



An IS/ISO 9001 : 2015
Company



A Navratna CPSE

No: NBCC/(Tech Audit/Quality)/2022/848

Date: 17.03.2022

Amendment No-1 to Technical Circular No: 06

Subject: Installation of RO Plant at all Project Sites- reg.

Vide Technical Circular No. 6 dated 09.10.2020, it was directed that installation of RO Plant is mandatory at all sites and in case of non-installation of RO Plant due to any specific reason, the same should have the approval of concerned Director or Sr. Executive Director.

Hence forth it has been directed that all projects irrespective of project value, the contractor shall compulsorily install the Reverse Osmosis Plant along with concrete batching plant and in case RMC is used, it should be ensured that RMC Plant is having RO Plant.

This is issued with the approval of the Competent Authority.

AP *17/3/2022*

(Annu Garg)

Executive Director (Tech Audit)



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A Navratna CPSE



एक कदम स्वच्छता की ओर

NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/CGM/Tech. Audit/Quality/2020/479

Dated: 07.09.2020

CIRCULAR

During site inspection by the Tech. Audit team and senior officers at various projects, one of the common and major deficiencies observed is the accumulation of water on the bathroom floor due to improper slope.

As normally tiles are being used in bathroom, it is very difficult to provide the slope in the floor from all directions towards floor trap.

To overcome the problem, grating in the form of channel of suitable size/ material as shown in **Annexure-A** may be provided in all bathrooms.

The typical specifications for normal use may be adopted as below:

- **Material:** Stainless Steel
- **Length:** Depends up on the size of bathroom.
- **Width** – 100 mm to 150 mm
- **Depth** – 40 mm to 50 mm.

However, the size may be finalized as per the requirements and actual design.

In view of above all RBG/SBG heads are requested to bring the above to the notice of Zonal/Unit/Site – in –Charges for their necessary action and to ensure its implementation with immediate effects.

Encl: Annexure-A.


(Anil Malla)

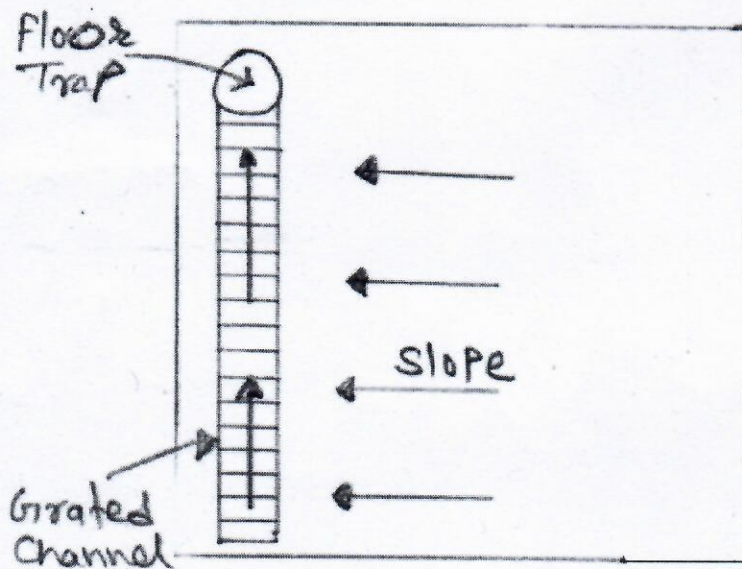
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Annexure - A



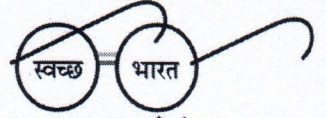
(Remedy)
Bathroom Plan.



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एक कदम स्वच्छता की ओर

NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

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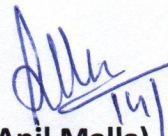
Dated: 14.09.2020

TECHNICAL CIRCULAR- 02

Sub: Formation of Quality Control Unit.

It has been decided by the Competent Authority that all projects shall have the Quality Control Unit.

The Quality Control unit shall report directly to the RBG/SBG heads. Observations raised by Quality Control Unit should be attended expeditiously by field team. Efforts should be made to ensure that deficiencies pointed out by Quality Control team are not repeated on the project.


14/09/2020
(Anil Malla)

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NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/CGM/Tech. Audit/Quality/2020/483

Dated: 18.09.2020

TECHNICAL CIRCULAR No - 03

Subject: Remedial measures for wider cracks in plastered surface.

During site inspection by the Tech. Audit team and senior officers at various projects, one of the most common deficiencies observed at site is the appearance of various types of cracks on plastered surface, especially wider and fine hair line cracks.

The wider cracks appears on plastered surface because plastering on wall is done in a single layer instead of doing on multiple layers, if plaster thickness more than 15 mm. This may also occurred due to inadequate curing time (less than 7 days - as per CPWD Specification/IS 1661).

In addition to above, separation of plaster from the wall (also called plaster De-bonding) is the one of major deficiency observed at site and this happens because the thickness of plaster used is beyond the permissible limits specified in CPWD specification or IS 1661 Code.

In view of above, all concerned (Zonal/Unit/Site – in –Charges) shall ensure that contractor is following the CPWD specifications and codal provisions of IS 1661 for plastering work. However, the some of the most important codal provisions of IS 1661 are reiterated below:

1. Recommended Plaster Specifications (Table 2, Page-14 of IS 1661)

The plastering should be done in multi layers if plaster thickness required is more than 15 mm. It is generally recommended to make 3 plaster coats in which first coat is of 10 to 15 mm thick, 2nd coat is of 3-8 mm and 3rd finishing coat is of 3- 5 mm thick. The maximum thickness can be done up to 28 mm in three layers where surface shall have to be very rough. The specification of cement & sand mortar may be adhered to as mentioned in table.

2. Thickness of Plastering (CL No 7.3, Page 10, IS -1661)

The thickness of plaster should not exceed beyond the permissible limits specified in IS 1661. For instance in case of brick walls, if the thickness of plaster is up to 15 mm, it shall be done in single coat. However, if the thickness of plaster is more than 15 mm up to 20 mm, it should be done in two layers. The situation of thickness of plaster shall be adopted as mentioned in table.

In case, the plaster is to be done beyond prescribed thickness, strengthening measures such as plaster in multiple layers, use of wire mesh, use of bonding agents and roughening of surfaces etc. may be adopted. However, the consultant of the project may give the location specific advice.

3. Curing – (CL: 16.0, Page-24, IS 1661)

Each coat shall be kept damp till next coat is applied or for a maximum period of seven days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury.

After completion of the finishing coat, the plaster shall be kept wet for at least 7 days and shall be kept protected during that period from extreme temperatures and weather.

In view of above all RBG/SBG heads are requested to bring the notice to Zonal/Unit/Site – in –Charges for the implementation of above.

End: IS 1661 Code.


18/09/2020

(Anil Malla)

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IS 1661 : 1972
(Reaffirmed 1987)

Indian Standard

CODE OF PRACTICE FOR
APPLICATION OF CEMENT AND
CEMENT-LIME PLASTER FINISHES

(*First Revision*)

Fifth Reprint SEPTEMBER 1996

UDC 693.621 : 69.001.3

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

CODE OF PRACTICE FOR APPLICATION OF CEMENT AND CEMENT-LIME PLASTER FINISHES

(*First Revision*)

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(*Continued on page 2*)

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IS : 1661 - 1972

(Continued from page 1)

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Indian Standard
CODE OF PRACTICE FOR
APPLICATION OF CEMENT AND
CEMENT-LIME PLASTER FINISHES
(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 25 February 1972, after the draft finalized by the Flooring and Plastering Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Cement plaster and cement plaster gauged with lime are widely used in this country for finishing of walls and ceilings of buildings. Practice in the country with regard to the preparation, application and finishing of the plaster varies considerably from state to state and from department to department. It is the object of this standard to lay down a code of practice generally suitable to Indian conditions, and striking a workable compromise between theoretical requirements and existing practices. This standard which was first published in 1960 is now being revised taking into account the experience gained in the plastering work for the past one decade.

0.3 This code is intended chiefly to lay down requirements regarding the quality of materials, their selection and the manner of their application in plaster work.

0.4 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from BSCP 211 : 1966 published by the British Standards Institution.

0.5 This standard is one of a series of Indian Standards on plaster finishes. Other standards published so far in the series are:

IS : 2394-1965 Code of practice for application of lime plaster finish

IS : 2402-1963 Code of practice for external rendered finishes

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS:2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers application of cement and cement-lime plaster finishes to walls, columns, ceilings and similar surfaces on backgrounds normally met with, such as brick, stone or concrete (plain or reinforced). Lime plasters, mud plasters and other special plasters are not covered by this code.

1.2 Recommendations are laid down with regard to the minimum preparation of surfaces to receive the plaster. Different materials available, their suitable mixes and the best methods of their application are also discussed.

2. TERMINOLOGY

2.0 For the purpose of this code, the following definitions shall apply.

2.1 Materials

2.1.1 Fat Lime — The lime which has high calcium oxide content and is dependent for setting and hardening solely on the absorption of carbon dioxide from the atmosphere.

2.1.2 Hydrated Lime — A dry powder obtained by treating quicklime with water enough to satisfy its chemical affinity for water under the conditions of its hydration. It consists essentially of calcium hydroxide and magnesium hydroxide.

2.1.3 Hydraulic Lime — Lime containing small quantities of silica and alumina and/or iron oxide which are in chemical combination with some of the calcium oxide content, giving a putty or mortar which has the property of setting and hardening under water.

2.1.4 Plaster — The general term for a material used to cover surfaces, which is applied while plastic and which hardens after application. Cement-lime plaster refers to cement plaster gauged with lime.

2.1.5 Quicklime — A calcined material, the major part of which is calcium oxide in natural association with a relatively small amount of magnesium oxide, capable of slaking in water. Lumlime is quicklime as it comes from the kilns.

*Rules for rounding off numerical values (revised).

2.2 Tools and Accessories — For tools and accessories, such as drag or scratcher, floats, rules or battens, squares, templates, trowels and iron pan, the definitions are as given in IS : 1630-1960*.

2.2.1 Scaffolding (Staging) — A temporary framework of bamboo, wood or steel to provide a platform from which the mason does the plastering work.

2.3 Site Operations

2.3.1 Finishing Coat — The final coat in two or three coat plaster work. This is also referred to as the final coat, setting coat, face coat or skimming coat (the term 'skimming coat' is also applied to single-coat work).

2.3.2 Gauging — The mixing of various constituents of a plaster. This term is also used for denoting the addition of cement to a lime-sand mix or of lime to a cement-sand mix. 'A gauging' is the term given to an individual plaster work.

2.3.3 Screeds — Narrow strips or bands of plaster laid on walls or ceilings to serve as guides for bringing the whole work to a true or even surface, the screeds being incorporated in the final undercoats.

2.3.4 Undercoats — Plaster coats (often referred to as backing coats) the main function of which is to provide surfaces suitable for the application of succeeding coats. There are following two types of undercoats:

- a) *Rendering coat* — The coat which is applied directly to the building surfaces to be plastered (also referred to as the 'first coat').
- b) *Floating coat* — The coat used in three-coat work to bring the first coat to a true and even surface before the finishing coat is applied (also referred to as the 'second coat').

2.4 Characteristic Defects

2.4.1 Blistering — The development of one or more local swellings on the finished plaster surface.

2.4.2 Cracking — The development of one or more fissures not assignable to structural cause.

NOTE — Cracks in plaster in the vicinity of a structural crack are not assignable to structural failure unless they are in conformity with the structural crack.

2.4.3 Crazing — The development of a series of hair cracks on the finished plaster surface. Known as 'map crazing', when it forms an haphazard pattern over the wall surface affected.

2.4.4 Efflorescence — A deposit of soluble salts on the surface of the plaster or background.

*Specification for mason's tools for plaster work and pointing work.

2.4.5 Flaking — The scaling away of patches of plaster surface due to lack or loss of adhesion with the previous coat.

2.4.6 Grinning — The appearance on the surface of the plaster of the pattern of joints or similar breaks in the continuity of the surface characteristics of the background.

2.4.7 Peeling — The dislodgement of substantial areas of plaster work from the background.

2.4.8 Popping or Blowing — The appearance on the surface of the plaster of conical hollows (pops or blows) in the backing and/or finishing coats.

2.5 General

2.5.1 Dubbing Out — The operation of attaching pieces of slate, tile, etc, to a wall with plaster, and then likewise covering them in order to fill out hollows or to form projections.

2.5.2 Fineness Modulus — A numeral indicating the fineness of an aggregate, as determined by ascertaining the percentage residue, by weight or volume, remaining on each of a series of fine sieves with apertures ranging from 40 mm to 150 micron, summing, and dividing by 100.

2.5.3 Suction — The property of background which determines its rate of absorption of water.

3. NECESSARY INFORMATION

3.1 In the selection of materials for plasters and in their mixing and application, information is necessary on the following points and detailed consideration shall be given to them before starting plaster work:

- a) Types of surface over which it is proposed to apply plaster, so that constructional details may be suitably adopted to them and the amount of subsequent preparation necessary before plastering may be minimized.

NOTE — This is of particular importance in the case of concrete soffits, and the construction details shall include the necessary provisions for adequate mechanical key left permanently embedded in or adhering to the concrete.

- b) Area, types of finish and thicknesses required, together with sufficient details of the nature of the surface to be plastered.
- c) Details of finish at junctions with doors, windows, and other openings, with ceilings, linings, etc, and at all corners.
- d) Types of cornice, arris and return treatments desired, and of dado treatments where required.
- e) Details of scaffolding (staging) for access to work in the correct sequence, together with provision for adequate protection of adjacent surfaces during plastering operations, particularly in ceiling work.

- f) Details of fixing accessories, templates, etc, to be embedded in the plaster.
- g) Types of surface or decorative finish to be applied over the plaster and detailed information on the compatibility of the plaster with the proposed decorative finish.

3.2 All information required in 3.1 shall be made available to those who are responsible for the plastering work. Necessary drawings and instructions for preparatory work shall also be given.

3.3 Arrangements shall be made for the proper exchange of information between those engaged in plastering and all others whose work will affect or will be affected.

4. MATERIALS, TOOLS AND ACCESSORIES

4.1 The following materials, conforming to relevant Indian Standard specifications, shown against them, shall be used:

- a) Cement conforming to IS : 269-1967* or IS : 455-1967†,
- b) Lime Class B and C conforming to IS : 712-1964‡, and
- c) Sand conforming to IS : 1542-1960§.

4.2 The following requirements shall also be complied with where applicable:

- a) *Lime Putty (or Neeru)* — This shall be obtained by slaking lime with fresh water, and sifting it. The slaking shall be done in accordance with IS : 1635-1960||. Putty shall be kept moist until used, and the quantity prepared at a time shall be not more than what may be consumed in 7 days.
- b) *Water* — The water used for mixing shall be clean, free from deleterious matter and also from unusual proportions of dissolved salts. Sea water or tidal astuary or brackish water shall not be used. Water fit for drinking is normally suitable; in case of doubt, the quality of water should be analysed to ascertain conformity with 4.3 of IS : 456-1964¶.
- c) *Wood Lath* — The pieces of wood used for wood lath shall be free from all decay and insect attack. Both hard woods and soft woods

*Specification for ordinary, rapid-hardening and low heat Portland cement (*second revision*).

†Specification for Portland blastfurnace slag cement (*second revision*).

‡Specification for building limes (*revised*). (*Since revised*)

§Specification for sand for plaster.

||Code of practice for field slaking of lime and preparation of putty.

¶Code of practice for plain and reinforced concrete (*second revision*).

may be used according to availability. Laths shall be free from knots or knot holes that are greater than one half the width of the lath. The timber shall be partially seasoned; and the moisture content shall not be greater than 20 percent.

- d) *Metal Lathing* — Metal lathing used as background for plastering should weigh not less than 1.6 kg/m².
- e) *Galvanized Wire Netting* — Where required to provide a mechanical key, galvanized wire netting of mesh not greater than 50 mm shall be used.

4.3 Tools and accessories used in plaster work may advantageously be in conformity with IS : 1630-1960*.

5. STORAGE OF MATERIALS

5.1 Cement — Cement shall be stored off the ground, under cover and away from damp surfaces so as to prevent deterioration either by moisture or by intrusion of foreign matter. If these precautions are neglected cement will be rendered less effective or useless (see IS : 4082-1967†).

5.2 Lime — Lime shall also be stored off the ground, under cover and away from damp surfaces. Quicklime may progressively deteriorate with keeping through absorption of atmospheric moisture and carbon dioxide. For this reason, it shall be kept in a dry place and be protected from direct contact with water, fumes from boilers or similar contamination. Hydrated lime will not develop any serious deterioration for a period of six months provided it is left undisturbed in the bag and kept in a cool dry place free from draughts, fumes from boilers or similar contamination (see IS : 4082-1967†).

5.3 Sand — Sand for plaster shall be stored under clean conditions to prevent contamination by soil or other deleterious substances.

6. CARE OF TOOLS AND ACCESSORIES

6.1 Tools — All tools shall be cleaned by scraping and washing at the end of each day's work, or after use with different materials. Metal tools shall be cleaned and greased after each operation. The tools shall be examined and thoroughly cleaned before plastering is begun. Cleanliness is particularly important with cement plasters, where contamination with set material may seriously affect the performance as well as reduce the effective life of the tools.

*Specification for mason's tools for plaster work and pointing work.

†Recommendations on stacking and storage of construction materials at site.

6.2 Scaffolding (Staging) — Wooden *BALLIES*, bamboos, planks, trestles and other scaffolding materials shall be sound and in accordance with local building regulations. These shall be properly examined before erection and use.

7. DESIGN CONSIDERATIONS

7.1 Suitability of Cement Lime Mixes

7.1.1 Plastering mixes containing lime putty dry hydrated lime, cement and sand are characterized by high workability and marked ease of application. Such properties become less pronounced as the proportion of cement increases.

7.1.2 Cement-lime mixes have a reasonably longer working time (*Max* 2 h), a fairly slow rate of strength development increasing with the amount of cement added and adequate early strength to withstand modern building conditions. They need moisture to complete the setting process and, therefore, rapid drying in the early stages should be avoided.

7.1.3 The weaker mixes of cement lime plaster containing smaller proportions of cement, shall not be used in conjunction with a strong finishing coat. Weaker mixes offer certain advantages over the stronger (richer) mixes when applied to non-rigid backgrounds, such as lathing.

7.1.4 For trowel finishes (very smooth surfaces), mixes of lime and cement shall not, in general, be used for finishing coats, as their shrinkage on drying creates a tendency for surface crazing.

7.2 Number of Plaster Coats

7.2.1 The ideal number of coats, where practicable, is two, namely, the undercoat followed by a finishing coat. It is recognized, however, that much successful work has been carried out in the past with plaster finishing coats with a single coat on reasonably plane backgrounds of brick, concrete and similar materials. However, for very rough surfaces, such as rough stone masonry, three coat plastering may be necessary. Metal lathing normally requires a three coat plaster finish for successful results. Renovation work on wood laths should also be carried out in three coats.

7.2.2 The range of coats normally employed for different backgrounds is as follows:

<i>Background</i>	<i>Number of Coats</i>
Brickwork or hollow clay tiles	2 or 1
Concrete, cast <i>in situ</i>	2 or 1
Building blocks	2 or 1
Wood or metal lath	3 or 2

<i>Background</i>	<i>Number of Coats</i>
Fibre building board (insulating board)	2 or 1
Wood wool slabs	2 or 1
Cork slabs	2 or 1
Uneven and rough stone masonry	3 or 2

7.2.2.1 A summary of background data for the internal plastering is given in Table 1 for guidance.

7.3 Thickness of Plastering

7.3.1 Finishing coats (and single-coat work, where employed) shall be of such minimum thickness as just to provide a sufficient body of material to harden satisfactorily under the site conditions in any particular case.

7.3.2 The total thickness of two-coat work exclusive of keys or dubbing-out shall be generally about, but shall not normally exceed 20 mm and it shall not exceed 15 mm in the case of *in situ* concrete soffits. The thickness of three-coat work shall be about, but shall not normally exceed 25 mm.

7.3.3 The thickness of an individual coat shall generally be as recommended in Table 2.

7.4 Recommended Plaster Specifications

7.4.1 A list of specifications for mixes suitable for various situations is given in Table 2, which covers single-coat work which is used generally and also two and three-coat works suitable for special situations. The lime in the mixes specified in Table 2 and in **7.4.2** is assumed to be measured as lime putty, but if it is measured as dry hydrated lime, the proportion of lime in any mix shall be slightly higher than is indicated and a suitable adjustment shall be made as indicated in **7.4.1.1**.

7.4.1.1 The actual weight of hydrated lime which a putty contains may be determined by using the following formula:

$$W_h = \frac{G}{G-1} (W_p - 1000)$$

where

W_h = weight of dry hydrate in kg/m³,

G = specific gravity of hydrate (see IS : 2394-1965*), and

W_p = weight of putty in kg/m³.

*Code of practice for application of lime plaster finish.

