with minimum **1.00 m tread width** & 0.45m riser for each step, finished with granite stone treads and risers, complete with stainless steel handrails and all associated civil works.

- **DRAIN:**

The scope shall include construction of an **RCC surface drain** with perforated precast RCC cover slabs, minimum **35 m** in length or as per the approved drawings, with minimum width of 0.45m & average height of 0.45m for efficient storm water drainage.

- All civil, structural, sports flooring, fencing, lighting, drainage and basketball equipment shall conform to the relevant BIS standards, applicable international standards and the manufacturer's recommendations.
- The Contractor shall carry out all necessary quality control tests, testing and commissioning of sports lighting and basketball equipment and shall hand over the facility complete in all respects and ready for use.

- Any item, material, labour, equipment, fitting or ancillary work not specifically mentioned but required for the complete construction, safety and satisfactory functioning of the Basketball Court shall be deemed to be included in the Contractor's scope without any additional cost to the Employer.

11. Volleyball court

- **Scope of Work:** Supply of all materials, labour, equipment, and execution for the construction of an outdoor clay Volleyball playing field, complete in all respects as per approved drawings and the directions of the Engineer-in-Charge.
- **Site Preparation:** Clearing, grubbing, removal of vegetation, debris, and unsuitable material, followed by excavation, filling, dressing, and levelling of the ground to the required levels.
- **Subgrade Preparation:** Preparation of a well-compacted subgrade to the required density, ensuring a stable and uniform foundation for the playing surface.
- **Base Layer:** Providing and laying approved moorum/base material in layers, each layer properly watered, rolled, and compacted to achieve the specified density and level.
- **Clay Topping:** Providing and laying minimum 200mm thick selected clay topping layer in uniform layers, free from stones, gravel, organic matter, and other deleterious materials.
- **Compaction:** Each layer of clay shall be adequately watered, rolled, and compacted using suitable rollers to achieve a smooth, firm, and uniform playing surface.
- **Surface Finish:** The finished surface shall be level, even, crack-free, and free from depressions, bumps, loose particles, or undulations that may affect play.
- **Drainage:** The court shall be finished with an appropriate slope to ensure efficient surface water drainage without affecting the playing characteristics.
- **Line Marking:** Providing and marking the **court lines** with approved marking material as per the latest **guidelines** or relevant authority standards.
- **Dimensions:** The playing field and all markings shall conform to the latest approved dimensions and specifications for national-level Volleyball competitions.
- **Moisture Conditioning:** The contractor shall ensure proper watering, dressing, and moisture conditioning of the clay surface before handing over the field.
- **Quality of Materials:** All clay, moorum, and other construction materials shall be approved by the Engineer-in-Charge and shall conform to the relevant Indian Standards wherever applicable.
- **Workmanship:** All works shall be executed by experienced personnel using approved construction practices to ensure a durable, uniform, and high-quality playing surface.
- **Testing & Inspection:** Levels, compaction, slope, and surface finish shall be inspected and approved by the Engineer-in-Charge before completion.
- **Completion:** The work shall include all incidental items, finishing, dressing, curing, cleaning, and preparation of the field ready for use, complete in all respects.
- **Equipment:** Supply & installation of adjustable, internal winding pair of poles with net including sleeves and cover for Volleyball court as per standards.
- **FENCING:**

The scope shall include construction of a **3.0 m high sports fence** around the court with minimum length of 125m using PVC-coated GI chain-link fencing of minimum 4mm dia PVC coated to achieve outer dia not less than 5 mm and 2 mm dia wire or nuts, bolts and washers as required fixed to structural steel tubular posts, complete with desired access gate, foundations, fittings and all associated accessories.

- **SEATING AREA:**

The scope shall include construction of stepped spectator seating with adequate foundation for comprising **four stepped rows**, for a minimum length of **24.0 m**, with minimum **1.00 m tread width** & 0.45m riser for each step, finished with granite stone treads and risers, complete with stainless steel handrails and all associated civil works.

- **DRAIN:**

The scope shall include construction of an **RCC surface drain** with perforated precast RCC cover slabs, minimum **35 m** in length or as per the approved drawings, with minimum width of 0.45m & average height of 0.45m for efficient storm water drainage.

12. Skating Rink

- The scope shall include excavation up to a minimum depth of 200 mm for sub-base preparation and providing and laying a minimum 100 mm thick Wet Mix Macadam (WMM), complete with compaction to the required density and levels as per MoRTH specifications and approved drawings.
- The scope shall include providing and laying minimum **100 mm thick VDF/Tremix flooring with M-30 plain concrete**, complete with vacuum dewatering, power trowel finishing, groove cutting, joint sealing and all associated materials, labour and equipment to achieve a smooth, durable and crack-resistant surface.
- The scope shall include providing a **4-layer acrylic synthetic sports surface (Deco Turf ITF-approved or equivalent)** comprising resurfacer coat(s), 2layers of acrylic colour coat(s) and game line markings, complete in all respects to provide a durable, weather-resistant and high-performance playing surface conforming to the relevant international standards and the approved drawings.

13. Kabaddi Court

- The scope shall include construction of one outdoor Kabaddi Court, complete in all respects, in accordance with the approved drawings, relevant BIS standards, AKFI guidelines and the directions of the Engineer-in-Charge.
- The Kabaddi Court shall be constructed for minimum area of 304 sq.m, complete with excavation, sand filling, PCC, RCC base slab and all associated civil works as per the approved drawings and specifications.
- The RCC playing surface shall be prepared with sand sub-base with minimum 150 mm thick DLC, and 200 mm thick M-25 grade RCC slab, finished to the required levels, slope and surface tolerance for installation of the Kabaddi mat.
- The playing surface shall be provided with 35 mm thick interlocking EVA Foam Kabaddi Mats of size 1000 mm × 1000 mm, manufactured from multi-layer high-density EVA foam with uniform shock absorption characteristics. The mats shall be dual-colour, reversible, interlocking (zig-zag type), and designed to prevent displacement during play, complete with all accessories required for installation.
- Court markings shall be provided on the Kabaddi mat in accordance with the latest Amateur Kabaddi Federation of India (AKFI) standards and the approved drawings.

- All civil works, Kabaddi mats and associated accessories shall conform to the relevant BIS standards, manufacturer's recommendations and applicable national standards.

14. Service Building

- The project includes the design and construction of an RCC framed Service Building having minimum builtup area of 148sqm complete with all civil, structural, architectural and MEP works as per the approved drawings and specifications.
- The building shall accommodate all service and utility functions, including service rooms, electrical room, service areas, other ancillary facilities as indicated in the approved drawings.
- The scope shall include RCC foundations, plinth beam, columns, beams, slabs, brick masonry, lintels, chajjas, staircase, roof waterproofing, parapet walls and all associated structural works.
- The scope shall include flooring with skirting with Kota stone flooring comprising granite flooring in steps, ramps as applicable, doors, windows, glazing and all finishing works as per the approved architectural drawings.
- The scope shall include galvanized steel doors, aluminium glazed windows, as per the approved architectural drawings.
- The scope shall include provision of GRC screens for achieving the desired elevation.
- Any material, equipment, fitting, fixture or ancillary work not specifically mentioned but required for the complete, safe, durable and functional construction and operation of the Service Building shall be deemed to be included within the Contractor's scope without any additional cost to the Employer.

15. SITE DEVELOPMENT WORK

Compound Wall, Gates & Entrance Features

- The scope shall include construction of the complete compound wall, entrance gate complexes and all associated civil, structural, architectural, electrical, plumbing, ICT and allied works, complete in all respects in accordance with the approved drawings, specifications and the directions of the Engineer-in-Charge.
- The compound wall shall have a minimum length of 1,640 m, enclosing the entire campus, comprising RCC foundations, RCC columns at a maximum spacing of 3.00 m c/c, RCC plinth beam, brick masonry wall panels, 150 mm thick RCC coping, anti-corrosion treatment, protective coatings and all associated civil works.
- The front boundary wall shall have a minimum height of 1.65 m of brickwork above Finished Ground Level (FGL) and shall be topped with a 0.90 m high architectural M.S. spike grill. The remaining three sides shall have a minimum height of 2.40 m of brickwork above FGL, topped with 600 mm diameter concertina coil fencing fixed with punched tape and horizontal barbed wire supports, complete with all necessary fixing arrangements and accessories.
- The scope shall include the design and construction of a minimum of two architecturally designed entrance/exit gate complexes, or additional gates as required for functional

accessibility, each comprising double-leaf vehicular swing/sliding gates with a minimum clear opening of 10.50 m and minimum height of 5.50 m, along with 2.30 m wide pedestrian wicket/service gates, RCC gate columns, portal beams, heavy-duty rollers, locking arrangements, foundations and all associated accessories.

- The entrance gate complexes shall also include security cabins with minimum built-up area of 10sqm with provision of door, windows, flooring & necessary electrical & plumbing provisions with Entry Inspection and Pedestrian Holding facilities, cattle traps, automatic boom barriers, access control systems, architectural entrance signage with LED illumination, lighting, drainage, electrical installations, ICT provisions, plumbing works and all allied civil, structural and MEP works required for complete operational functionality.
- All structural steel members, gates, grills, fencing and associated steel components shall receive suitable anti-corrosion treatment and protective coating as per the approved specifications.
- Any material, equipment, fitting, accessory or ancillary work not specifically mentioned but required for the complete, safe, durable and satisfactory construction and operation of the compound wall, entrance gate complexes and associated facilities shall be deemed to be included within the Contractor's scope without any additional cost to the Employer.

Internal driveway

- The scope shall include construction of the complete internal driveway and associated works, in accordance with the approved drawings, MoRTH Specifications (5th Revision), relevant BIS standards and the directions of the Engineer-in-Charge.
- The internal driveway shall comprise a minimum 6.00 m wide Cement Concrete (CC) road with minimum paved area of 22,878 sq.m, complete with all associated earthwork, pavement layers, drainage provisions, kerbs and finishing works.
- The work shall include minimum 500mm subgrade preparation, followed by construction of a minimum 200 mm thick Granular Sub-Base (GSB) using close-graded material, properly spread, watered and compacted as per MoRTH specifications.
- The pavement shall comprise a minimum 150 mm thick Dry Lean Concrete (DLC) sub-base and a minimum 250 mm thick unreinforced, dowel-jointed Plain Cement Concrete (PQC) pavement, complete with expansion/contraction joints, dowel bars, joint sealing, curing and finishing as per the approved drawings and relevant standards.
- The scope shall include providing cement concrete kerbs on both sides of the driveway with PCC foundation, sand bed, backing concrete, alignment, finishing and two coats of synthetic enamel paint of approved colour.
- The Contractor shall also execute all associated excavation, sand filling, PCC below kerbs, joint cutting and sealing, curing, testing, quality control, road markings (where applicable), tie-ins with adjoining pavements and all incidental works required for complete and satisfactory execution.
- Any material, equipment, labour or ancillary work not specifically mentioned but required for the complete construction, durability, safety and functional performance of the internal driveway and pavement system shall be deemed to be included within the Contractor's scope.

Parking Areas & Footpaths

- The scope shall include construction of the complete parking areas, paved roads and footpaths, having minimum paved area of 22,173 sq.m, comprising parking areas, internal paved roads near hostel buildings and pedestrian footpaths, complete in accordance with the approved drawings, MoRTH Specifications (5th Revision), IRC guidelines and relevant BIS standards.
- The work shall include minimum 500mm subgrade preparation, followed by providing and laying a minimum 250 mm thick Granular Sub-Base (GSB) using close-graded material, complete with spreading, watering and compaction as per MoRTH specifications.
- The scope shall further include providing and laying 80 mm thick M-40 grade precast cement concrete interlocking paver blocks of approved make, colour, shape and pattern, machine manufactured and conforming to IRC:SP:63-2018, complete with bedding layer, joint filling, edge restraints, cutting, compaction and all associated works required for a durable and uniform paved surface.
- The scope shall include providing cement concrete kerbs on both sides of the driveway with PCC foundation, sand bed, backing concrete, alignment, finishing and two coats of synthetic enamel paint of approved colour.
- Any material, labour, equipment or ancillary work not specifically mentioned but required for the complete, durable and functional construction of the parking areas and paved footpaths shall be deemed to be included within the Contractor's scope.

Storm Water Drainage System

- The project includes the design and construction of a covered RCC storm water drainage system having a minimum total length of 1,500 m, complete with excavation, PCC, RCC base slab, side walls, bed concrete, reinforcement, waterproofing (where required), backfilling and all associated civil works, in accordance with the approved drawings and relevant standards.
- The drain shall have a minimum clear width of 800mm with varying depth with avg depth of 750mm or as specified in the approved drawings to ensure adequate storm water conveyance.
- The scope shall include providing RCC precast/perforated cover slabs of minimum 150 mm thickness for pedestrian loading and 200 mm thickness where vehicular loading is anticipated, complete with lifting arrangements, seating, locking and replacement provisions.
- The drain shall be provided with a minimum 150 mm thick RCC base slab, RCC side walls, construction/expansion joints, benching (where required), and all necessary inlet, outlet and inspection arrangements for proper operation and maintenance.
- Any material, equipment, fittings or ancillary work not specifically mentioned but required for the complete, durable and efficient functioning of the storm water drainage system shall be deemed to be included within the Contractor's scope.

Landscaping & Plantation

- The project includes the design, development and maintenance of landscaped areas over a minimum area of 14,900 sq.m. Softscape and hardscape elements are desired to create an

aesthetically pleasing, functional and sustainable landscape in accordance with the approved landscape master plan and architectural drawings.

- The landscaping shall be planned to provide shaded pedestrian areas, enhance the visual character of the campus, improve environmental quality and ensure harmonious integration with the surrounding built environment. The Contractor shall submit a detailed landscape layout, planting plan and irrigation scheme for approval by the Engineer-in-Charge prior to commencement of the work.
- The scope shall include complete site preparation, grading, levelling, dressing, supply and spreading of minimum 300 mm thick approved good earth, 100 mm thick sludge, 100 mm thick well-decomposed manure, mixing in the specified proportions and preparation of a suitable planting medium for lawns, shrubs and trees.
- The scope shall include providing and laying *Zoysia japonica* (Selection-I) lawn grass over the prepared surface, complete with rolling, watering, establishment and maintenance until successful growth and handing over.
- The Contractor shall supply and plant avenue, ornamental and shade trees, palms and shrubs including *Lagerstroemia speciosa* (Rose of India), *Lagerstroemia indica* (Pride of India), *Saraca asoca* (Sita Ashok), *Spathodea campanulata* (Rudra Palash), *Callistemon citrinus* (Bottle Brush), *Delonix regia* (Gulmohar), *Cassia fistula* (Amaltas), *Erythrina indica* (Indian Coral Tree), *Pterospermum acerifolium* (Kanak Champa), *Bauhinia purpurea* (Kachnar), *Polyalthia longifolia* (Ashok), *Morus alba* (Mulberry), *Ficus benjamina*, Foxtail Palm, and other approved species of the sizes as approved by the Engineer-in-Charge/Landscape Architect.
- The scope shall include excavation of planting pits, backfilling with approved soil-manure mixture, staking, mulching, watering, pruning, application of fertilizers and pesticides, installation of tree guards (where required), irrigation arrangements and all horticultural operations necessary for healthy establishment of the landscape.
- The Contractor shall provide a complete irrigation system for all landscaped areas, including water supply arrangements, pipelines, valves, sprinklers/drip irrigation (where applicable), and all accessories required for efficient watering and long-term maintenance.
- The Contractor shall maintain all lawns, trees, palms, shrubs and landscaped areas, including watering, mowing, weeding, pruning, replacement of dead plants and general horticultural upkeep during the Defect Liability Period.
- Any material, labour, equipment, irrigation components, fertilizers, plant protection measures or ancillary works not specifically mentioned but required for the complete, healthy and sustainable development of the landscape shall be deemed to be included within the Contractor's scope.

UG Tank

- The scope shall include the design, construction, testing and commissioning of an Underground Water Reservoir (UGR) of minimum 210 KLD capacity for storage of treated water to cater to the operational water demand of the sports complex, including irrigation, flushing, housekeeping, landscape maintenance, HVAC make-up water (where applicable) and other non-potable utility requirements. The UGR shall be of RCC construction complete with excavation, waterproofing, inlet, outlet, overflow, scour arrangement, ventilation, access manholes, level indicators, piping connections, valves, ladders, internal and external finishing, pumping arrangements, instrumentation and all allied civil, electrical and mechanical works as per the approved

drawings, relevant BIS standards and NBC requirements.

TERMS OF REFERENCE AND SCOPE OF WORK FOR ELECTRICAL SYSTEM

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1) Introduction

This section deals with Electrical & ELV design for the proposed Regional Sports Hub. The concept design report is to provide an overview of the building services and planning with the objective of ensuring smooth, safe and efficient operation.

Electrical supply and distribution system is essential and vital to smooth operation of all services. It is proposed to obtain 11 KV/33KV supply from the local Electricity supply company to cater to the Electrical load of all Electrical and Electro Mechanical services.

2) Design Philosophy and Scope of Work

It is proposed to obtain electric supply of 11KV/33KV from the discom.

