

CODE OF PRACTICE

GENERAL

- (1) The method of execution of the items shall conform to the relevant specifications as per the latest version of the Indian Standard unless specified otherwise and as far as applicable.
- (2) Wherever a reference to ANY Indian Standard appears in the specification, it shall be taken to mean as a reference to the latest version of the standard.
- (3) The following specifications, standards, and codes are made as a part of this specification.
Indian Standards : specification for building materials, specification for equipment, method of test, method of measurement of building works ,code of practice for construction , safety code for demolition of building, safety code for scaffolds etc. published by the Bureau of Indian Standards
- (4) The contractor shall invariably carry out Materials & work Tests as specified in the tender document (**B1- Form**) and IS code. However, if the additional tests are required as per the opinion of the Engineer-in-charge, the same shall also have to be carried out. All such tests shall be got carried out in Government or as approved laboratories and cost thereof shall be entirely borne by the contractor. No collection of materials shall be made before it is got approved from the Engineer-in-charge.

 All moulds, equipments etc. required of preparing specimens for the test shall be kept in sufficient numbers and in good state, as directed by the Engineer-in-charge on the site of work.

 Specimen for tests shall sent to the laboratory along with representative of GIDC in time and the results thereof shall be promptly obtained and reported to the Engineer-in-charge.
- (5) Satisfactory test results shall not observed the contractor from dismantling and re-doing any work revealed to the defective at a later date. The contractor shall have no claim for any payment or compensation whatsoever on account of replacement of such defective work. Contractor shall take all precautions and care during dismantling and re-doing the work to ensure that any other work so far executed does not get damage or affected.
- (6) The work shall be carried out in true line and level and in conformity with the detailed drawing and specified patterns.
- (7) All the work shall be carried out in a workmanship like manner and as per the best techniques for the particular item.
- (8) All tools, tempts equipments etc. for correct execution of the work as well as for checking lines, levels, alignments of the works, during execution shall be kept in sufficient numbers on the side of work.
- (9) All installations pertaining to water supply and its fixtures as well as drainage lines and sanitary fitting shall be deemed to be completed only after giving satisfactory tests by the contractor.
- (10) Scaffolding being provided by the contractor at his own cost for such of the items for the execution of which it is essential.

C-1/1 Excavation

General:

In all sorts of soil, sand, gravel, soft murrum and other similar soft or loose material. The excavation will generally refer to the open excavation for foundation.

Clearing the site:

The site on which the structure is to be built shall be cleared and all obstructions, loose stones, material, and rubbish of all kind, bush, wood, and trees shall be removed as directed. The materials so obtained shall be the property of the GIDC and shall be conveyed the stacked as directed by the Engineer-in-charge.

Setting out:

After clearing the site the centre lines will be given by the Engineer. The contractor shall assume full responsibility for alignment, elevation, and dimension of each and all parts of the work. Contractors shall supply labour materials, etc. required for setting out the reference marks and bench marks and shall maintain them as long as required.

Excavation:

It shall be all sorts of soil, sand, gravel, soft murrum, or other similar soft or loose materials.

The excavating for foundation and for basement shall be carried out in true line and level and shall have the width and depth as shown in the drawing or as directed by the Engineer-in-charge. The contractor shall do the necessary shorting and shutting or slopes to a safe angel, if necessary including bailing and pumping out water when separate provision does not exist for it in tender, at his own cost. The bottom of the excavated area shall be leveled both longitudinally and transversely as directed by the Engineer-in-charge. No earth filling will be allowed to bring it to level if by mistake or any other reasons excavation is made deeper or wider than shown on the plan or directed by the Engineer-in- charge. The extra depth or width shall be made up with concrete or masonry of the foundation grade as directed by the Engineer-in- charge and at the cost of the contractor.

Disposal of the excavated stuff:

The excavated stuff of the selected type shall be used in filling the trenches in layers including ramming and watering etc.

The balance of the excavated quantity shall be removed by the contractor from site of work to a place as directed by the Engineer-in-charge with all lead and lift but within the same estate.

C-1/2 Excavation in Hard murrum :

Same as C-1/1 except that the excavation shall be in hard murrum.

C-1/3 Excavation in Hard murrum and boulders.