TABLE 1 SUMMARY OF BACKGROUND DATA FOR INTERNAL PLASTERING

(Clause 7.2.2.1)

SL No.	CLASS	TYPE	DRYING SHRINKAGE MOVEMENT	SURFACE CHARACTERISTICS	PREPARATION OF SURFACE	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Solid	a) Dense clay and bricks blocks	Negligible	Low suction and poor key	May require more than raking joints, for example, bonding agents, spatterdash or wire mesh or special plasters	Spatterdash coat, 1:2, or 3 cement: coarse sand should be allowed to harden before applying undercoat. Wire mesh should be fixed at least 6 mm in clear of surface
		b) Normal clay brick and blocks	Negligible	Moderate to high suction and reasonable key	Rake joints unless key provided	Should be dry to minimize efflorescences
		c) Dense concrete, either precast or <i>in situ</i>	Low to high according to quality. Differential thermal movement varies with aggregate	Suction generally low, but varies according to aggregate and water / cement ratio. Poor key unless provided by special shuttering or retarder	Unless keyed, use spatterdash, bonding treatment or special plasters	Use bonding treatment or special plasters according to manufacturers' recommendations
		d) No-fines concrete	Varies from low to moderate. Varies with aggregate	Low suction and good key	None	—

(Continued)

TABLE 1 SUMMARY OF BACKGROUND DATA FOR INTERNAL PLASTERING — *Contd*

Sl. No.	CLASS	TYPE	DRYING SHRINKAGE MOVEMENT	SURFACE CHARACTERISTICS	PREPARATION OF SURFACE	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		e) Open textured concrete blocks and concrete containing light-weight aggregate	Moderate to high	Low suction and good key	None	Should be dry to minimize shrinkage movement
		f) Close textured concrete blocks	Moderate to high	Variable suction	May need treatment with a bonding agent to provide key	Differential thermal movement may be high with some aggregates
		g) Aerated concrete	Moderate to high	Moderate to high suction, reasonable key	It may be necessary to reduce the suction unless special plasters are used	Should be dry to minimize shrinkage movement
ii)	Slab	a) Wood-wool	High but generally fixed dry and may also be restrained	Low suction and good key	None other than joints scrimmed	When used as permanent shuttering special precautions are necessary
		b) Strawboard	—	No key	Key can be provided by use of bonding treatment or wire netting or metal lathing. Joints should be scrimmed	—

		c) Cork	—	Low suction, key variable	If the surface provides insufficient mechanical key a 1 : 1 cement : fine sand slurry should be brushed on and wire meshed fixed	—
iii)	Boards	a) Plasterboard	Negligible	Low suction, adequate key with suitable plasters	Joints scrimmed unless gypsum lath is used	—
		b) Insulating fibreboard	High, but fixed dry and easily restrained	Low suction, adequate key with suitable plasters	Joints scrimmed	Boards must be conditioned on site
		c) Expanded plastics	—	Low suction, adequate key with suitable plasters	None, other than joint scrimming where recommended by manufacturer	Consideration should be given to the strength of the board and the possibility of impact damage
iv)	Metal lathing	Expanded metal and clay	—	Good key	None	—

TABLE 2 RECOMMENDED PLASTER SPECIFICATIONS

(Clauses 7.3.3 and 7.4.1)

SL No.	No. of Coat of Plaster	SITUATION	Mix* (Proportion by Volume)	THICKNESS
(1)	(2)	(3)	(4)	(5)
i)	Single coat plaster	Both internal and external	1:0:3 1:0:4 1:0:6 1:1:6 1:2:9	10 to 15 mm
ii)	Two coat plaster:	do		
	a) Backing coat		1:0:3 1:0:4 1:0:6 1:1:6	10 to 12 mm
	b) Finishing coat		1:0:3 to 6 1:1:6 1:2:9	3 to 8 mm
iii)	Three coat plaster:	Very rough surface; both internal and external		
	a) Base coat		1:0:3 1:0:4 1:0:6 1:1:6	10 to 15 mm
	b) Second coat		1:0:3 to 6 1:1:6 1:2:9	3 to 8 mm
	c) Finishing coat		Fat lime and fine sand or marble dust in equal proportions	3 to 5 mm

NOTE 1 — Where two or three coat plasters are adopted, as far as possible the mix for the under coats should contain coarse sand conforming to grading zone II of IS: 383-1970† and having fineness modulus not less than 2.0.

NOTE 2 — For single coat plaster the fineness modulus of sand should be as far as possible 1.5 and conforming to grading zone IV of IS: 383-1970†. Where only fine sand is available the fineness modulus of sand may be improved by mixing the required percentage of coarse sand. The strength of plaster mix gets reduced with the reduction in the fineness modulus of sand.

NOTE 3 — Other mixes of cement/lime and sand may also be adopted depending on the quality of sand available and local conditions provided the strength conforms to any of the above mixes given in Table 2.

*Cement : lime : sand.

†Specification for coarse and fine aggregates from natural sources for concrete (second revision).

7.4.2 The mix for the finishing coat shall depend on the texture and colour of the surface desired. If the surface is to have a lime-putty finish, then it is advisable to have rich mix of 1 part of cement, 1 part of lime and 3 parts of sand. For any rough finish a mix of 1 part of cement to 3 to 4 parts of sand is recommended.

7.5 Surface Finish — Internal plasters are usually finished to a smooth surface. If textured finishes are required, special techniques may have to be employed and the success of the treatment is largely dependent on good craftsmanship.

7.6 Corrosive Effect on Metals

7.6.1 In normal circumstances, matured plaster work may be regarded as dry and therefore non-corrosive. Such dangers of corrosion as do arise should only occur during the initial drying period and subsequently during periods of heavy condensation. Plasters containing uncarbonated lime (for example, lime and cement mixes) have a protective effect on iron and steel, but are likely when persistently damp to corrode lead and aluminium unless protected by a suitable paint.

7.6.2 Plastering mixes in which sand or water contaminated with sea-salts have been used are likely to be continually damp, due to the deliquescent or moisture-attracting nature of the salts, and may corrode metals in contact with them. Frost proofing additives containing soluble chlorides, for example, calcium chloride, are likely to have similar effects.

7.6.3 Protection may be given to steel and aluminium when necessary by means of suitable metallic or paint coatings. Sleeves of material resistant to any corrosive effects may sometimes provide a convenient means of avoiding contact of metal pipes or conduits with plasters which accelerate corrosion, or the metal may be embedded in a plastering mix of a more suitable composition. Under persistently wet conditions no form of plastering can be relied on to protect metals from corrosion.

7.6.4 With cold water service pipes the provision of an insulating sleeve serves also to avoid condensation of moisture in the plaster in their immediate vicinity during the subsequent life of the building.

7.7 Effect of Atmospheric Conditions

7.7.1 The prevailing weather at the time of plastering or during the setting, drying and hardening period may affect the finished work as follows:

- a) *Frost* — The destructive effect of frost on plaster work is substantial. Unless special precautions are adopted, plastering work shall be suspended entirely during frosty weather. Recommendations have been made from time to time in countries which experience long continued periods of frosty weather and they should serve as a guide to good practice in this country.

- b) *Cold* — The setting and hardening times of all plasters are appreciably lengthened by a reduction in the atmospheric temperature. Where plastering has got to be carried out in cold weather, the time intervals shall be lengthened to allow for this, and the work programmed or re-programmed accordingly.
- c) *Condensation* — In certain localities condensation resulting from cold wintry conditions may be so excessive as to impair the finished plaster work. It may also retard or prevent the drying out of wet building operations for periods of week, or even months, thus presenting conditions unsuitable for plastering.
- d) *Extreme dry conditions* — Under hot dry conditions the applied plaster may become dry before the setting process is sufficiently advanced. The partially set weak material often has a powdery surface which will not provide a satisfactory base for the subsequent coat or for decoration. Plasters containing cement are particularly sensitive in this respect. In such contingencies the surface should be continually kept wet during the curing period.

8. GENERAL PRECAUTION IN PLASTERING

8.1 Cleanliness and Protection of Existing Work

8.1.1 Cleanliness is essential in carrying out plaster work. Adequate protection shall be given to all existing work and fittings which are liable to be damaged, not only in the area of plastering operations, but also in the approaches thereto by covering up with boards, dust sheets, etc, as necessary.

8.1.2 *Cleaning off on Completion* — On completion, all work affected by plastering operations shall be left clean. Special care is necessary when removing set plaster from glass to avoid damaging its surface.

8.2 Suction Adjustment

8.2.1 The careful adjustment of suction is very necessary for good plastering, and may be done either by wetting the backing suitably if it is dry, or by sprinkling with a cement-mix as in the case of a concrete surface with low suction. Without the aid of suction, plaster would creep and slide down due to its own weight. On the other hand, high rate of suction withdraws all moisture from the plaster and makes it weak porous and friable. Too much water makes it impossible to keep the mortar in position till it sets. A failure in bond due to excessive water leads to further failures as the pocket formed may hold water and break up the plaster when the water freezes; or if the water is salt-laden, the same results will be produced on evaporation by crystal formation.

8.2.2 The wall shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry in spots, such areas shall be moistened again to restore uniform suction. A fog-spray is recommended for this work.

8.3 Adjustment of Working to the Setting Properties of Plaster

8.3.1 Cement plasters and cement-lime plasters contain materials which set when brought into contact with water, and the fullest use of their strength producing properties is not made unless the mix is applied before the setting process has started. If retampering of such mixes is carried out after the set has commenced, an inevitable loss in strength and efficiency will result.

8.3.2 In the case of cement plasters, the commencement of the set is accompanied by a noticeable stiffening of the mix. In the case of cement plaster heavily gauged with lime, however, it is not always obvious to the operator when the set has started and it is with this type of mix that the retention of the full measure of strength afforded by the cementitious material is particularly important. Such plasters may be overworked both before and after application with resultant impairment of the set of the gauging plaster. This not only reduces the strength of the material, but also gives it the shrinkage characteristics of a pure-lime plaster with its liable accompaniment of the surface crazing. It is essential, therefore, that mixes shall be used as soon as possible after water has been added and that working periods recommended in this code shall not be exceeded.

8.4 Control of Cracking — This is normally a structural problem, but the plaster will be able to reduce the effects of structural cracking by making a trowel cut between adjacent surfaces.

8.5 Maintenance of Proper Time Intervals — Shrinkage, partly irreversible, occurs on drying, causing stresses to be set up both in the applied coat and in the undercoat or background, and in order to avoid break-down of adhesion between successive coats, it is very important that the drying shrinkage of the first coat should be materially complete before a subsequent coat is applied. The rate of drying will vary widely with conditions of temperature, humidity and ventilation. Proper time interval serves to diminish the possibility of efflorescent salts finding their way to the final plaster surface, and also of the drying and naturing shrinkage (map crazing) of the undercoat reaching the finished plaster face over a period of time. The surface then shall be allowed to set for at least a day or two depending upon the weather (one day in summer and two days in winter). During this period the surface of this coat shall be kept damp and shall not be allowed to dry.

9. PRELIMINARY PROGRAMMING OF WORK

9.1 All materials necessary for plastering shall be kept readily available at the site, in cases where lime putty is to be used, it shall be run sufficiently

in advance so as to mature before use. An adequate supply of water suitable for mixing the plaster and for curing purposes shall be available.

9.2 In building operations, such as construction of brick and block walls, the encasement of steel columns and beams with concrete, etc, requiring plastering shall be so programmed that they are sufficiently matured to receive the plaster without subsequent damage to plaster or decoration. Careful programming and avoidance of last minute alterations in the design or in the sequence of work can avoid serious damage to the plaster finish. Where such alterations are unavoidable the permanent decoration shall be postponed.

9.3 Plastering operations shall not be started until all necessary fixing, such as door and window frames, mantelpieces are completed and all pipes and conduits to be embedded in the wall or plaster are installed.

9.4 A preliminary inspection shall be made to ensure that the surfaces are in a suitable condition for plastering, particularly as regards their planeness and dryness. If dubbing out is necessary, it should be done in advance, so that an adequate time interval may be permitted before the application of the first undercoat. Plastering operations shall be so scheduled as to allow sufficient interval between undercoats and finishing coats.

10. SEQUENCE OF OPERATIONS

10.1 For external plaster, the plastering operations may be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supports of the ceiling resting on the wall or the floor have been removed.

10.2 The surfaces to be plastered shall first be prepared as described in **12**.

10.3 When the preparation has been done, arrangements may be made for a constant supply of plastering material prepared as described in **11**.

10.4 The first undercoat is then applied to ceilings and walls. It is an advantage to plaster the ceilings first to permit removal of scaffolding before plastering the wall. In the case of high rooms, the same scaffolding may be needed for plastering the top portions of the walls.

10.5 After a suitable time interval (preferably not more than 5 days) the second coat may be applied. Surface of the first undercoat shall be adjusted and screeds laid to serve as guides in bringing the work to an even surface. After a further suitable time interval, the finishing coat may be applied first to the ceilings and then to the walls.

10.6 Plastering of cornices, decorative features, etc, shall normally be completed before the finishing coat is applied.

10.7 Sometimes, ends of scaffolding *BALLIES* have to be housed in the wall which is being treated with plaster. In such cases after the *BALLIES* are taken out, the hole or holes left in the wall shall be filled up with brick and mortar, and the patch plastered up true, even and smooth in conformity with the rest of the wall, so that no sign of any patch work shows out.

10.8 Where corners and edges have to be rounded off, such rounding off shall be completed along with the finishing coat to prevent any joint marks showing out later.

11. PREPARATION OF PLASTER

11.1 Proportioning

11.1.1 The material used in the preparation of plastering mixes may be measured by volume using gauge boxes.

11.1.2 Cement shall be measured by weight. For the purpose of proportioning one cubic metre of cement shall be taken to weigh 1 440 kg approximately.

11.1.3 Proportioning of lime may be done by measurement of volume as lime putty or dry hydrated lime before the preparation of putty. The mix proportion of lime, unless otherwise stated, generally refers to the volume of putty.

NOTE 1 — Lime putty weighs about 1 280 kg/m³.

NOTE 2 — One m³ of dry hydrated lime normally gives about 0.8 to 0.9 m³ of lime putty.

11.1.4 Quantity of Water — For general cement-plaster work with 1 : 3 proportion the quantity of water required is about 70 percent by weight of cement. This may, however, vary depending on the following factors, and adjustment shall be done as explained in IS : 2250-1965*:

- a) The nature and condition of the fine aggregate;
- b) The temperature and humidity at the time of working;
- c) Richness of the mix, namely, whether rich or leaner than 1 : 3;
- d) The varying quantities of lime in composite mortars; and
- e) The use of admixtures added for improving the workability.

11.2 Mixing

11.2.1 Cement-Lime Plaster — The cement-lime plaster shall be prepared by mixing dry in the required proportions cement and sand. Lime putty mixed with water shall then be added to the mix and the contents mixed for sometime until a satisfactory mortar is obtained.

*Code of practice for preparation and use of masonry mortars.

11.2.2 Cement Plaster — Cement and sand 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.

11.2.3 Cement-lime plaster shall be used within two hours after the addition of water to cement provided it is kept agitated or turned over at intervals of at least 20 min. Cement plasters shall be used within half an hour after the addition of water. Any mortar or plaster which is partially set shall be rejected and removed forthwith from the site.

11.2.4 Mixing may be done either manually or mechanically. 'Hand mixing' shall be carried out on a clean, water-tight platform. During mixing, the mortar shall be heeled back and forth for 10 to 15 min after the water is added. In 'machine mixing' the mixer shall run at least 5 min after placing all the ingredients in the drum.

11.2.4.1 Machine mixing is preferable to hand mixing for all mortars.

12. PREPARATION OF BACKGROUND FOR APPLICATION OF PLASTER

12.1 For the durability of the plaster or rendering, it is vital to obtain a satisfactory bond between the background and the first plaster coat and also to ensure that the bond is maintained subsequently. The requirements of good background in this respect are explained in 12.1.1 to 12.1.7.2. Necessary preparation of the background shall be done to fulfil these requirements. The preparation for different types of backgrounds is individually dealt with in 12.2 to 12.4.

12.1.1 Cleanliness — The loose layer of dust on masonry shall be removed either by watering or by brushing as required. A freshly cast concrete surface is often covered by laitance and this shall be removed. A concrete surface may also often be contaminated by the soap which is formed with calcium hydroxide and the oils in the moulds. The contaminated layer shall be removed by brush. Special care shall be taken in repairing for rendering an old plaster coat. Old layers of the plaster coat shall be completely removed and made good. Crumbled and frost-damaged parts shall be cut out and patched. Any trace of algae or mass formation shall be removed. If the background contains soluble salts, particularly sulphates, the application of the plaster shall be done only after the efflorescence of the salts is complete, and the efflorescence is thoroughly removed from the surface.

12.1.2 Roughness — The roughness of the background may generally improve the bond of the plaster. A smooth surface may be roughened by wire brushing, if it is not hard; or by hacking or bush-hammering if it is hard. Alternatively, to obtain a rough surface, a mortar 1 cement : 1½ to 3 coarse sand by volume prepared to a wet consistency may be forcibly

dashed or to the surface (spatterdash treatment) by suitable means on to a hard surface like concrete. After roughening the surface, care shall be taken to moisten the surface sufficiently before plastering, as otherwise the surface may tend to absorb considerable amount of water from the plaster. In addition to general roughness in the masonry, the joints shall also be raked to a depth of about one centimetre for providing key to the plaster. On a soft smooth surface after hacking a thin coat of cement slurry (1 : 1 :: cement : fine sand) may be applied. In special cases wire netting, etc., may be fixed to improve further the key to the plaster.

12.1.3 Suitable Suction — The adjustment of suction of the background during the application of plaster is already dealt with in 8.2. The amount of water introduced in the background during its construction has an important bearing and adequate drying intervals shall be allowed between erection and plastering to bring the surface suitable for suction adjustment.

12.1.4 Evenness — The background shall be even in order to avoid variations in the thickness of the plaster. Any unevenness must be levelled before the plaster is applied. Local projections in brickwork are serious from the point of view of plastering. For three-coat plaster work, the local projection shall not exceed 1.2 cm proud of the general surface as determined by the periphery of the surface concerned and local depression shall not exceed 2.0 cm. For two-coat plaster, a local projection shall not exceed 0.6 cm and local depression 1.2 cm.

12.1.5 Strength and Elasticity — The strength and elasticity of the plaster shall be compatible with that of the background. The recommendations given in this standard already cover this aspect.

12.1.6 Immobility — The background must be immobile at the time of application of the plaster or subsequently the movements of the background shall be in step with and in the same direction as those of the plaster. Differential movements between the background and the plaster due to moisture change, temperature change, structural settlement, deflection, etc., will cause cracking of the plaster. The major part of such movements shall be allowed to set in before the plaster is applied, as for example, by giving in the case of moisture movement sufficient drying interval to the background.

12.1.7 Precaution Against Discontinuity in Backgrounds — Cracking of walls or of plaster is often caused by discontinuity, for instance changing from concrete to brickwork, from clay brickwork to lightweight concrete blockwork or even changing from one type of brick to another. Differential drying shrinkage is probably the main cause but difference in thermal movements may also contribute. Reinforcement of the plaster by metal lathing or scrim over the junction is not always successful. The best treatment may be to separate the two portions by a neat cut through the

plaster at the junction. The junction may be masked, if so desired, by fixing a cover strip to one side.

12.1.7.1 A change from wall to ceiling can be regarded as a discontinuity. To provide for the crack, a cornice that would allow slight movement without cracking or a straight cut through the plaster at the junction may be provided.

12.1.7.2 When plaster is applied to provide an unbroken surface over a board or slab background, the plaster coat bridging the joints is subject to higher stresses and any movement in the background will show at once by cracks along the joints. To avoid this, the plaster is reinforced at the joints by fixing jute scrim (namely, 'scrimming'), or a suitable wire netting, gauge. This treatment may still be ineffective if large changes in humidity take place and if thin board backgrounds with high moisture movement are used.

12.2 Surface Preparation for Brickwork or Hollow Block Masonry — The masonry shall be allowed to dry out for sufficient period so that initial drying shrinkage is fairly complete, and suction adjustment is possible during plastering (*see 12.1.3 and 12.1.6*).

12.2.1 Joints of new brickwork or block masonry, if particularly the bricks or blocks are smooth, shall be raked out as the work proceeds (*see 12.1.2*). Projecting bricks shall be trimmed off where necessary (*see 12.1.4*).

12.2.2 Old brickwork shall be considered on its merits with the object of securing adequate key. The surface shall be thoroughly brushed down to remove dust and loose particles or efflorescence where it has occurred. Low spots may, where necessary, be dubbed out at this stage by means of a mix similar to that intended for the first coat of plaster but stronger (richer) and coarser.

12.3 Surface Preparation for *in situ* Concrete

12.3.1 The surface shall be cleaned and roughened as in 12.1.1 and 12.1.2.

12.3.2 Concrete surfaces shall have sufficient roughness to provide proper adhesion (*see 12.1.2*). The surface shall be evenly wetted (not saturated) to provide correct suction (*see 12.1.3*).