- a. 11KV/33KV HT Metering Cubicle to be provided as per local EB requirements. It is not in the Scope of Contract.
- b. The 11KV HT/33KV power received and distributed through RMU with 01 incomers with LBS, VCB & 02 outgoing feeder with VCB having Protections and metering.
- c. 11KV/33KV HT Cables proposed for connecting the HT Metering cubicle, HT RMU and Transformer laid through underground RCC trench / Hume pipe.
- d. Transformer is of ONAN type having OFF load tap changer with cable termination to be used box for Outdoor installation.
- e. Enclosed type DG set is proposed for emergency power back up with necessary DG Exhaust stack as per CPCB-IV norms.
- f. D.G will switch on automatically when there is a main power failure. DG will be provided with synchronising. Connection from synchronising panel LT panel should be with XLPE Armoured AL cable in cable tray.
- g. All main incoming breakers i.e air circuits breakers (ACB), moulded case circuit breakers (MCCB) and miniature circuit breakers (MCB) shall be of 4 pole for 3 phase power.
- h. Connection from Main LT Panel to individual distribution panels shall be given through suitable rating of XLPE armoured aluminium cable laid in ground in RCC Cable trench /Hume Pipe. In case of Overhead cable should laid on cable tray.
- i. Distribution of power supply for buildings, each floor shall be provided with LDBs and PDBs which will be located corridor of separate floor.
- j. Connection to all high mast lighting DBs through armoured copper cables.
- k. Building lighting and power wiring provided with suitable size PVC conduits, FRLS copper wires, Modular type switch and socket shall be provided.
- l. UPS shall be considered for Emergency Lighting Load for Common Area and ELV with 30Min back up.
- m. The steady state voltage drop shall be < 5% at farthest point
- n. Air conditioning for Office, Single Rooms & Common areas shall be proposed with Split A.C system & Dormitories shall be proposed with AC Points.

3) General:

The electrical system is designed considering latest technologies, quality, aesthetics energy efficiency and economy.

A. Reference Codes & Standards

The following standards and codes shall be followed/ referred during detailed design of the services:

- a) Local Bye – Laws
- b) National Building Code of India – 2026
- c) Energy Conservation Building Codes 2017
- d) Relevant Codes of National Fire Codes 2016
- e) Relevant Codes of Bureau of Indian Standards.
- f) Institute of Electrical & Electronic Engineers (Design Hand Book)
- g) Illuminating Engineering Society of North America (Design Hand Book)
- h) BS 7671 Requirements for Electrical installation
- i) NEC – NFPA 70, National Electric Code

- j) NEC, National Electric Code of India
- k) GRIHA
- l) OERC Rules & Regulations
- m) IGBC Green New Buildings

B. Objectives

The project objective includes the following.

- a) To meet the all-statutory regulations
- b) Ensure system to meet the environmental health and safety standards.
- c) Reduce the utility space requirements by doing centralized locations of services installations.
- d) Reduce the load or the duty for the system.
- e) Reduce the operation & maintenance cost
- f) Maximise the usage of sustainability principles.
- g) Implement lean principles / avoid excess or redundant system build-ups.
- h) Better Lighting, convenient power and communication capability. Safe and energy sustaining operation of buildings.
- i) Most efficient and reliable Electrical distribution system.
- j) Minimize the Interruption and reduction in overall system losses.
- k) Selection of utility systems / equipment with best possible operating efficiency.
- l) Safety of persons and equipment and maintenance of these requirements throughout the life of the installation.
- m) Establish cabling network designs to ensure that:
- n) Minimize voltage drops at all points.
- o) Minimize energy conservation by implementing energy efficiency systems
- p) Safety of the systems through Earthling.

C. Design Basis

The design shall be done on the guide lines of NBC 2016 and the applicable local codes and standards, illustratively listed below as per the project requirements and site conditions.

Sr. no	Standards	Code Description
A	Ring Main Unit (RMU) / High voltage Switchgear (HVS)	
1	IS: 13118, IEC: 56	Circuit Breakers
2	IS:3427, IEC:298, IEC:694	Metal enclosed Switchgear
3	IS: 2705 IEC: 44	Current Transformers
4	IS: 3156 IEC: 186	Potential Transformers
5	IS: 5578, IS: 11353	Guide for Marking Bus bars, Main Connection and auxiliary wiring
6	IS: 2544, IEC: 273	Busbar support insulators
7	IS:13947, IS:3427, IEC: 947	Degree of Protection
8	IS: 3231, IEC: 255	Electrical relays for Power System Protection
9	IS: 1248, IEC: 51	Electrical Indicating Instruments
10	IS: 9385, IEC: 282	High Voltage Fuses
11	IS: 722	AC Electricity Meters
12	IS: 4171, IEC: 694	Copper Busbars
13	IEC: 129	Off load isolators
14	IS: 6005	IS: 4171, IEC: 694
15	IS: 9224	HRC Fuses

Sr. no	Standards	Code Description
B	Transformer	
1	IS 2026 Part I IV	Power transformer
2	IS 3639	Fittings & accessories
3	IS 2147	Degree of protection
4	IS 2026	Tests
5	IS 2026	Tolerance on guaranteed particulars
6	IS 1271	Electrical insulation classified by Thermal stability
7	IS 335	Insulating oil
8	IS 8468	OLTC
9	IS 10028 Part II	Installation and maintenance of transformer
10	IS 6600	Guide for loading of oil immersed Transformer
C	Low Voltage Switchgear (LVS)	
1	IEC 60439/IEC61439	MV Switch Board
2	IS 4237, IEC 947	Switchgear General Requirements
3	IS 13118, IEC 56	AC Circuit Breakers
4	IS 8623, IEC 439	Factory built assemblies of switchgear and control gear for voltages upto and including 1000V AC and 1200V DC
5	IS 13947(Part3), IEC 947-3	Air brake switches
6	IS 8828, IEC 898	Miniature circuit breakers
7	IS 9224, IEC-269	HRC cartridge fuses
8	IS 8187	D Type fuses
9	IS 13947(Part4), IEC 947	Contactors
10	IS 13947(Part 4), IEC 947	Starters
11	IS 6875	Control switches / push buttons
12	IS 2705, IEC 44-1	Current transformers
13	IS 3156, IEC 186	Voltage transformers
14	IS 3231, IEC 255	Relays
15	IS 1248, IEC 51	Indicating instruments
16	IS 11353 / IS 5578	Arrangement for burbars main connections and accessories
17	IS 722	AC electricity meters
18	IS13947(Part1), IEC947-1	Degree of protection
19	IS 10118	Code of practice for installation and maintenance of switchgear
20	IS 6005	Code of practice for phosphating iron and steel
21	IS 5082, IEC 114	Wrought Aluminium & Aluminium alloys for electrical purposes
22	IS 12021, IEC947	Control transformer for switchgear and control gear for voltage not exceeding 1000V AC
D	Lighting	
1	IS 1913 (Pt 1): 1978	General and safety requirements for luminaries: Part-1 Tubular fluorescent Lamps (Second revision).
2	IS 2206 (Pt.1): 1984	Flameproof electric lighting fittings: Part-1 Well-glass and bulkhead types (first revision).
3	IS 3528: 1966	Waterproof electric lighting fittings

Sr. no	Standards	Code Description
4	IS 5077: 1969	Decorative lighting outfits
5	IS 9583: 1981	Emergency lighting units.
6	IS 10322 (Pt.4): 1984	Luminaries: Part-4 Methods of tests
7	IS 10322 (Pt.5/Sec2): 1985	Luminaries: Part-5 Particular requirements, Section-2 Recessed luminaries.
8	IS 2418	Tubular fluorescent lamps
9	IS 1777: 1978	Industrial Luminaire with metal reflectors and its Amendments
10	IS 4012: 1967	Dust-proof electric lighting fittings.
11	IS 4347: 1967	Code of practice for hospital lighting
E	Cables	
1	IS: 7098-Part-1 1998, IEC:502 1983	11KV Cables
2	IS:1554 - Part - I (1988)	433 V Cables
F	UPS	
1	IS 589	Basic climatic & mechanical durability tests for Components for electronic and electrical equipment
2	IS 9000	Environmental tests for electronic & Electrical equipment
3	IS 5921	Metal clad base material for printed circuits for use in electronic and telecommunication equipment.
4	IS 6297	Transformer and inductors (power, audio, pulse & switching) for electronic equipment
5	IS 7405	Printed wiring boards
6	IS 6553	Environmental requirements for semiconductor Devices & integrated circuits
7	IS 4007	Terminals for electronic equipment
8	IS 8623	Factory built assemblies of switchgear and control gear for voltages up to and including 1000V AC and 1200V DC
9	IS 13947-3	Air brake switches
10	IS 9224	HRC Cartridge fuses
11	IS13947-4	Contactors
12	IS 6875	Control switches / push buttons
13	IS1248	Indicating instruments
14	IS 2147	Degree of protection
15	IEC 146	Semiconductor converters
16	IS 6619	Semiconductor rectifier equipment code
17	IEEE 446	Emergency power systems
18	IEEE 472	Surge withstand capability test
G	EARTHING	
1	IS 3043	Earthing
2	IS 9078: 2002	Earthing of Electrical Systems - Power Stations and Substations:
H	LIGHTING ARRESTER	
	IS/IEC 62305 (Part 1-4)	Protection Against Lightning (International Standard Adaptation)
	IS 15783: 2008	Installation of Lightning Protection Systems in

Sr. no	Standards	Code Description
		Buildings
	IS 8080: 1984	Code of Practice for the Installation of Low Voltage Surge Protection Devices (SPDs)
	IS 2309: 1989	Protection of buildings and structures against lightning.
I	SOLAR SYSTEM	
	IS 14286: 2010	Photovoltaic (PV) Modules
	IS 16157 (Part 1): 2012	Requirement of Solar Photovoltaic (PV) Systems
	IS 11790: 2014	Solar Thermal Systems
	IS 12933: 2017	Solar Water Heating Systems
	IS 15801: 2008	Specification for Solar Power Generating Systems
	IS 13503: 2017	Battery for Solar Power Applications
	IS 16129: 2014	Grid Connected Solar Photovoltaic (PV) Systems

D. Design Inputs

The Electrical system shall be designed to provide safe, reliable, energy-efficient, and maintainable power distribution network meeting the applicable Indian standards, utility regulations, NBC requirements, and project-specific operational requirements. The design shall consider present and future load requirements, redundancy philosophy, fault levels, power quality and safety and maintainability.

4) System Proposed: -

The scope of work includes complete design, engineering with necessary design calculations, fit – up details, supporting details for the following electrical items.

- a) External Power Supply
- b) RMU
- c) Distribution Transformer
- d) LT Kiosk
- e) LT Panel Boards & Sub-Panel Boards
- f) APFC Panel.
- g) DG Sets for Power Backup
- h) D.G Synchronisation cum AMF Panel.
- i) UPS.
- j) HT & LT Power & control cables
- k) Cable end terminations
- l) GI Cable trays with supports
- m) MCB Distribution Boards
- n) Lighting and Power wiring
- o) LED Light fittings
- p) Modular type power receptacles
- q) Earthing system as per IS 3043
- r) Lightning Protection system
- s) External Street Lighting & Façade Lighting.
- t) Fire Fighting system.
- u) CCTV, Audio Video Conference System, Fire Alarm, EPABX System for Services.
- v) Interactive Display for Smart Classroom

w) High Wall type Split AC

5) Electrical Load Estimation: -

The load calculation provided below is for reference and is minimum. Agency to take up calculation based on the requirement and occupancy.

Regional Sports Complex Dhamnagar Bhadrak Load sheet:

Tentative Load Calculation Sheet of Dhamanagar sports complex								
S No	Description of Item	watt	Qty	Connected Load(in Watt)	Diversity Factor	Maximum Demand Load(Watt)	DG Load	UPS
	Light,Power & AC							
	CRIC STADIUM							
1	1000Watt flood Light	1000	192	192000	1	192000	192000	
	FOOT STADIUM							
2	1000Watt flood Light	1000	160	160000	1	160000	160000	
	CRICKET PRATICE PITCH							
3	500Watt flood Light	500	10	5000	1	5000	5000	
	BASKET BALL							
4	150Watt flood Light	150	8	1200	1	1200	1200	
	VOLLYBALL							
5	120Watt flood Light	120	4	480	1	480	480	
	KHO KHO							
6	500Watt flood Light	120	4	480	1	480	480	
	KABADI							
7	500Watt flood Light	150	8	1200	1	1200	1200	
	AREA LIGHT							
8	100Watt street Light	100	72	7200	0.8	5760	5760	
9	70Watt spot Light	70	20	1400	0.8	1120	1120	
10	60Watt gate Light	60	6	360	0.8	288	288	
	Total Load in Watt			369320		367528	367528	
	Total Load in KW			369.3		367.5	367.5	
	MPH							
11	36 Watt Light LED PANEL	36	32	1152	0.8	921.6	921.6	184.32
12	20 Watt Light BATTERN	20	40	800	0.8	640	640	128
13	18 Watt Light SQ LIGHT	18	22	396	0.8	316.8	316.8	63.36
14	6 Watt Light	6	20	120	0.8	96	96	19.2
15	12 Watt Light	12	27	324	0.8	259.2	259.2	51.84
16	10 Watt Light	10	6	60	0.8	48	48	9.6
17	Ceiling Fan	60	18	1080	0.8	864	864	
18	Ex. Fan	50	12	600	0.8	480	480	
19	6A Power Socket	100	80	8000	0.5	4000	4000	
20	16A Socket	500	40	20000	0.5	10000	10000	
21	25A Socket for Split AC	2500	9	22500	0.5	11250	11250	
22	25A Shockt for Geyser	2000	4	8000	0.3	2400		
23	300WATT INDOOR SPORT LIGHT	300	44	13200	1	13200	13200	

	Total Load in Watt			76232		44475.6	44475.6	456.32
	Total Load in KW			76.232		44.48	44.48	0.46
	FACILITY BUILDING SWIMMING POOL							
24	36 Watt Light LED PANEL	36	6	216	0.8	172.8	172.8	34.56
25	20 Watt Light BATTERN	20	40	800	0.8	640	640	128
26	18 Watt Light SQ LIGHT	18	30	540	0.8	432	432	86.4
27	6 Watt Light	6	14	84	0.8	67.2	67.2	13.44
28	12 Watt Light	12	27	324	0.8	259.2	259.2	51.84
29	10 Watt Light	10	8	80	0.8	64	64	12.8
30	Ceiling Fan	60	10	600	0.8	480	480	
31	Ex. Fan	50	12	600	0.8	480	480	
32	6A Power Socket	100	55	5500	0.5	2750	2750	
33	16A Socket	500	5	2500	0.5	1250	1250	
34	25A Socketfor Split AC	2000	5	10000	0.5	5000	5000	
35	25A Shockt for Geyser	2000	8	16000	0.3	4800		
	Total Load in watt			21244		11595.2	11595.2	327.04
	Total Load in KW			21.244		11.60	11.60	0.33
	FACILITY BUILDING CRICKET STADIUM							
36	36 Watt Light LED PANEL	36	6	216	0.8	172.8	172.8	34.56
37	20 Watt Light BATTERN	20	40	800	0.8	640	640	128
38	18 Watt Light SQ LIGHT	18	30	540	0.8	432	432	86.4
39	6 Watt Light	6	14	84	0.8	67.2	67.2	13.44
40	12 Watt Light	12	27	324	0.8	259.2	259.2	51.84
41	10 Watt Light	10	8	80	0.8	64	64	12.8
42	Ceiling Fan	60	10	600	0.8	480	480	
43	Ex. Fan	50	12	600	0.8	480	480	
44	6A Power Socket	100	55	5500	0.5	2750	2750	
45	16A Socket	500	5	2500	0.5	1250	1250	
46	25A Socket for Split AC	2000	5	10000	0.5	5000	5000	
47	25A Shockt for Geyser	2000	5	10000	0.3	3000		
	Total Load in Watt			21244		11595.2	11595.2	327.04
	Total Load in KW			21.244		11.60	11.60	0.33
	FACILITY BUILDINGFOOTBALL STADIUM							
48	36 Watt Light LED PANEL	36	6	216	0.8	172.8	172.8	34.56
49	20 Watt Light BATTERN	20	40	800	0.8	640	640	128
50	18 Watt Light SQ LIGHT	18	30	540	0.8	432	432	86.4
51	6 Watt Light	6	14	84	0.8	67.2	67.2	13.44
52	12 Watt Light	12	27	324	0.8	259.2	259.2	51.84
53	10 Watt Light	10	8	80	0.8	64	64	12.8
54	Ceiling Fan	60	10	600	0.8	480	480	
55	Ex. Fan	50	12	600	0.8	480	480	
56	6A Power Socket	100	55	5500	0.5	2750	2750	
57	16A Socket	500	5	2500	0.5	1250	1250	

58	25A Socketfor Split AC	2000	5	10000	0.5	5000	5000	
59	25A Shockt for Geyser	2000	4	8000	0.3	2400		
	Total Load in Watt			21244		11595.2	11595.2	327.04
	Total Load in KW			21.2		11.6	11.6	0.3
	OTHER SERVICES							
60	PH PUMP	20000	1	20000	0.3	6000	6000	
61	SWIMMING SPOOL PUMP ROOM	50000	1	50000	0.3	15000	15000	
	Total Load in Watt			70000		21000		
	Total Load in KW			70		21	21	
	BOYS HOSTEL							
62	36 Watt Light LED PANEL	36	94	3384	0.8	2707.2		541.44
63	20 Watt Light BATTERN	20	117	2340	0.8	1872		374.4
64	18 Watt Light SQ LIGHT	18	63	1134	0.8	907.2		181.44
65	6 Watt Light	6	53	318	0.8	254.4		50.88
66	12 Watt Light	12	0	0	0.8	0		0
67	10 Watt Light	10	9	90	0.8	72		14.4
68	Ceiling Fan	60	52	3120	0.8	2496		
69	Ex. Fan	50	19	950	0.8	760		
70	6A Power Socket	100	157	15700	0.5	7850		
71	16A Socket	500	9	4500	0.5	2250		
72	25A Shockt for Split AC	1500	5	7500	0.5	3750		
73	25A Shockt for Split AC	2000	38	76000	0.5	38000		
74	25A Shockt for Split AC	2500	7	17500	0.5	8750		
75	25A Shockt for Geyser	2000	17	34000	0.3	10200		
	Total load			166536		79868.8		1162.56
	Total Load in KW			166.54		79.87		1.16
	GIRLS HOSTEL							
76	36 Watt Light LED PANEL	36	94	3384	0.8	2707.2		541.44
77	20 Watt Light BATTERN	20	117	2340	0.8	1872		374.4
78	18 Watt Light SQ LIGHT	18	63	1134	0.8	907.2		181.44
79	6 Watt Light	6	53	318	0.8	254.4		50.88
80	12 Watt Light	12	0	0	0.8	0		0
81	10 Watt Light	10	9	90	0.8	72		14.4
82	Ceiling Fan	60	52	3120	0.8	2496		
83	Ex. Fan	50	19	950	0.8	760		
84	6A Power Socket	100	157	15700	0.5	7850		
85	16A Socket	500	9	4500	0.5	2250		
86	25A Shockt for Split AC	1500	5	7500	0.5	3750		
87	25A Shockt for Split AC	2000	38	76000	0.5	38000		
88	25A Shockt for Split AC	2500	7	17500	0.5	8750		
89	25A Shockt for Geyser	2000	17	34000	0.3	10200		
	Total Load			166536		79868.8		1162.56
	Total Load in KW			166.5		79.87		1.16
	GRAND TOTAL LOAD IN WATT			912356		627526.8		

	GRAND TOTAL LOAD IN KW			912.356		627.5	467.8	
	TRANSFORMER CAPACITY IN KVA							
	Sum Of maximum demand in KW					627.53		
	Composite MD in KW@85% Diversity					533.4		
	Maximum Demand in KVA @0.90 PF					592.66		
	Loading factor @85%					697.3		
	Consider 20% extra load for Future expansion.					836.70		
	CONSIDERING TRANSFORMER SIZE IN KVA (1W+1S)					2X1000		
	DG CAPACITY							
	Connected Load in KW						467.8	
	Composite MD in KW@75% Diversity						350.8	
	Maximum Demand in KVA @0.80 PF						438.6	
	Loading Factor@90%						487.3	
	CONSIDERING DG CAPACITY IN KVA(2W)						2X250	

Substation, Transformer and DG capacities:

Based on the above loads capacity of the substation shall be minimum of the following

(a) 11KV or 33KV 0.43 KV substation:

l No	Load Description	Connected Load (KW)	Maximum Demand (KW)
1	Regional sports complex	912.3	627.5

To cater to above load minimum of 2 Nos 1000 KVA(1W+1S), 11KV or 33KV/0.43 KV Oil cooled transformer to be provided.