Same as C-1/1 except that the excavation shall be in hard murrum and boulders.

C-1/4 Excavation in soft rock :

Same as C-1/1 except that the excavation shall be in soft rock.

C-1/5 Excavation in Hard rock.

Same as C-1/1 except that the excavation shall be in hard rock

C-2 Plain Cement Concrete Laying in Foundation / for Floor Bedding :

General:

Before starting concrete, the bed of the foundation trenches shall be cleared of all loose materials and watered as directed.

Proportioning of Mix:

The proportion of the cement to sand and coarse aggregates shall be as specified in the item and shall be measured by volume.

Mixing:

The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantities of work if approved by the Engineer-in-charge. The mixing shall be done for a period of 1 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

Scaffolding:

All scaffolding, hoisting arrangement and ladders etc. required for the facility of concrete shall be provided by the contractor and removed on completion of work. The scaffolding, hoisting arrangement and ladders shall allow easy approach to the work and afford easy inspection.

Form work:

The form work shall be provided if necessary as directed by the Engineer-in-charge and shall be as per I.S. 461-1972 or revised from time to time.

Transporting & placing the concrete:

The concrete shall be handled from the place of mixing to the final position by not more than 15 minutes by the method as directed by the Engineer-in-charge and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

The concrete shall be laid in layers of 15 cms to 20 cms.

Compaction:

The concrete shall be thoroughly compacted by hammers immediately after depositing to get a dense concrete. Concrete shall not be disturbed once it has set.

Curing:

After the final set, the concrete shall be kept continuously wet, if required by pounding for a period of not less than 7 days from the date of placement.

C-3 Lime Cinder Concrete Laying :

This shall be as per C-2 of code of practice. The coarse aggregate in this case shall cylinder.

C-4 Ordinary Cement Concrete Plain or Reinforce :

I.S. 466-1978 or as revised from time to time shall be followed in general cement sand by black trap grit and coarse aggregate shall be measured by volume. For proportioning of cement by volume one bag of cement shall be taken as 0.0342 cu.m. (1.2 cft)

Mixing:

Concrete shall be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency

but in no case shall mixing be done for less and 1.1/2 minutes. When hand mixing is permitted by the Engineer-in-charge in case of small work or in case of break down of machineries and in the interest of the work it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required have to be used without any extra cost.

Transporting:

Concrete shall be handled from the place of mixing of the final position as quickly as practicable by methods which will prevent segregation or loss of ingredients. In no case operation shall be taken more than 15 minutes.

Placing:

The concrete shall be placed into its final position and completed and finished within 30 minutes of mixing the water and before setting commence. Method of placing shall be such as to avoid segregation, approved by the Engineer-in-charge. Concreting shall be carried out continuously up to construction joints, the position and arrangement of which, shall be pre-determined by the designer.

When the work has to be resumed on a surface which has hardened, such surface shall be roughened. It shall then be swept clean thoroughly wetted and covered with a thin layer or mortar composed of cement and sand in the same proportion as the cement and sand in the concrete mix. This layer of mortar shall be freshly mixed and placed immediately before the placing of the concrete.

When the concrete has not fully hardened, all laitance shall be removed by scrapping the wet surface with wire or bristles care being taken to avoid dislodgement of particles or aggregates. The surface shall be thoroughly wetted and all free water removed. The surface shall be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness and shall be well rammed against old work. Particular attention is paid no corners and spots.

Compaction:

Concrete shall be thoroughly compacted during the operation of placing and thoroughly worked around the reinforcement, around embedded fixtures and into corners of the form work. Compacting shall be done by mechanical vibrations, in such a way that a dense mix is obtained.

Curing:

The concrete shall be kept covered with a layer of sacking canvas or similar materials or by pounding and kept constantly wet for twenty one days from the date of placing concrete. Curing by pounding shall preferably be done by erecting suitable dykes of lean mortar.

Form work:

General:

The form work shall conform to the shape, lines and dimensions as on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete, and shall be sufficiently water tight to prevent loss of liquid from concrete. Adequate arrangements shall be made by the contractor to safeguard against any settlement of the form work during the course of concreting and after concreting. The design of the form work and centering shall be got approved form Engineer-in-charge before erection.