12.3.2.1 If a chemical retarder has been applied to the formwork, a roughened surface may be formed by wire-brushing and all the resulting dust and loose particles cleaned off, and care shall be taken that none of the retarders is left on the concrete or on other surfaces, as it may interfere with the set of the plaster or with other building operations.

12.3.2.2 Where mechanical key-forming devices have been used in the concrete, these shall be stripped off if still adhering and the resulting surface cleaned down.

12.3.3 Ridges or fins left on soffits or on the sides of concrete beams by shuttering imperfections shall be removed before cleaning down, to be compatible with the plaster finish particularly when it is not thicker than one centimetre.

12.4 Boards and Slabs — When the boards or slabs are fixed in accordance with relevant Indian Standard for fixing wall coverings and fixing ceiling coverings, 'scrimming' (see 12.1.7) is all the preparation that is necessary.

13. APPLICATION OF UNDERCOATS

13.1 The Rendering or First Coat

13.1.1 The rendering coat shall be 10 to 15 mm thick and carried to the full length of the wall or to natural breaking points like doors or windows. Before the rendering coat hardens, it shall be roughened to provide mechanical key for the second coat.

13.1.2 Masonry walls on which plaster is to be applied directly, shall be properly set and cured with the joints raked to a depth of at least 10 mm. Before applying the rendering coat, the surface shall be cleaned and damped evenly to control suction, an essential treatment for securing first class work. The rendering coat shall be trowelled hard and tight, forcing it into surface depressions to obtain a permanent bond.

13.1.3 On smooth concrete walls, the surface shall be roughened according to 12.1.2 and the rendering coat shall be dashed on to ensure adequate bond. The dashing of the rendering coat shall be done using a strong whipping motion at right angles to the face of the wall, or it may be applied with a plaster-machine or cement-gun. In either case, the plaster shall be projected on to the surface with considerable force.

13.2 The Floating or Second Coat — Before starting to apply the second coat, the surface of the rendering coat shall be damped evenly as described in 8.2. The second coat shall be approximately 3 to 8 mm thick. It shall be brought to a true, even surface and then roughened to provide bond for the finishing coat. Each under coat shall be damp-cured for at least two days.

14. APPLICATION OF FINISHING COAT

14.1 Before starting to apply the finishing coat, the second coat shall be damped evenly as described in 8.2. Whenever possible, textures shall be applied from top to bottom in one operation to eliminate joining marks.

14.2 Coloured Cement Work

14.2.1 This work may be classified under two categories as follows:

- a) In which the coloured cement used in the work is made by intimately grinding mineral pigments with the cement clinker, and

- b) Where mineral pigments are added to white or ordinary (grey) cement to get the required shade.

The former method has the advantage that the work can be carried out in the absence of skilled workmen. The mineral pigment added shall not in any way interfere with the physical and chemical properties of cement.

14.2.2 In the case of coloured cement plastering, it is necessary to add an integral waterproofer in the undercoats to minimize the risk of efflorescence. Where a coloured cement plastering is to be done on an already existing mortar base, it is recommended to apply a surface waterproofer on the base and also mix an integral water-proofer with the coloured cement plaster for the finishing coat.

14.3 Special Finishing Textures — Various types of special textures for rendered surfaces may be obtained by using special tools for the application of the final coat. The special finishes shall be applied in accordance with the details given in IS : 2402-1963*.

15. TRUENESS OF PLASTERING SYSTEM

15.1 The finished plaster surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 m length placed against the surface.

16. CURING

16.1 To develop maximum strength and density in the plaster, it is necessary to cure cement and cement-lime plasters properly. Each coat shall be kept damp continuously till the next coat is applied or for a maximum period of 7 days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied by using a fine fog-spray. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or windward sides of buildings in hot dry weather, may be prevented by hanging mattings or gunny bags on the outside of the plaster and keeping them wet.

16.2 After the completion of the finishing coat, the plaster shall be kept wet for at least seven days, and shall be protected during that period from extremes of temperature and weather.

17. INSPECTION AND DIAGNOSIS

17.1 Interrelation of Various Factors

17.1.1 It is essential to determine the cause of any defects of plaster-work before any attempt is made to remedy or repair them and unless the

*Code of practice for external rendered finishes.

cause is properly dealt with, the majority of defects will continue to recur after repair. The interpretation of defects of plasterwork and the determination of their causes can only be done by approaching the subject in a systematic and logical manner.

17.1.2 Since it is the final plaster finish which claims the attention of the casual observer, it is a common error to blame only the plastering materials or workmanship for all defects. Actually, these, although perhaps the most important, are not the only factors that may influence the final result.

17.1.3 Every defect in plastering is more or less connected with the whole history and treatment of the background. Consideration shall be given not only to the plastering material used and to the quality of workmanship, but also the climatic conditions prior to, during and after the plastering process, and to the correct choice of the plastering system.

17.1.4 Detailed consideration has already been made in 7 and 8 or several factors in this connection such as:

- a) the possible causes for lack of bond between successive coats of plaster and between the first undercoat and the background concerned,
- b) the possible effect of inadequate time intervals in promoting severe efflorescence or 'map crazing' on the finished surface, and
- c) the effect of climatic conditions in causing or aggravating the above as well as other troubles.

17.1.4.1 Besides, the active influences of the various atmospheric conditions, the effect of the physical properties of the building surface prior to plastering shall also receive due consideration.

18. PLASTERING DEFECTS AND THEIR REMEDIES

18.1 General — It is not possible to give simple rules for the correction of all plastering defects or failures. Many serious defects may be shown to have causes outside the materials or techniques used in the plastering operations and it is often useless to repair or even replace the plaster without first having discovered and corrected the primary fault.

18.1.1 Thus, penetration of moisture through an external wall may cause blistering, efflorescence, flaking or complete disintegration of the plaster. To patch or to replaster such a wall without first taking steps to prevent further damp penetration would be useless. Again, plastered ceilings may develop cracks because the ceiling construction permits excessive deflection, and no plaster repair could be expected to be effective in preventing it. Recurrent surface dampness may be associated with the presence of deliquescent salts in the plasterwork, but it would not

necessarily be effective to renew the plaster. The salts may also be in the background and would probably migrate into the new plaster and bring about a renewal of the trouble. This type of defect usually traced to the use of an unwashed estuarine or sea sand, is best corrected by battening out and erecting a new plaster base out of capillary contact with the affected area.

18.1.2 Defects caused by the use of unsuitable plastering materials or by faulty technique may be corrected by means of an appropriate repair.

18.2 Typical Plastering Defects

18.2.1 Blistering — This is due to intense local relative movement of the final coat, where the component of the splitting force at right angles to the plaster surface exceeds the bond strength at the inter-face, which is aggravated by the absence of an adequate key between the final coat and undercoat. The most common cause is local exposure to radiant heat.

18.2.2 Bond Failure or Loss of Adhesion — This, according to its severity, results in 'hollow' patches, flaking of top coats, or peeling of substantial areas. It is essential to prevent moisture penetration from the outside, as otherwise peeling will eventually occur.

18.2.3 Cracking — This is usually caused by movement in the background or the surrounding structure. Shrinkage movement in undercoats based on cement or lime or the use of unsuitable grades of sand may cause cracking of the final coat.

18.2.4 Cracking — The effect of this may, however, be reduced to tolerable or even to negligible proportions by attention to the points enumerated in **18.2.4.1** and **18.2.4.2**.

18.2.4.1 Cement plaster or cement-lime plaster, attempts to shrink on hardening but is restrained by bond with the background which, either has already undergone most of the shrinkage if of concrete, or is practically immune from movement, if of brick or stone. This restraint to shrinkage causes tensile stress in the plaster which is maximum at the skin. If the shrinkage is great, these failures develop into cracks which exist through the whole depth of the plaster. In order to prevent this formation, it is necessary to limit the differences in shrinkage and thereby reduce the tensile stress to within safe limits.

18.2.4.2 Attention to the following points will reduce the tendency to surface crazing to a minimum:

- a) Use of well-graded sand and the most suitable proportions of cement and sand as recommended in this code;
- b) Avoidance of overworking of cement finishings so that excess cement may not be drawn to the surface to cause shrinkage at the top layer;

- c) Observance of adequate time intervals between undercoats and subsequent finishing coat, so that each successive coat undergoes a portion of its shrinkage before the next is applied and thus, reduces the skin tension in the preceding coat; and
- d) Suitable control over variations in moisture-content and temperature subsequent to plastering.

18.2.5 Efflorescence — This is caused by the presence of soluble salts, such as sulphates of sodium, calcium and magnesium normally in the background, and sufficient water to carry these to the surface as the structure dries.

18.2.5.1 Remedy — Sealing coats may not effectively hold back strong efflorescence. Dry brushing of the growth as it appears is the only remedy. Efflorescent salts shall not be removed by washing with water as it may carry some of the salts back into the pores. On redrying, efflorescence may be even worse than before if the salts were still present in the structure. Efflorescence will continue as long as there is sufficient water in the structure or plaster backings to carry the soluble salts forward and it is useless to attempt to seal the moisture by the paint film on the surface. The treatment of an old wall with silicone solution will frequently stop the efflorescence as the liquid blocks the passage for movement of moisture. In the case of efflorescence due to the rising of salt solutions through capillary action from sub-soil the only remedy is to provide bitumen or metallic seals in the walls above the ground level so that an effective barrier to the capillary action is created.

18.2.6 Grinning — Grinning is generally caused by marked differences in suction of the background which are not masked by the procedure of adjusting the suction, and which are manifested as areas of varying texture on the plaster surface. Such differences are often caused by the use of a mortar having suction characteristics markedly different from those of the bricks or blocks with which it is used. Grinning is more usually associated with single coat work (two coat work is normally provided on most solid backgrounds and with this thickness of plasterwork grinning is rare).

18.2.7 Irregularity of Surface Texture — This may be caused by faulty workmanship, but even a skilled craftsman may be unable to prevent it on backgrounds exhibiting varying suction characteristics unless three coat plastering is employed.

18.2.8 Popping or Blowing — These occasionally occur in plaster mixes which contain particles of materials which may keep on expanding even after the plaster coat has set. The expansive force is sufficiently great to push out the plaster in front of the particles, leaving a conical hole known as a 'Pop or Blow'. Insufficiently slaked and unmatured lime is frequently the source of unsound particles causing popping or blowing. Popping may also be caused by the presence of particles of coal or other oxidizable material contained in the sand used for the plaster mix.

18.2.9 Recurrent Surface Dampness — The presence of deliquescent salts as occur in sea-water will bring about recurrent dampness in plaster finishes when the atmospheric humidity is high. It may also be caused by condensation of moisture in chimney flues with a permeable lining, for example, where slow combustion stoves are employed.

18.2.10 Softness or Chalkiness — This may result from excessive suction of the background, undue thinness of the finishing coat, working past the setting point, or subsequent exposure of the finishing coat to excessive heat or draught during setting.

19. MAINTENANCE

19.1 Plastering work shall be protected at all stages of its life from persistent attack by water or moisture either through the undercoats or through the outer surface. The matter is particularly important during the interval between plastering and decorating. Subsequent decoration on the whole surface may be vitiated by a persistent stream of water down on particular part due to flooding of upper floors under construction, delay in provision of gutters, etc. This would be particularly serious if conditions are favourable to formation of efflorescence. In extreme cases, the plaster surface may be softened or badly channelled, necessitating local repair.

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No. NBCC/ED/Tech. Audit/Quality/2020/495

Dated: 06.10.2020

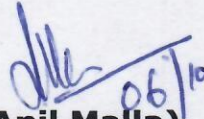
TECHNICAL CIRCULAR No.-04

Sub: Use of Robust and readymade Railing in balconies-reg.

It has been observed on various projects, that the balcony railings are being constructed in MS balusters with RCC pillars RCC Railings. There is a scope of RCC pillars and support not getting integrated with the main slab done due to lack of curing, variance in materials etc. leading to deteriorated quality of work such as cracks, peeling of plasters & other finishings.

For overcoming such defects/deficiencies, it is emphasized to use alternate facade materials in the balcony railings. The alternative materials can be Mild steel and Stainless steel tube & section fixed with fasteners, hold fast, insert plate (should be inserted in RCC during pouring of the concrete). A typical sketch drawing is attached herewith for reference. Use of slender concrete members should be avoided as far as possible.

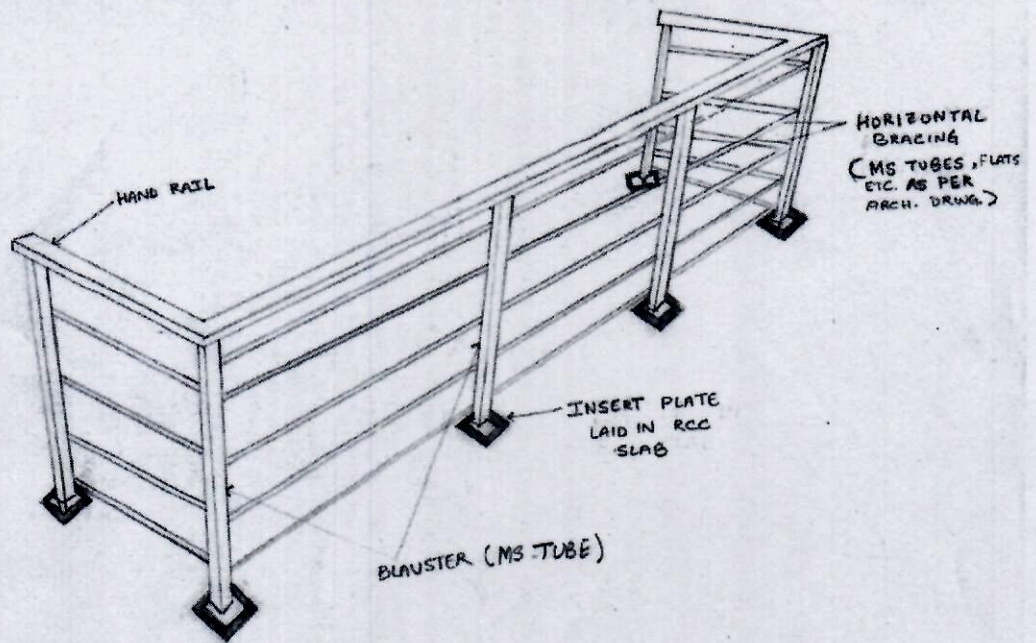
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TYPICAL RAILING DETAILS



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No. NBCC/ED/Tech. Audit/Quality/2020/ 436

Dated: 06.10.2020

TECHNICAL CIRCULAR No. – 05


Subject: Sunken slabs in wet areas in projects.

It is observed that the cases of seepage/leakage are more prevalent where the sanitary & plumbing pipes for the toilets/Kitchen/WCs are laid in the sunken portion of the slab. For rectification of the leakages/seepages, the flooring/ wall dado/fittings etc are required to be demolished and redone after rectification.

To overcome such situation, the construction of sunken slab should be avoided. As far as possible, the sanitary, plumbing & water supply pipes should be laid through the false ceiling of the lower floor and connected to the nearest shaft directly. Laying of pipes through walls should also be minimum possible. In case of any leakage in the pipes, the rectification can be attended through false ceiling of the lower floor. A typical arrangement sketch/drawing showing the line arrangement of the pipes is enclosed herewith as Annexure-A. However, the drawing may vary as per the site requirement.

Detailed drawings of all such arrangement should be got prepared from Architect/Consultant before implementation at site.

This issue with the approval of Competent Authority.

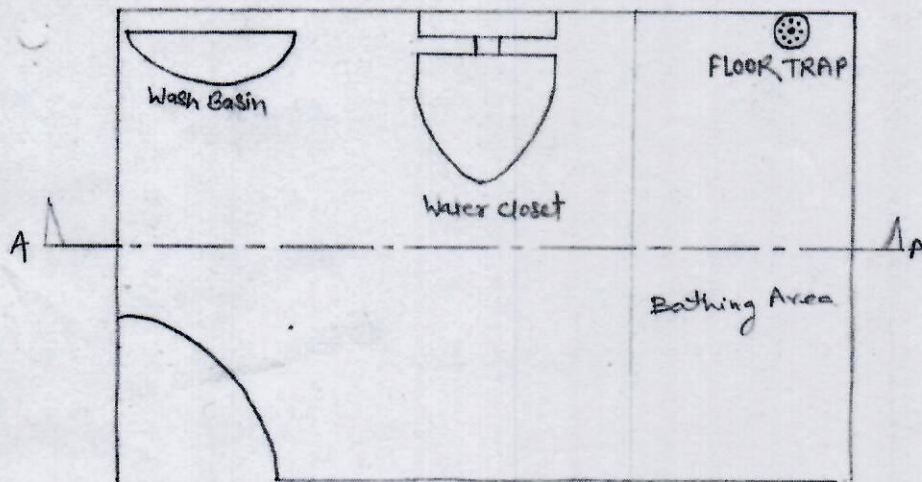
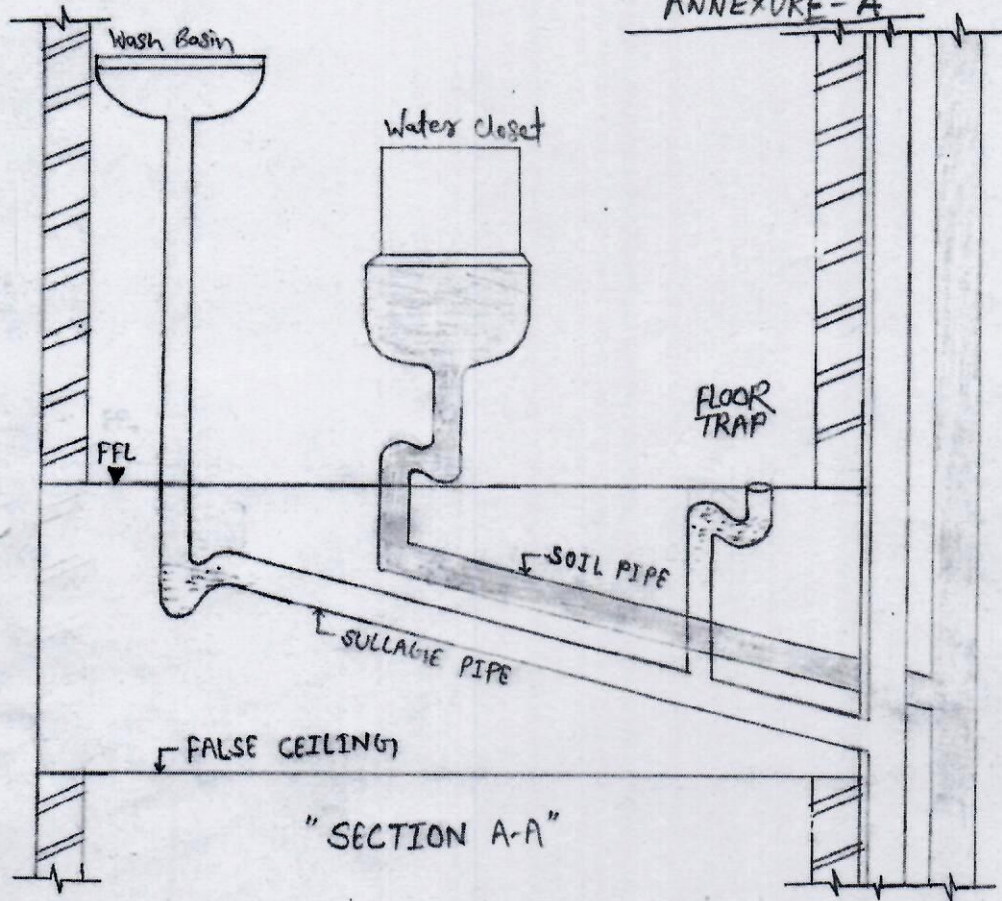

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ANNEXURE - A



BATHROOM PLAN

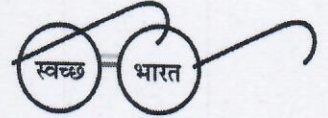


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No. NBCC/ED/Tech. Audit/Quality/2020/498

Dated: 09.10.2020

TECHNICAL CIRCULAR No.:-06

Subject: Installation of RO plant at Project Sites-reg.


Appropriate quality of water as per codal provision is of paramount importance to ensure proper quality of construction.

The quality of water is required to be maintained as per IS code 456:2000 (Cl. No. 5.4) (copy attached). Continuous availability of water of required quality has to be ensured without waiting for test results from laboratory which may take 3-4 days or even more. Therefore, in order to maintain all the quality parameters, RO plant must be installed at project sites as per the requirement (the size of RO plant may be according to the quantum of work and size of the project).

All RBG/SBG heads are hereby requested to ensure that the RO plant is installed at site for mitigating the scope of any unsuitable water being used at site.

However, relaxation of the requirement of RO at site can be given by Directors on the recommendation of field officers, if continuous availability of water of required quality can be ensured without treatment by RO.

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Portland cements provided uniform blending with cement is ensured.

5.3 Aggregates

Aggregates shall comply with the requirements of IS 383. As far as possible preference shall be given to natural aggregates.

5.3.1 Other types of aggregates such as slag and crushed overburnt brick or tile, which may be found suitable with regard to strength, durability of concrete and freedom from harmful effects may be used for plain concrete members, but such aggregates should not contain more than 0.5 percent of sulphates as SO_3 and should not absorb more than 10 percent of their own mass of water.