(b) DG set capacity calculation:

No	Load Description	Maximum Demand (KW)
	Regional Sports Complex	7.8

Minimum of 2 Nos 250 KVA 415 VOLT silent DG Set with Acoustic enclose to be provided

(c) Synchronisation panel shall be provided for DG sets.

6) External Power Distribution System.

The External distribution of power supply to the buildings to be provided in the following sequences.

- a) 11KV/33 KV supply to be obtained from the discom.
- b) Metering Cubic shall be provided by local discom & installed outside building.
- c) The 11KV HT/33KV power received and distributed through RMU with 01 incomers with LA, LBS, VCB and 02 outgoing feeder with VCB having Protections and metring.
- d) All the Substation related items like metering unit, RMU Panel 11 KV/33KV distribution transformer should be placed Outside.
- e) Connection between transformer to main LT Panel and main LT Panel to DG Synchronizing Panel should be connected through cable and will be laid in RCC Cable trench/RCC hume pipe.

A. RING MAIN UNIT (RMU):

- I. Outdoor ring main unit (RMU) shall be provided for receiving and distributing the HT power supply to transformer.
- II. The RMU shall be indoor metal clad, single front, single tier, fully compartmentalized construction comprising of a row of free standing, floor mounted panels. RMU shall comply IP 55 for Outdoor/IP 42 for indoor installation.
- III. The RMU shall consist of ring incoming load break switch (LBS) with vacuum circuit breaker and transformer feeders with vacuum circuit breakers (VCBs) complete with numerical over current and earth fault protection.
- IV. The unit shall incorporate mechanical and electrical interlocks, integral earthing switches, cable termination compartments, voltage presence indicator and padlock.
- V. The transformer VCB feeders should have O/C, S/C, E/F, WTI and buchholz relay protection. All the indicating and measuring instruments shall be digital type.
- VI. Minimum Short circuit withstand rating current: 21 kA for 3 second.
- VII. The operating mechanism of the circuit breaker shall be motor wound spring charged type.
- VIII. HT Cables proposed for connecting the transformer HT Metering cubic & RMU shall be laid through RCC trench / Hume pipe.
- IX. 11kV/33KV will be further stepped down to 415 Volts by ONAN transformer.
- X. Location: - Outside

B. Transformer

- I. **Minimum 2 x 1000 KVA ONAN Type Distribution Transformer** (1 Working +1 Standby) 11V or 33KV /0.415 kV, copper wound cast resin ONAN with an off Load Tap Changer & in step of 2.5% each Transformer should be provided with Energy Efficiency as per latest IS:11171 (PART-I) 2016 ammendment-4, Level-II/star-2 for entire sports complex Loads. For more details, refer technical specification.
- II. Location: - Outside.

C. Emergency Power Backup System (D.G)

- I. Back up Diesel Generator is to be provide for all emergency load for any unexpected / unavoidable power outages of the building.
- II. During the failure of EB supply the D.G should be automatically Start.
- III. Generator Capacity: Minimum 2x250 KVA, 415V, 50Hz, DG set with Acoustic enclosure type has been proposed to be installed at Outside the building.

- IV. Maximum demand on DG for the entire Project is worked out for different type of loads, power factor of 0.8 and maximum loading of 80%
- V. DG set shall be of prime duty type with acoustic treatment as per CPCB -4 norms.
- VI. DG set will have AMF facility. D.G panel shall be with 2 incoming and 1 outgoing with facility for synchronising and provided with load manager.
- VII. The noise level shall be limited to 75 dB as per CPCB-4 norms at one meter from enclosure surface at full load.
- VIII. Day tank shall have capacity to run 8 hours at 100% load.
- IX. DG will have separate exhaust pipe with stack point as per CPCB norms.

D. Main LT Panel

- I. Main LT panel shall be Outdoor type with protection class typically IP65 and connected through XLPE Cable.
- II. All BUS BAR should be made of aluminium.
- III. Proposed fault level of ACB's and MCCB's of Main LT panel & other panel should be 50KA.
- IV. Switchboard shall be form 4B for main panel and balance panel shall be 3B unless until not mentioned, for form of separation only, metallic covers shall be used, Hylem / PVC sheets shall not be allowed.
- V. All switchgear and associate components should be considering at least equal to 110% of the respective rating.
- VI. Spare outgoing feeders shall be provided in all switchgears as per GES & shall be furnished with approximately 15% spare breaker & 20% future spaces.
- VII. Safety interlocking logics should have both electrical & mechanical.
- VIII. Provide 4 Pole type ACB or MCCB for incomers and bus coupler. All ACB and MCCB of more than 250A rating should have microprocessor basis relay.
- IX. For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

E. Power factor Improvement (APFC)

- I. **Capacity of APFC Panel should be 2X125 KVAR.**
- II. Supply, installation, testing & commissioning of Automatic Power Factor control panels are designed to achieve power factor of 0.98. On each transformer to improve the system power factor above 0.98 for effective utilization of active power through contactor logic & detuned reactor is used for power factor correction. Capacitor Banks will be automatically switch on and off based on the load variation.
- III. APP (All Polypropylene) hermetically sealed with inbuilt harmonics filter or detuned reactor type Capacitors are considered for Power Factor improvement. Capacitor shall be with stand for high inrush current & voltage fluctuation. It shall be designed to carry a minimum of 1.5 times the rated current at 110% of rated voltage and 1.35 times rated reactive power continuously.
- IV. Detuned filter will be provided where % VFD load is more than 10%. The harmonic spectrum of the drives will be considered while designing detuned filters, by the drive manufacturer.
- V. The panel should be equipped with filters tuned to specific harmonic orders (e.g., 3rd, 5th, 7th, 11th, 13th) that are commonly present in electrical systems.
- VI. The design calculations for Capacitors bank with active harmonic filters will be carried out and suggestions will be provided for maintaining the overall power factor at 0.98. It shall be connected in delta formation. The control and protection elements for 415V capacitor banks shall be mounted

on the capacitor bank panel itself, however MCCB/HRC fuses of suitable ratings shall be provided on the capacitor terminals by the contractor.

- VII. The capacitor units shall be provided with discharge resistors will safely discharge the capacitors to less than 50 V within 1 minute upon disconnection. Capacitors units shall also be protected against the internal faults and effected units shall be automatically and immediately isolated in the event of such faults.
- VIII. All capacitors shall be suitably protected against over current & short circuit.

F. HT Cable.

- I. 11 KV/33KV cables shall be (E) grade XLPE type as per TPCODL approved specification and compile IS 7098-II with insulation screen shall all be extruded in one operation by "Triple Extrusion" process to ensure perfect bonding between the layers. The core identification shall be by coloured stripes or by printed numerals. The insulating shielding shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic screening of copper. The copper screen shall be capable of carrying the single line to ground fault current.
- II. The conductor shall be of stranded, high conductivity annealed Aluminium wire. Conductor shall be smooth, uniform in quality, free from scale, spills, Splits and any other defects there shall be no joints in individual standards expect those made in the base rod or wire before final drawing. The conductor shall be AL, 'stranded' and compacted circular for all cables. Cables shall be heavy-duty type.
- III. The colour of outer sheath of all XLPE cables shall be as per Specific requirement and pigment added shall be such that they don't fade even when exposed to direct sunlight. In addition, suitable chemical shall be added into the PVC compounds of the outer sheath to protect the cable against rodent and termite attack.
- IV. Minimum short circuit current considering 21KA.

G. Utility Panel

- I. Main incoming and outgoing breakers should be of MCCB or MCB for utility Panel
- II. All Bus bar should be made of Aluminium and internal wiring is of Copper wire.
- III. Provide Protection devices including surge protection if specified. Panel enclosure rated for indoor/outdoor use (e.g., IP55).

7) Internal Electrification & Power Distribution: -

A. Lighting System:

1-General: -

- I. All proposed indoor & outdoor Light fixtures shall be LED type. Lighting fixtures and accessories shall be considered for continuous trouble-free operation under diverse atmospheric conditions without deterioration of materials. Degree of protection of enclosure shall be IP-65 for outdoor fixtures. All internal lighting fixtures shall be IP20.
- II. All the light fitting in the building shall be energy saving types & should confirm to relevant IS and shall be complete with all standard accessories like driver, heat sink, 4 KV surge

protector in case of LED fittings and aluminium. In all rooms and corridor appropriate number of lights should be kept in Ups backup during design

- III. Illumination levels of different areas in compliance with NBC 2016. However as per the client requirements, light fixtures have been proposed based on the client / architect requirements.
- IV. Selection of light fixtures matching the architecture within the building and outside of the building.
- V. Luminous Efficacy is considered as 120 Lumen/watt for lighting fixture more than 100W for all light fitting.
- VI. Automatic Timer Control shall be provided for External light fittings & Presence sensor shall be used for all office rooms and motion sensor shall be used lobbies and corridor area.
- VII. Occupancy sensor shall be provided in basement lighting for 50% lighting & the lights will get switched off automatically if area is unoccupied for more than 3 to 5 Minutes.
- VIII. Maintenance factor & Utilization factor shall consider based on below area lighting.
- IX. lighting fixtures will be selected based guidance of the stakeholders, and any addition/deletion of lighting provisions shall be identified upon approval of DBR for financial analysis.
- X. Air conditioning for Office, Single Rooms & Common areas shall be proposed with Split A.C system & Dormitories shall be proposed with AC Points.
- XI. Geyser points for all Bathroom shall be proposed.

16. Lighting System for Stadium Playground & Court.

2.1 Cricket Field Lighting:

- I. Minimum 1500 lux level to be maintained in the field with all accessories both Cricket field and athletic track.
- II. Stadium Mast (upto top of head frame 35 mtr) minimum indicative high mast 04 nos provided. Hot dip galvanised, polygonal stadium masts with fixed type head frame.
- III. Mast shaft shall be in 2 or 3 section hot dip galvanised and suitable for bearing wind velocity 250km/hr , accessories like double drum winch its control gear boxes are included.
- IV. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightning arrester etc. as per the specification of the design parameters.(Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.
- V. Flood lights (FL) Minimum 1500 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VI. Distribution Panel should be outdoor type floor mounted feeder pillar Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%, 3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sec Minimum. Separate neutral and earth bus bars.

- VII. Provision should be made for Controlling and operation of luminaries through PLC/SCADA.
- VIII. selection of match mode, practice mode and maintenance mode and emergency switching facilities should be provided.
- IX. High mast and floodlights connected to dedicated lighting protection system.
- X. GI pipe earthing for High mast with 3M long 40 mm dia. GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.
- XII. 6'/10' Digital Display, size 60sqft (Cricket Scoreboard) with all accessories
- XIII. Camera stand Weight - 3340g, Maximum Height - 1810mm, Folded Height - 860mm, Loading Capacity - 15 kg. Made from High Grade Aluminium Alloy. Quick Flip Leg Locks Quick Release Plate.

2.2 Foot ball Field Lighting:

- I. Minimum 1250 lux level to be maintained in the field with all accessories both football field and athletic track.
- II. Stadium Mast (upto top of head frame 30 mtr) minimum indicative high mast 04 nos provided. Hot dip galvanised, polygonal stadium masts with fixed type head frame.
- III. Mast shaft shall be in 2 or 3 section hot dip galvanised and suitable for bearing wind velocity 250km/hr, accessories like double drum winch its control gear boxes are included.
- IV. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightening arrester etc. as per the specification of the design parameters. (Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.
- V. Flood lights (FL) Minimum 1250 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VI. Distribution Panel should be outdoor type floor mounted feeder pillar Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%,3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sesc. Minimum. Separate neutral and earth bus bars.
- VII. Provision should be made for Controlling and operation of luminaries through PLC/SCADA.
- VIII. selection of match mode, practice mode and maintenance mode and emergency switching facilities should be provided.
- IX. High mast and floodlights connected to dedicated lighting protection system.

- X. GI pipe earthing for High mast with 3M long 40 mm dia GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

2.3 Basket bulb Court Lighting:

- I. Minimum 500 lux level to be maintained in the field with all accessories both court and athletic track.
- II. Stadium mast of 10m fixed mini mast with mast shaft in one section. No of poles should be minimum 04 numbers.
- III. Mast shaft shall be in hot dip galvanised and suitable to bear wind velocity 250km/hr.
- IV. Mast including accessories like double drum winch its control gear boxes.
- V. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightening arrester etc. as per the specification of the design parameters. (Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.
- VI. Flood lights (FL) Minimum 500 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VII. Distribution Panel should outdoor floor mounted feeder pillar type Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%,3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sesc. Separate neutral and earth bus bars provided.
- VIII. Provision should be made for automatic and manual operation of luminaries.
- IX. High mast and floodlights should have dedicated lighting protection system.
- X. GI pipe earthing for High mast with 3M long 40 mm dia GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

2.4 Volley Ball Court Lighting:

- I. Minimum 300 lux level to be maintained in the field with all accessories both court and athletic track
- II. Stadium mast of 10m fixed mini mast with mast shaft in one section. No of poles should be minimum 02 numbers.
- III. Mast shaft shall be in hot dip galvanised and suitable to bear wind velocity 250km/hr.
- IV. Mast including accessories like double drum winch its control gear boxes.
- V. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightening arrester etc.

as per the specification of the design parameters. (Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.

- VI. Flood lights (FL) Minimum 300 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VII. Distribution Panel should outdoor floor mounted feeder pillar type Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%,3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sec. Separate neutral and earth bus bars provided.
- VIII. Provision should be made for automatic and manual operation of luminaries.
- IX. High mast and floodlights should have dedicated lighting protection system.
- X. GI pipe earthing for High mast with 3M long 40 mm dia GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

2.5 Kho Kho Court Lighting:

- I. Minimum 300 lux level to be maintained in the field with all accessories both court and athletic track.
- II. Stadium mast of 10m fixed mini mast with mast shaft in one section. No of poles should be minimum 02 numbers.
- III. Mast shaft shall be in hot dip galvanised and suitable to bear wind velocity 250km/hr.
- IV. Mast including accessories like double drum winch its control gear boxes.
- V. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightening arrester etc. as per the specification of the design parameters. (Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.
- VI. Flood lights (FL) Minimum 300 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VII. Distribution Panel should outdoor floor mounted feeder pillar type Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%,3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sesc. Separate neutral and earth bus bars provided.
- VIII. Provision should be made for automatic and manual operation of luminaries.

- IX. High mast and floodlights should have dedicated lighting protection system.
- X. GI pipe earthing for High mast with 3M long 40 mm dia GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

2.6 Kabaddi Court Lighting:

- I. Minimum 500 lux level to be maintained in the field with all accessories both court and athletic track.
- II. Stadium mast of 8m fixed mini mast with mast shaft in one section. No of poles should be minimum 02 numbers.
- III. Mast shaft shall be in hot dip galvanised and suitable to bear wind velocity 250km/hr.
- IV. Mast including accessories like double drum winch its control gear boxes.
- V. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightening arrester etc. as per the specification of the design parameters. (Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.
- VI. Flood lights (FL) Minimum 500 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VII. Distribution Panel should outdoor floor mounted feeder pillar type Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%,3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sesc. Separate neutral and earth bus bars provided.
- VIII. Provision should be made for automatic and manual operation of luminaries.
- IX. High mast and floodlights should have dedicated lighting protection system.
- X. GI pipe earthing for High mast with 3M long 40 mm dia. GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

2.7 Cricket practice field Lighting:

- I. Minimum 500 lux level to be maintained in the field with all accessories both court and athletic track.
- II. Stadium mast of 10m fixed mini mast with mast shaft in one section.
- III. Mast shaft shall be in hot dip galvanised and suitable to bear wind velocity 250km/hr.
- IV. Mast including accessories like double drum winch its control gear boxes.
- V. The mast shall have arrangement of an integral power tools installed inside the base compartment for its operation including LED Aviation light, lightening arrester etc.

as per the specification of the design parameters. (Mast is including of foundation bolts sets & anchored & template), stadium mast with suitable main rider unit with anti-fall arrester, Construction of shallow foundation with M25 grade concrete for the high mast considering the safe soil bearing capacity.