Cleaning & Treatment of Forms:

All rubbish, particularly chipping shavings and saw dust shall be removed from the interior of the forms before the concrete is placed and the form work in contact with concrete shall be cleaned and thoroughly wetted or treatment with an approved composition. Care shall be taken that such approved composition is kept out of contact with reinforcement.

Stripping Time:

In normal circumstances and where ordinary cement is used, forms may be struck after expiry of following period

(a)	Walls columns & vertical side of beams	24 to 48 hours as may be decided by the Engineer-in-charge.
(b)	Side of slabs	3 days
(c)	Beam	7 days
(d)	Removal of props to slabs. (i) Slabs spanning up to 4.5 M (ii) Spanning over 4.5 M	7 days. 14 days.
(e)	Removal of props to beams & arches. (i) Spanning up to 6 M (ii) Spanning over 5 M	14 days 21 days

Procedure when removing the Form work:

All form shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffits and struts are removed and concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. The form work will be paid under the respective item if provided in the tender.

Centering:

The centering to be provided shall be got approved from the Engineer-in-charge. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during, and after pouring concrete. Watch should be kept to see that behavior of centering and formwork is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

The props of centering shall be provided on firm foundation of base of sufficient strength to carry the loads without settlement.

The centering and form work will be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor or his responsibility for strength, adequacy, and safety of form work and if there is a failure of form work or centering, contractor shall be responsible for the damages to work, injury to life and damage to the property.

Scaffolding:

All scaffolding, hoisting arrangements etc. required for the facility of concreting shall be provided and removed on completion of work by the contractor at his own expenses. The scaffolding, hoisting arrangement and ladders etc. shall be strong enough to withstand all live, dead and impact loads expected to act and shall be subject to the approval of the Engineer-in-charge. However, contractor shall be solely responsible for

the safety of the scaffolding, hoisting arrangement, ladders, work, and workmanship etc. The scaffolding, hoisting arrangement and ladders shall allow easy approach to the work spot and afford easy inspection.

Testing:

Work sample of concrete 150mmx150mm x 150mm shall be taken as under:

Qty. of work in M3	No. of sample
1.5	1
6.15	2
16-30	3
31-50	4
51 & above	4+1 for each additional quantity of 50 M or part thereof.

The contractor shall make his own arrangement for taking sample and testing of the sample in the Government or the approved laboratories. The test shall be carried out in accordance with IS 516-1959 or as revised from time to time. A register of cubes shall be maintained the site of work in the prescribed Performa. The result of the cubes shall be submitted to the Engineer-in-charge by the contractor.

Note: (1) At least one sample shall be taken from each shift

(2) Each sample consists of three test specimens for testing at 28 days.

Additional cubes may be required for various purposes. Such as to determine the strength of concrete at 7 days or at the time of striking the form work or to determine the duration of curing or to check the testing error.

Finishing unless otherwise specified in the item to keep the exposed concrete surface, the concrete surface shall be finished with cement mortar 1:4 (1- cement: 4-sand) in true line level in accordance with M-9 of specification of materials.

C-5 Controlled concrete :

Grade:

The concrete shall be designed as M-150, M-200, M-250, M -300 & M-400 as prescribed in I.S. 456-1978 or as revised from time to time.

Aggregates:

Samples of the aggregates proposed to be used shall be got approved from the Engineer-in-charge prior to collection of the materials at the site of work field test for determining the content of silt, loam, clay etc. In fine aggregate and grading and moisture content in both fine and coarse aggregate shall be carried out before commencing the concreting work and record of the test shall be maintained till the completion of the work.

The grading of aggregate shall be controlled by obtaining the fine and coarse aggregate in different size being stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible. The frequency shall be as directed by the Engineer-in-charge, to ensure that the uniform grading as per approved samples used in the preliminary tests is maintained.

As soon as possible, after receiving the order to commence the work the contractor shall design the mix for different grades of concrete required in the work submit details in respect of proportion of cement and aggregates water cement ration etc. and arrangement to make trial mixes for preliminary tests to be carried out in the Government or any other approved laboratory to satisfy the Engineer-in-charge that the

designed mix meets with the prescribed strength. The maximum total quantity to aggregates by weight per 50 Kg. of cement shall not exceed 450 Kg. except where otherwise specifically permitted by the Engineer-in-charge.