5.3.2 Heavy weight aggregates or light weight aggregates such as bloated clay aggregates and sintered fly ash aggregates may also be used provided the engineer-in-charge is satisfied with the data on the properties of concrete made with them.

NOTE—Some of the provisions of the code would require modification when these aggregates are used; specialist literature may be consulted for guidance.

5.3.3 Size of Aggregate

The nominal maximum size of coarse aggregate should be as large as possible within the limits specified but in no case greater than one-fourth of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. For most work, 20 mm aggregate is suitable. Where there is no restriction to the flow of concrete into sections, 40 mm or larger size may be permitted. In concrete elements with thin sections, closely spaced reinforcement or small cover, consideration should be given to the use of 10 mm nominal maximum size.

Plums above 160 mm and up to any reasonable size may be used in plain concrete work up to a maximum limit of 20 percent by volume of concrete when specifically permitted by the engineer-in-charge. The plums shall be distributed evenly and shall be not closer than 150 mm from the surface.

5.3.3.1 For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of the aggregate should usually be restricted to 5 mm less than the minimum clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement whichever is smaller.

5.3.4 Coarse and fine aggregate shall be batched separately. All-in-aggregate may be used only where specifically permitted by the engineer-in-charge.

5.4 Water

Water used for mixing and curing shall be clean and

free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel.

Potable water is generally considered satisfactory for mixing concrete. As a guide the following concentrations represent the maximum permissible values:

- a) To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5 ml of 0.02 normal NaOH. The details of test are given in 8.1 of IS 3025 (Part 22).
- b) To neutralize 100 ml sample of water, using mixed indicator, it should not require more than 25 ml of 0.02 normal H_2SO_4 . The details of test shall be as given in 8 of IS 3025 (Part 23).
- c) Permissible limits for solids shall be as given in Table 1.

5.4.1 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 5.4.1.2 and 5.4.1.3.

5.4.1.1 The sample of water taken for testing shall represent the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

5.4.1.2 Average 28 days compressive strength of at least three 150 mm concrete cubes prepared with water proposed to be used shall not be less than 90 percent of the average of strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements of IS 516.

5.4.1.3 The initial setting time of test block made with the appropriate cement and the water proposed to be used shall not be less than 30 min and shall not differ by ± 30 min from the initial setting time of control test block prepared with the same cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of IS 4031 (Part 5).

5.4.2 The pH value of water shall be not less than 6.

5.4.3 Sea Water

Mixing or curing of concrete with sea water is not recommended because of presence of harmful salts in sea water. Under unavoidable circumstances sea water may be used for mixing or curing in plain concrete with no embedded steel after having given due consideration to possible disadvantages and precautions including use of appropriate cement system.

Table 1 Permissible Limit for Solids
(Clause 5.4)

Sl No.	Tested as per	Permissible Limit, Max
i) Organic	IS 3025 (Part 18)	200 mg/l
ii) Inorganic	IS 3025 (Part 18)	3 (ACI) mg/l
iii) Sulphates (as SO_4)	IS 3025 (Part 24)	400 mg/l
iv) Chlorides (as Cl)	IS 3025 (Part 32)	2 000 mg/l for concrete not containing embedded steel and 500 mg/l for reinforced concrete work
v) Suspended matter	IS 3025 (Part 17)	2 000 mg/l

5.4.4 Water found satisfactory for mixing is also suitable for curing concrete. However, water used for curing should not produce any objectionable stain or unsightly deposit on the concrete surface. The presence of tannic acid or iron compounds is objectionable.

5.5 Admixtures

5.5.1 Admixture, if used shall comply with IS 9103. Previous experience with and data on such materials should be considered in relation to the likely standards of supervision and workmanship to the work being specified.

5.5.2 Admixtures should not impair durability of concrete nor combine with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

5.5.3 The workability, compressive strength and the slump loss of concrete with and without the use of admixtures shall be established during the trial mixes before use of admixtures

5.5.4 The relative density of liquid admixtures shall be checked for each drum containing admixtures and compared with the specified value before acceptance.

5.5.5 The chloride content of admixtures shall be independently tested for each batch before acceptance.

5.5.6 If two or more admixtures are used simultaneously in the same concrete mix, data should be obtained to assess their interaction and to ensure their compatibility.

5.6 Reinforcement

The reinforcement shall be any of the following:

- Mild steel and medium tensile steel bars conforming to IS 432 (Part 1).
- High strength deformed steel bars conforming to IS 1786.
- Hard-drawn steel wire fabric conforming to IS 1566.
- Structural steel conforming to Grade A of IS 2062.

5.6.1 All reinforcement shall be free from loose mill scales, loose rust and coats of paints, oil, mud or any other substances which may destroy or reduce bond. Sand blasting or other treatment is recommended to clean reinforcement.

5.6.2 Special precautions like coating of reinforcement may be required for reinforced concrete elements in exceptional cases and for rehabilitation of structures. Specialist literature may be referred to in such cases.

5.6.3 The modulus of elasticity of steel shall be taken as 200 kN/mm^2 . The characteristic yield strength of different steel shall be assumed as the minimum yield stress/0.2 percent proof stress specified in the relevant Indian Standard.

5.7 Storage of Materials

Storage of materials shall be as described in IS 4082.

6 CONCRETE

6.1 Grades

The concrete shall be in grades designated as per Table 2

6.1.1 The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

6.1.2 The minimum grade of concrete for plain and reinforced concrete shall be as per Table 5.

6.1.3 Concrete of grades lower than those given in Table 5 may be used for plain concrete constructions, lean concrete, simple foundations, foundation for masonry walls and other simple or temporary reinforced concrete construction.

6.2 Properties of Concrete

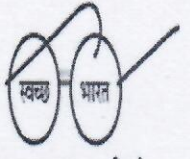
6.2.1 Increase of Strength with Age

There is normally a gain of strength beyond 28 days. The quantum of increase depends upon the grade and type of cement, curing and environmental conditions, etc. The design should be based on 28 days characteristic strength of concrete unless there is a evidence to



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No. NBCC/ED/Tech. Audit/Quality/2020/510

Date: 20.10.2020

TECHNICAL CIRCULAR No.:-07

Sub: Sampling/Testing of material at site-reg.

Samples of material at site are generally being sent to the testing laboratories for testing through the contractor. The reports are submitted either by the contractor or the laboratory sends the same directly to NBCC site office. The reports are being accepted and kept in record for reference.

In order to have unbiased quality check of the materials, it is prudent that all Unit-in-charge, Zonal-in-Charges and RBG/SBG Heads should collect the samples at their level also in association with contractor and send the collected samples to the independent laboratories (NABL accredited), preferably a government laboratories at suitable intervals depending on quantity and material lot and progress of work. Broadly one sample should be sent to this independent laboratory once in 03 months if work is in regular progress. Otherwise frequency can be reduced.

Para 56 of GCC already gives the discretion to NBCC officials to get this testing done in a lab of their choice with payment to be made by contractor. Testing charges for this test can be paid by NBCC and recovered from contractor's Bill to keep identity confidential.

All RBG/SBG Heads are requested to adhere to this.

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(Bal Mukund)
AGM (Tech. Audit/Quality)

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No. NBCC/ED/Tech. Audit/Quality/2021/550

Dated: 11.01.2021


TECHNICAL CIRCULAR No: 08

Sub: Use of Tile Spacers in Flooring tiles of toilets-reg.

RCC slab and vitrified tiles have different co-efficient of thermal expansion and therefore, there is a possibility of crackling sound in vitrified tiles and subsequent cracking.

Therefore, while laying the floor tiles spacers of 3-5mm thickness may be used on each corner of tile. The uniform joints so made can be properly sealed with sealant to avoid seepage of water into the floor.

In view of above, all RBGs/SBGs are requested to take necessary action to implement above.

 11/01/2021

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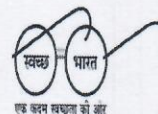


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No. NBCC/ED/Tech. Audit/Quality/2021/SSI

Dated: 11.01.2021

TECHNICAL CIRCULAR No: 09

Sub: Durability aspects of Reinforced Cement Concrete (RCC) structures - regarding Testing for important deleterious materials

1. Introduction

Reinforced Cement Concrete (RCC) structures that are constructed according to the required specifications and standards show excellent durability and perform well over their service life. However, deterioration of concrete may occur due to a number of mechanisms. Corrosion of reinforcement steel is the most common form of damage affecting durability and strength of concrete structures.

2. Limit of Chloride content

Knowing the chloride content of concrete is critical in determining the potential for reinforcing steel to corrode within the concrete. Chloride is a negatively charged ion that causes reinforcing steel to corrode. Chlorides can be introduced to the concrete from a number of sources. The most common source of chloride ions is from water (unfit for construction) but they can also come from aggregates, cement, admixtures, and even from adjacent soils. The total soluble (acid soluble and water soluble) chloride need to be determined as per the Indian Standards (IS 14959). Limit of chloride content at the time of placing is given in para 8.2.5.2 and Table 7 of Section 2 of IS 456: 2000, summary of which is given below:

S.No	Type or Use of Concrete	Maximum Total Acid soluble Chloride content Expressed as Kg/m ³ of Concrete
I.	Concrete containing metal and steam cured at elevated temperature and pre-stressed concrete	0.4
II.	RCC or PCC containing embedded metal	0.6
III.	Concrete not containing embedded metal or any material requiring protection from chloride.	3.0

3. Limit of Sulphate content

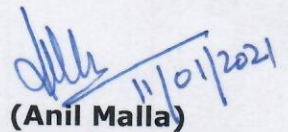
Sulphates are present in most cements, some aggregates and other mix constituents of concrete. Excessive amounts of water-soluble sulphate in the concrete can cause expansion and disruption of the concrete itself. The total sulphate content should be calculated from various constituents of the mix and to have durable concrete, total water-soluble sulphate content of the concrete mix, expressed as SO₃, should not exceed 4% (in compliance of IS456) by mass of cement in the mix.

4. Considering the above, it is required for all the projects to have Chloride and Sulphate content tests at the following stages:

1. At the time of Concrete Mix Design with proposed source materials.
2. At the time of start of work at project site.
3. Intermittently during execution at interval of 3 months or change of any source of concrete whichever is earlier.

All RBGs/SBGs to take necessary action for implementation on the subject matter.

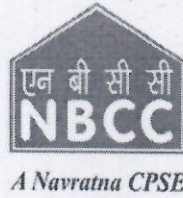
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No. NBCC/ED/Tech. Audit/Quality/2021/ 552

Dated: 11.01.2021

TECHNICAL CIRCULAR No:10

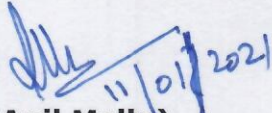
Sub: Inspection lifts for High rise buildings -reg.

At present number of projects with high rise building construction are in progress and also new projects with high rise construction are coming up. For effective site management, ensuring full compliance with terms and conditions of contract with contractor, implementing proper Quality control and safety norms, the supervising officers are required to conduct the site inspection for all the floors frequently on daily basis. However, the site inspection at higher floors becomes difficult due to non-availability of inspection lifts at the projects. This results in less frequency of site visits to higher floors by the inspecting officer thereby could lead to compromising the quality and other contractual norms. Therefore it is prudent that the inspection lifts are installed at these projects for ease of conducting the supervision and inspection by the officers.

At every site there should be sufficient no. of inspection lifts **(all buildings with height 25m and above)** to ensure that every location of site is approachable directly or through connections with adjacent towers.

All RBGs/SBGs to take necessary action for implementation on the subject matter.

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No. NBCC/(Tech. Audit/Quality)/2022/ 851

Date: 24.03.2022

TECHNICAL CIRCULAR No.:-11 (REVISION-1)(Amended on 24.03.2022)

SUB: Testing Of Materials.

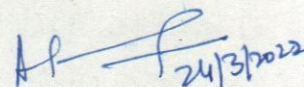
In order to have unbiased quality check of the materials all samples for testing from outside laboratories should be collected in association with contractor and sent to the empanelled labs in Delhi/NCR. In areas other than Delhi/NCR, sample should be sent to Govt. Laboratories as far as possible.

In case it is not possible to send it to Govt. Labs, the approval of lab shall be taken from RBG/SBG. RBG/SBG Heads will check/get checked the documents of the certification of lab through Zonal Incharge and/or Unit Incharge. The officials may also be deputed to the laboratory to check the facilities of testing and other systems in the laboratory. Only if the systems are found satisfactory, the testing in the laboratory should be permitted. It should also be ensured that laboratory should have the NABL accreditation specifically for the materials to be sent for testing.

From now onwards testing charges for all tests shall be paid by NBCC to laboratories and recovered from contractor's Bill to keep the sanctity of testing intact. Laboratories should be asked to send the reports directly to NBCC and not through contractor.

All concerned officials should make all out efforts to ensure that there is no vitiation at any stage of testing process.

This issues with the approval of Competent Authority.

 24/3/2022

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NBCC (INDIA) LIMITED
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No. NBCC/CGM/Tech.Audit/Quality/2021/706

Dated: 10.08.2021

TECHNICAL CIRCULAR No:12

It has been noticed that integral crystalline admixtures are being added in concrete as a part of waterproofing treatment; however, its efficacy is yet to be established. Perhaps, solely depending on these integral crystalline admixtures for waterproofing purposes, often results in recurring issues of seepage and dampness in the building.

Therefore, it has been decided that usage of integral crystalline admixtures in concrete should be discontinued, and in case the item has been part of BOQ/Contract Documents, the same should be suitably replaced with proper water-proofing treatment.

This is issued with the approval of Competent Authority.

(Mohd. Rafiq)

CGM (Tech. Audit/Quality)

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An IS/ISO 9001 : 2015
Company



A Navratna CPSE

No: NBCC/(Tech.Audit/Quality)/2022/833

Date: 25.02.2022

TECHNICAL CIRCULAR No: 13

Subject: Repair Methodology for Honeycomb Surfaces

Repair Methodology-1 :

For locations where minor honeycomb is observed (for area < 0.5 m² and depth < 15mm)

Stage A: Identify the area where honeycomb is observed.

Stage B: Remove loose concrete or loosened aggregate by hammer or wire brush. Prevent application of large forces such as electrical chippers to avoid sound concrete damage around the honeycomb area.

Stage C: Remove the debris and dust in honeycomb area by blowing oil free compressed air, if available by air compressor or by hand operated blow out pump to prepare the surface for repair.

Stage D: Repair the prepared surface using Polymer modified mortar or Micro-concrete or non-shrink special grouts having strength not less than that of actual strength of concrete of the structural member.

Stage E: Cure the surface with water/ curing compound.

Repair Methodology -2 :

For locations where major honeycomb is observed (depth > 15mm)

Stage A: Identify the area where honeycomb is observed.

Stage B: Remove loose concrete or loosened aggregate by hammer or wire brush. Prevent application of large forces such as electrical chippers to avoid sound concrete damage around the honeycomb area.

Stage C: Remove the debris and dust in honeycomb area by blowing oil free compressed air, if available by air compressor or by hand operated blow out pump to prepare the surface for repair.

Stage D: Cement pressure grouting: Drill holes of 12mm diameter @ 600mm c/c in staggered pattern at the honeycombed area for fixing of NRV nozzles. Insert 10mm diameter NRV nozzles and seal the same as well as any surface crack with epoxy mortar/ epoxy putty and allow air curing for around 16 hours to gain strength. Inject the Non-shrink Micro-fine Cement grout into the nozzles at a pressure of up to 4 kg/cm².

Stage E: Repair the prepared surface using Polymer modified mortar or Micro-concrete or non-shrink special grouts having strength not less than that of actual strength of concrete of the structural member.

Stage F: Cure the surface with water/ curing compound.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of the Competent Authority.



(Annu Garg)
ED (Tech.Audit/Consultancy)



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A Navratna CPSE



NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/Tech.Audit/Quality/2022/830

Dated: 18.02.2022

TECHNICAL CIRCULAR No:14

**Sub: - Appointment of Third Party Quality Monitoring Agency(TPQMA)-
reg.**

NBCC is committed to follow the quality norms as specified in the contract to maintain the desired quality on all its projects.

At present, third party quality monitoring agency has been appointed either by NBCC or by Our client directly at some of project sites which is a welcoming sign & it is leading towards better controls checks on the quality as confirmed by various RBG/SBG.

Therefore, at all project sites having value of Rs. 50 Cr. & above (where at least 25% work is balance) the third party quality monitoring agency should be appointed. Third party quality agency should be only Govt. Agency like IIT/NIT/ NCCBM or similar agency like Engineering Colleges of repute.

In existing projects even if the TPQMA already appointed is a private agency, it should continue and there is no need to appoint a fresh Govt. agency.

This issues with the approval of competent authority.

Handwritten signature and date: 18/2/2022

(Annu Garg)
ED (Tech.Audit)

No: NBCC/(Tech Audit/Quality)/2022/ 832

Date: 23.02.2022

TECHNICAL CIRCULAR No: 15

Subject: Quality assurance by periodic testing of concrete using UPV test- reg.

For all the projects involving RCC works, to ensure the quality of the hardened concrete, non-destructive tests like Ultrasonic Pulse Velocity Test (UPV) test shall be conducted as per "IS 516-Part 5, Section 1" through specialist agency / 3rd Party Quality Assurance team besides maintaining all the standard quality tests of quality control of RCC.

1.0 Ultrasonic Pulse Velocity Test (UPV):

1.1 The frequency of this test shall be as under –

SI No	Location	Frequency of Test
(i)	Column-Beam and slab Junction	Minimum One Test
(ii)	Column, Beam and Slab at critically identified location	20 Cum of concrete or part thereof.
(iii)	Mass Concreting (Raft etc.)	Min one test for 50-100 cum of concrete

The tests shall be conducted on hardened concrete (after minimum 28 days of casting of RCC) on the dry surface as per Indian Standards as above.

1.2 UPV test shall be used to check the internal consistency of concrete quality by measured velocity of the pulse through this test. For concrete to be classified as acceptable, the velocity achieved shall be in class of "Good or Excellent" as per Table-1 of the Code (Latest IS 516-part 5/ Sec1)

Table -1: Velocity Criterion for Concrete Quality Grading

SI No	Average Value of Pulse Velocity by Cross Probing (km/s)	Concrete Grading	Quality
i)	For Concrete (\leq M25)		
1	Below 3.5	Doubtful	
2	3.5-4.5	Good	
3	Above 4.5	Excellent	
ii)	For Concrete ($>$ M25)		
1	Below 3.75	Doubtful	
2	3.75-4.50	Good	
3	Above 4.5	Excellent	

- 1.3 If the regular UPV test results indicate that the concrete does not meet the acceptance criteria of "Good or Excellent" concrete at more than 80% test locations, then further detailed testing shall be planned which will include the UPV at reduced frequency as below:

SI No	Location	Frequency of Test
(i)	Column-Beam and slab Junction	Minimum One Test
(ii)	Column, Beam and Slab at critically identified location	10 Cum of concrete or part thereof.
(iii)	Mass Concreting (Raft etc.)	Min one test for 25-50 cum of concrete

Based on the detailed testing, wherever doubtful workmanship/ concrete quality is observed/found, a remedial plan shall be worked out (including for all critical structural locations) with the guidance of the structural consultant of the project/ expert consultant to ensure the structural stability, safety and durability.

The above provisions shall be implemented rigorously by planning the testing every month and required corrective/ preventive measures shall be taken within 15 days of the findings. The record of all the testing and remediation actions taken shall be kept in a separate Quality Control file of the project.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of the Competent Authority.


23/2/2022

(Annu Garg)
ED (Technical Audit)



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A Navratna CPSE

No: NBCC/(Tech Audit/Quality)/2022/837

Date: 02.03.2022

TECHNICAL CIRCULAR No: 16

Subject: Vetting/proof checking of structural design & MEP works (load calculation) in EPC contracts-reg.

During the Technical Audit visit to the various project sites (especially in EPC contracts), it has been observed that in few projects, the vetting/proof checking of structure design as well as MEP works (load calculation) have been done from institutions other than IITs/NITs.

Henceforth, considering the importance of vetting/proof checking of design, in all ongoing projects (wherein the vetting/proof checking of more than 50% of the design/drawing are pending) including upcoming projects, structural vetting as well as vetting of MEP works (especially load calculation) should be done from IITs/NITs only.

All RBGs/SBGs are requested to take necessary action for strict implementation of the subject matter.

This issues with the approval of the competent authority.

HP
21/3/2022

(Annu Garg)
ED (Technical Audit)



A Navratna CPSE

NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)



No. NBCC/ED/Tech. Audit/Quality/2022/839

Date: 02.03.2022

TECHNICAL CIRCULAR 17

Subject: Guidelines for "Issue of drawings" in EPC Contracts-Approval reg.

Following important steps and instructions must be followed while preparing and using the drawings in EPC Contracts, where the preparation of design/ drawings is the responsibility of EPC Contractors. The instructions are in addition to any other steps required in this regard.