- VI. Flood lights (FL) Minimum 500 lux level to be maintained luminaire of comprises of die cast aluminium housing with toughened glass and PC Lens cradle mounting with high efficacy and innovative, aesthetic and robust design with wide operating voltage 140-270 V AC with high surge protection of 4KV +10 KV, PF>0.95, Potted driver for better thermal reliability and easy maintenance, 50000 BH as per L70B50, Operating Temp -10 D to +45D, Beam Angle-30 D, CRI-70, IP66 and IK 07 protected.
- VII. Distribution Panel should outdoor floor mounted feeder pillar type Panel reliable for operation, maintenance and surge protection. It is Outdoor Floor mounted LT Distribution board type, suitable for Operation at 415V±10%,3phase ,4 wire ,50Hz AC Supply. Protection class IP 65 for outdoor installation. Short circuit withstand capacity is 50KA for 1 sec. Separate neutral and earth bus bars provided.
- VIII. Provision should be made for automatic and manual operation of luminaries.
- IX. High mast and floodlights should have dedicated lighting protection system.
- X. GI pipe earthing for High mast with 3M long 40 mm dia. GI Pipe including connection to High mast earth terminal with 25 x 3 mm GI flats with all materials and labour. (2nos per mast).
- XI. Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

2.8 Swimming Pool lighting:

It is recommended Lux Level should be 500 Lux. Swimming Pool light consists of under water and pool deck light.

- a) Under water Pool lights should have:
 - LED Under water luminaries.
 - Housing is made of SS316 stainless steel or corrosion resistance Polymer.
 - Protection: IP68
 - Operating Voltage :12VDC/12AC.
 - Power factor ≥0.98
 - CRI ≥80.
 - Colour Temperature: 3000K-4000K
 - Minimum Life-50000 hours
 - Beam Angle suitable for uniform pool luminaries.
- b) Pool Deck light should have:
 - LED bollard light, recessed light or pole mounted fixtures.
 - IP 65 minimum,
 - IK08 impact resistance minimum,
 - corrosion resistance construction.
- c) Earthing, Safety & Control system of Pool Light:
 - Separate earthing for lighting Panel
 - Equipotential bonding around pool perimeter.
 - All equipment suitable for wet and chlorinated environment.
 - Touch voltage limit as per applicable standard.
 - Local and automatic control through timer.

- d) Manufacture should have own NABL Lab, Manufacture should have Toll free based service centres across Odisha and within 100 Km from the site for better aftersales services.

B. Indoor Lighting: -

- a) Following is the Lighting Lux requirement for each area is selected based on NBCS 2026 & bidder shall submit lux level design of entire building using suitable software using the fixtures mentioned below and lux level to be achieved.
1. Office areas 400-500 lux, glare below 17, CRI above 80.
 2. Conference room & meeting Room: areas 500-700 lux, glare below 17, CRI above 80.
 3. Corridor and lobbies areas 250-300 lux, glare below 17, CRI above 80.
- b) Office room and basement lights should be controlled by occupancy sensor for energy saving.
- c) For the above area lighting quantity based on required lux level shall be design by the DIALUX/Similar Software.
- d) For Building internal lighting fixture details refer the technical specification.
- e) Emergency lighting shall be in accordance with CPWD Internal Electrical -2023 ,ECBC-2024 & nbs-2026 specifications to light primary escape routes during lighting failure.
- f) Emergency lighting with built-in solid-state charger and battery pack capable of 90 minutes of operation shall be provided in each building and inside the mechanical and electrical rooms maintaining minimum illumination level.
- g) Exit doors shall be provided with exit lights.
- h) The number and locations of emergency and exit lighting fixtures shall be based on calculations in accordance with the Illuminating Engineering Society (IES).

C. Outdoor Lighting: -

- a) The NBCS-2026 also provides guidelines for outdoor lighting to ensure safety, security, and energy efficiency in outdoor environments such as streets, parks, gardens, building facades, and other outdoor spaces.
- b) The scope of the section is Planning, designing with load details, Complete design details, supply, installation, testing and commissioning of External Façade lighting as per EIC which includes copper RGB lighting, cabling and Feeder panels etc. All lighting technical details are considered as per technical specification.
- c) The proposed Landscaping, faced lighting design will through LED flood light, bush lights, pathway decorative light, wall washer led light etc as per specification.
- d) Led Lights with Decorative poles and Tubular poles for path way lighting and Main Road illumination and bollards shall be provided for landscape lighting
- e) Following are the Key Factor to be considered for outdoor lighting.
- **Illumination levels (lux) for streets, parks, and monuments** should comply with NBC guidelines.
 - **Energy-efficient lighting** (LEDs, solar-powered systems) should be prioritized.
 - **Lighting control** (glare reduction, colour temperature, and automatic control systems) should be employed.
 - **Safety and security** through adequate visibility and emergency lighting is essential.
- f) Lighting Levels (Lux Requirements):

- **Street Lighting (Main Roads):** 15 to 30 lux
- **Street Lighting (Residential Roads):** 10 to 20 lux
- **Parks and Gardens (Public Areas):** 10 to 20 lux
- **Facades and Monuments:** 100 to 300 lux (can vary depending on the importance of the structure and the need for architectural highlight)
- **Staircases and Pathways:** 30 to 50 lux (to ensure visibility and safety)
- **Car Parking Areas:** 30 to 50 lux (depending on the size and type of parking area)
- **Open Spaces / Public Gathering Areas:** 10 to 20 lux (depending on the level of activity and gathering)

g) Types of Outdoor Lighting:

Different types of outdoor lighting are recommended based on the space and its use:

- Street Lighting.
- Decorative Lighting.
- Façade Lighting.
- Security Lighting.
- Area Lighting etc.

h) Lighting Design Considerations:

- **Pole Height and Spacing:** The height and spacing of lighting poles should be optimized to ensure uniform lighting without excessive power usage or light wastage. For example, street lights may be installed at higher heights (typically 6 to 12 meters) for roads, with distances between poles depending on the lighting level required. Same for the internal pathway & Gardening area.
- **Lighting Fixtures:** The types of fixtures used should be weather-resistant and designed for outdoor environments. This includes considerations for heat dissipation, corrosion resistance, and durability against environmental conditions.
- **Floodlighting and Spotlights:** These types of lighting may be used for buildings, monuments, and other important outdoor features to enhance their visibility at night.

i) Emergency Lighting:

- **Safety:** Emergency lighting should be provided for public spaces, assembly point, walkways, stairways, and entrances, exit area to ensure safe evacuation in case of an emergency or power failure.
- **Pathway Marking:** Emergency lighting systems should highlight escape routes, emergency exits, and any obstacles that may pose a risk during evacuation.

j) Smart Outdoor Lighting:

- **Automation:** The use of smart lighting systems, including sensors, timers, and automatic dimming systems, can help save energy. For example, lights may automatically dim or turn off based on time of day, or they may be activated by motion.
- **Solar-Powered Lighting:** In some areas, solar-powered outdoor lighting systems are encouraged, especially in parks, gardens, and rural or off-grid locations, to promote sustainability.

k) Durability:

- **Weather Resistance:** Outdoor lighting systems must be designed to withstand harsh weather conditions such as heavy rain, extreme temperatures, and exposure to pollutants. Fixtures should be rated for outdoor use (IP65 or higher).

l) Security and Surveillance:

- **Integration with Surveillance:** Outdoor lighting systems may also be integrated with surveillance cameras or security systems to enhance security in outdoor environments, such as parking lots and building perimeters.

Note: -

1. Emergency lighting is considered for the entire building. Distribution of emergency lighting i.e. 20% of overall lighting load will be tapped from separate UPS located in UPS Room
2. Central Battery system with 4.3" TFT display emergency lighting design shall be provided for monitoring & controlling the emergency power solution for a building. For more details refer the technical specification.

D. Internal Electrical Work: -

Proposed Internal electrical works for complete supply, installation, testing & commissioning of internal wiring, providing lighting fixture, conduit with all required accessories for all the building floor area.

The items/activities covered under internal electrical works shall include the following:

- I. Providing Sub Distribution Boards for each floor (PDBs & LDBs etc.).
- II. Cables from Main Panel Boards to Sub Distribution Boards. Sub main Wiring from Main/Sub Distribution Boards to various final Distribution Boards.
- III. Point wiring of all lights points. Ceiling fan points, exhaust fan points, light Plug points, general power points, metal clad plug & socket outlet points etc., including supply and fixing of light and power accessories etc. complete in all respects as per above-described location.
- IV. All the internal electrical wiring shall be done through heavy duty PVC conduit for concealed area, fall ceiling area & electrical metallic tubing (EMT) conduit for open area.
- V. Light fixtures, ceiling fans, exhaust fans.
- VI. Provision for telephone system consisting of conduit and cabling from telephone distribution board up to each outlet including main & sub tag blocks, telephone outlets incoming PVC/MS conduit pipe etc. complete in all respect.
- VII. Providing cable tray and other items required to complete with electrical installation work in all respects floor & basement area.
- VIII. Providing for telephone system consisting of conduit and cabling from telephone distribution board up to each outlet including main and sub tag blocks etc.
- IX. Fire Detection and alarm system (if required) consisting of manual call points, smoke detectors, heat detectors, response indicators, fire alarm bells/hooters, main fire detection and alarm panel including all conducting and cabling required completed.
- X. Earthing of electrical installation complete in all respects.
- XI. Scope of work shall include supply installation, testing and commissioning of complete electrical installation as described above.
- XII.** Internal cabling from Substation to various blocks/panels.
- XIII.** Separate LDB, PDB & UPSDB shall be provided for Lighting & Power. All DB's shall be phase segregated type DBs with MCB & RCCB as incomer & MCBs as Outgoings. 30mA setting for lighting DBs & 100mA setting for Power DBs shall be provided.
- XIV.** All the internal wiring of DBs shall be properly dressed & provided with proper size lugs, ferrules & coloured wire for easily identify.

- XV.** All MCB shall be “C” Curve type for lighting & power with indicative flap.
- XVI.** For complete details of each internal electrical items shall referred the technical specification.

E. Distribution Board

- I. Supply, installation, termination, testing, and commissioning of the Distribution Board (DB) for the internal wiring for lighting, power & emergency light & power.
- II. Supply factory-assembled, type-tested distribution boards in accordance with relevant standards (IEC 61439 or BS EN 60439) & shall be of double door design fabricated out of 1.2 mm or higher thick CRCA sheet and finished with powder coated paint, IK-09.
- III. All the distribution board shall be connected with sub-distribution panel as per SLD & Specification.
- IV. Distribution board shall include:
 - Main Incomer (MCB/MCCB/RCB/RCBO).
 - Outgoing miniature circuit breakers (MCBs)
 - Separate Neutral and Earth bars inside in each DB with external earth terminal for metal body earthing.
 - Copper bus bars with appropriate current rating
 - Phase indicators, interlocks, and nameplates
 - Enclosure with IP rating suitable for site conditions (e.g., IP43/IP65)

F. LT Power Cable & Control Cable

- I. LT power cable shall be of 1.1kV (E) grade, stranded aluminium conductor with FRLS, XLPE insulated conforming to IS: 7098 Part-I (as amended up to date). The outer sheath shall have FRLS properties.
- II. For multi-core cables the inner sheath and outer sheath shall be of extruded PVC of Type ST-2 of IS: 5831. Armouring for single core cables shall be aluminium strips/wires and for multi-core cables galvanized steel strips/ wires.
- III. Maximum operating temperature under normal condition for XLPE insulation cables will be 90°C and 250°C under short circuit condition.
- IV. Cables less than 10 sq.mm shall be of copper conductor.
- V. Control cables will be 1100V (E) grade, multi-core with stranded 2.5 mm² and copper conductor with FRLS, PVC insulated, extruded PVC inner sheath, and extruded sheath of PVC (ST-1) with numbering of all cores, conforming to IS 1554 part-I/IS 5831.

G. Cable Glands and Multi cable transit (MCT) Frames

- I. Suitable size double compression type glands are supplied for all cables. For entries into Panel Enclosures & for all outgoing cables. All cable glands and adaptors are made up of nickel-plated brass and are fitted with soft sealing nylon washer.
- II. For Hazardous area like UPS room, server room area shall be provided with fire retardant type cable gland.
- III. Cable Lugs shall be as per cable conductor type & providing bi-metallic lugs where conductor shall be different.
- IV. Cable transit frames are to be fitted where cables pass from outdoor trays / trenches to indoor areas or vice-versa.

- V. Such cable transit frames are designed to include 25 % spare capacity for future use. Cable transit frames are to be supplied with test certificates from an accredited independent test authority to confirm adequate fire rating for areas where they are to be installed.

8) Earthing: -

- I. Proposed grounding shall be in TT system where in the neutral of Transformer and DG set will be earthed at source and all non-current carrying metal parts shall be solidly earthed in the premises.
- II. The grounding system shall be designed to limit the earth resistance to less than one ohm or lower as per standards IS 3043.
- III. The earthing system shall be designed to ensure effective operation of protective gears in case of earth faults. The total earth resistance at any point of the earthing system shall not be more than one ohm.
- IV. The material and no/size of earthing electrodes/conductors etc shall be worked out based on the prospective fault level and soil resistivity of the premises. A cost-effective approach will be adopted.
- V. Earthing system is proposed for the electrical panels, UPS, Transformer, DG set and other equipment's inside & outside the premises area.
- VI. All non-current carrying metal parts of electrical installation – earthed as per IS 3043.
- VII. The entire installations are effectively earthed and bonded as per IS 3043 and comprising of GI and Copper earth pits and strips.
- VIII. Earthing systems should be considered as Conventional Earthing 600x600x3.15 mm copper plate/GI plate earthing as directed by Engineer-In-Charge. Copper earthing should be provided for Transformer & DG set Neutral & UPS System.
- IX. Lightning arrester earthing pit should be separate & should be copper plate earthing & designed as per IS62305.
- X. Earth flat is run along the cable tray. Dedicated earthing for below equipment's:
- XI. All the equipment body earthing should be designed & provided as per fault level calculation & soil resistivity.
- XII. All the Neutral earthing pit & strip also shall be designed & provided as per fault level calculation & soil resistivity.

9) Lightning Protection System (LPS):

- i. The Lightning Protection System shall be designed & provided strictly in accordance with IS 62305. The lightning protection installation can consist of Mesh, down conductors, earthing and bonding. Bidder shall provide the test report & installation procedure with prior approval from the consultant/client before installing at site.
- ii. Down conductors should be HIGH VOLTAGE INSULATED with current carrying capacity of 200 kA with lightning impulse 10/350 micro sec. Level of protection to be considered is Level-I with Rolling Sphere method.
- iii. The materials of lightning conductor, down conductors, earth termination etc., are aluminium and conform to BIS/IEC 62305.
- iv. Each down conductor has an independent earth termination. All the earth termination interconnected and shall be capable of isolation for testing using test links.
- v. Earth pits will be installed in accordance with BIS: 3043. The resistance of earthing system shall not exceed 1 ohm.
- vi. Provision for Type 1 +2 ,4 pole SPD, $\geq$ with 50 Ka /pole (and $\geq$ 125 ka in total 500 A gl/gG (HRC) back-up fuse, protection level $\geq$ 1.7 kv in main LT panel all incomer should be made.
- vii. Provision for Type 1 +2 ,4 pole SPD, with $\geq$ 30 Ka /pole (10/350 micro sec) ka in total 160 A gl/gG(HRC) back-up fuse, protection level $\leq$ 0.9kv in all sub panel r should be made. Provision for

Type 2 ,4 pole SPD, with ≥ 20 Ka /pole 125 A backup fuse, protection level $\leq .9$ kv in all sub panel r should be made.

viii. An external LPS which consists of

- Air-termination system
- Down-conductor system

The above systems is intended to, intercept a lightning flash to the structure (with an air termination system), conduct the lightning current safely towards earth (using a down conductor system), and disperse the lightning current into the earth (using an earth-termination system).

An internal LPS comprises equipotential bonding or a separation distance (and hence electrical insulation) between the external LPS components and other electrically conducting elements internal to the structure.

Main protection measures against injury to living beings due to touch and step voltages are intended to, reduce the dangerous current flowing through bodies by insulating exposed conductive parts, and/or by increasing the surface soil resistivity; and reduce the occurrence of dangerous touch and step voltages by physical restrictions and/or warning notices.

10) UPS:

Proposed On line UPS shall be provided for critical load like emergency lighting, office room, cctv, critical ELV loads & Critical automation loads. Battery with 30 Min Back Up on running 93.8% as per ECSBC norms along MS Battery Rack & Battery interconnection link with CB and other standard accessories with PRS. (Parallel redundant system)

- Proposed UPS rating for
- MPH Building is 6 KVA, Three Phase UPS, Input /Output Voltage -230V,50HZ
- Boys Hostel is 6 KVA, Three Phase UPS. Input/output Voltage – 230V,50HZ.
- Girls Hostel is 6 KVA, Three Phase UPS, input/output Voltage – 230V,50HZ.
- All Facilite Buildings are 6 KVA, Three Phase UPS, input/output Voltage – 230V,50HZ.

11) Solar Energy:

As per the Odisha bylaw norms for Solar PV system i.e Solar Power back up of minimum generation capacity of 5% of the connected load or 20 W/sq.ft for available roof space whichever is less. The generation of Solar Energy is directly connected to the main EB Panel for “**Net Metering**” Purpose no store system (battery) planned.

The Proposed Total Solar PV system is 20 KWp (10Kwp for girls’ hostel & 10Kwp for boys’ hostel)

12) CCTV Surveillance:

The CCTV Surveillance system shall comprise with IP-based dome cameras for indoor common areas, bullet cameras for outdoor and perimeter surveillance, and PTZ cameras at strategic locations requiring wide range monitoring. All cameras shall support day and night operation.

The CCTV and Surveillance System shall control and monitor different buildings in the Campus as per NBCS 2026/ relevant IS codes/Local by laws.