The minimum number of specimens for preliminary test and criteria for acceptance of test strength shall conform to Table –V **Acceptance criteria for concrete of I.S. 456-1978.**

On the satisfactory results of the above tests, the mix actually to be used shall be got approved from Engineer-in-charge. The approval of the Engineer-in-charge will not relieve the contractor of his responsibility for obtaining the required minimum strength in the work test. Record of all tests in support of mix design shall be maintained as a part of record of the contract.

STRENGTH REQUIREMENT OF CONCRETE:

The compressive strength requirements for various grades of concrete shall not be lower than the figures given below:

Grade of concrete	Compressive strength of 15 cms cubes conducted in accordance with I.S. 516-1959.		
	After 28 days after mixing in preliminary test (Kg/cm ²)	At 7 days after mixing in work test	At 28 days after mixing in work test (Kg/cm ²)
M-100	135	70	100
M-150	200	100	150
M-200	260	135	200
M-250	320	170	200
M-300	380	200	300
M-350	440	235	350
M-400	500	270	400

PROPORTIONING & WORKS CONTROL:

The mix proportions shall be selected to ensure that the workability of the fresh concrete suitable for the condition of handling and placing, so that after compaction it surrounds all reinforcement and completely fills the form work. When concrete is hardened, it shall have the required strength, durability and surface finish.

The determination of the proportions of cement, aggregate and water to attain the required strength shall as follows:

- (a) By designing the concrete mix; such concrete shall be called "Design Mix Concrete" or "Controlled Concrete".
- (b) By adopting nominal mix, such concrete shall be called "Nominal Mix Concrete".

TABLE - 2.8
OPTIONAL WORK TEST REQUIREMENTS OF CONCRETE (All values in N/mm²)
(All tests conducted in accordance with IS: 516)

Grade of Concrete	Compressive Strength of 150mm cubes, min at 7 days	Modulus of Rupture by Beams Test Min.	
		At 72 + 2 hrs.	at 7 days
M - 10	7	1.2	1.7
M - 15	10	1.5	2.1
M - 20	13.5	1.7	2.4
M - 25	17	1.9	2.7
M - 30	20	2.1	3.0
M - 35	23.5	2.3	3.2
M - 40	27	2.5	3.4

The concrete mix shall be designed to have an average strength corresponding to the values specified for preliminary tests in Table. The proportions chosen should be such that the concrete is of adequate workability for the conditions prevailing on the work in question, and can be properly compacted with the means available. The maximum total quantity of aggregate by weight per 50 kg. Of cement shall not exceed 450 kg. except where otherwise specially permitted by the Engineer-in-Charge.

Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right portions when required, the different sizes being stocked in separate stock piles. The material should be stock piled for several hours preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge to ensure that the suppliers are maintaining the grading uniform with that of the samples used in the preliminary test.

In proportioning concrete, the quantity of both cement and aggregate should be determined by weight, where the weight of cement is determined by accepting the maker's weight per bag. A reasonable number of bags should be weighted separately to check the net weight. Where the cement is weighed on the site and not in bags, it should be either measured by volume in calibrated tanks or weighed. All measuring equipment should be maintained in clean serviceable conditions, and their accuracy periodically checked.

It is most important to maintain the water cement ratio constant at its correct value. To this end, determination of moisture contents in both fine and coarse aggregates should be made as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge according to weather conditions. The amount of the added water shall be justified to compensate for any observed variations in the moisture contents. For the determination of moisture content in the aggregate for concrete: Part-III specific gravity, density, voids, absorption and bulking may be referred to. To allow for the variation in weight of aggregate due to variation in their moisture content, suitable adjustments in the weights of aggregate should also be made.

No substitutions in materials used on the work or alterations in the established proportions, except as permitted in the above para shall be made without additional tests to show that the quality and strength of concrete are satisfactory.