(A)TENDER STAGE


- I. After appointment of Consultant by NBCC, he will submit the list of his associate consultants which will include team leader, Architectural Consultant, Structural designer/MEP designer and designer of other services. RBG/SBG Head will approve the team appointed by NBCC's Consultant based on the credentials.
- II. Based on the "concept plans" approved by client, the NBCC's appointed architectural consultant shall submit relevant drawings to obtain "in-principle approvals" on conceptual drawings from statutory authorities.
- III. Parallely along with the processing of "***in-principle approval***" by statutory authorities. NBCC's appointed Architectural Consultant shall prepare a complete set of "***tender drawings & documents***" for call of tenders for appointment of EPC-contractor, and submit to RBG/SBG head.
- IV. The tender drawings and documents will be checked by required authority of NBCC as per the schedule of power and the practices in this regard.
- V. After incorporating the discrepancies/suggestions and any changes suggested by the statutory authorities in concept drawings submitted for "in-principle approval", the NBCC's appointed architectural consultant shall sign & stamp the final "tender drawings & documents" and submit the same to RBG/SBG head.
- VI. The ZIC (or any other officer authorized by SBG/RBG head) shall ensure that all the tender drawing and documents have been duly signed & stamped by the NBCC'S appointed architectural consultant.

(B) EXECUTION STAGE:

- I. After award of work, the EPC contractor shall appoint his team of "associate consultants" (comprising team leader, Architectural Head, Structural consultant, MEP consultant and consultants for other services) and get it approved from RBG/SBGs, who will approve the same after examining the credentials including qualification and experience of the persons being deployed.
- II. After the award of work and appointment of consultants by EPC contractor, he shall get all the Architectural, Structural, MEP, Other/Miscellaneous drawings prepared through his associate consultants based on tender drawings and submit to NBCC's appointed Architectural Consultant for vetting.
- III. All the drawings prepared by Consultant of EPC Contractor and proof checked by NBCC's appointed Consultant have to be proof checked by NIT/IIT. RBG/SBG Head will approve the institution i.e. NIT/IIT and the name of the concerned professor in-charge/s before the work of vetting is assigned to any institution.
- IV. The drawings for vetting by NIT/IIT can be submitted parallelly by EPC contractor to NIT/IIT but the final stamping by NIT/IIT should be done only after checking and signing by NBCC's Consultant.
- V. Structural designer/MEP designer or the designer of any other services who has prepared the design and drawings will sign the drawings himself in addition to team leader of Consultant of EPC Contractor and authorized representative of EPC Contractor.
- VI. Similarly the drawings have to be signed by the Structural designer/MEP designer and designer of other services who have checked the design/drawings along with the team leader on behalf of NBCC's Consultant.
- VII. After receipt of duly vetted drawings which has the signature of all the consultants and NIT/IIT, the same should be signed by a representative of NBCC (duly nominated by RBG/SBG for the project) and then issued to site for execution.
- VIII. NBCC's Consultant shall certify on the drawing that GFC Drawings has been prepared in conformity with the approved structural as well as Architectural designs. NBCC's Consultant shall also certify that the scope of work as stipulated in design basis report has been incorporated in the GFC and there are no deviations in specifications. Similar certificates should be given by EPC Contractor and his Consultant.

All RBG/SBGs are requested to adhere aforesaid important steps and instructions for issue of drawings in EPC Contract.

This issues with the approval of competent authority.


(Annu Garg)
ED (Tech. Audit/Quality)

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NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/Tech.Audit/Quality/2022/904(a)

Dated: 23.05.2022


TECHNICAL CIRCULAR No:18

Subject – Witnessing of concreting.

No concreting at any of the sites should be carried out without the presence of a site Engineer/Supervisory staff. Site Engineer/Supervisory staff should be nominated in writing by Unit In charge to witness the concreting. No. of engineers required to witness the concreting should be decided depending upon the quantity of concrete. All large volume of concreting should be witnessed by Unit In Charge himself also. An intermittent video recording of concreting should be done by Site Engineer / Supervisory staff himself through his mobile phone and sent to Unit In-charge, Zonal In-charge and RBG / SBG.

All RBG / SBG Heads should store the data of videography of concreting in a centralized computer/laptop and should frequently check it to ensure the quality of concreting and the presence of site Engineer/ Supervisory staff during concreting. Detailed local instructions and system of monitoring should be developed by each RBG / SBG.

This is issued with the approval of Competent Authority.


(Annu Garg)
ED (Tech.Audit)

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NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/Tech.Audit/Quality/2022/943

Dated 25.07.2022

Technical Circular:-19

Subject: - Timely submission of Quality Audit Compliance Report - regarding.

It has been noticed that compliance/ action taken report against Quality Audit paras submitted by respective Zonal Incharge through RBG's / SBG's is taking more than a month time and in some cases it takes 2-3 months, which is diluting the purpose of quality audit.

Hence, to comply Quality Audit paras in time bound manner, a timeline of 30 days has been fixed for submission of compliance reports after Audit.

Therefore, all RBG's/SBG's and concerned officials should put their best effort to ensure timely submission of compliance report for closing of Audit paras within stipulated time limits as above.

This issues with the approval of Competent Authority.


25/7/2022

(Annu Garg)

ED (Tech.Audit/Quality)



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A Navratna CPSE

No: NBCC/(Tech.Audit/Quality)/2022/1011

Date: 22.11.2022

TECHNICAL CIRCULAR No: 20

Subject: Ceiling Plaster - reg.

There have been a few complaints of peeling off of ceiling plaster. Main reason for this is that hacking is not done timely and properly. Hacking should be done immediately after removal of scaffolding otherwise it becomes more and more difficult with passage of time. A record of Hacking should be kept and roof should be cleared by one nominated engineer of contractor and NBCC before plastering is started. Photograph of each roof should be kept in record in soft copy by nominated engineer.

All ceiling plaster in future should be done by Gypsum only as it avoids the need of curing. Wherever plaster is being done by cement mortar, proper mixing of mortar, use before its setting and proper curing must be ensured.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of the competent authority.

(Pranay Jain)
CGM (Tech. Audit)

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22/11/22



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एक कदम स्वच्छता की ओर

No. NBCC/HO/Tech.Audit/2023/1074

Date: 26.05.2023

Technical Circular No. -21

Sub: Permeability test of concrete-reg.

Permeability of concrete has particular significance in structures. Besides functional considerations, permeability is also intimately related to the durability of concrete, especially its resistance, against progressive deterioration under exposure to severe climate and leaching due to prolonged seepage of water, particularly when it contains aggressive gases or minerals in solution. The determination of the permeability characteristics of concrete, therefore, assumes considerable importance.

So, in cases where concrete is permeable, deleterious materials like water, CO₂, SO₂ & Cl etc. permeates through the pores of the concrete and reacts with the reinforcement; forms corrosion which decreases the strength of the reinforcement and thereby damages the structure. Therefore, Permeability tests become very important especially for Reinforced Cement Concrete (RCC).

There are various methods to check the permeability of concrete, out of them the most commonly used methods are :

1. Water permeability test/ Determination of depth of penetration of water under pressure: Testing and specification shall be complies with IS 516 (P-2/Sec-1):2018 Cl. 5, DIN-1048 (P-5) & MORTH Sec. 1700, Cl. 1717/7.5.
2. Rapid Chloride Permeability Test (RCPT Test): Testing and specification shall be complies with ASTM C-1202.

The frequency of testing may be tabulated as below:

S. No.	Test name	Frequency of testing	Remarks
1.	Water permeability test/ Determination of depth of penetration of water under pressure.	1. Initially, during design mix (for trial mixes) for each RCC grades. 2. Subsequently once in three months for each RCC grades.	1. <u>Project value of Rs. 500 Cr. & above:</u> a) In-house testing facility for conducting the said tests should be available at project. b) Also, random 3rd party test shall be done as per direction of EIC.
2.	Rapid Chloride Permeability Test (RCPT test).	(Ref: Inspection Test Plan of DMRC)	

			<p><u>2. Project value less than Rs. 500 Cr.:</u></p> <p>3rd party testing shall be done as per the said frequency. The availability of testing facility to perform such tests at site is not mandatory.</p>
--	--	--	--

Considering the importance of the test in respect of the durability of concrete, all RBGs/SBGs are requested to take necessary action for implementation of subject matter in all projects as per the said frequency & provisions and subsequently corrective/preventive measures in case of any finding.

This is issued with the approval of the competent authority.


 (Annu Garg)

ED (Tech.Audit/Quality)

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A Navratna CPSE

No: NBCC/(Tech.Audit/Quality)/2023/1094

Date: 21.06.2023

Technical Circular - 22

Subject:- Use of Debris Chutes - reg.

During Site Inspection by the Tech. Audit team and senior officers at various projects, one of the common and major deficiencies pertains to Health, Safety and Environment (HSE) is the disposal of construction debris.

Frequently, it is observed that debris are collected at specific area at respective floor, resulting into localized additional dead load at given floor, in addition to this when debris are disposed from height using traditional systems that are much more prone to accidents and safety hazards at site.

To overcome the problem, Debris Chutes should be installed at every site in sufficient number to avoid the accident & improve safety.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of the competent authority.


21/06/2023

(Annu Garg)
ED (Tech.Audit/Quality)

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No: NBCC/(Tech.Audit/Quality)/2023/1105

Date: 08.08.2023

Technical Circular - 23

Subject: Use of Acrylic Based Curing Compound - reg.

Curing is the most important step to achieve durable and enables effective hydration of the cement particles in concrete and usually most neglected. However, as per modern practices in construction industry the **Curing compound** may be used in lieu of traditional/moist curing method to keep the concrete surface moist and Acrylic based curing compound are white pigmented resulted into appearance of white colour protective film when drying on concrete surface.

It is observed that curing of vertical surfaces by water is difficult to implement, hence it is instructed that Acrylic based curing compound should be mandatorily used on vertical surfaces of concrete, immediately after removing the form work and should be applied in single coat in two applications at right angle to each other.

Testing and specification of concrete curing compounds can be carried out as per ASTM C-309, however following test should be performed prior to application of acrylic curing compound as mentioned hereunder;

- | | |
|--|---|
| 1. Drying Time (ASTM C309) | - not more than 4 hour
(Preferably 1 hour) |
| 2. Rate of Application/
Water Retention by Concrete Curing Materials
(ASTM C156/ C309) | - Typically 5 mtr ² /Ltr |
| 3. Reflectance Test (E 1347) | - not less than 60% |
| 4. Curing efficiency (BS7542) | - more than 85% |

Advantage of Curing Compound: -

1. Reduces surface shrinkage & cracks by eliminating moisture loss from surface.
2. Rapid film formation; enables concrete to hydrate more efficiently.
3. Ideal for application on interior, exterior, horizontal, and vertical concrete surfaces.
4. Reduces cost of manpower and supervision cost compared to conventional ponding.
5. It is economical to use and for large areas may work out cost effective.

Few Notable brands like **Fosroc/ Sika/ Cico** may be used in Project with the approval of Engineer Incharge or as per Tender Conditions.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of the competent authority.


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A Navratna CPSE

No: NBCC/(Tech.Audit/Quality)/2023/1109

Date: 06.09.2023

Technical Circular – 24

Subject: Control of project QA/QC non-Conformities/Compliances.

It has been observed that the project sites deal with the QA/QC inspections on daily basis and report the non-Conformities/Compliances for required actions in non-standard format(s).

To overcome this issue, all project sites having project value more than 50.00 Crore would follow the system of reporting as below:-

1. **Non-Conformance Notice (NCN) Part- A:** This shall be issued by NBCC officials to contractor (as per format attached) as early as the non-Conformance (s) is/are noticed at project site.
2. **Non-Conformance Notice (NCN) Part- B:** Based on the issuance of NCNs, the contractor will submit the corrective/required actions for approval and submit the post conformities details by providing the photographs (as per format attached). The closure of NCN will be done by the RBG/SBG Heads only.
3. **Non-Conformance Notice (NCN) Part- C:** A Summary report stating the status of non-Conformities/Compliance shall also be prepared & submitted by the contractor (as per format attached) on monthly basis and will be reviewed by the RBG/SBG heads.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of the competent authority.

[Signature]
6/9/2023

(Annu Garg)

ED (Tech.Audit/Quality)

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1. All RBGs/SBGs/Zonal/ Unit Heads.
2. TO to CMD, TO to Director (Commercial) and TO to Director (Projects) - For kind information please.



A Navratna CPSE

NBCC (India) Limited

FORMAT FOR ISSUANCE OF NON-CONFORMANCE NOTICE (NCN)

Non-Conformance Notice No.:

Date:

Details of project

Name of work:

Name of contractor:

Agreement No:

Details of Non-Conformance observed by NBCC/representative:

Based on the Inspection/ Laboratory report, following Non-Conformance have been observed for corrective actions.

1.

2.

Referred/Attached documents/Photographs:

Name/Signature of NBCC:

Designation: Date of issue:

Instruction:

Rejection actions to be taken by contractor with time frame.

Or

Corrective action required from the contractor/ consultant with time frame.

Name/Signature of NBCC/ representative:

Designation:

Acknowledgement:

Name/Signature of Contractor/ Execution agency representative:

Date of acknowledgement:



A Navratna CPSE

NBCC (India) Limited

FORMAT FOR NON-CONFORMANCE NOTICE (NCN)

Non-Conformance Report No.:

Date:

Details of project:

Name of work:

Name of contractor:

Agreement No:

Section 1: Details of Non-Conformance Notices (NCNs) issued by NBCC/representative and acknowledged by the contractor:

Reference number of NCNs issued with date

(Attach as annexures):

Section 2: Corrective/ required action proposed by contractor/ consultants along-with supporting documents/Photographs:

(Attach as annexures)

Section 3: Review of Proposal (s) by NBCC/representative:

Proposal found: Acceptable Non- Acceptable

Name/Signature of Unit Incharge & Zonal Incharge: Designation: Date:

Note: In case proposal found non-acceptable, revised proposal shall be submitted by contractor.

Section 4: Submission of Action Taken Report (ATR) by contractor as per approved proposal

along-with supporting document/photograph:

Reference number of ATRs duly signed by contractor representative with date

(Attach as annexures)

Section 5: Closure of Non-Conformance Notice (NCN) by RBGs/SBGs as per recommendation of Zonal Incharge:

Non-Conformance Notice (NCN reference No. and date) Closed out on _____

Name/Signature of NBCC:

Designation: Date of issue:

Note: In case ATR is not found as per approved proposal, re-submission of ATR shall be done.

Monthly status of Non-conformities (NCs)

Name of work:

Name of contractor:

Agreement No:

S. No.	Reference and date of NCN/NCR issued	No. of NCs issued	Status of NCs		Remarks
			No. of NCs Closed	No. of NCs opened	
	JAN				
	FEB				
	MAR				
	APR				
	MAY				
	JUN				
	JUL				
	AUG				
	SEP				
	OCT				
	NOV				
	DEC				



NBCC (INDIA) LIMITED
(FORMERLY NATIONAL BUILDINGS CONSTRUCTION CORPORATION LIMITED)
(A GOVT. OF INDIA ENTERPRISE)
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An IS/ISO 9001:2015
Certified Company

No. NBCC/(Tech. Audit/Quality)/HO/2023/110

Date: 13.09.2023

Technical Circular-25

Sub: Monthly Project Quality Walk/ Inspection by Zonal Incharge reg.

As directed by Competent Authority, for the Projects having awarded value of Rs 100 Crores or more, The Zonal Incharge are instructed to organize Quality walk/ Inspection along with Quality team of Contractor of respective project, Quality team of Zones & RBG/SBG and Third Party Quality Management Agency i.e. TPQMA (if deployed) on monthly basis and shall prepare and submit Inspection Report to RBG/SBG Head for their information.

Further, Contractor of respective project shall prepare and submit Action Taken Report (ATR) to Zonal Incharge within 20 days or prior to next Quality Walk/Inspection and the same shall be verified by Zonal Incharge during his next visit.

The above said Quality Walk/ Inspection report shall be prepared as per attached format as "Annexure -A".

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of competent authority.


13/9/2023

(Annu Garg)

ED (Tech. Audit/Quality)

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2. TO to CMD, TO to Director (Commercial) and TO to Director (Projects) – For kind information please.

Observations of Quality Cell, NBCC

Quality Walk No.	
Date of Quality walk:	
Contract :	
Contractor :	
Inspecting officer :	
Officials Present During Site Inspection:	NBCC : Contractor :
Location:	

Purpose of site visit:

The purpose of the visit was to observe and describe the system employed by the Contractor and whether it is in compliance with the approved "Project Quality Management Plan" (Such as planning, executing, controlling, monitoring, documenting and completing the work) as per contractual requirements.

Observations of Site Visit

S. No.	Photographs	Observations	Compliance		
			Photo	Date	Remarks

(Sign of Zonal Quality Head)

(RBG/SBG/ZI)



NBCC (INDIA) LIMITED
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No. NBCC/ (Tech. Audit/Quality)/HO/2023/1115

Date: 19.09.2023

Technical Circular - 26

Sub: Use of Concrete from Batching Plant installed at site only-reg.

As directed by Competent Authority, No Concreting (i.e. RCC/PCC) shall be procured from the sources other than Batching Plant installed at site. In case, RMC is required to be procured from outside sources in emergent cases, then the concerned RBG/SBG/ZI will obtain the prior approval from the concerned Director along with full justifications.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of competent authority.


19/9/2023

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A Navratna CPSE

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Certified Company

No. NBCC/(Tech. Audit/Quality)/HO/2024/1152

Date: 16.01.2024

Technical Circular -27

Sub: Concrete Core Cutting Test req.

To ensure the structural durability and quality of our concrete structures, Concrete Core Cutting test is being made mandatory along with UPV Test/ Chloride/ Sulphate/ Permeability test, one test (i.e. minimum 3 Sample) shall be conducted on Quarterly basis for each grade of concrete.

Hence the sampling procedure and acceptance criteria for said test are as follows:-

Indian Standard IS 516 (Part 4): 2018 specifies a method for taking cores from hardened concrete, their examination, preparation for testing and determination of compressive strength.

SAMPLING:

General guideline, for grades of concrete up to M25 the concrete shall be at least 14 days old before the cores are taken. For higher grades, cores may be taken at an earlier age.

Cores shall be taken preferably from the middle part of the member leaving top and bottom parts where variation can be more.

Cores shall be drilled perpendicular to the surface in such a manner as not to damage the cores.

In no Case, however shall fewer than three (3) cores to be tested.

Dimensions & Correction Factors:

The ratio of diameter to the nominal maximum size of aggregate (up to 20 mm) shall be greater than 3, the core diameter shall generally be 100 mm to 150 mm.

For other smaller diameters (not less than 3 times the nominal maximum aggregate size), the effect of the diameter on the accuracy of the result is also considered as follows;

Diameter of Core (mm)	Correction factor
75 ± 5	1.03
< 70	1.06

Above corrected compressive strength value is called corrected compressive strength for diameter.

The length of the core sample shall be decided based on

- The diameter of the core; and
- Whether comparison will be made with cube strength or cylinder strength (for preferred length/diameter (l/d) ratios)

The preferred l/d ratio shall be 2, however l/d values from 1 to 2 may also be permitted (the length includes the capping material also).

When l/d < 2; then compressive strength corrected corresponding to a value of l/d of 2.0 are as follows

F = 0.11N+0.78; where F is correction factor and N is l/d ratio.

The product of correction factor (F) and the measured compressive strength or corrected compressive strength for diameter is known as Corrected cylinder strength.

The equivalent cube strength of concrete shall be determined by multiplying the corrected cylinder strength by 5/4.

Acceptance Criteria of Core test result:

For acceptance of concrete based on limited in-situ testing, little lower confidence level is acceptable, generally 75 percent confidence level (75 percent probability of 95 percent results $>f_{ck}$) is considered. **However, this is valid only if sufficient numbers of cores are tested.**

Procedure as per IS 456

If average of equivalent cube strength of minimum three cores is more than 0.85 times the specified cube strength (characteristic strength, f_{ck}) and no individual core has equivalent cube strength less than 0.75 times specified cube strength (f_{ck}), the core test results are considered satisfactory.

All RBGs/SBGs are requested to take necessary action for strict implementation of subject matter.

This is issued with the approval of competent authority.


16/01/2024
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Indian Standard

HARDENED CONCRETE — METHODS OF TEST

PART 4 SAMPLING, PREPARING AND TESTING OF CONCRETE CORES

(First Revision)

1 SCOPE

This standard (Part 4) specifies a method for taking cores from hardened concrete, their examination, preparation for testing and determination of compressive strength.

NOTE — Extracting other types of specimens from structures and pavements, like beam specimens and slab removal are given in Annex A.

2 REFERENCES

The standards listed below contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
460 (Part 1) : 1985	Test sieves: Part 1 Wire cloth test sieves
456 : 2000	Code of practice for plain and reinforced concrete (<i>fourth revision</i>)
516	Hardened concrete — Methods of test:
(Part 2/Sec 1) : 2018	Properties of hardened concrete other than strength, Section 1 Density of hardened concrete and depth of water penetration under pressure (<i>first revision</i>)
(Part 5/Sec 1) : 2018	Non-destructive testing of hardened concrete, Section 1 Ultrasonic pulse velocity testing (<i>first revision</i>)
4031 (Part 8) : 1988	Methods of physical tests for hydraulic cement: Part 8 Determination of transverse and compressive strength of plastic mortar using prism
14858 : 2000	Requirements for compression testing machine used for testing of concrete and mortar

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Concrete Core — Cylindrical specimen of hardened concrete obtained by drilling from hardened concrete.