The types of cameras & locations of various Cameras indicated herein are minimum to be provided. However, during detailed designing if required and found necessary the type/ rating of the Cameras shall be upgraded.

Dome and Bullet: - The dome and bullet Cameras are proposed to be installed at all Entry, Exit Points, main corridor, office room, & common areas at all floor including terrace.

PTZ outdoor cameras: - The true IP day and night viewing PTZ cameras proposed are 20 x optical zoom, Auto iris & auto focus lens with focal length 4.7 mm to 94 mm or better. The PTZ camera shall

automatically track the object to use its Pan/Tilt/Zoom feature and record 30 frames/ sec. The cameras shall be UL/FM Listed. RJ- 45 Cable connectors will be used for Network/POE connectivity. Proposed for main entrance. All buildings & sports complex.

The outdoor cameras shall be in IP-66 Housing with Junction box, LIU etc. is proposed in weather proof housing. The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports.

Network connectivity for outdoor cameras having distance more than 75 metres, shall be on optical Fiber. Suitable provision shall be provided to connect with existing LAN infrastructure. The power supply to LAN switches and Monitors will be on UPS. The video recording shall be non-embedded based recording sever.

NETWORK VIDEO RECORDER (NVR): - The NVR must have 64 channel having 8 SATA port with H264 & H265 Compline. It contains 1 Lan port two HDMI Port along with 1 VGA Port.

LED Display Monitor: - The sufficient no. of Full HD LED Monitors with high resolutions screen size of 43” (Diagonal) are to be provided for viewing all live/ recorded camera proceedings. The resolutions of 1920(H) x 1080(v) pixels with comfortable viewing angle is proposed for all monitors suitable for operation on 220-240V AC 50 Hz power for the display panel should be equipped with all standard features such as video in, Audio in, HDMI/DVI, RJ 45 Port etc.

CCTV Control Room shall be located in the Ground Floor or as per site condition. The wiring inside the building shall be with CAT 6A cable in conduit and for Outdoor connectivity Armoured fibre Optic Cable shall be used. Optical fibre cable shall be laid underground in HDPE pipes with suitable Manholes for easy pulling and proper Maintenance. PTZ cameras will be placed on roof top and on Street Light Poles with necessary mounting arrangements in external areas.

13) IPBAX SYSTEM:

RJ-45 Telephone socket outlets with suitable IP Phones instruments shall be provided in all blocks / buildings at convenient locations, as required. CAT 6A wiring shall be provided in recessed/surface conduits / raceways from each telephone point up to the Rack panel (Patch Panel & Switch) at each floor or nearest Rack Panel of SIDM building. The Maximum length of the CAT6A cable shall be 90 M.

IPABX with minimum capacity of 100 Telephones & expandable up to 200 telephones shall be located at Server Room in the SIDM Ground Floor. The PRI lines for IPABX shall be terminated in the separate Rack in server room. This Rack will be connected to the IPABX system.

The Rack Panel (comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, SFP Module, Fiber patch cord etc.) of individual floor (Bed room, Dinning, office, conference, Reception, security room etc.) shall be connected to the main IPABX Server Rack with optical Fiber cables to be laid underground in DWC HDPE Pipe of suitable size /ELV shaft through HMS PVC conduit laying through MS cable tray. .

Manholes with covers shall be provided in the underground DWC HDPE pipes at suitable lengths for easy pulling & maintenance of cables.

14) Data and Networking:

- I. For data system complete backbone will be fibre cable network is proposed in the building.

- II. Proposed Ethernet system will be supported but not limited to wired Ethernet and wireless as per IEEE802.11a/b/g/n/ac. IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI).
- III. Common space (FTTH) is provided for service providers to install network racks and associated active \ passive infrastructure.
- IV. Supply, installation, testing & commissioning of wall mounted networking enclosures (6u to 9u usable heights) at each floor as per technical specification.
- V. Supply, installation, testing & commissioning of Floor standing networking enclosures (22u to 42u usable heights) at server room as per technical specification.
- VI. Supply, Installation, Testing & commissioning of Single/Dual I/O Face Plate with Keystone will be mounted on wall/ table as requirement.
- VII. SITC of ceiling mounted of Access point shall be provide in corridors of each floor and conference hall or any other area as per Engineer-in-Charge.
- VIII. Poe switch (managed/un managed) will be installed inside the distribution RACK (6U/9U).
- IX. CAT 6A cable is used to connect the I/O point, Access point with Poe Switches to make a network. The fibre optical cable is used to connect the PoE Switch Floor Wise along with Server by the use of LIU, SFP Module and Fibre Patch Cord.

15) Interactive Display for Smart Classroom:

- SITC of 75" 4K UHD interactive display featuring a high-contrast VA panel with 350 nits brightness, 50-point ultra-precise infrared touch, 10-bit color accuracy ($\Delta E \leq 1.5$), integrated triple 50MP AI camera with auto-framing and speaker tracking, 16-mic array with intelligent noise cancellation, powerful 2.1 audio system, Wi-Fi 6 and Bluetooth 5.2 connectivity, and comprehensive multi-OS compatibility with advanced collaboration, annotation, and device management capabilities., Certifications BIS, , Operational Life of 50,000 hours, Certificate-BIS & RoHS certified and offered product should be under Make in India product, ISO 9001, ISO14001, ISO 27001, OHSAS 45001.

16) Electrical Make List

ITEM DESCRIPTION	MAKES
PVC CONDUIT PIPE	AKG/ PRECISION/ NEROPACK/BEC
M.S. CONDUIT PIPE	AKG/ PRECISION/ NEROPACK/BEC
WIRE	KEI/ POLYCAB / HAVELLS/ GLOSTER
HT CABLE & LT CABLE	KEI/ POLYCAB / HAVELLS/RR KABEL
SWITCHES & SOCKETS	LEGRAND(MYRUS)/SCHNEIDER(Zencelo)/ SIEMENS (SINOVA MARQ)/ABB(IVIE)
CEILING ROSE & BRACKET HOLDER	ANCHOR/ CONA
MCCB, MCB, RCCB, RCBO	LEGRAND-DX-3/LK-DSHINE/ABB-200 SERIES/SIEMENS-BETAGUARD/SCHNEIDER- ACTI9
DISTRIBUTION BOARD	LEGRAND-EKINOX/SIEMENS-BETAGUARD/ SCHNEIDER- ACTI 9/ABB ITUS/LK EXORA.N
OIL COOLED TRANSFORMER	OTPL/ALFA/ KILOSKAR

DRY TYPE TRANSFORMER	KILOSKAR/POWER STAR/ SCHNEIDER
HT PANEL (VCB PANEL)	SCHNEIDER/ABB/SIEMENS/LK
MAIN LT PNAEL DISTRIBUTION (TTA PANEL INCLUDING SAME MAKE OEM SWITCHGEAR & ACCESSORIES)	SCHNEIDER(BLOCKSET)/ABB(ARTUK)/SIEMENS(SIEPAN)/LK (Ti Range)/LEGRAND XL3
SUB DISTRIBUTION PANEL INCLUDING SAME MAKE OEM SWITCHGEAR & ACCESSORIES)	SCHNEIDER(BLOCKSET)/ABB(ARTUK)/SIEMENS(SIEPAN)/LK (Ti Range)/LEGRAND XL3
LOCAL DISTRIBUTION BOARD	BALAJI ELECTRO CONTROLS/SK ELECTRICAL/ ELECTRO CONTROLS VDEAL
VERTICAL & HORIZONTAL RISING MAIN	LEGRAND/SIEMENS/ABB/C&S
SWITCH GEARS	LEGRAND/ SIEMENS/ LK/ ABB
SELECTOR SWITCH	KAYCEE/ SALTZER
INDICATING LAMP	SIEMENS/ L&T/ ABB/ LEGRAND
ENERGY METERS	<u>GEC/ SECURE/ L&T/ Elmeasure</u>
CTS & PTS	AE/ KAPPA/ EASTERN SWITCHGEAR
KITKATS EXTENSION TYPE	ANCHOR/ HAVELLS/ BPC/ ABB/ PANASONIC
METAL CLAD PLUG SOCKET	LEGRAND/ HAVELLS/ L&T/ ABB
PVC INSULATED CABLES & ARMOURED CABLE	KEI/ POLYCAB /RR KABEL/GLOSTER
CABLE LUGS	DOWELLS/ ISMAL/ CLIPON
CABLE JOINTING KITS	M SEAL/ GRIP-SIL
INDOOR FITTING & FIXTURES	WIPRO/ PHILIPS /LT/K-LITE
CEILING FANS & EXHAUST FANS	CROMPTON/ BAJAJ/ HAVELLS/ USHA/ ORIENT/ KHAITAN
LIGHTENING ARRESTER	ABB/ OBO/ OBLUM
EARTHING	ABB/ OBO/ OBLUM
SOLAR STREET LIGHT	WIPRO/BAJAJ/PHILIPS/PANASONIC
STREETLIGHT	K-LITE /WIPRO/PHILIPS/BAJAJ/ Reytek
BOLLARD	K-LITE /WIPRO/PHILIPS/ Reytek/ JAGUAR
STREET POLE & HIGHMAST	BAJAJ/UTKARSH/VANKAL/RR ISPAT/PPE
SPORT HIGHMAST	RR Ispat/valmont/transrail/Bajaj/Utkrash
SPORT LIGHT	Panasonic/wipro/Bajaj/Philips
DECORATIVE POLE	JAGUAR/K-LITE/ HOMEDECK/Reytek
FACADE LIGHT DESIGN	Reytek/ WIPRO/ K-LITE/ PHILIPS/LT
LIFTS/ESCALATOR	JOHNSON/THYSSENKRUP/ SCHINDLER / OTIS

DG SET	JACKSON / KIRLOSKAR/SUDHIR POWER
UPS	SCHNEIDER-APC/EMERSON- VERTIVE/GE/TMAC/GUTOR/NUMERIC
CABLE TRAY	PILCO, MEM, LEGRAND
APFC & PROTECTIVE RELAY	SCHNEIDER, SIEMENS, LK, ABB

LOW VOLTAGE ITEMS MAKE LIST	
POINT WIRING	MODULAR
PVC CONDUIT PIPE	AKG/ POLYCAB/ PRECISION/ NEROPACK
M.S. CONDUIT PIPE	BEC/ SUPREME/ KALINGA/ PRECISION/ ANCHOR
CCTV	
CAMERA	BOSCH/ AXIS/ PELCO
CCTV CABLE	COMMSCOPE/LEGRAND/PANDUIT/TYCO
ANDROID LED DISPLAY	PANASONIC/BARCO/SONY
HARD DISK	WD/SEAGATE
PoE SWITCH	CISCO/GRANDSTREAM/DIGISOL
RACK	NETRACK/VALRACK
NVR	BOSCH/ AXIS/ PELCO
MONITOR	LG/SAMSUNG/SONY/BARCO/DELTA
PA SYSTEM	
SOUND SYSTEM CONTROLLER	BOSCH PAVIRO PVA-4CR12 / NEUMANN /ELECTROVOICE/HARMAN
WALL MOUNT SPEAKER	BOSCH PAVIRO PVA-4CR12 / NEUMANN /ELECTROVOICE/ HARMAN
AMPLIFIER	BOSCH PAVIRO PVA-4CR12 / NEUMANN /ELECTROVOICE/ HARMAN
CALL STATION	BOSCH PAVIRO PVA-4CR12 / NEUMANN /ELECTROVOICE/ HARMAN
CONFERENCE SPEAKER	
MICROPHONE	SENNHEISER/ SHURE/ BRAEHLER
CONTROLLER	SENNHEISER/ SHURE/ BRAEHLER
SPEAKER	D&B/MEYER
ADD. FIRE ALARAM SYSTEM	
ALL FIRE DETECTOR & SOUNDER & MANUAL CALL POINT , ISOLATOR	BOSCH/NOTIFIER/EDWARD/COOPER
FIRE ALARAM PANEL	BOSCH/NOTIFIER/EDWARD/COOPER
REPEATER PANEL	BOSCH/NOTIFIER/EDWARD/COOPER
FIRE CABLE	POLYCAB/ HAVELLS /KEI

ACTIVE PASSIVE IT SYSTEM AND IPBX SYSTEM	
CATEGORY 6 A CABLE/ PATCH CORD/ I/O / JACK PANEL/PATCH PANEL/ LIU	PANDUIT/ COMMSCOPE/ SEIMON/ LEGRAND
FIBER MEDIA CONVERTER/LIU/ JACK PANEL	
	PANDUIT/ COMMSCOPE/ SEIMON/ /LEGRAND
RACK	NETRACK/ RITTAL/ PANDUIT/VALRACK
MDF BOX	KRONE/DELTON/BELDEN
RISER CABLE	KRONE/DELTON/BELDEN
FIBER RUNNER	PANDUIT/ COMMSCOPE/ SEIMON/BELDEN
CORE SWITCH	JUNIPER/ CISCO/ ALCATEL/ ARISTA
DISTRIBUTION SWITCH	JUNIPER/ CISCO/ ALCATEL/ ARISTA
MANAGEMENT PLATEFORM/ CONTROLLER	JUNIPER/ CISCO/ ALCATEL/ ARISTA
WIRELESS INDOOR ACCESS POINT	JUNIPER/ CISCO/ ALCATEL/ ARISTA
FIREWALL	JUNIPER/ CISCO/ PALOALTO/FORTINET
INTERNET ROUTER	JUNIPER/ CISCO/ ALCATEL/HP
WI-FI ROUTER	JUNIPER/ CISCO/ ALCATEL/HP
WI-FI CONTROLLER	JUNIPER/ CISCO/ ALCATEL/HP
WI-FI ACCESS POINT	JoUfN1I4PE0R9/ CISCO/ ALCATEL/HP
DIGITAL KEY PHONE	PANASONIC/ ALCATEL/ AVAYA/ MICROSOFT
IP PHONE	PANASONIC/ ALCATEL/ AVAYA/ MICROSOFT
ANALOGUE PHONE	PANASONIC/ALCATEL/AVAYA/ BEETEL/ PROTEL
IP-PBX	PANASONIC/ALCATEL/AVAYA
END POINT PROTECTION	TREND MICRO/ QUICKHEAL/ NORTON
MAIL & DATABASE SERVER	DELL/LENOVO/ HP
AUDIO VIDEO WORKS	
WALL MOUNT AND CEILING LOUDSPEAKERS	BOSE/L-ACOUSTIC/SENNHEISER/MEYER SOUND/YAMAHA
POWER AMPLIFIERS	BOSE/L-ACOUSTIC/SENNHEISER/MEYER SOUND/YAMAHA
DIGITAL SIGNAL PROCESSOR	BOSE/XILICA/ MEYER SOUND/ YAMAHA
CEILING TILE MICROPHONE	SENNHEISER/SHURE/RODE/BAYER-DYNAMIC
WIRELESS HANDHELD/LAPEL MICROPHONE /GOOSENECK MICROPHONE	SENNHEISER/BEYERDYNAMIC/SHURE/RODE

CHAIRMAN UNIT	BOSCH/TELEVIC/SHURE/ADONIS AV
DELEGATE UNIT	BOSCH/TELEVIC/SHURE
CENTRAL CONTROLLER UNIT WITH RECORDING FACILITY	BOSCH/TELEVIC/SHURE
SPEAKER CABLE	BELDEN/KRAMER/CRESTRON
MICROPHONE CABLE	BELDEN/KRAMER/CRESTRON
PROJECTORS	CHRISTIE/BARCO/BENQ
MOTORIZED PROJECTION SCREEN	SUDPI/SUVIRA/LIBERT AV
LED DISPLAY	SAMSUNG/LG/DELTA/BARCO/SONY
CABLE CUBBY	LOGIC/KRAMER/EXTRON
PODIUM	AHA/TECOM/PEOPLELINK/GLOBUS
IPPTZ CAMERA(FOR CONFERENCING PURPOSE)	LUMENS/VADDIO/PANASONIC/SONY
RECORDING,STREAMING& WEBCASTING DEVICE	LUMENS/CYPRESS
JOYSTICK	LUMENS/VADDIO/PANASONIC
VIDEO CONFERENCING SYSTEM	CISCO/BARCO
HDMI MATRIX SWITCHER	KRAMER/EXTRON/CRESTRON
WALL PLATE	KRAMER/EXTRON/CRESTRON
WIRELESS PRESENTATION SYSTEM	BARCO/EXTRON/KRAMER/CRESTRON
HDMI TRANSMITTER & RECEIVER	KRAMER/EXTRON/CRESTRON
CONTROL SYSTEM	KRAMER/EXTRON/CRESTRON
TOUCH PANEL	KRAMER/EXTRON/CRESTRON/APPLE
NETWORK SWITCH	CISCO/ALCATEL/ARISTA/JUNIPER
WI-FI ROUTER.	CISCO/ALCATEL/JUNIPER/HP
HDMI CABLE.	KRAMER/EXTRON/CRESTRON/LIBERTY AV/FALCON
EQUIPMENT RACK	NETRACK/ RITTAL / VALRACK
Interactive Display	Delta/ Barco/Chirstie/LG/Samsung/Panasonic
Split AC	Hitachi/Daikin/Bluestar

Scope of PH Work

Scope of work shall comprise specifications to be followed for the works have been provided in Section-5, and in addition, manufacture's specification shall also be adhered to for the brands approved for the project. Scope includes designing and producing PH drawings for approval and construction for the project. Scope also includes O & M of all the electromechanical items (for STP, WTP if any) for at least five years and to produce warranty certificates for all sanitary fixtures, fittings and all other items related to PH works. All PH installations shall be tested, commissioned, and formally handed over in complete working condition.

Scope for WS & SI Work:

The scope of WS & SI work (Water Supply & Sanitary Installations) for the project is about providing all fittings and fixtures to make it fully functional with regard to supply, storage, distribution of water and collection and other areas of the building.