WORKABILITY OF CONCRETE:

The concrete mix proportions chosen should be such that concrete is of adequate workability for the placing conditions of the concrete and can properly be compacted with the means available. The definitions of the ranges of "workability" of concrete as measured by either the slump or V-B tests (IS: 1199) and the range to be adopted for different kinds of work unless specified otherwise is given in Table - 2.9.

TABLE - 2.9
WORKABILITY OF CONCRETE

Placing conditions	Degree of Workability	Slump (mm)	Values of Workability	
			Vee-Bee	Compacting Factor
Blinding concrete; Shallow Sections; Pavements using pavers	Very Low	--	20- 10 secs	0.75 - 0.80
Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strip footings	Low	25 - 75	10 - 5 secs	0.80 - 0.85
Heavily reinforced sections in slabs, beams walls, columns; Slip form work; Pumped concrete	Medium	50 - 100 75 - 100	5 - 2 secs	0.85 - 0.92*
Trench fill; In-situ piling Termite concrete	High Very high	100 - 150 Workability to be decided by determination of flow (IS: 9103)	--	Above 0.92** Above 0.92**

Note: For most of the placing conditions, internal vibrators (needle vibrators) are suitable. The diameter of the needle shall be determined based on the density and spacing of reinforcement bars and thickness of sections. For tremie concrete, vibrators are not required to be used.

A competent person should be employed whose duty will be to supervise all stages in the preparation and placing of the concrete. All works test specimens should be prepared and site tests carried out under his direct supervision

REQUIREMENT FOR DURABILITY:

Minimum cement content required in cement concrete to ensure durability under specified conditions of exposure should be as given in Table 2.12 unless otherwise specified. The general environment to which the concrete will be exposed during its working life is classified into five levels of severity, that is, mild, moderate, severe, very severe and extreme as described in Table 2.13.

TABLE - 2.12

Minimum Cement Content, Maximum Water Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20mm Nominal Maximum Size

Sr. No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m ³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m ³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
1.	Mild	220	0.60	--	300	0.55	M-20
2.	Moderate	240	0.60	M-15	300	0.50	M-25
3.	Severe	250	0.50	M-20	320	0.45	M-30
4.	Very Severe	260	0.45	M-20	340	0.45	M-35
5.	Extreme	280	0.40	M-25	360	0.40	M-40

The general environment to which the concrete will be exposed during its working life is classified into five levels of severity, that is, mild moderate, severe, very severe and extreme as described in Table 2.13.

TABLE 2.13**ENVIRONMENTAL EXPOSURE CONDITIONS**

Sr. No.	Environment	Exposure Conditions
1.	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
2.	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet. Concrete exposed to condensation and rain Concrete continuously under water Concrete in contact or buried under non-aggressive soil/ground water Concrete surfaces sheltered from saturated salt air in coastal area
3.	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation. Concrete completely immersed in seawater Concrete exposed to coastal environment
4.	Very Severe	Concrete surfaces exposed to seawater spray, corrosive fumes or severe freezing conditions whilst wet. Concrete in contact with or buried under aggressive sub-soil/ground water
5.	Extreme	Surface of members in tidal zone Members in direct contact with liquid/solid aggressive chemicals

MIX DESIGN AND SAMPLING AND TESTING FOR CONCRETE

Facilities required for sampling materials, shall be provided when required by the Engineer. The methods used in sampling, laying curing and testing the concrete samples, either in the field or in the laboratory, shall be in accordance with the appropriate Indian Standards. This is to

investigate the grading of aggregate, water cement ratio, workability and the quantity of cement required to give works cubes of the minimum strength specified.

The mix shall be designed to produce the grade of concrete having required workability and desired characteristic strength. As long as the quality of the materials does not change, a mix design done earlier may be considered adequate for later work. As already stated under "proportioning" the proportion of the mix shall be by weight. In case uniformity in the materials used for concrete making has been established over a period of time, the proportioning may be done by volume batching, by the use of bulk densities, provided periodic checks are made on mass/volume relationships of materials. Where weigh batching is not practicable, the quantities of fine and coarse aggregate (not cement) may be determined by volume. If aggregate is moist and volume batching is adopted, allowance shall be made for bulging in accordance with IS: 2386 (Part-III). Mix proportioning shall be carried out according to the ACI Standard ACI 631 or "Design of Concrete Mixes" Road Research Note No.4 of Department of Scientific and Industrial Research, U.K.