3.2 Corrected Compressive Strength of Core — Strength of core obtained by applying the correction factor for diameter to the measured compressive strength as per 8.4.1.

3.3 Corrected Cylinder Strength of Core — Equivalent strength of cylinder having l/d ratio of 2 as per 8.4.2.

3.4 Equivalent Cube Strength — Cube strength of concrete obtained as per 8.4.2.

3.5 Measured Compressive Strength of Core — Compressive strength obtained by dividing the maximum load applied by the cross-sectional area as per 8.4.

4 APPARATUS

4.1 Core Drill, shall be capable of extracting cores from the hardened concrete to the dimensions specified in 5.5 to 5.7 with the tolerances specified in 7.5.

4.2 Compression Testing Machine (CTM), shall be conforming to IS 14858, of sufficient capacity for the tests and capable of applying the load at the rate specified in 8.2. The accuracy of the testing machine shall be as per IS 14858. The testing machine shall be equipped with two steel bearing platens with hardened faces. One of the platens (preferably the one that normally will bear on the upper surface of the core specimen) shall be fitted with a ball seating in the form of a portion of a sphere, the centre of which coincides with the central point of the face of the platen. The other compression platen shall be plain rigid bearing block. The bearing faces of both platens shall be at least as large as, and preferably larger, than the nominal size of the core specimen to which the load is applied. The bearing surface of the platens, when new, shall not depart from a plane by more than 0.01 mm at any point, and they shall be maintained with a permissible variation limit of 0.02 mm. The movable portion of the spherically seated compression platen shall be held on the spherical seat, but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction.

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4.3 Balance or Scale, shall be capable of determining the mass of the core, as tested, to an accuracy of 0.1 percent of the mass.

4.4 Callipers and/or Ruler, shall be capable of measuring the dimensions of the core and the steel reinforcement to a tolerance of ± 0.01 mm.

4.5 Gauge, shall be capable of establishing that the relevant flatness of the specimen is within the requirements as specified in 7.5.

5 EXTRACTION OF CORES

5.1 Age of Concrete

Core to be tested for strength shall not be removed from the structure until the concrete has become hard enough to permit its removal without disturbing the bond between the mortar and the coarse aggregate. As a general guideline, for grades of concrete up to M25, the concrete shall be at least 14 days old before the cores are taken. For higher grades, cores may be taken at an earlier age.

5.2 Location

The location from where the core is extracted shall be specified by the Engineer-in-Charge on the basis of the purpose of the core extraction and the possible structural implications resulting from taking the core from the location.

Cores shall preferably be taken at points not near or at the edges of the concrete joints and reinforcement shall be avoided as far as possible.

Cores shall be taken preferably from the middle part of the member leaving top and bottom parts where variation can be more. While taking cores vertically from top, like from slab or from foundation top, the test length of core shall not contain concrete from top 15 percent to 20 percent depth as top part of the core may not contain uniform distribution of aggregates (maximum up to 60 mm). In case of cores which are not across full depth of member, about 10 percent to 15 percent portion of the bottom side of core may be trimmed off as the portion near to the broken end may contain some micro cracks/fractures.

Locations where there can be micro-cracks due to tension shall be avoided and cores shall preferably be taken from compression zone.

5.3 Drilling

Unless otherwise specified, the cores shall be drilled perpendicular to the surface in such a manner as not to damage the cores. The drilling of the core shall be carried out by an experienced operator using a diamond-impregnated bit attached to the core barrel. The drilling

apparatus shall be rigidly anchored to the member to avoid bit wobble, which may result in a specimen with a variable cross-section. The drill bit shall be lubricated with water and shall be resurfaced periodically. Cores that show abnormal defects or that have been damaged in removal shall not be used.

The cores may be extracted preferably from a location where there is no interference of reinforcement

NOTE — In case of cores to be taken from the removed slab, a sufficiently large portion of the slab shall be removed so that the desired test specimens may be secured without the inclusion of any concrete which has been cracked, spalled, undercut, or otherwise damaged.

5.4 Number of Cores

The points from which cores are to be taken and the number of cores required shall be at the discretion of the Engineer-in-Charge and shall be representative of the whole of concrete concerned. In no case, however, shall fewer than three cores be tested.

5.5 Diameter of Cores

The diameter of the cores to be taken shall be specified, before testing.

The ratio of diameter to the nominal maximum size of aggregate shall be greater than 3. The core diameter shall generally be 100 mm to 150 mm (± 10 mm), with the preferred diameter being 100 mm for nominal maximum aggregate size up to 20 mm.

Other smaller diameters (not less than 3 times the nominal maximum aggregate size), which may make drilling easier and reduce the damage to the element, may be used, if the effect of the diameter on the accuracy of the result is also considered, as per 8.4.

5.6 Length of Cores

The total length of core to be extracted and the length of the core sample to be used for testing, shall be specified by the Engineer-in-Charge.

The length of the core sample shall be decided based on,

- the diameter of the core; and
- whether comparison will be made with cube strength or cylinder strength (see 5.7 for preferred length/diameter ratios).

5.7 Length/Diameter (l/d) Ratio

The preferred l/d ratio shall be 2, however, l/d values from 1 to 2 may also be permitted (the length includes the capping material also).

In the case of using a specimen with a length-to-diameter ratio smaller than 2.0, the test value of the compressive strength should be corrected

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corresponding to a value of l/d of 2.0, as per 8.4.2.

5.8 Marking and Identification

Immediately after drilling, mark each core clearly and indelibly. Record its location and orientation within the element from which it was drilled. If a core is subsequently cut to produce a number of specimens, mark each specimen to indicate its position and orientation within the original core.

5.9 Reinforcement

Drilling through reinforcement shall be avoided. The core shall not contain any reinforcement bars along or near its longitudinal axis. Cores containing cross reinforcement shall be trimmed off to obtain core free from reinforcement. The reinforcement detector (cover meter) can be used for selecting the drilling location free of reinforcement.

6 EXAMINATION

6.1 Visual Inspection

Carry out visual examination of the cored specimen to identify abnormalities.

6.2 Measurements and Calculations of Drilled Core Specimens

Take the following measurements:

- Core diameter** — Take three pairs of measurements at right angles, at the half and quarter points of the length of the core to an accuracy of ± 0.01 mm. Determine the average diameter (d_m).
- Core length** — Measure the maximum and minimum lengths after completion of the end preparation in accordance with 7 (excluding capping material) to an accuracy of ± 0.01 mm. Determine the average length.
- Mass** — Each specimen shall be weighed as received and/or saturated, as specified. The mass shall be recorded to the nearest 0.1 percentage of the mass of the specimen.
- Density** — The density of each specimen shall be determined as received and/or saturated, as specified, in accordance with IS 516 (Part 2/Sec 1).

7 PREPARATION OF CORES

7.1 General

The size of the specimen shall be adjusted, whenever necessary. The specimen shall be sawn perpendicular to its longitudinal axis. The intended load-bearing surfaces shall be prepared either by grinding or by capping to improve the contact with the loading

machine. Cutting and grinding shall be carried out in such a way that structural changes of the test specimen are avoided. Various preparation methods including capping materials suitable for different maximum compressive strengths are given in Table 1.

Table 1 Suitable Methods of Preparation of Load Bearing Surfaces of Specimens
(Clause 7.1)

Sl No.	Anticipated Strength of Concrete	Preparation Method
(1)	(2)	(3)
i)	For any value of strength	Grinding
ii)	Up to 50 MPa	Capping with calcium aluminate cement mortar ¹⁾
		Capping with sulphur mixture
iii)	Up to 100 MPa	Capping with high strength sulphur mixture

¹⁾ Other cements may be used provided that, at the time of test, the mortar has a strength at least equal to the anticipated strength of the concrete.

NOTE — Other capping materials may also be used provided that, at the time of testing, it has a strength at least equal to the anticipated strength of concrete.

The details of the preparation methods for load bearing surfaces of specimens mentioned in Table 1 are given below.

7.2 Grinding

Specimens cured in water shall be removed from the water for grinding for not more than 1h at a time and re-immersed in water for at least 1 h before further grinding or testing. The ends of the specimen shall be ground to the tolerances as given in 7.5.

7.3 Capping — Calcium Aluminate Cement Mortar

7.3.1 General

Before capping, ensure that the surface of the core specimen is in a wet condition, clean and free from all loose particles. The caps shall be as thin as possible and shall not, on average, be greater than 5 mm thick, small local deviations are permissible.

7.3.2 Capping with Calcium Aluminate Cement Mortar

The capping material shall consist of a mortar containing three parts by mass of calcium aluminate cement to one part by mass of fine sand in a saturated surface dry condition [most of which passes a 300µm wire cloth sieve conforming to IS 460 Part (1)]. The water-cement ratio shall not exceed 0.35.

The soaked core specimen shall be placed with one end on a horizontal metal plate. A steel collar of correct dimensions and having a machined upper edge shall be rigidly clamped to the upper end of the core specimen

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to be capped in such a way that the upper edge is horizontal and just extends beyond the highest part of the concrete surface.

The capping material shall be filled into the collar until it is the form of a convex surface above the edge of the collar. The glass capping plate, coated with a thin film of mould oil shall be pressed down on to the capping material with a rotary motion until it makes complete contact with the edge of the collar. The core specimen with collar and plate in position shall immediately be placed in moist air of at least 90 percent relative humidity and at a temperature of $27 \pm 2^\circ\text{C}$. The plate and collar shall be removed when the mortar is hard enough to resist handling damage.

7.4 Capping — Sulphur Mixture Method (Normal and High Strength)

7.4.1 General

Before capping, ensure that the surface of the core specimen is in a dry condition, is clean and free from all loose particles. The caps shall be as thin as possible and should not, on average, be greater than 5 mm thick. Small local deviations are permissible.

7.4.2 Capping Material

Sulphur mixtures shall be of normal strength or of high strength, and as follows:

- a) *Normal strength (for concrete up to 50 MPa)* — The capping material shall comprise equal mass fractions of sulphur and fine siliceous sand (most of which passes a 250 μm wire cloth sieve conforming to IS 460 (Part 1) and is retained on a 125 μm wire cloth sieve). A small proportion, up to 2 percent, of carbon black may be added. The strength of the mixture tested in accordance with 7.4.4 shall be as follows:

Compressive strength: At least the anticipated compressive strength of the concrete.

- b) *High strength (for concrete from 50 to 100 MPa)* — The capping material shall consist of a blend of sulphur and suitable additions passing a 0.5 mm sieve. The strength of the mixture tested in accordance with 7.4.4 shall be as follows:

- 1) *Flexure strength* : At least 6.5 MPa; and
- 2) *Compressive strength* : At least the anticipated compressive strength of the concrete.

7.4.3 Procedure

Lower one end of the core specimen, which is held vertically, into a pool of molten sulphur mixture on a horizontal plate/mould. Allow specimen to harden

before repeating the procedure for the other end. Use a capping frame that will ensure that both capped surfaces are parallel. Mineral oil shall be used as a release agent for plates/moulds. Where necessary, trim surplus capping material from the edges of the core specimen.

The level of the mixture in the melting pot shall never be allowed to fall too low, as there will be an increased risk of the production of sulphur vapour, which could ignite.

The core specimen shall be checked to ensure that the capping material has adhered to both ends of the core specimen. If a capping layer sounds hollow, it shall be removed and the capping operation repeated. The cap shall not fail or fracture before the concrete fails when the core specimen is tested. The compression test on the test core specimen shall not be carried out until at least 30 min have elapsed since the last capping operation.

NOTES

1 Stir the mixture continuously to ensure its homogeneity and to avoid sediment forming at the bottom of the melting pot.

2 If capping operations are carried out repeatedly, it is advisable to use two thermostatically controlled melting pots.

3 A fume extraction system shall be operating during the whole melting process to ensure full extraction of the sulphur vapour, which is heavier than air. Care shall be taken to ensure that the temperature of the mixture is maintained within the specified range to reduce the risk of pollution.

7.4.4 Material Test for High Strength Sulphur Mixture

7.4.4.1 Principle

It gives the methodology to be adopted for carrying out flexural strength and compressive strength tests to check the conformity of the capping material used for the high-strength sulphur mixture method.

7.4.4.2 Apparatus

- a) *Prism mould*, with dimensions of 40 mm \times 40 mm \times 160 mm, complete with a filling frame.
- b) *Melting pot*, with a thermostat to control the temperature of the mixture to $130 \pm 10^\circ\text{C}$.
- c) *Ladle*, with a capacity of at least 1/3 litre.
- d) *Saw*, capable of cutting the capping material when it is dry.
- e) *Compression testing machine*, capable of testing mortar prisms for flexural and compressive strength in accordance with IS 4031 (Part 8).

7.4.4.3 Procedure

The sulphur mixture shall be heated in the melting pot to $130 \pm 10^\circ\text{C}$, stirring with the ladle to make the mixture homogenous. The filling frame shall be fitted to the mould and both shall be lightly oiled using a normal mould-release oil. The liquid sulphur mixture

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shall be poured into the mould, overfilling each part in turn using the filling frame to produce three specimens. Thirty minutes after casting the last specimen, the filling frame shall be removed and the three specimens demoulded. They shall then be left at ambient temperature for a further 30 min. Approximately 1 h after casting, each test specimen shall be sawn to remove the excess height and to produce three specimens with dimensions of $40 \pm 1 \text{ mm} \times 40 \pm 1 \text{ mm} \times 160 \pm 1 \text{ mm}$. The actual dimensions shall be measured and recorded. Approximately 2 h after casting, the specimens shall be tested for flexural and compressive strength.

7.4.4.4 Test result

The flexural and the compressive strength of each beam specimen made shall be determined using the actual dimensions recorded, not the nominal dimensions. The test procedures are as described in IS 4031 (Part 8). The compressive strength of the sulphur mixture shall be taken as the mean of the results of the tests on the three specimens.

7.5 Tolerances

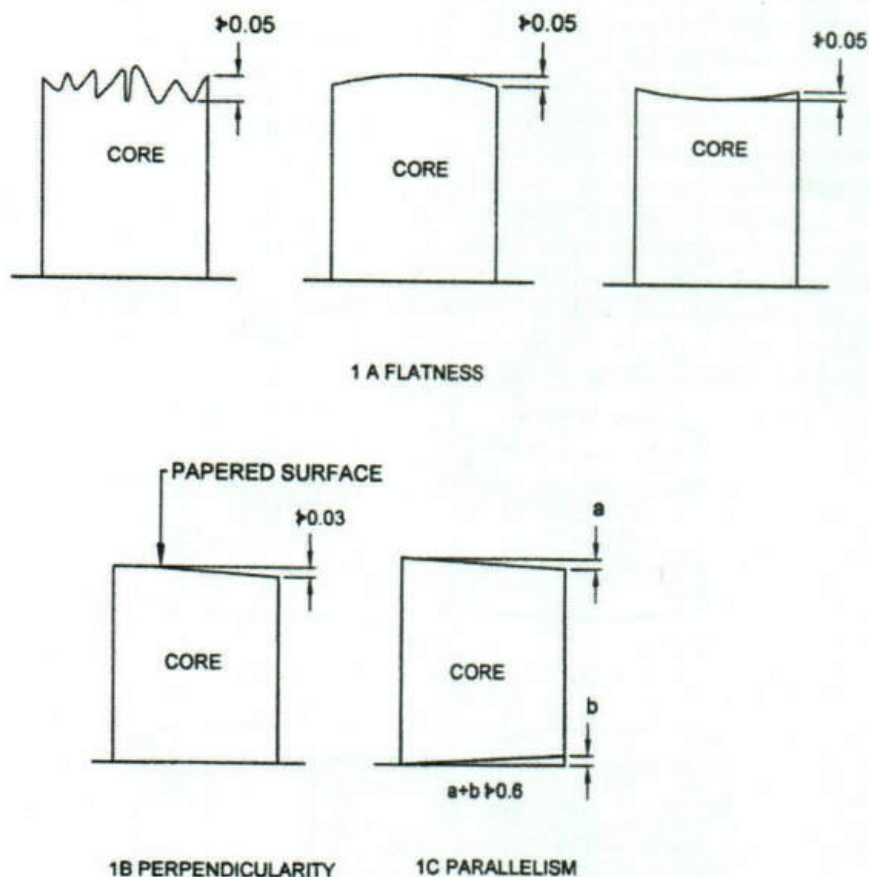
Prepare the core specimen as per methods mentioned

in 7 within the following tolerances:

- Flatness* (see Fig. 1A) — The tolerance on flatness of the prepared end surfaces shall be $\pm 0.05 \text{ mm}$.
- Perpendicularity* (see Fig. 1B) — The tolerance on perpendicularity of the prepared end, with respect to the axis of the specimen as datum, shall be $\pm 0.03 \text{ mm}$.
- Parallelism* (see Fig. 1C) — The tolerance on parallelism of the prepared top surface, with respect to the bottom surface of the specimen as datum, shall be $\pm 0.6 \text{ mm}$.
- Straightness* — The tolerance on straightness of any surface parallel to the centre line of the core shall be ± 3 percent of the average core diameter (d_m).

The above tolerances values are for 100 mm diameter core. If the cores with diameter less than the values recommended in 5.5, the tolerances shall be reduced in proportion to the tolerances specified for 100 mm diameter core.

7.6 Calipers, rulers, carpenters arm, etc, can also be used for measuring the tolerances. Flatness can also be



All dimensions in millimetres.

FIG. 1 PERMISSIBLE TOLERANCES FOR PREPARED CORE SPECIMENS

checked by covering the surface with a thin carbon paper and an ordinary paper and checking the impression formed on the ordinary paper, while tightening the platen over the paper covered surface. The papers are to be removed before testing.

8 COMPRESSION TEST

8.1 Storage

Cores may be tested generally in saturated condition except if specifically required to be tested in air dry condition. For the saturated condition, soak in water at $27 \pm 3^\circ\text{C}$ for a minimum of 40 h and maximum up to 48h before testing. Core shall be removed from the water and tested while it is still wet but remove all excess surface grit and water by wiping off. If it is required to test the core specimen in air-dry conditions, store in laboratory air for a minimum of 40 h and maximum up to 48 h prior to testing, record the storage time, ambient temperature and relative humidity of the storage conditions during air-dry storage of the specimens.

8.2 Placing and Testing of Core Specimen

Before placing the core specimen in testing machine, weigh it and also determine its length. The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the core specimen which are to be in contact with the compression platens. The core specimen shall be placed in the machine in such a manner that the load shall be applied to the top and bottom prepared surfaces. The axis of the core specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. As the spherically seated block is brought to bear on the core specimen, the movable portion shall be rotated gently by hand so that uniform seating may be obtained. The load shall be applied without shock and increased

continuously at a rate of approximately $14 \text{ N/mm}^2/\text{min}$ until the the core specimen breaks down and no greater load can be sustained. The maximum load applied to the core specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

8.3 Assessment of Type of Failure

For core specimens, if the failure is satisfactory (see Fig. 2), this fact shall be recorded. If the failure pattern is unsatisfactory, this fact shall be recorded and the type of failure recorded using the pattern letter (a to m) as given in Fig. 3, closest to the observed failure.

8.4 Calculation

8.4.1 The measured compressive strength of the core specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area, calculated from the mean dimensions of the section and shall be expressed to the nearest N/mm^2 .