- W.C. Pan with flushing system: Floor mounted EWC with ceramic flush tank at all locations.
- Providing all materials, labour, T&P for fitting and fixing of standard size HPL Toilet Cubicle of approved make in all toilets of facility building at cricket, football field and swimming pool.
- Urinal valve autoclosing system to be proposed at common player and visitors toilet location.
- 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 all toilets of facility building at cricket, football field, MPH building and swimming pool.
- Half pedestal basin at attached toilets and under counter basin to be proposed at common player and visitors toilet location.
- One no. vertical swing grab bar & 4 nos. grab bars 692 mm long including supply of suitable PVC wall plug and Brass screws etc. shall be fixed in Physically Handicapped (PH) toilets.
- Required nos. of OHT of adequate Capacities Triple Layer Tank white conforming to IS : 12701/1996 shall be installed in each buildings.
- Three phase sensor with level indicator and cables etc as per direction of EIC shall be installed in Drinking & Flushing OHT.
- All accessories for Sanitary fixtures (CP finish) and fittings to be provided such as health faucet, toilet paper roll holder, two-way bib cock, Pillar cock, towel ring round, wall mixture, over head shower, mirror, soap holder, robe hook, bottle trap, floor drain, sink cock, angular stop cock, long body bib cock, concealed stopcock, square multi floor trap with SS anti cockroach grating, waste coupling, extension piece, hand dryer etc.

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 toilet(considering at least two brands) for approval by the Authority prior to proceeding with the full installation across all floors.**
- **The sanitary fixtures and fittings will be finalized as per latest sports manual at the time of execution and must be approved from the authority before execution.**

Sewerage(Soil And Waste) & Storm Water System:

The scope includes planning, designing and construction of providing and laying external sewer lines with RCC NP2/3 (as per codal requirements) 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.

- i. Waste & wastewater from kitchen & dining (if any) shall not be directly discharged in the sewerage system. For garbage, a separate storage bin shall be provided and all codal provisions of SWD should be followed. For pre-treatment of wastewater Gulley Trap, screen chamber, Grit Chamber shall be designed and constructed.
- ii. All internal sewage pipeline to be of UPVC type B as per IS 13592.
- iii. All rainwater & balcony drain pipe to be of UPVC type A IS 13592.
- iv. Vertical Grating 150x150mm for Rain water gutter on terrace ,opening to 110mm dia Rain water pipes shall be provided.
- v. This item is operated from the first manhole to including construction of gully trap, grit chamber, screen chamber etc, making connection from and to the manholes wherever required, all complete.
- vi. A two pipe system with common vents shall be provided in accordance with NBC 2026, with separate piping networks for sewage (soil water) and sullage (wastewater) collection and conveyance.
- vii. uPVC SWR Type-B self-fit pipes and fittings with solvent cement joints shall be used for internal toilet plumbing, while O-ring type pipes and fittings shall be used in plumbing ducts, attached balconies, and terraces, and the system shall be designed to maintain a minimum self-cleansing velocity of 0.75 m/s.
- viii. Manholes, inspection chambers, and gully traps shall be provided in accordance with NBCS 2026, complete with structural detailing and approved drawings. RCC NP-2/NP-3 pipes shall be selected based on load conditions and relevant IS standards, and detailed shop drawings shall be submitted for approval prior to execution.
- ix. The first inspection chamber shall be provided with a vent pipe for proper ventilation.
- x. The last manhole chamber shall be provided with a vent pipe for proper ventilation.
- xi. PVC (SWR and rigid) soil, waste, and vent pipes,vent cowls(ss/pvc) and fittings made of UPVC shall conform to IS 4985/13592, BS, and DIN standards with specified diameters, wall thickness, and rubber ring joints, including proper jointing, fixing, anti-siphonage piping, trap water seals, and water closet installation.
- xii. 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.

- xiii. Floor Trap with Channel Grating – Stainless steel floor drain with removable grating for efficient drainage of wastewater and easy cleaning.
- xiv. 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.
- xv. Individual septic tank with soak pit of required capacity as per IS code to be designed for each building (6nos.). Septic tank to be of RCC and soak pit of brick work to be made.
- xvi. Minimum capacity of the septic tank be designed for 100 users .However the detail design and calculation to be submitted as per the actual requirement prior to execution of the work.
- xvii. Planning to be such a way to avoid large distance to carry the sewage.
- xviii. Rainwater Recharge pit: A minimum of 32nos of rainwater recharge pit plan has to be designed for recharging ground water table by considering run off calculation. Rainwater recharge pit system has to be planned for roof top areas and site areas including road, pathway, paved areas, landscape zones as per NBC 2026 with necessary desilting chamber before discharging to recharge pit.
- xix. 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.
- xx. Planning to be such a way to avoid large distance to carry the sewage.
- xxi. For swimming pool filter back wash water and cleaning of the pool, necessary arrangement to be done to carry the back wash water into the nearest drain , if not present necessary arrangement to be done by the concerned agency for the final disposal of the water to the nearest drain suitably (including holding tanks and necessary pumping arrangements).

Water Supply Network:

- i. The scope includes planning, designing and construction of providing and laying Water supply main, branch and distribution lines including chambers and fittings/specials such as Tees, Bends, collars, Unions, tappers, caps, Sluice Valves, Gate Valves, scour valves, non-return valves, strainer, air-relief valves, thrust blocks etc. complete and as per direction of Engineer.
- ii. Supply and installation of pipe supports including clamps, hangers, brackets, saddles, anchor fasteners, and necessary fixing accessories of approved make and material, suitable for supporting hot and cold water piping systems. The scope shall include proper alignment, spacing, and secure fixing of pipes on walls, ceilings, or structural members to ensure safe load distribution, vibration control, and long-term stability of the piping system as per site requirements and engineering standards.
- iii. The selected SDR (Standard Dimension Ratio) shall be suitable for the intended application, operating pressure, and service conditions. All pipes shall conform to relevant standards and shall be installed

with compatible fittings, joints, and supports to ensure leak-proof and reliable performance. The Internal water supply in toilets shall be provided through concealed piping routed via plumbing shafts with no exposed services.

- iv. The water supply network should cater to the needs of supplying water from UG sumps (from various locations) to individual buildings.
- v. All buildings are to be connected with OHT by water supply lines by UPVC pipes so that water supply should be made to the building along with fittings, gun metal gate valves, gun metal non return valves, masonry chambers for valves, including excavation, providing sand around and refilling after laying etc.
- vi. Internal water supply of building has to be made with CPVC SDR 11 pipes.
- vii. External water supply such as from UGR to OHT and from external borewell or municipal water supply to UGR pipe will be considered UPVC sch 80 pipes.
- viii. Planning, designing and construction of RCC Under Ground Sumps of adequate capacity as per norms of NBCS 2026, with necessary partitions for domestic & firefighting etc. including preparation of preliminary & detailed working drawings, structural analysis & design, planning, designing & execution of all services including providing and laying pipes of required diameter up to overhead tank etc. by incorporating stipulated specifications and integrating all services with external development works all complete as per directions of Engineer.
- ix. The minimum indicative UGR capacities for the respective facilities shall be as follows:
 - 1. Facility Building for Football Ground & Multipurpose Hall –Domestic and Field Irrigation UGR:150KL
 - 2. Facility Building for Cricket Ground – Domestic and Field Irrigation UGR: 150 KL
 - 3. Hostel Buildings (Boys & Girls) – Domestic UGR: 44 KL
 - 4. Site Irrigation & Swimming Pool (Domestic Use) UGR: 210 KL

The above capacities are indicative minimum requirements. The final capacity, dimensions, and configuration of the UGRs shall be determined based on detailed design calculations, actual site conditions, peak demand assessment, storage requirements, and applicable codes and standards. In all cases, the designed capacity shall not be less than the minimum indicative capacities specified above. The Capacities of UGT and OHT considered exclude fire requirements which has to be design as per the latest fire norms.

- x. Borewell: Bore wells for water supply shall be provided for each building with additional one number borewell for irrigation/landscaping water supply requirement. In case water supply can be made available from WATCO/PH/RWSS the same may be considered as source but in such case alternate water supply from borewells may also be considered.
- xi. 200mmX150mm dia borewell shall be provided/installed, cleaning and developing the tubewell using compressor ,sanitary sealing and construction of brick masonry chamber of outer size

1400mmX1400mmX1200mm with RCC cover slab and MH-opening ,encasing the annular area of casing pipe with cement concrete.

- xii. 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 4 core flat cable , control and earthing etc. all complete.
- xiii. Supply and installation of required size centrifugal pump set (1W+1S) including construction of concrete foundation base with electrical control panel suitable for the pump set , suction and delivery piping arrangement, brass ball valve ,footvalve with stainer etc.with sensor arrangement for filling up overhead tanks automatically from UGT all complete.
- xiv. Provision of hydro pneumatic pumping system if required.
- xv. At least 2 nos of Storage Cooler cum RO+UV Water Purifier 120 lit Capacity having 40 ltr per hr cooling capacity, 120 ltr storage (40 ltr warm, 40 ltr cold, 40 ltr normal) to be provided in each floor of the buildings.
- xvi. RCC HUME pipes to be laid in between road crossing wherever water supply pipes cross both internal and external roads.
- xvii. Storage type geyser with 15 lit capacity at each shower areas to be provided.
- xviii. A booster pump system shall be provided to serve the upper three floors of the building. The system shall include all necessary fittings, isolation valves, a Pressure Reducing Valve (PRV), velocity breaker,and pressure gauges(calibarated) to ensure the required and uniform water pressure at the terminal plumbing fixtures. The installation shall be designed to deliver consistent and smooth pressure at the point of use.
- xix. Isolation valves, gate valves (brass,chromium finish) or approved equivalent) shall be provided on all major pipelines, branch lines, and at the base and top of each riser to enable sectional shutdown for maintenance and emergency purposes. Valves shall be of approved make and rating, suitable for the system operating pressure, and installed at accessible locations for safe operation and servicing.
- xx. Pipe risers shall be provided to vertically convey plumbing services between floors through designated service shafts. All risers shall be properly supported, aligned, and anchored, and shall include isolation valves, access provisions, and necessary fire-stopping at each floor level to ensure safe operation, maintenance access, and compliance with relevant standards.
- xxi. 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. The UGR capacity shall be designed for 1.5 days of total daily water demand, and the OHT capacity shall be designed for 0.5 days of total daily water demand. Fire water storage and related provisions shall comply with Fire NOC requirements, NBCS 2026 guidelines.

- **Sewage Treatment Plant (STP):**

- The scope shall include the **design, construction, testing, commissioning and successful operation of a Sewage Treatment Plant (STP) of adequate capacity**, based on the ultimate sewage generation from the entire sports complex, hostel buildings and all associated facilities, in accordance with the approved design, NBC, CPHEEO Manual, CPCB/SPCB guidelines and relevant BIS standards. The STP shall comprise collection sump, screening chamber, equalization tank, biological treatment units, clarification, filtration, disinfection, sludge handling system, treated water storage tank, pumping system, PLC-based control panel, instrumentation, odour control measures, interconnecting pipelines, valves, electrical works and all associated civil, structural, mechanical and electrical works required for complete functionality.
- The treated water shall be suitable for **non-potable reuse**, including landscape irrigation, toilet flushing, washing, cooling water make-up (where applicable) and other utility purposes, conforming to the discharge and reuse standards prescribed by the competent statutory authorities.
- The Contractor shall provide all pumps, blowers, diffusers, mixers, dosing systems, filters, instrumentation, automation, power supply arrangements, testing, commissioning, trial operation, operator training, performance testing and all ancillary works required for satisfactory operation of the STP.
- Any material, labour, equipment, piping, valves, instruments, electrical panels, automation systems, civil works or ancillary item not specifically mentioned but required for the complete, safe, efficient and uninterrupted functioning of the Sewage Treatment Plant shall be deemed to be included within the Contractor's scope without any additional cost to the Employer.

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 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.

Garbage Disposal/Waste management:

Each floor of the building has to be provided with adequate numbers of dustbins to segregate wet

waste, dry waste, e waste and hazardous waste like batteries, e waste, lamps etc. Collected waste will be taken to a centralised location and then the non-biodegradable waste is made to be segregated and sent from the collection yard to recycling units outside building.

Note: All the sanitary fixtures and fittings have to be selected as per GRIHA 3 rating standard. Design such as using water efficient plumbing fixtures, BEE 5 star rated pumping system, terrace and periphery RWH system, waste water treatment and reuse for landscaping, segregation of waste (such as dry waste, wet waste, and hazardous waste like batteries, e waste, lamps etc).

Reference Standards:

NBCS 2026	National Building Construction Standard of India
SP 35	Handbook on water supply and Drainage
IS 5329 – 1983	Code of practice for sanitary pipe work above ground for buildings.
IS 2064 – 1973	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 1200 (Part 1)	Method of measurement of building earthwork
IS 1200 (Part 16)	Method of measurement of laying of water and sewer lines including appurtenant
IS 1200 (Part 19)	Method of measurement of Water supply, plumbing and drains.
IS 783 – 1959	Code of practice for laying of concrete pipes
IS 13592 – 1992	Specification for un plasticized PVC pipes for soil and waste discharge system inside building including ventilation and rainwater.
IS 2527 – 1984	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS 6784 – 1984	Method of performance testing of water meters (Domestic type).
IS 12235 (Parts 1 to 11)	Methods of test for un plasticized PVC pipes
IS 458 – 1988	Specification for pre-cast concrete pipes (with or without reinforcement)

IS 771 – (Part 3 to 6)	Specific requirements for urinals
IS 2548 (Part 1 & 2)	Specification for plastic seats and covers for water closets.
IS 3004 – 1979	Specification for plug cocks for water supply purposes.
IS 1711 – 1984	Specification for self-closing taps for water supply
IS 1703 – 1977	Specification for ball valves (Horizontal plunger type) including floats for water supply purposes.
IS 4038 – 1979	Specification for foot valves for water works purposes.
IS 1172 – 1983	Code of basic requirements for water supply, drainage & sanitation
IS 1239 – 1990 (Part I)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239 – 1992 (Part II)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1742 – 1983	Code of practice for building drainage.
IS 2064 – 1973	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065 – 1983	Code of practice for water supply to buildings.
IS 4111 – 1986	Code of practice for Ancillary structures in sewerage system
BS 4515	Specification for un plasticized PVC pipe fittings.
IS 4985 – 1988	Specification for un plasticized PVC pipes
IS 732 & IS 2274 – 1963	Indian Standard code of practice for electrical wiring & installation.
IS 15778	(CPVC) Pipes for Potable Hot & Cold water
CPHEEO MANUAL-2019	

List of Acceptable Makes

The following list of approved vendors are provided for different materials.

WATER SUPPLY & SANITATION WORKS	
SANITARY FIXTURES & FITTINGS	JAQUAR/KOHLER/ ROCA/ GROHE
CONCEAL CISTERN/CERAMIC CISTERN/PVC CISTERN	JAQUAR/KOHLER/ ROCA/ GROHE
URINAL	JAQUAR/KOHLER/ ROCA/ GROHE
DA TOILET	JAQUAR/KOHLER/ ROCA/ GROHE
CP FITTINGS	JAQUAR/KOHLER/ ROCA/ GROHE
CPVC PIPES & FITTINGS	ASTRAL/ ASHIRBAD
UPVC PIPES	ASTRAL/ ASHIRBAD
SWR PIPES	ASTRAL/ ASHIRBAD
MIRRORS	MODIGUARD/ SAINT GOBAIN
BALL VALVES/ NRV/PRV	LEADER/ ZOLOTO
SINK	NIRALI/ CERA
PUMPS	ARMSTRONG/XYLEM/KIROLOSKAR/ WILO
TOILET CUBICLE	MERINO/ GREENLAM
WATER COOLER CUM PURIFIER	AQUAGUARD BY EUREKA FORBES/ION EXCHANGE

Scope of Swimming Pool Electro mechanical equipment Work:

- Following swimming pool electro mechanical equipment to be provided in filtration plant room along with all necessary flanges, core cuttings etc complete required for fully functional of the swimming pool with necessary backwash arrangement. All the Supply , installation, testing commissioning will be under the contractors scope. Any ancillary items, fittings, supports, connections, or components necessary for the proper operation of the equipment, whether specifically mentioned or not, shall be deemed to be included within the scope of work and shall be provided by the agency without any additional cost.
- Any material, labour, equipment, pumps, filtration units, filters, dosing systems, pipelines, valves, strainers, fittings, instruments, sensors, electrical panels, control systems, automation, underwater lighting, cable trays, supports, civil embedment, testing equipment, commissioning accessories or any ancillary item not specifically mentioned but required for the complete, safe, efficient and uninterrupted operation of the swimming pool electro-mechanical, filtration, circulation, water treatment and disinfection systems shall be deemed to be included within the Contractor's scope.

SN	Description	Qty	Unit
1	Circulating pump & Control Valves		
	a) Supply & Erection of Single stage/Horizontal pumps set with inbuilt prefilter, Thermoplastic injected pump casing. Impeller in noryl with Stainless steel shaft, mechanical seal in stainless steel connected to TEFC induction motor with built-in thermal protection and automatic reset suitable for 190/ 380 volts, 12.5 HP, 3 phase, 50 cycles A.C supply, IP-55 motor protection complete with inbuilt Filter basket in injected plastic material. Flow 150 m ³ /hr. @ 12-14 Mtrs. Head (Working 4 Nos. , Standby : 1 No.)	5	No
	b) 200 mm dia. UPVC Suction valve (Butterfly) with Valve mounting kit in PVC, Complete with PVC stud ends, PVC flanges, Nut bolts and washers.	5	No.
	b) 160 mm dia. UPVC Delivery valve (Butterfly) with Valve mounting kit in PVC, Complete with PVC stud ends, PVC flanges, Nut bolts and washers.	5	No.
	b) 160 mm dia. UPVC Delivery Non Return valve (Wafer Type) with Valve mounting kit in PVC, Complete with PVC stud ends, PVC flanges, Nut bolts and washers.	5	No.
2	Filter (Horizontal Type) -Totally Anticorrosive Pressure Sand Filter 2000 mm dia. x 2500 mm Long, Manufactured with fiber glass & polyester resin, fitted with collector arms & diffuser made from unplasticized PVC & polypropelene, capable of accomodating a flow rate of 150 cum / Hour @ 30-40 cum / Hour / Sqm., 1.20 mtr. Bed Depth, complete with lid in polyester resin & fiber glass, manual air purge, cap for sand discharge & PVC flanged connection for inlet & outlet.	4	No.
3	Filtermedia & underbed -		
	a) Sillica sand media for filter with granulometry between 0.4 & 0.8mm	24000	Kg
	b) Gravel for filter with granulometry between 1-2mm	4200	Kg.