Whenever there is either a change in strength of concrete required, water cement ratio, workability or the source of aggregates and cement, preliminary tests shall be conducted again to determine the revised proportions of the mix to suit the later conditions. While designing mix proportions, over wet mixes should always be avoided.

PRELIMINARY TESTS:

The materials and proportion used in main preliminary tests shall be similar in all respects to those to be actually employed in the works as the object of this test is to determine proportion of cement, aggregates and water necessary to produce the concrete of consistency required to give the strength specified. It will be the contractor's sole responsibility to carry out these tests and he shall therefore furnish to the Engineer, statement of proportions proposed to be used for concrete mix. For preliminary tests, the following procedure shall be followed. Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregate for each batch shall be determined by weight to an accuracy of 1 Part in 1000.

(a) Mixing:

Concrete shall be mixed in a mechanical mixer. The mixer should comply with IS: 1791. The cement and fine aggregate shall first be mixed dry until the mixture is in uniform colour. The coarse aggregate shall then be added, mixed and water added and mixed thoroughly for a period of not less than two minutes after all the materials are in the drum and until the resulting concrete is uniform in appearance. If there is segregation after unloading from the mixer, the concrete should be remixed.

(b) The consistency of each batch of concrete shall be measured immediately after mixing, by the slump test in accordance with IS: 1999. In the slump test, care shall be taken to ensure that no water is lost; the material used for slump test may be remixed with the remainder of concrete for making the test specimen. The period of remixing shall be as short as possible yet sufficient to produce a homogeneous mass.

Note: In exceptional circumstances such as mechanical breakdown of mixer, work in the remote areas or when the quantity of concrete work is very small, hand mixing may be permitted, subject to adding 10% extra cement at his (contractor's) cost. When hand mixing is permitted, it shall be carried out on a watertight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour and consistency.

CONCRETE CUBES:

(a) Size of test specimen & moulds:

Test specimens cubical in shape shall be 150 x 150 x 150 mm. If the largest nominal size of the aggregate does not exceed 200mm, 100 mm cubes may be used as an alternative.

A cube mould should be of metal and stout enough to prevent distortion. It shall be constructed in such a manner as to facilitate the removal of the moulded specimen without damage, and shall be so machined that, when it is assembled ready for use, the dimensions and internal faces shall be accurate within the following limits:

Height of mould and distance between opposite faces: Specified size + 0.2 mm.

Angle between adjacent faces: 90 + 0.5 degree

Each mould shall have a plane face metal base plate of such size as to support the mould during the filling without leakage and shall be attached to the moulds; when assembled shall be positively and rigidly held together and suitable methods of ensuring this, both during filling and on subsequent handling of the filled mould, shall be provided. In assembling the mould for use, the joints between the sections of mould shall be thinly coated with mould oil and a similar coating of mould oil shall be applied between the contact surfaces of the bottom of the mould and the base plate in order to ensure that no water escapes during filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete. The tamping bar shall be a steel bar 16 mm. in diameter, 0.6 m. long and bullet pointed at the lower end.

(b) Compacting:

The test specimens shall be made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled into the mould in layers approximately 50 mm deep. In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete slides from it, in order to ensure a symmetrical distribution of the concrete within the mould. Each layer shall be compacted as described below. After the top layer has been compacted, the surface of the concrete shall be finished level with the top of the mould using a trowel, and covered with a glass or metal plate to prevent evaporation.

For compacting, standard tamping bar shall be used and the strokes of the bar shall be distributed in a uniform manner over the cross section of the mould. The number of strokes per layer required to produce specified conditions will vary according to the type of concrete but in no cases shall be less than 35 strokes per layer for 150 mm cubes or 25 strokes per layer for 100 mm cubes. The strokes shall penetrate into the underlying layer and the bottom layer shall be rodded throughout its depth. Where the tamping bar leaves voids, the sides of the mould shall be tapped to close the voids.