The product of correction factor for core diameter (cores having diameter less than 100 mm) as given below, and the measured compressive strength shall be known as the corrected compressive strength:

Diameter of Core (No. of Cores ≥ 3) mm	Correction Factor
75 ± 5	1.03
< 70	1.06

8.4.2 A correction factor according to the l/d ratio of core specimen after capping shall be obtained from the following equation:

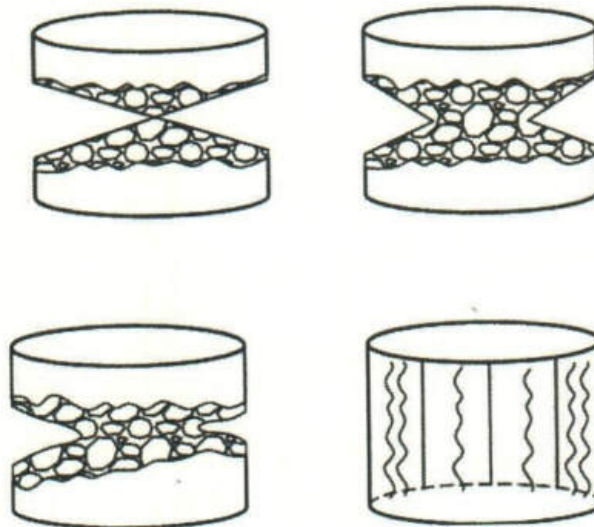


FIG. 2 SATISFACTORY FAILURE OF SPECIMEN

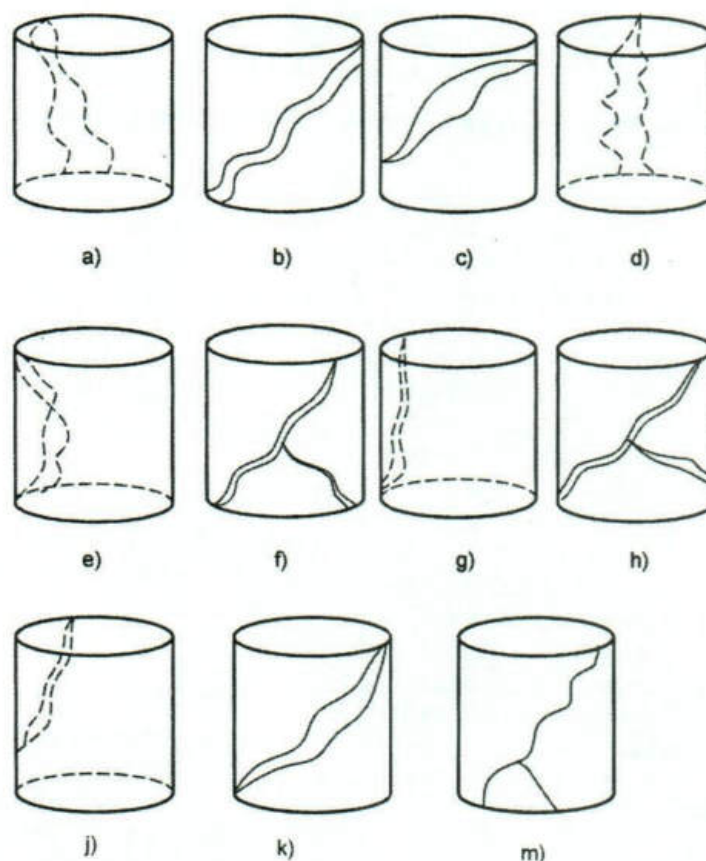


FIG. 3 UNSATISFACTORY FAILURE OF SPECIMEN

$$F = 0.11N + 0.78$$

where

F = correction factor, and

N = length / diameter ratio.

The product of this correction factor and the measured compressive strength or the corrected compressive strength for diameter as per 8.4.1, shall be known as the corrected cylinder strength, this being the equivalent strength of a cylinder having a height/diameter ratio of two. The equivalent cube strength of the concrete shall be determined by multiplying the corrected cylinder strength by 5/4.

8.4.3 Report

The following information shall be included in the report on each test specimen:

- Identification mark;
- Date of test;
- Age of specimen (if known/supplied);
- Maximum nominal size of aggregate (if known/supplied);
- Curing conditions, including date of manufacture of specimen in the field (if known/

supplied);

- Density of specimen (after end surface preparation) and dry density (prior to capping), the density of a core may be determined by weighing it and dividing it by the volume calculated from average diameter and length. Wet density to be reported, if specifically asked;
- Method used for preparation of specimen: cutting/grinding/capping;
- Dimensions of specimen (diameter and length (after preparation));
- Cross-sectional area;
- Maximum load;
- Measured compressive strength;
- Corrected compressive strength;
- Corrected cylinder strength;
- Equivalent cube strength; and
- Appearance of fractured faces of concrete (satisfactory/unsatisfactory) and, type of fracture, if these are unusual.

Annex B, gives guidelines for interpretation of core test results based on various factors.

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ANNEX A

(Clause 1)

SECURING AND PREPARING TEST SPECIMENS FROM HARDENED CONCRETE

A-1 This annex specifies the procedure for securing and preparing test specimens from hardened concrete in structures and pavements. A specimen to be tested for strength shall not be removed from the structure until the concrete has become hard enough to permit its removal without disturbing the bond between the mortar and the coarse aggregate. Normally, the concrete shall be 14 days old before the specimens are removed. Specimens that show abnormal defects or that have been damaged in removal shall not be used.

A-2 APPARATUS

A-2.1 Saw — A saw shall be used for securing beam specimens from the structure or pavement for flexural strength tests. The saw shall have a diamond or silicon carbide cutting edge and shall have adjustments that permit cutting of specimens conforming to the dimensions specified in A-3.1.

A-3 TEST SPECIMENS

A-3.1 Beam Specimen

The beam specimen for the determination of flexural

strength shall normally have a cross-section of 150×150 mm and shall be at least 700 mm in length. If the largest size of the aggregate does not exceed 20 mm, the beam specimen shall be $100 \text{ mm} \times 100 \text{ mm} \times 500 \text{ mm}$.

NOTE — In many cases particularly with prisms cut from pavement slabs, the width is governed by the size of the coarse aggregate and the depth by the thickness of the slabs.

A-4 PROCEDURE

A-4.1 Slab Removal

A sufficiently large slab shall be removed so that the desired test specimens may be secured without the inclusion of any concrete which has been cracked, spalled, undercut, or otherwise damaged.

A-4.2 Beam Sawing

The sawing operation shall be so performed that the concrete will not be weakened by shock or by heating. The sawn surfaces shall be smooth, plane, parallel and shall be free from steps, ridges and grooves. Care shall be taken in handling the sawn beam specimens to avoid chipping or cracking.

ANNEX B

(Clause 8.4.3)

INTERPRETATION OF CORE TEST RESULTS (INFORMATIVE)

B-1 FACTORS AFFECTING STRENGTH OF CORES

The following are the factors that affect the strength of cores:

- a) *Place of drilling the core* — There can be variation within the member. For example, generally the in-place strength of concrete at the top of member as cast is less than the strength at the bottom.
- b) *Micro-cracking* — Micro-cracking present in the concrete may reduce the core strength. Micro-cracks can be present if the core is

drilled from a region of the structure that has been subjected to stress resulting from applied load or restraint of imposed deformation. Rough handling of core sample may also cause micro cracking.

- c) *Curing* — Curing period and curing temperature both affect the strength. In mass concrete, differential moisture and temperature within the member can give variation in results of cores taken from outer face and inner mass. Inner mass can have lower compressive strength due to high initial temperature. Similarly, for non-continuous curing, the

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moisture gradient between surface and inner mass can result in different strengths in concrete, that is, lower strength in cores along face, due to less curing and higher strength within the inner mass due to availability of moisture for continuous curing.

- d) **Compaction** — Entrapped air in the concrete due to poor compaction or bleeding can reduce the strength. As the extent of poor compaction or bleeding can vary within the member, visual inspection of cores is essential to see if there is the presence of voids or honeycombs in the core samples. The extent of non-compaction and/or bleeding can be assessed by ultrasonic pulse velocity testing, as per IS 516 (Part 5/ Sec 1).
- e) **Moisture content** — Moisture condition of cores also affects the strength. Dried core samples give about 5 to 10 percent more strength than saturated samples. Therefore, for comparison with the cube test results, saturated sample testing is recommended in the test procedure of this code.
- f) The overall average effect of factors mentioned at (a) to (e) and other minor factors like coring direction, etc., is that, the core test is generally 85 to 90 percent of corresponding cube strength and the same has been considered in the acceptance criteria for core given in IS 456. However, if cracks are observed in the core, the core should not be tested or if cracking is observed during testing from failure pattern or from load machine displacement curve, the core results can be discarded [see also note under B-2.5.2 (b)].

The effect of diameter is considered in the correction factors at 8.4. While there is consensus that difference between 100 mm and 150 mm diameter cores are negligible, there is less agreement concerning smaller diameter cores. The analysis of large number of cores by various investigators indicated that the strength of 50 mm diameter cores was on an average 6 percent less than the strength of 100 mm diameter cores. In other tests, the average strength of 60 mm diameter cores was less by about 7 percent (for cores with average strength of 32 N/mm²). As the strength increases, the difference reduces. The scatter in results of 60 mm diameter cores is also found to be more. Therefore, when core diameter is less than 100 mm, more number of cores will give better assessment.

B-2 ACCEPTANCE CRITERIA OF CORE TEST RESULTS

The acceptance criteria for the core test results shall be as given hereunder.

B-2.1 As the specified compressive strength is generally cube strength, the results of cores are also expressed in terms of equivalent cube strength. Accordingly the acceptance criteria of core test results should also be correlated to acceptance criteria of cube tests.

B-2.2 Acceptance criteria of cube tests in the Indian Standards and other International Standards are based on statistical analysis technique. The confidence level considered in the Indian Standard is 95 percent (that is, 95 percent probability that 95 percent of the results will be more than f_{ck} , with minimum 30 samples).

B-2.3 In the expression, $f_{mean} = f_{ck} + z\sigma$, for 95 percent confidence level, z is 1.65 and the same is considered in target strength calculation. Therefore in IS 456, for acceptance based on average of 4 consecutive samples ($4 \times 3 = 12$ cubes).

$$f_{min} \text{ for avg of 4 samples} = [(f_{mean} = f_{ck} + 1.65\sigma) - 1.65 \times s]$$

where $s = \sigma/4^{0.5} = \sigma/2$.

$$\text{So } f_{min} = f_{ck} + 0.825 \times \sigma, \text{ subject to } f_{min} = f_{ck} + 3$$

B-2.4 For acceptance of concrete based on limited *in-situ* testing, little lower confidence level is acceptable. Generally 75 percent confidence level (75 percent probability of 95 percent results $> f_{ck}$) is considered. So mean core strength required is $f'_{mean} \geq (f'_{ck} + 1.48\sigma)$ where σ is the standard deviation. However, this is valid only if sufficient numbers of cores are tested.

B-2.5 Acceptance of core test results is generally required for two purposes as mentioned below, particularly for new construction. For existing structures the requirement is generally to assess the grade or strength of concrete in place,

- a) acceptance for structural adequacy; and
- b) contractual acceptance for conformance to specification.

(Deviations from specifications also affects durability besides strength.)

B-2.5.1 Procedure as per IS 456

If average of equivalent cube strength of minimum three cores is more than 0.85 times the specified cube strength (characteristic strength, f_{ck}) and no individual core has equivalent cube strength less than 0.75 times specified cube strength (f_{ck}), the core test results are considered satisfactory.

The international approach for assessing the core strength is also similar.

B-2.5.2 Recommended procedure for acceptance of core test results:

- a) The present procedure of IS 456 as mentioned before at B-2.5.1 is simple and can be used

IS 516 (Part 4) : 2018

for assessing strength of a particular member by taking three cores or in a case where one set of cube samples (set of 4 consecutive sample) has failed. The specified strength will be considered as characteristic strength.

- > b) For overall assessment requirement or where large number of cube sets (each set consisting of 4 consecutive samples) have failed say 2 consecutive sets or 3 scattered sets have failed (for the same grade/class of concrete) within a batch to be assessed, minimum 10 cores will be tested and the acceptance in such case will be as under:

$$f'(\text{avg}) \geq 0.85 (f_{ck} + 3)$$

$$f'(i) \geq 0.75 (f_{ck})$$

where $f'(\text{avg})$ is average equivalent cube strength of all cores (minimum nine cores - after excluding outliers if any).

$f'(i)$ is equivalent cube strength of individual core.

NOTE — Detecting outliers in test results: Outlier can be detected by inspection of load-machine displacement curves or using statistical tests. For statistical test, values beyond ' $f(\text{avg}) \pm 2s$ ' may be treated as outliers as a guide. Out of every 10 cores tested, one core test result can be outlier.

- c) Where the requirements of procedure **B-2.5.2** (a) and **B-2.5.2** (b) as the case may be, have been met, the concrete can be said to be meeting requirements of specification of IS 456. But where, 10 or more than 10 cores are taken but the results do not meet the criteria of **B-2.5.2** (b), but results of average of cores from all the individual members tested have strength more than $0.85f_{ck}$ and no individual core has strength less than $0.75f_{ck}$, the concrete in the particular batch or member may be accepted for structural adequacy and contractual acceptance/ penalties/deduction may be decided as per contract provisions by the project authorities.

NOTE — The procedure for assessment of strength of concrete by core test as given above is generally in line with international practice but modified to make it in line with present acceptance criteria given in IS 456 for acceptance of cube test results.

B-2.5.2.1 *Age factors for increase of strength with age*

Though there is normally a gain of strength beyond 28 days, the quantum of increase depends upon the grade, type of cement, curing and environmental condition. Therefore, while assessing the strength of concrete based on cores extracted at a later age, no age factor is generally considered except where considered in design or included in the contract specifications (*see also 6.2.1 of IS 456*).

NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/Tech.Audit/Quality/2025/1210

Dated: 06.02.2025

TECHNICAL CIRCULAR No:28

Subject: Mandatory Supervision of Sample Collection and Delivery to Labs by NBCC Representative Nominated by RBG's/SBG's/ZI - req

In order to maintain the integrity of the testing process, it is hereby made mandatory for NBCC's Representative on site to ensure the following:

1. **Sample Collection:** -

NBCC's Representative (nominated by RBG's/SBG's/ZI) must ensure that the samples for testing are collected as per the prescribed standards and procedures from the construction site in their presence.

2. **Supervision and Witnessing:** -

The NBCC's Representative (nominated by RBG's/SBG's/ZI) is responsible for personally witnessing the collection of the samples and ensuring that they are properly sealed, labelled, and documented before being dispatched.

3. **Delivery to Labs:** -

The NBCC's Representative (nominated by RBG's/SBG's/ZI) must ensure that the samples are delivered to the designated testing labs in the same condition as collected from the site, with no alteration or contamination during transit. The NBCC's Representative must keep the documentary evidence of the process ready at all times if asked by the Senior Officials/TAD team during their visit.

The above guidelines are to be strictly followed in letter and spirit. The concerned NBCC's Representative shall be held responsible if Lapses are found in near future.

This is issued with the approval of Competent Authority.


(A.K.Sharma)
ED (Tech.Audit)

Distribution through ERP only:

- 1.All RBGs/SBGs/Zonal/Unit Heads.
- 2.TO to Director (Projects) and TO to Director (Commercial)-For kind Information please.
- 3.TO to CMD-For kind Information please.



NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No. NBCC/Tech.Audit/Quality/2025/22

Dated: 09.04.2025

TECHNICAL CIRCULAR No:29

Subject: Implementation of 3R (Reduce, Reuse, Recycle) in all Projects

The 12th Regional 3R and Circular Economy Forum in Asia and the Pacific, held from 3rd to 5th March 2025 at Jaipur, emphasized sustainable waste management and circular economy initiatives. The Forum agreed on a good-will, voluntary and legally non-binding 3R and Circular Economy Declaration (2025-2034) for achieving resource-efficient, clean, resilient, sound material cycle and low-carbon society.

NBCC participated in the event as an implementing agency, showcasing its commitment to sustainability through initiatives that integrate energy efficiency, organic and inorganic waste management, and the use of eco-friendly materials.

Illustrating 3R principals for waste management further as follows:

1. Reduce:

- Minimize material wastage through optimized designs and prefabrication.
- Use energy-efficient construction techniques and eco-friendly materials.

2. Reuse:

- Salvage and repurpose building materials.
- Renovate and repurpose existing structures instead of demolishing them.

3. Recycle:

- Implement on-site waste sorting and recycling systems.
- Incorporate recycled materials into construction.
- Use water and energy recycling systems like rainwater harvesting and solar energy.

To promote sustainability, all RBGs/SBGs are advised to promote the implementation of 3R principles in all projects to ensure circular economy.

This is issued with the approval of Competent Authority.


(A.K.Sharma)
ED (Tech.Audit)

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- 2.TO to CMD, and TO to Director (Projects) - For kind Information please.

No. NBCC/Tech. Audit/Quality/2025/ **53**

Dated: **07.08.2025**

TECHNICAL CIRCULAR No: -30

Subject – Formulation of a uniform fixing method/norm/drawing for ducts and to be made mandatory for all projects- reg

As directed by the Competent Authority and to ensure quality work on the projects, the standards suggesting usage of screw rods for hanging and MS angle iron for base support, as outlined in CPWD specification 2024 Clause No. 9.11.1(iv) & 9.11.3 for duct support and hangers must be followed as stated below: -

Duct Width (mm)	Support angle in mm	Hangar Rod	Location	Support spacing	Remarks
Up to 1200 mm	40 x 40 x 3	10 mm	At Transverse Joints OR Support length not exceeding 2500mm	Ducts shall be supported independently from the building structure and adequately, to keep the ducts true to shape. The support spacing shall be not more than 2 m. where ducts cannot be suspended from ceiling, wall brackets or other suitable arrangements, as approved by the Engineer-in-charge shall be adopted. Neoprene or other vibration isolation packing of minimum 6 mm thickness shall be provided between the ducts and the angle iron supports/brackets. Vertical duct work shall be suitably supported at each floor by steel structural members. All duct supports, flanges, hangers shall be hot-dip galvanized.	HVAC ducting system, supports and hangers are embedded within concrete structures before pouring by using concrete inserts or by attaching them to the rebar. The ductwork is then suspended from these embedded supports using threaded rods, straps, or other suitable hardware. However, powder-actuated fasteners are installed for existing concrete structures, specialized tools can be used to drive fasteners into the concrete, providing attachment points for support & hangers. These fasteners should not be used in lightweight concrete or in slab less than 100mm thick. The minimum effective embedded depth should follow manufacture's data sheet as per IS 1946.
Over 1200-1800	40 x 40 x 3	10 mm	At Transverse Joints OR Support length not exceeding 2500mm		
Over 1800-2500	40 x 40 x 6	12 mm	At Transverse Joints OR Limiting Support length not exceeding 2500mm		
Over 2500	50 x 50 x 6	12 mm	At Transverse Joints OR Limiting support length not exceeding 1200mm		

All RBG's/ SBG's/ZI's are advised to adhere and take necessary action for strict implementation of subject matter.to this stated circular (*Annexure 'A'*)

This is issued with the approval of Competent Authority.

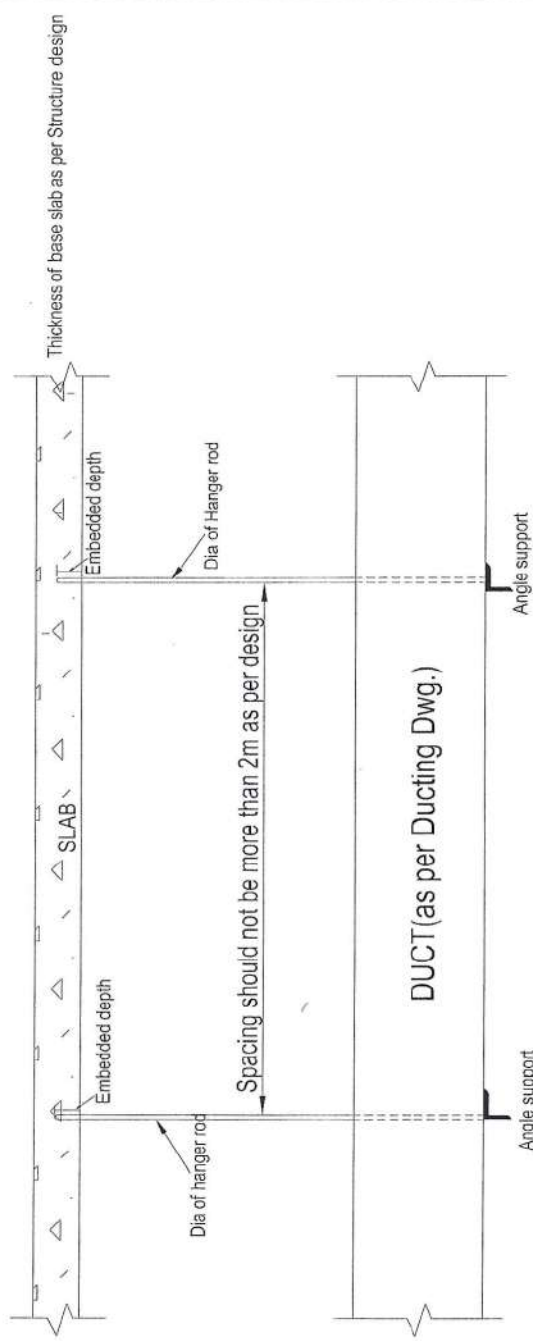

(Aditya Chandra)
CGM (Tech. Audit)

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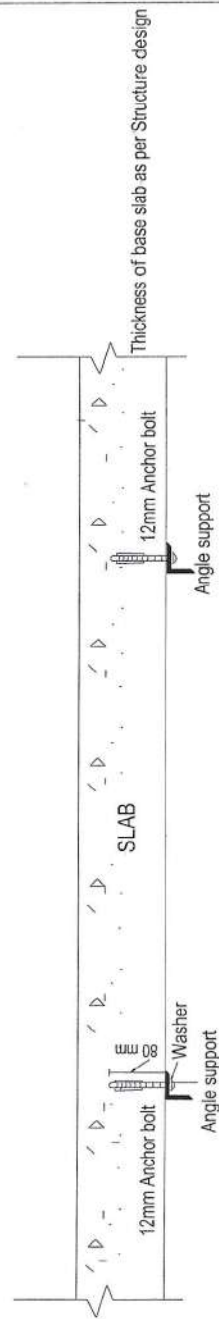
As per IS 1946 (Part 2) clause 7.2.3

Anchor Diameter	Embedded Depth
dia \leq 10 mm	60 mm
dia = 12 mm	70 mm
dia = 16 mm	80 mm
dia = 20 mm	90 mm



DUCT SUPPORT (Adhesive Anchors)

As per IS 1946 (Part 2) clause 7.2.2
For Mechanical anchors, the Embedded depth of the anchor shall be at least 6 times the anchor diameter, but not less than 40 mm. For Fastening statically indeterminate non structural elements, minimum embedded depth of anchor shall be 30 mm



DUCT SUPPORT (Mechanical Anchors) As per clause 7.2.2 - IS 1946 (Part 2) - 2025

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An ISO 9001:2015
Certified Company



A Navratna CPSE



एक कदम स्वच्छता की ओर

**OFFICE OF THE CHIEF GENERAL MANAGER
(TECHNICAL AUDIT/QUALITY)**

No.-NBCC/Tech. Audit/Quality/2025/64

Date: 01.10.2025

TECHNICAL CIRCULAR- 31

Subject: Mandatory installation of digital countdown/reverse clock at all project sites on PAN India reg.