4	Automatic Valve Battery for Filter -		
	Automatic Motorised driven 5-Valve batteries built entirely in UPVC with flange connections to filters according to DIN standards. Butterfly valves also in PVC supports made of zinc coated steel pipe with antivibration clamps & fixing plugs, Conn. 160 mm Dia.	4	No.
5	CIRCULATION PIPING		
	Supply, Install, Testing & commissioning uPVC Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. for Swimming Pool Inlet & Drain & Suction piping, Swimming Pool filtration plant piping, drain pipe along the pipe periphery including all fittings, fixtures and Ceiling/ Wall Support System suitable for following uPVC pipe as specified and directed.		
	a) 400 mm Dia. X 6 Kg/cm2	18	Mtrs.
	b) 350 mm Dia. X 6 Kg/cm2	6	Mtrs.
	c) 315 mm Dia. X 6 Kg/cm2	6	Mtrs.
	d) 250 mm Dia. X 10 Kg/cm2	30	Mtrs.
	e) 200 mm Dia. X 10 Kg/cm2	120	Mtrs.
	f) 160 mm Dia. X 10 Kg/cm2	180	Mtrs.
	g) 110 mm Dia. X 10 Kg/cm2	120	Mtrs.
	h) 90 mm Dia. X 10 Kg/cm2	90	Mtrs.
	i) 75 mm Dia. X 10 Kg/cm2	60	Mtrs.
	j) 63 mm Dia. X 10 Kg/cm2	120	Mtrs.
	* Piping quantities are to be measured actually at site and paid as per unit rate.		
6	Isolation Valves - (Pool Inlets)		
	a) 160 mm dia. UPVC Inlet valve (Butterfly) with Valve mounting kit in PVC, Complete with PVC stud ends, PVC flanges, Nut bolts and washers.	4	No.
7	Drain Valves - (Pool Drains)		
	a) 160 mm dia. UPVC Pool Drain valve (Butterfly) with Valve mounting kit in PVC, Complete with PVC stud ends, PVC flanges, Nut bolts and washers.	2	No
8	Pool Basin Fittings		
	a) ABS Plastic Concrete floor inlet with s.s. screw flow 12 m3/hr with 2" female and male connection.	100	No
	b) VGBA Approved Drain grating in ABS Plastic , Frame in injected moulded plastic, Size of Grill - 450mmx450mm	4	No
	c) SS-316 Plate type hair strainer for gutter connecting S. Pool Overflow Gutter to Balancing tank.	1	No

	d) S.S.316 Ladder (4 Step) SS ladder with polished stainless steel hollow pipe of 43mm Dia. and of 14 gauge(1.6mm) thick, Anti-slip stainless steel steps with anchoring fixtures.	4	No
	e) S.S.316 Ladder (5 Step) SS ladder with polished stainless steel hollow pipe of 43mm Dia. and of 14 gauge(1.6mm) thick, Anti-slip stainless steel steps with anchoring fixtures.	4	No
	f) Overflow Grating 495 mm wide, 34/35 mm Thick, Made with uv stabilised Polypropylene.	152	Rmt.
10	Pool Cleaning Accessories		
	a) Robotic Cleaner suitable for 50 m long pool, comply with the international certification of water proof rating for electronic products. The main unit should have Water 'Ingress Protection' (IP) rating of 68. Remote Control have IP21 and for Power Supply have rating of IP23.	1	No
	b)Trolley mounted Plastic self priming pump with Inbuilt Prefilter and Catridge Filter set 3 HP, 3 Phase 415 V directly coupled with motor on suitable Stainless Steel frame work provision of small switch board comprising of ICTPN 32 Amps, DOL starter of suitable capacity and control wiring with copper cable.	1	No
	c) Metallic vacuum head in Anodised Aluminium, 800 mm Long, connection external 2" to fit hoses, fork in Stainless Steel. for connection.	1	No
	d) Extensible handles for cleaning attachments in anodized aluminium which can be adapted to the entire range of cleaning equipment, brushes, leaf skimmers and scoops, 9 feet to 27 feet. Long.	1	No
	e) Transparent plastic vacuum hose 2" dia 30 mtrs. long including hose cuffs for connection to suction inlets.	1	No
	f) Deep bag net made in polypropylene and white polyester netting butterfly nut connection.	2	No
	g) Curved brushes made in polypropylene for pool basis and scum liners.	2	No
	h) Algae brushes with stainless steel bristles.	2	No
11	Pool Water Testing Instrument		
	Test kit suitable for measurement of residual Chlorine and pH	2	No

12	Chlorine & PH Dosing Equipments		
	Liquid Chlorine dosing equipment - Chlorine solution preparation tank (200 lit. Complete with Agitator, water inlet, drain & overflow piping (all 25mm) all necessary valves (3 nos.) & accessories dosing piping / tubing from tank to the dosing point with necessary valves & fittings and 2 Nos. dosing pump of Cap. 20 LPH.	2	No
13	Automatic pH Correction system comprise of an automatic proportional dosing system combining controller, electrical box and hydraulic by-pass probe holder in a single ready-to install unit. IP65 enclosures protect against water jets, Should Include two washable cartridge filters. 200 ltrs. Capacity PVC tank and PVC stirrer.	1	No.
14	Electrical Control Panel for Filtration Plant Pumps and Chlorine Dosing System factory made, Suitable for 415V, 3 phase, 4 Wires, 50 Hz, fabricated out of 16 SWG CRCA steel Sheet, IP 52, Floor mounting type, The steel sheet shall undergo minimum seven tank treatment followed by finishing powder coating of min. 60 microns thickness. Star delta starters with SPP, 3 Nos. of phase indicating lights, flush mounted Ammeter, Voltmeter, Selector Switches, Protective fuses. The board includes removable gland plates, cable glands, including connection with outgoing feeders complete with all respects. also includes all required cabling from Panel to Pumps with Cable, Cable Trays, Conduits, ect. within Plant Room.	1	No.
15	Underwater LED Lights		
	a) Stainless Steel Underwater led Light with S.S. 316L Housing, 45 w, 12 v Supply, Cool White Color, Niche in ABS Plastic, White color, with 2 m long cable, Plastic Conduit Hose, Junction Box in ABS Plastic with 3 entries of 3/4"	50	No
	b) Electrical Cabling for Underwater Lights of 'Polycab/Finolex 'Make Copper Flexible cable enclosed in PVC Conduit., 4.50 Sq. mm x 3 Core • Cable quantities are to be measured actually at site and paid as per unit rate.	2500	Rmt.
	c) Electrical Control Panel for LED Underwater Lights, factory made, Including separate transformers for each LED Underwater Light , suitable for 415 V, 3 phase, 4 Wires, 50 Hz, fabricated out of 16 SWG CRCA steel Sheet, IP 52, Floor mounting type with phase indicating lights, Selector Switches, Protective fuses. The board includes removable gland plates.	1	No.

Note:

- The quantity shown above are minimum indicative quantity.
- In the event of any variation between the indicative quantity and the quantity derived from the approved detailed calculations and design, 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 or design 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, whatsoever shall be entertained by the Client at a later stage on this account.

List of Acceptable Makes

The following list of approved vendors are provided for different materials.

SWIMMING POOLS ELECTRO MECHANICAL EQUIPMENTS	ASTRAL POOLS/SUPREME POOLS/PLANET POOLS & SPAS/SWIMMING POOLS AND SPA
KITCHEN EQUIPMENTS	JB EQUIPMENTS / MODERN RASOI SOLUTIONS PVT. LTD / INGNUUS OVERSIUS PVT. LTD
LAUNDRY EQUIPMENTS	IFB/FEBTECH/ JB EQUIPMENTS

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
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
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 WARRANTY)	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/EQ UIVALENT
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
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/EQUIVALENT
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/EQUIVALENT
47	STAINLESS STEEL	SALEM/ JINDAL/ TATA/EQUIVALENT
48	GYPSON PARTITION	SAINT GOBIN/ LAFARGE/ USG KNAUF/EQUIVALENT
49	GYPSON 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
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/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
66	MODULAR FURNITURE	GODREJ/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
67	CHAIRS AND SOFAS	GODREJ/FEATHERLITE/GEEKEN/ISIT/BOMBAYSAFE/EQUIVALENT
68	MODULAR FIXED & LAB FURNITURE, etc.	GODREJ/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
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/ALUFLOOR/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/THO RN/TEKNOWARE /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	TOSTEM/REYNERS/KAWNEER/SCHUCO/ALUK/HAFELE/EQUI VALENT
101	BAFFLE METAL CEILINGS	HUNTER DOUGLAS/DURLUM/BOLLARD/USG/KNAUF/ARMSTRONG/EQ UIVALENT
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
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 Processor	SP Coating / MJ Coaters / Aura International/Equivalent
127	Smoke Seal Intumescent	HAFELE/ENVIROGRAF/WEDGE/PROMAT/MANN MAGOWAN/INTUFLAME/EQUIVALENT
128	SS Spider Fittings	DORMA/HETTICH/DORSET/EQUIVALENT
129	SS Patch Fitting	DORMA/HETTICH/DORSET/EQUIVALENT
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	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
146	METAL CLAD SOCKET (Industrial)	Lauritz Knudsen/ ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT
147	RISING MAINS / BUS DUCT	Lauritz Knudsen/ ABB/SCHNEIDER/ADVANCE/LEGRAND/SUPER TECH CONTROL/EQUIVALENT
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
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 ACTUATORS - 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	OBO/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/EQUIV ALENT
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
168	33&11 KV Ring Main Unit (With Metering)	Lauritz Knudsen/ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT (Approved by Discom)
169	33&11 KV Ring Main Unit (Without Metering)	Lauritz Knudsen/ABB/ SCHNEIDER/ SIEMENS/GE/EQUIVALENT (Approved by Discom)
170	CABLES/ TERMINATIONS/ACC ESSORIES	
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)	POLYCAB/KEI/AKG/HAVELLS/EQUIVALENT
174	CONTROL CABLE (COPPER)	POLYCAB/KEI/AKG/HAVELLS/EQUIVALENT
175	HT XLPE CABLE	POLYCAB/KEI/AKG/HAVELLS/EQUIVALENT
176	H.T. CABLE END TERMINATION	POLYCAB/KEI/AKG/HAVELLS/3M/XYLEM/RAYCHEM/EQUIVA LENT
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/OBO/ 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	
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
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/OBO/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	VOLTAMP/ KIRLOSKAR /Crompton Greaves /PVJ/EQUIVALENT (Approved by Discom)
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
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	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
247	F.B.P.R.V.	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
248	FLOAT VALVE	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
249	C.I, SLUICE VALVE	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/KIRLOSKAR/Lauritz Knudsen/EQUIVALENT
250	C.I. BUTTER FLY	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/KIRLOSKAR/Lauritz Knudsen/EQUIVALENT
251	C.I.NRV REFLUX	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
252	C.I. DUAL PLATE	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
253	D.I. WAFER TYPE CHECK VALVE	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/Lauritz Knudsen/EQUIVALENT
254	C.I. Y TYPE STRAINER	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
255	C.I. DOUBLE ACTING AIR VALVE	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/KIRLOSKAR/EQUIVALENT
256	FOOT VALVE	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
257	REST ALL TYPE OF VALVE	ZOOTO/ 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/ CONEX BÄNNINGER/ VIEGA/ AQUINOX/VSH/EQUIVALENT
265	FRP Manholes Covers	EVERLAST/THERMO SET/RX/EQUIVALENT
266	PRESSURE RELIEF VALVES	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
267	PRESSURE REDUCING VALVES	ZOOTO/ 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/Elegant Controls/EQUIVALENT
273	WATER LEVEL	MINILEC/AUTOPUMP/TECHNIKA/Elegant

	CONTROLLER	Controls/EQUIVALENT
274	ELECTRONIC SENSING PROBE	MINILEC/AUTOPUMP/TECHNIKA/Elegant 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)	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
280	BUTTERFLY VALVE (LEVER TYPE)	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/AUDCO/DANFOS/EQUIVALENT
281	BUTTERFLY VALVE (GEAR TYPE)	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/AUDCO/DANFOS/EQUIVALENT
282	MOTORIZED VALVE	ZOOTO/ 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/ EVERS SAFE/EQUIVALENT
292	FIRST AID FIRE HOSE REEL WITH BRACKET, DRUM AND SHUT OFFNOZZLE	NEWAGE / MINMAX / TYCO/ EVERS SAFE/EQUIVALENT
293	G.I. AND M.S. FITTINGS	ZOOTO/ JAINSON / BHARATFORGE/EQUIVALENT
294	C.I. DOUBLE FLANGED SLUICE / GATE VALVE / NON-RETURN VALVES	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
295	SLIM SEAL BUTTERFLY VALVES (PN- 1.6)	ZOOTO/ ADVANCE/ SANT / KARTAR / CRI/EQUIVALENT
296	C. I. BODY BUTTERFLY VALVE	ZOOTO/ 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
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/ Emerald/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	NEWAGE / MINMAX/HD/VIKING/EQUIVALENT

	BREACHING	
321	4-WAY INLET BREACHING	NEWAGE / MINMAX/HD/VIKING/EQUIVALENT
322	GAS FIRE SUPPRESSION 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
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
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 /Nicta / Systemair/EQUIVALENT
354	CENTRIFUGAL FAN FOR VENTILATION (AMCA CERTIFIED FOR SOUND & PERFORMANCE)	Greenheck /Nicta / Systemair/EQUIVALENT
355	PROPELLER FAN	Greenheck /Nicta / 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
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
386	EXPANDED POLYSTYRENE	METTUR BEARDSSELL / 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/SOCOMEK/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	Armocell 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
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 ANALYSER/ TDS ANALYSER	HACH/ABB/OMICRON/SIEMENS/HONEYWELL/JOHNSON CONTROL/SCHNEIDER
430	FCU/AHU VALVES	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/ROUTE R	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 READER	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
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 PLATFORM/ 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	BOSE/AUDAC/TOA/YAMAHA/SENNHEISER/EQUIVALENT

	System	
485	CEILING TILE MICROPHONE	BOSE/AUDAC/TOA/YAMAHA/SENNHEISER/EQUIVALENT
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
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

- The above list is indicative in nature; however, the contractor can propose a higher or similar make based on the Technical Specifications, Warranty Details, Serviceability 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 Serviceability) 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: PAYMENT SCHEDULE

PAYMENT SCHEDULE			
NAME OF WORK: PROPOSED REGIONAL SPORTS HUB IN DHAMNAGAR, BHADRAK			
SL NO	ACTIVITY	PERCENTAGE BREAKUP OF COMPONENTS	PAYMENT AS % OF AGREEMENT COST
A	B	C	D
	DESIGN STAGE		2.00%
1	On approval of Inception Report, detail survey and draft concept architectural drawing, QMP & site Development Plan		0.50%
2	On approval of architectural & Structural Drawings of all components including approval of test piles, if any		0.50%
3	On approval of MEP		0.50%
4	On approval of final Architectural drawing showing electrical and sanitary layout plan and detail structural design and interior design/decoration		0.50%
	CONSTRUCTION STAGE		95.00%
I	FOOTBALL FIELD FACILITY BUILDING		4.78%
A	CIVIL WORK		% as per Item I as mentioned in Column (C).
1	On Completion of foundation work upto pile work	8.58%	
2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	9.35%	
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	12.20%	
4	On Completion upto First Floor Superstructure excluding gallery structural work	6.60%	
5	On Completion of Gallery structural work including tensile fabric work	13.61%	
6	On Completion of Brickwork	5.63%	
7	On Completion of Joineries work like door & window works	3.29%	
8	On Completion of Flooring & tiling work	5.81%	
9	On Completion of Finishing work like paster paint & putty	5.75%	
10	On Completion of civil works in all respect	6.05%	
11	On completion of supply, fitting and fixing of furniture	1.92%	
12	On completion of supply, fitting and fixing Signage	0.46%	
13	On completion of supply, fitting and fixing Seating Chairs	5.02%	
14	On completion of PH Internal work	6.16%	
15	On completion of PH External work	4.09%	
16	On completion of Internal Electrical work	5.46%	

II	FOOTBALL FIELD		7.86%
A	FOOTBALL FIELD CIVIL ESTIMATE		% as per Item II as mentioned in Column (C).
1	On completion of Subbase including Laying & Compacting 10-20mm stone aggregate Spreading in uniform layers etc.	4.97%	
2	On completion of mixture of sand and manure mixed with cocopeat etc.	2.44%	
3	On completion of Spreading of Organic matter, basal fertilizer etc.	1.91%	
4	On completion of Bermuda TIFWAY419 grass	4.09%	
5	On completion of perforated sub-drainage pipes pipe with Geotextile in trenches	2.67%	
6	On completion of laying of Geotextile over the entire FOP	2.26%	
7	On completion of fixing of Football Equipment	0.80%	
8	On completion of fixing of Dugout	0.95%	
B	On completion of Fencing work		
1	on completion of foundation work including fixing of angle	2.61%	
2	On completion of fencing work in all respect	1.81%	
C	On completion of supply, fitting and fixing of Drainage Work		
1	on completion of Drainage work upto wall	1.44%	
2	On completion of Drainage work in all respect	0.80%	
D	5 YEARS MAINTENANCE		
1	On completion of 1 st Year Maintenance	1.30%	
2	On completion of 2 nd Year Maintenance	1.94%	
3	On completion of 3 rd Year Maintenance	2.59%	
4	On completion of 4 th Year Maintenance	3.24%	
5	On completion of 5 th Year Maintenance	3.89%	
E	on completion including Testing and Commissioning of all Irrigation/sprinkler System in all respect	2.31%	
F	150 KLD UNDER GROUND TANK FOR FOOTBALL GROUND	1.89%	
G	FOOTBALL FIELD LIGHTING	56.09%	
III	SITE DEVELOPMENT WORKS		1.20%
	On Completion of site cleaning & earth filling		
IV	MPH BUILDING		5.70%
A	Civil Works		% as per Item IV as
1	On Completion of foundation work upto pile work	7.42%	

2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	6.69%	mentioned in Column (C).
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	9.44%	
4	On Completion upto First Floor Superstructure	2.69%	
5	On Completion upto Second Floor Superstructure	2.38%	
6	On completion of Standing Seam Roofing, Flashing, Gutter Work, etc.	13.50%	
7	On Completion of Brickwork	3.81%	
8	On Completion of Joineries work like door & window works	2.35%	
9	On Completion of Finishing work like paster paint & putty	5.72%	
10	On Completion of building Flooring & tiling work	1.62%	
11	On completion of Arena, Gym, Weightlifting Area Flooring works	13.54%	
12	On Completion of civil works in all respect	3.37%	
13	On completion of supply, fitting and fixing of Gym equipment	7.16%	
14	On completion of supply, fitting and fixing of Sports equipment	0.07%	
15	On completion of supply, fitting and fixing of Furniture	1.17%	
16	On completion of supply, fitting and fixing of Signage	0.21%	
17	On completion of PH Internal work	3.14%	
18	On completion of PH External work	3.46%	
19	On completion of Internal Electrical work	12.23%	
V	9 LANE SYNTHETIC ATHELETIC TRACK: 400 Rmt		9.54%
1	on completion of Sub-Base and Base for Synthetic Athletic Track, Long Jump, High Jump & water jump		% as per Item V as mentioned in Column (C).
2	On completion upto granular sub-base course	4.70%	
3	On completion upto granular base course	3.33%	
4	On completion upto bituminous base course	5.21%	
5	On completion upto bituminous wearing course	4.38%	
6	on completion of Synthetic Athletic Surface (Full Pur)	76.35%	
7	On completion of supply, fitting and fixing of Track & Events Equipment	0.47%	
8	On completion of supply, fitting and fixing of Competition Equipment	3.84%	
9	On completion of Pedestrian Pathway Periphery Of Track	1.72%	
VI	CRICKET FIELD FACILITY BUILDING		5.17%
A	CIVIL WORK		% as per Item VI as
1	On Completion of foundation work upto pile work	7.57%	

2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	6.68%	mentioned in Column (C).
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	11.48%	
4	On Completion upto First Floor Superstructure excluding gallery structural work	10.57%	
5	On Completion of Gallery structural work including tensile fabric work	12.59%	
6	On Completion of Brickwork	6.08%	
7	On Completion of Joineries work like door & window works	3.35%	
8	On Completion of Flooring & tiling work	5.15%	
9	On Completion of Finishing work like paster paint & putty	6.70%	
10	On Completion of civil works in all respect	5.98%	
11	On completion of supply, fitting and fixing of furniture	1.78%	
12	On completion of supply, fitting and fixing of Signage	0.43%	
13	On completion of supply, fitting and fixing of Seating Chairs	5.59%	
14	On completion of PH internal work	6.93%	
15	On completion of PH external work	3.80%	
16	On completion of Internal Electrical work	5.32%	
VII	NATURAL CRICKET FIELD		10.47%
A	CRICKET FIELD CIVIL ESTIMATE		% as per Item VII as mentioned in Column (C).
1	On completion of Subbase including Laying & Compacting 6-10mm stone aggregate Spreading in uniform layers etc.	8.75%	
2	On completion of mixture of sand and manure mixed with cocopeat etc.	3.15%	
3	On completion of Spreading of Organic matter, basal fertilizer etc.	2.56%	
4	On completion of Bermuda TIFWAY419 grass	5.28%	
5	On completion of perforated sub-drainage pipes pipe with Geotextile in trenches	2.51%	
6	On completion of laying of Geotextile over the entire FOP	2.91%	
7	on Completion of construction of pitches	2.40%	
8	on Completion of BOWLING RUN UP at both ends of the pitch	0.39%	
9	on completion including Testing and Commissioning of all Irrigation/sprinkler System in all respect	2.23%	
B	5 YEARS MAINTAINANCE		
1	On completion of 1 st Year Maintenance	1.42%	
2	On completion of 2 nd Year Maintenance	2.13%	

3	On completion of 3 rd Year Maintenance	2.84%	
4	On completion of 4 th Year Maintenance	3.55%	
5	On completion of 5 th Year Maintenance	4.26%	
C	On completion of Fencing work		
1	on completion of foundation work including fixing of angle	1.63%	
2	On completion of fencing work in all respect	0.61%	
D	On completion of supply, fitting and fixing of equipment	1.47%	
E	On completion of Drainage Work		
1	on completion of Drainage work upto wall	2.55%	
2	On completion of Drainage work in all respect	1.42%	
F	On completion of supply, fitting and fixing of 150 KLD Under Ground Tank for Cricket Field	1.42%	
G	On completion of Cricket Field Lighting	46.52%	
VIII	INDOOR SWIMMING POOL		13.62%
A	CIVIL WORK		% as per Item VIII as mentioned in Column (C).
1	On Completion of foundation work upto pile work	5.30%	
2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	10.34%	
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	5.33%	
4	On Completion upto First Floor superstructure work i.e slab including lintel	1.88%	
5	On completion of Standing Seam Roofing, Flashing, Gutter Work, etc.	26.49%	
6	On Completion of Aluminium perforated sheet with aluminium frame and accessories	1.69%	
7	On Completion of Brickwork	1.83%	
8	On Completion of Joineries work like door & window works	1.35%	
9	On Completion of Flooring & tiling work	7.26%	
10	On Completion of Finishing work like paster paint & putty	2.59%	
11	On Completion of civil work in all respect	4.96%	
12	On completion of supply, fitting and fixing of Furniture & Pool equipment	9.56%	
13	On completion of supply, fitting and fixing of Signage	0.06%	
14	On completion of PH Internal work	1.79%	
15	On completion of PH External work	1.41%	
16	On completion of Filtration Plant & Accessories	15.63%	
17	On completion of Internal Electrical work	2.53%	
IX	CRICKET PRACTICE PITCH		0.40%

A	CRICKET PRACTICE PITCH, WARM-UP AREA		% as per Item IX as mentioned in Column (C).
1	On completion upto Granular Subbase, etc.	9.01%	
2	On completion of spreading of good earth, dump manure etc.	15.05%	
3	On completion of Bermuda TIFWAY419 grass	31.15%	
4	On completion of practice pitch (concrete & synthetic) in all respect	7.91%	
B	On completion of Fencing work		
1	on completion of foundation work including fixing of angle	14.56%	
2	On completion of fencing work in all respect	5.19%	
C	On completion of Electrical Work	17.13%	
X	BASKETBALL COURT-1 No (PU Based Court)		0.95%
A	COURT ESTIMATE		% as per Item X as mentioned in Column (C).
1	On completion of base course.	9.74%	
2	On completion of Supply & Installation of SYNTHETIC SPORTS SURFACE with marking painting, kerb etc in all respect	30.48%	
B	On completion of supply, fitting and fixing of equipment	4.17%	
C	On completion of Fencing work	9.16%	
D	On completion of Stepped Seating work	42.07%	
E	On completion of Drain-35 Rmt work	1.62%	
F	On completion of Electrical work	2.77%	
XI	KHO KHO COURT-1 No (Clay Based)		0.05%
A	COURT ESTIMATE		% as per Item XI as mentioned in Column (C).
1	On completion of outdoor clay surface for Kho-Kho court complete in all respects.	57.02%	
B	On completion of supply, fitting and fixing of equipment	2.34%	
C	On completion of Electrical work	40.64%	
XII	100 BEDDED BOYS HOSTEL-(G+2)		6.45%
A	Civil Work		% as per Item XII as mentioned in Column (C).
1	On Completion of foundation work upto pile work	5.70%	
2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	4.50%	
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	6.43%	
4	On Completion of Brickwork (GF)	1.24%	
5	On Completion of Joineries work like door & window works (GF)	1.87%	
6	On Completion of Flooring & tiling work (GF)	2.30%	
7	On completion of VDF, Gym, Weightlifting Area Flooring works (GF)	1.88%	

8	On Completion of Finishing work like paster paint & putty (GF)	1.72%	
9	On Completion upto First Floor superstructure work i.e slab including lintel	6.06%	
10	On Completion of Brickwork (FF)	1.98%	
11	On Completion of Joineries work like door & window works (FF)	1.71%	
12	On Completion of Flooring & tiling work (FF)	2.35%	
13	On Completion of Finishing work like paster paint & putty (FF)	1.54%	
14	On Completion upto Second Floor superstructure work i.e slab including lintel	6.10%	
15	On Completion of Brickwork (SF)	2.16%	
16	On Completion of Joineries work like door & window works (SF)	1.71%	
17	On Completion of Flooring & tiling work (SF)	2.38%	
18	On Completion of Finishing work like paster paint & putty (SF)	1.59%	
19	On Completion upto Terrace Floor superstructure work i.e slab including lintel	0.72%	
20	On Completion of Brickwork, joineries work, flooring & tiling work, finishing works (Terrace Floor)	1.06%	
21	On Completion of civil work in all respect	1.84%	
22	On completion of supply, fitting and fixing of Furniture	12.78%	
23	On completion of supply, fitting and fixing of Modular Kitchen	3.47%	
24	On completion of supply, fitting and fixing of Gym equipment	6.33%	
25	On completion of supply, fitting and fixing of Laundry equipment	1.57%	
26	On completion of PH Internal work	4.08%	
27	On completion of PH External work	2.97%	
28	On completion of Internal Electrical work	11.94%	
XIII	100 BEDDED GIRLS HOSTEL-(G+2)		6.45%
A	Civil Work		% as per Item XIII as mentioned in Column (C).
1	On Completion of foundation work upto pile work	5.70%	
2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	4.50%	
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	6.43%	
4	On Completion of Brickwork (GF)	1.24%	
5	On Completion of Joineries work like door & window works (GF)	1.87%	

6	On Completion of Flooring & tiling work (GF)	2.30%	
7	On completion of VDF, Gym, Weightlifting Area Flooring works (GF)	1.88%	
8	On Completion of Finishing work like paster paint & putty (GF)	1.72%	
9	On Completion upto First Floor superstructure work i.e slab including lintel	6.06%	
10	On Completion of Brickwork (FF)	1.98%	
11	On Completion of Joineries work like door & window works (FF)	1.71%	
12	On Completion of Flooring & tiling work (FF)	2.35%	
13	On Completion of Finishing work like paster paint & putty (FF)	1.54%	
14	On Completion upto Second Floor superstructure work i.e slab including lintel	6.10%	
15	On Completion of Brickwork (SF)	2.16%	
16	On Completion of Joineries work like door & window works (SF)	1.71%	
17	On Completion of Flooring & tiling work (SF)	2.38%	
18	On Completion of Finishing work like paster paint & putty (SF)	1.59%	
19	On Completion upto Terrace Floor superstructure work i.e slab including lintel	0.72%	
20	On Completion of Brickwork, joineries work, flooring & tiling work, finishing works (Terrace Floor)	1.06%	
21	On Completion of civil work in all respect	1.84%	
22	On completion of supply, fitting and fixing of Furniture	12.78%	
23	On completion of supply, fitting and fixing of Modular Kitchen	3.47%	
24	On completion of supply, fitting and fixing of Gym equipment	6.33%	
25	On completion of supply, fitting and fixing of Laundry equipment	1.57%	
26	On completion of PH Internal work	4.08%	
27	On completion of PH External work	2.97%	
28	On completion of Internal Electrical work	11.94%	
XIV	SKATING RINK		0.28%
A	Court Estimate		% as per Item XIV as mentioned in Column (C).
1	On completion of outdoor clay surface for Volleyball court complete in all respects.	51.30%	
2	On completion of 4 Layer Acrylic specifications for Skirting Acrylic Synthetic Flooring (Deco Turf ITF Approved)	48.70%	

XV	VOLLEYBALL COURT-1 No (lay Court)		0.26%
A	Court Estimate		% as per Item XV as mentioned in Column (C).
1	On completion of outdoor clay surface for Volleyball court complete in all respects.	6.89%	
B	On completion of supply, fitting and fixing of equipment	3.25%	
C	On completion of Fencing work	34.10%	
D	On completion of Stepped Seating work	42.50%	
E	On completion of Drain-35 Rmt work	5.86%	
F	On completion of Electrical work	7.40%	
XVI	On Completion of UGR (44 KLD)		0.10%
XVII	SERVICE BUILDING		0.50%
A	Civil Work		% as per Item XVII as mentioned in Column (C).
1	On Completion of foundation work upto pile work	12.38%	
2	On Completion of sub-structure work i.e. upto plinth including ramp, steps & plinth protection	9.92%	
3	On Completion upto Ground Floor superstructure work i.e slab including lintel	20.26%	
4	On Completion of Brickwork	5.56%	
5	On Completion of Joineries work like door & window works	8.06%	
6	On Completion of Flooring & tiling work	0.24%	
7	On Completion of Finishing work like paster paint & putty	8.18%	
8	On Completion of other misc works like water proofing, grading, glazing works etc & completion of work in all respect	8.91%	
9	On completion of Internal Electrical work	26.49%	
XVIII	SITE DEVELOPMENT WORKS		16.09%
A	Internal Driveway (CC ROAD)		% as per Item XVIII as mentioned in Column (C).
1	On completion of Excavation, Compaction, GSB, Sand Filling, PCC etc	10.24%	
2	On completion of concreting of road	34.06%	
3	On completion of road in all respect	2.30%	
B	Parking (Paving)		
1	On completion Granular layer, etc	10.91%	
2	On completion of Paving in all respect	8.47%	
C	1640 Rmt Compound Wall		
1	On Completion of foundation work upto pile work	7.98%	
2	On Completion of sub-structure i.e. Upto plinth	3.35%	
3	On completion of Super Structure work	2.80%	
4	On Completion of Brickwork	1.55%	

5	On Completion of MS Grill & concertina coil fencing works	0.49%	
6	On Completion of Finishing work in all respect	1.32%	
D	Gate Complex (2 Nos)	0.32%	
E	Guard Room - 2 nos	0.61%	
F	On Completion of Landscape work	4.20%	
G	Main Drain-1500 Rmt		
1	on completion of Drainage work upto bed	2.08%	
2	on completion of Drainage work upto wall	3.27%	
3	On completion of Drainage work in all respect	1.69%	
H	On Completion of Recharge Pit work	1.64%	
I	On Completion of PH External (Pipes, Valves, Borewell, Pumps) work	0.72%	
J	On Completion of Irrigation UGR 210 KLD	2.01%	
XIX	EXTERNAL ELECTRICAL WORKS		4.96%
1	On Completion of Area Lighting	11.75%	% as per Item XIX as mentioned in Column (C).
2	On Completion of Panel & Cables	36.28%	
3	On Completion of Substation	49.96%	
4	On Completion of Solar PV System	2.01%	
XX	KABADDI COURT-1 No (Mat Based Court) (MALE)		0.17%
1	On Completion of Civil Works	84.93%	% as per Item XX as mentioned in Column (C).
2	On Completion of Electrical Works	15.07%	
	ACCEPTANCE STAGE		3.00%
1	Final approval from competent authority viz. development authority including testing, commissioning with approval from authority like fire officer and completion of all items as per approval.		1.00%
2	On issuance of 3-star GRIHA rating		0.50%
3	On submission of As-Built drawings and other documents as mentioned in Contract Data		1.00%
4	Handover of all components as per scope to the end user i.e. Sports Department		0.50%
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	Contractor's Bid	As per format provided at Sl. No. 1, Section-2	
2	Bid Processing Fees	Scanned copy of BG	
3	EMD/ Bid Security -	Scanned copy of DD	
4	Written power of attorney of the signatory of the Bid to commit the Bidder	Copy of power of attorney	
5	Whether Indian firms (Y/N)	Certificate of Incorporation	
6	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	
7	Constitution or legal status of Bidder	Incorporation Certificate, Partnership Deed, Trade License, MoA, AoA	
8	Place of registration	Qualification Information	
9	Principal place of business	Qualification Information	
10	Major items of construction equipment proposed to carry out the Contract	Invoices of equipment / Lease agreement	
11	Qualifications and experience of key site management and technical personnel proposed for the Contract	Detailed CV	
12	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	

13	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	
14	Authority to seek references from the Bidder's bankers	Bankers Details	
15	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	
16	Methodology & Programme.	To be submitted in Cover-III as DBR	
17	Bids from Joint venture - Bids from Joint ventures/ Consortiums /Association of Parties are not acceptable	To be mentioned	
18	Annual minimum turnover	Turnover from Civil Construction works certified by chartered accountant	
19	The Firm should demonstrate making profit	CA/ Statutory auditor certificate	
20	Should have valid PAN and GSTIN	Scan copy of valid PAN and GSTIN	
21	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	
22	Bid Validity Undertaking	Undertaking	
23	Affidavit	Affidavit by the bidder duly signed by the Notary Public and as specified in Section 2,	
24	Design Basis Report	As mentioned in the RFP	
25	Certificate of No Relationships	As per format given in Section-2 of the tender document	
26	Information Regarding Any Conflicting Activities and Declaration Thereof	As per format given in Section-2 of the tender document	
27	Proposal for Sub-Contract	To be mentioned	

Total 685 (Six Hundred Eighty Five) pages only.

[Signature]
14/07/26

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14/07/2026

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14/7

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14/7/26

APPROVED
Sd/-
Chief Engineer-I