As per instructions of the Competent Authority, all RBGs/SBGs are required to display the digital countdown/reverse clock at their respective project site offices and contractor's office across all projects valuing more than Rs. 50 Cr in existing as well as upcoming projects.

A confirmation report must required to send to Technical Audit division within 15 days from the date of issue of the circular to upraise the Competent Authority. Compliance will also be verified during Technical Audit inspections.

This issues with the approval of the Competent Authority.


Aditya Chandra
CGM (Tech. Audit)

Distribution through ERP only:

1. All RBGs/SBGs/Zonal/Unit Heads
2. TO to CMD, TO to Director (Commercial) and TO to Director (Projects)
- For kind information please.

No. NBCC/Tech. Audit/HO/2025/67

Date: 10.10.2025

TECHNICAL CIRCULAR No: -32

Subject – Formulation of Labor's Data Bank – Mandatory for All NBCC's Projects across Pan India.

It has been decided that a **Labor Data Bank** is required to be maintained for all NBCC's projects across Pan India.

The Unit In-charge of the respective project shall maintain the record of labours working at site as skilled, semiskilled & unskilled on the basis of the questionnaire attached with this circular as **Annexure A**.


The details should be maintained in the following format:

Name of the Project:						
Name of the Unit In charge:						
Name of the Zonal In charge:						
Sl No.	Trade of labours	Total Nos.	Labor			Name & contact Nos of skilled labours
			Skilled	Semi-skilled	Unskilled	
1	Masons					
2	Carpenters					
3	Blacksmiths					
4	Plumbers					
5	Mechanics					
6	Electricians					
7	HVAC Works					
8	Water proofing works					
9	Any other trade if any					

All Zonal In-charges are required to ensure that the above records are regularly updated on monthly basis and submitted to the respective RBG's/ SBG's. The details shall be checked during Technical Audit inspection also.

All RBG's/ SBG's/ZI's are advised to adhere and take necessary action for strict implementation of the subject matter.

This is issued with the approval of Competent Authority.


10/10/25
(Aditya Chandra)
CGM (Tech. Audit)

Distribution through ERP only:

1. All RBGs/SBGs/Zonal/Unit Heads.
2. TO to CMD, TO to Director (Projects) and TO to Director (Commercial) - For kind Information please.

Construction Labour Screening Checklist for Highly-Skilled Labour

Name of Project:-

Name of Contractor:-

General Information:-

Name:

Age:

Address:

Aadhaar / ID Proof Verified ☐ Yes ☐ No

Labour Card / Registration No.: (☐ Yes ☐ No)

EPF No.

Medical Fitness Checked ☐ Yes ☐ No

Note:- Colour blindness test is mandatory for safety-sensitive trades.

The Highly-Skilled Labour knowledge of following the details:- (Tick in the Box)

<input type="checkbox"/> Crane & Equipment Operators	<input type="checkbox"/> Surveyors	<input type="checkbox"/> Site Supervisors / Foremen
<input type="checkbox"/> Certification Course (Technical or Any other).	<input type="checkbox"/> Certification Course (Technical or Any other).	<input type="checkbox"/> Certification Course (Technical or Any other).
<input type="checkbox"/> Reads and follows load charts for safe lifting limits.	<input type="checkbox"/> Understands construction drawings and site plans.	<input type="checkbox"/> Knowledge of construction processes: concreting, bar bending, shuttering, masonry, finishing.
<input type="checkbox"/> Understands load capacity, center of gravity, and stability requirements.	<input type="checkbox"/> Knows surveying basics (benchmarks, coordinates, triangulation, traversing).	<input type="checkbox"/> Can allocate daily work to skilled, semi-skilled, and unskilled labour efficiently.
<input type="checkbox"/> Performs pre-operation inspection (fuel, brakes, hydraulics, lights)	<input type="checkbox"/> Can calculate area, volume (earthwork, concrete quantity).	<input type="checkbox"/> Prepares daily progress reports and labour attendance sheets.
<input type="checkbox"/> Can start, operate, and shut down equipment safely.	<input type="checkbox"/> Measures distances and angles with high accuracy.	<input type="checkbox"/> Capable of checking measurement sheets and material usage.
<input type="checkbox"/> Can lift, move, and place loads accurately as per site instructions.	<input type="checkbox"/> Can set up and operate Total Station correctly (station setup, backsight, resection).	<input type="checkbox"/> Coordinates with engineers, surveyors, and safety officers.

<input type="checkbox"/> Demonstrates smooth control of crane/JCB/excavator functions.	<input type="checkbox"/> Uses Auto Level for accurate leveling measurement.	<input type="checkbox"/> Verifies quality of workmanship (concreting, masonry, bar bending, finishing, etc.).
<input type="checkbox"/> Familiar with hand signals and radio instructions from riggers/signalmen.	<input type="checkbox"/> Checks and transfers levels (benchmarks, plinth, floor levels).	<input type="checkbox"/> Reads and interprets construction drawings (basic levels, dimensions, specifications).
<input type="checkbox"/> Reads basic machine gauges and warning alarms.	<input type="checkbox"/> Can carry out building layout marking as per drawings.	<input type="checkbox"/> Aware of quality checklists for each activity (cover blocks, curing, alignment, finishing standards)
<input type="checkbox"/> Knows emergency shutdown procedures.	<input type="checkbox"/> Records field data systematically in field book / digital format.	<input type="checkbox"/> Understands productivity norms (labour output rates) for planning and monitoring
<input type="checkbox"/> Aware of ground conditions and positioning requirements for equipment.	<input type="checkbox"/> Familiar with setting out columns, foundations, roads, utilities.	<input type="checkbox"/> Knows material requirements and avoids wastage
<input type="checkbox"/> Familiar with manufacturer's operating manuals.	<input type="checkbox"/> Can convert field data into AutoCAD / digital drawings (basic knowledge of CAD).	<input type="checkbox"/> Aware of first aid, emergency exits, and fire extinguishers on site
<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.
<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.
<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.
Experience in Years_____	Experience in Years_____	Experience in Years_____

Final Screening Decision

☐ Fit for Assigned Trade / Role
 ☐ Conditionally Fit (requires additional training or supervision)
 ☐ Not Suitable

Unit In-charge Name & Signature
NBCC

Project In-charge Name & Signature
Contractor

Date: _____



Construction Labour Screening Checklist for Skilled Labour

Name of Project:-

Name of Contractor:-

General Information:-

Name:

Age:

Address:

Aadhaar / ID Proof Verified ☐ Yes ☐ No

Labour Card / Registration No.: (☐ Yes ☐ No)

EPF No.

Medical Fitness Checked ☐ Yes ☐ No

Note:- Colour blindness test is mandatory for safety-sensitive trades (electrician, machine operator, painter, signalman).

The Skilled Labour knowledge of following the details:- (Tick in the Box)

<input type="checkbox"/> Carpenter	<input type="checkbox"/> Bar Bender	<input type="checkbox"/> Mason	<input type="checkbox"/> Electrician	<input type="checkbox"/> Plumber	<input type="checkbox"/> Welder	<input type="checkbox"/> Painters
<input type="checkbox"/> Reading Drawings.	<input type="checkbox"/> Reading reinforcement drawings (structural drawings).	<input type="checkbox"/> Plumb Checking.	<input type="checkbox"/> Electrical drawings.	<input type="checkbox"/> Laying water supply including hot & cold water line installation.	<input type="checkbox"/> Different metals (MS, SS, aluminum, mild steel)	<input type="checkbox"/> Prepares surfaces (scraping, sanding, putty application, primer coating).
<input type="checkbox"/> Measuring.	<input type="checkbox"/> Different steel bar diameters (8 mm, 10 mm, 12 mm, 16 mm, etc.)	<input type="checkbox"/> Water/laser level checking.	<input type="checkbox"/> Fixing conduits in slabs & Wall.	<input type="checkbox"/> Drainage & sanitary pipe installation.	<input type="checkbox"/> Different welding processes & Test: Arc, MIG, TIG, Gas welding.	<input type="checkbox"/> Applies paint/finish evenly with brush, roller, or spray gun.
<input type="checkbox"/> Assembling of Pannel.	<input type="checkbox"/> Cutting, bending & tying bars with accuracy.	<input type="checkbox"/> Tile laying (ceramic, vitrified, granite etc.).	<input type="checkbox"/> Wiring, looping.	<input type="checkbox"/> Plumbing drawings/layouts	<input type="checkbox"/> Welding joint.	<input type="checkbox"/> Mixes paint, thinner, and finishes in correct proportions.
<input type="checkbox"/> Cutting & Assembling plywood.	<input type="checkbox"/> Placing reinforcement in beams, slabs, columns.	<input type="checkbox"/> Plastering thickness & Finishing.	<input type="checkbox"/> switch/socket installation.	<input type="checkbox"/> Pipe sizing and water flow basics.	<input type="checkbox"/> Fabrication or welding drawings	<input type="checkbox"/> Knowledge of colour shades, mixing, and matching.

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<input type="checkbox"/> Plum Checking.	<input type="checkbox"/> Fixing stirrups, hooks, lap splices.	<input type="checkbox"/> Ratio Mixing.	<input type="checkbox"/> Installing DB boards.	<input type="checkbox"/> Pipe line slope & alignment.	<input type="checkbox"/> Gas cutting, plasma cutting, oxyacetylene torch.	<input type="checkbox"/> Finishing schedule/drawings.
<input type="checkbox"/> Scaffolding.	<input type="checkbox"/> Maintains correct cover & alignment for bars.	<input type="checkbox"/> Curing.	<input type="checkbox"/> Installing earthing.	<input type="checkbox"/> Cutting, traps, valves, joints, reducers, elbows.	<input type="checkbox"/> Electrode selection for given metal thickness.	<input type="checkbox"/> Knows types of paints (emulsion, enamel, distemper, oil paint, texture, primer, polish).
<input type="checkbox"/> Installing doors, windows, partitions.	<input type="checkbox"/> Operating bar bending and cutting machines.	<input type="checkbox"/> Brick/Block work with Bond.	<input type="checkbox"/> Installing light fixtures.	<input type="checkbox"/> Leak testing (pressure test / water test)	<input type="checkbox"/> Weld quality check (visual inspection, weld size, penetration).	<input type="checkbox"/> Understands correct sequence: surface preparation → putty → primer → paint/finish.
<input type="checkbox"/> Using power tools (saws, drills).	<input type="checkbox"/> Coupler & its fixing.	<input type="checkbox"/> Cladding.	<input type="checkbox"/> Testing with multimeter & insulation tester	<input type="checkbox"/> Using power tools (pipe cutter, threading machine, wrench, drill, hacksaw)	<input type="checkbox"/> Prepare work surface (cleaning, grinding, beveling)	<input type="checkbox"/> Storage of paints, chemicals, and flammable materials.
<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.
<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.
<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work while handling steel bars (sharp edges, lifting heavy bars).	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.
Experience in Years_____	Experience in Years_____	Experience in Years_____	Experience in Years_____	Experience in Years_____	Experience in Years_____	Experience in Years_____

Final Screening Decision

☐ Skilled

☐ Semi-Skilled

☐ Un-Skilled

Unit In-charge Name & Signature
NBCC

Project In-charge Name & Signature
Contractor

Date: _____

Construction Labour Screening Checklist for Semi-Skilled Labour

Name of Project:-

Name of Contractor:-

General Information:-

Name:

Age:

Address:

Aadhaar / ID Proof Verified ☐ Yes ☐ No

Labour Card / Registration No.: (☐ Yes ☐ No)

EPF No.

ESI No.. (If applicable)

Medical Fitness Checked ☐ Yes ☐ No

Note:- Colour blindness test is mandatory for safety-sensitive trades (electrician, machine operator, painter, signalman).

The Semi-Skilled Labour knowledge of following the details:- (Tick in the Box)

<input type="checkbox"/> Concrete Helper	<input type="checkbox"/> Bar Bending Helper	<input type="checkbox"/> Painting & Finishing Helper	<input type="checkbox"/> Masonry Helper	<input type="checkbox"/> Carpenter/Formwork Helper
<input type="checkbox"/> Knows load/unload concrete materials at site	<input type="checkbox"/> Knows identification and carrying different types of steel bars (8mm, 10mm, 12mm, etc.)	<input type="checkbox"/> Preparation of surface (cleaning, scraping, sanding, removing dust/loose plaster)	<input type="checkbox"/> Soak and carry bricks/blocks to working area.	<input type="checkbox"/> Can carry and arrange shuttering materials (plywood, props, clamps, soldiers)
<input type="checkbox"/> Knows pouring, compacting, and leveling concrete.	<input type="checkbox"/> Knows Cuts binding wire into required lengths.	<input type="checkbox"/> Mixing of paint, primer, putty, and finishing materials.	<input type="checkbox"/> Prepares and carries mortar as instructed (cement, sand, water)	<input type="checkbox"/> Assists in holding and fixing formwork panels under supervision
<input type="checkbox"/> Knows concrete surface leveling.	<input type="checkbox"/> Knows Supplies bars, tools, and wire to bar bender as instructed.	<input type="checkbox"/> Assists in applying putty and primer.	<input type="checkbox"/> Line dori (string line), Plumb and checking alignment	<input type="checkbox"/> Supplies nails, hammers, clamps, and other tools to carpenter
<input type="checkbox"/> Knows operating of concrete vibrator.	<input type="checkbox"/> Knows Bars in position during tying and bending.	<input type="checkbox"/> Identify Equipment and basic painting tools (brush, roller, scraper, putty knife, sandpaper) in work.	<input type="checkbox"/> Can do basic leveling and water curing.	<input type="checkbox"/> Helps in oiling/form release agent application on shuttering boards.
<input type="checkbox"/> Equipment, tools using in concreting work tools like spade, bucket,	<input type="checkbox"/> Knows stacking, bundling, and shifting reinforcement steel.	<input type="checkbox"/> Knows names of common paints (emulsion, enamel, distemper,	<input type="checkbox"/> Knows common masonry materials (cement, sand, bricks, blocks, stone)	<input type="checkbox"/> Assists in dismantling formwork safely and stacking materials properly.

wheelbarrow, shovel, trowel.		primer, putty)		
<input type="checkbox"/> Knows cement, sand, aggregate, and water usage.	<input type="checkbox"/> Knows names of basic tools (pliers, wire cutter, hammer, measuring tape)	<input type="checkbox"/> Aware of simple mixing ratios (paint + thinner/water)	<input type="checkbox"/> Understands basic mortar mixing ratios (e.g., 1:4, 1:6)	<input type="checkbox"/> Knows names of common shuttering materials (plywood, steel plates, wooden battens, props)
<input type="checkbox"/> Knows simple mixing ratios (e.g., 1:2:4, 1:3:6).	<input type="checkbox"/> Knows Understands simple bar shapes (straight, hook, stirrup)	<input type="checkbox"/> Understands importance of surface preparation before finishing.	<input type="checkbox"/> Identifies basic tools (trowel, plumb bob, spirit level, hammer, bucket, pan)	<input type="checkbox"/> Identifies basic tools (hammer, saw, spanner, nails, clamps)
<input type="checkbox"/> Aware of curing methods (sprinkling water, covering with wet cloths/gunny bags)	<input type="checkbox"/> Knows lap length and proper tying.	<input type="checkbox"/> Aware of hazards of chemicals, thinners, and dust inhalation	<input type="checkbox"/> Aware of basic brick bonding patterns (stretcher, header)	<input type="checkbox"/> Aware of simple alignment tools (plumb bob, measuring tape, spirit level)
<input type="checkbox"/> Knows Storage of Material.	<input type="checkbox"/> Knows measurement reading.	<input type="checkbox"/> Safely storage of paint cans and flammable materials.	<input type="checkbox"/> Knows Plumb Checking.	<input type="checkbox"/> Understands importance of proper support and bracing and installation of staging in formwork.
<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.	<input type="checkbox"/> Fear of Heights.
<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.	<input type="checkbox"/> PPE.
<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.	<input type="checkbox"/> Safety in work.
Experience _____ in	Experience in Years _____	Experience _____ in	Experience in Years _____	Experience in Years _____

Final Screening Decision

☐ Semi-Skilled

☐ Un-Skilled

Unit In-charge Name & Signature
NBCC

Project In-charge Name & Signature
Contractor

Date: _____



Construction Labour Screening Checklist for Un-Skilled Labour

Name of Project:-.....

Name of Contractor:-.....

General Information:-

Name:

Age:

Address:.....

Aadhaar / ID Proof Verified ☐ Yes ☐ No

Labour Card / Registration No.:.....(☐ Yes ☐ No)

EPF No.

ESI No.. (If applicable)

Medical Fitness Checked ☐ Yes ☐ No

Note:- Colour blindness test is mandatory for safety-sensitive trades.

The Un-Skilled Labour knowledge of following the details:- (Tick in the Box)

- Understands simple instructions related to material handling. ☐
- Safe lifting and carrying of material. ☐
- Proper stacking & storage of materials (cement godown rules, steel stacking). ☐
- Loading/unloading of construction materials. ☐
- Site cleaning (Before & After work), housekeeping, and waste segregation. ☐
- Use of simple hand tools (spade, shovel, wheelbarrow, hammer). ☐
- Assisting masons, carpenters, bar benders, painters. ☐
- Awareness of PPE (helmet, gloves, shoes, mask). ☐
- Follow safety signs and supervisor's instructions. ☐
- Mixing mortar and concrete manually (basic ratio knowledge). ☐
- Willing to learn and progress towards semi-skilled category. ☐

Final Screening Decision

☐ Suitable

☐ Not Suitable

Unit In-charge Name & Signature
NBCC

Project In-charge Name & Signature
Contractor

Date: _____

[Handwritten signature]



A Navratna CPSE

NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

No.-NBCC/TAD /HO/2025/ 79

Date: 01.01.2026

TECHNICAL CIRCULAR- 33

Subject: Mandatory to produce Soil Test Report at site during Technical Audit.

At inception of the project on site, soil testing is the most important activity to assess the type of foundation for the proposed structure.

In view of above, for upcoming projects and during excavation stage of projects, it has been directed by competent authority, that all RBG/SBG or nominated representative must witness the soil testing process at sites and sign the document/ soil testing report before carrying out the foundation design of the structure. The Soil test report duly signed by respective RBG/SBG or representative nominated by RBG/SBG must be produced/checked by the technical audit team during their visit of the respective projects.

This is issued with approval of Competent Authority.

Aditya Chandra
CGM (Engg.)

HOD (Technical Audit and D&C)

Distribution through ERP only:

- 1. All RBGs/SBGs/Zonal In charges**
- 2. TO to CMD, TO to Director (Commercial) and TO to Director (Projects) – For kind information please.**

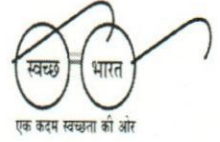


An ISO 9001 : 2015
Company



A Navratna CPSE

NBCC (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)



No. NBCC/CGM/Tech. Audit/Quality/2021/ 686

Dated: 27.07.2021

TECHNICAL CIRCULAR No: 11

As per General Conditions of Contract, testing of all materials is to be done from NABL Accredited Lab. However, there have been instances where the result of testing in lab has not been found appropriate. Therefore, it is imperative that our officials check and approve the lab before permitting the contractor to get the testing done.

Therefore, in all construction contracts RBG/SBG Heads will approve the lab for testing on the application of the Contractor. RBG/SBG Heads will check/get checked the documents of the certification of lab through Zonal Incharge and/or Unit Incharge. The officials may also be deputed to the laboratory to check the facilities of testing and other systems in the laboratory. Only if the systems are found satisfactory, the testing in the laboratory should be permitted. It should also be ensured that laboratory should have the NABL accreditation specifically for the materials to be sent for testing.

This is issued with the approval of Competent Authority.

(Md. Rafiq)

CGM (Tech. Audit/Quality)

Distribution through ERP only:

1. All RBGs/SBGs/Zonal/Unit Heads.
2. TO to CMD, NBCC (I) Ltd.- For kind Information please.