(c) Curing:

The test specimen shall be stored on the site at a place free from vibration under damp-matting, sacks or other similar material for 24 hours + 0.5 hour from the time of adding water to the other ingredients at a temperature range of 22° C to 32° C After 24 hours, they shall be marked for later identification, removed from the moulds and stored in clean water at a temperature of 24° C to 30° C. They shall be sent to the testing laboratory well packed in damp sand, sacks or other suitable material so as to arrive there in a damp condition not less than 24 hours before the time of test. On arrival at the testing laboratory, the specimen shall be stored in water at 27° C +2° C temperature until the time of test. Records of the daily maximum and minimum temperature shall be kept both during the period the specimens remain on the site and in the laboratory.

(d) Tests for Cube Specimen:

The concrete cubes shall be tested in standard testing machines by skilled personnel. Tests shall be made at recognized ages of the test specimen, the most usual being 7 and 28 days.

Tests may be made at 24 hours + 1/2 hour and 72 hours + 2 hours if early strengths are needed. The age shall be calculated from the time of the addition of water to the dry ingredients.

At least three specimens, preferably from different batches shall be made for testing at each selected age.

Specimens stored in water shall be tested immediately on removal from the water and while they are still in the wet condition. Surface water and grit shall be wiped off the specimens and any projecting fins removed.

The bearing surface of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen, which are to be in contact with the compression platens. The specimen shall be so placed in the machine that the load shall be applied to the opposite sides of the cubes as cast, that is, not to the top and bottom. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing plates shall be used between specimen and platens of the machine. Once the uniform seating is obtained, load shall be applied without shock and increased continuously at a rate of approximately 14.0 N/mm² /Min. until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

The measured compressive strength of the specimen shall be the maximum load applied to the specimen divided by the cross sectional area of the specimen and shall be expressed to the nearest N. per sq. mm. Average of the values shall be taken as the representative of the batch provided the individual variation is not more than + 15 percent of the average. Otherwise repeat tests shall be made. Cube crushing strength shall conform to the values given in Tables 2. 7 and 2.8.

(e) Frequency of Sampling of Concrete Cubes:

A random sampling procedure should be adopted to ensure that each concrete batch shall have a reasonable chance of being tested; that is, the sampling should be spread over the entire period of concreting covering all mixing units. The minimum frequency of sampling of concrete of each grade shall be as follows:

Quantity of concrete in the work cu. m.	No.of samples
1 - 5	1
6 - 15	2
16 - 30	3
31 - 50	4
51 and above	5 Plus one additional sample for each additional 50m or part thereof

The test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for determining strength of concrete at 7 days. The test strength of the sample shall be the average strength of three specimens. The individual variation should not be more than 15 percent of the average.

Concrete shall be assessed daily for compliance. The contractor shall keep a record at site of all such tests identifying them with the proportion of the work to which they relate. The

Architects will check this record from time to time. The said record shall give the following details and shall be initiated by the Engineer-in-Charge.

- (i) Reference to specific structural member receiving the batch of concrete from which the cubes were cast.
- (ii) Mark on cubes.
- (iii) Mix of concrete.
- (iv) Data and time of casting.
- (v) Water cement ratio by weight and slump.
- (vi) Crushing strength as obtained at the end of 7 days for 3 cubes out of a set of 6 cubes and the end of 28 days for the remaining 3 cubes.
- (vii) Laboratory in which tested and reference to test certificates.
- (viii) The quantity of concrete, incorporated in work that is represented by the quantity of concrete of the set of the cubes.
- (ix) Any other information required by Architects.

(f) Consistency:

The consistency of each sample of concrete shall be measured immediately after remixing by the slump test. The slump shall be as directed by the Engineer, which would be based on the preliminary test result keeping in view, the workability of the concrete. The approved slump shall be maintained through the field operations unless otherwise directed by the Engineer. In order to ensure the maintenance of uniform consistency, slump tests shall be carried out as often as demanded by the Engineer and invariably with the batch of concrete from which test cubes are made.

(g) Record of Temperature:

A record of maximum and minimum temperature at the places of storage of the cube shall be maintained, during the period they remain at site, by the Contractor.

OPTIONAL TESTS:

The Engineer, if he so desires, may order tests to be carried out on cement, sand, coarse aggregate in accordance with the Indian Code of Practice or any other approved code.

Tests on cement shall include:

- (i) Fineness Test,
- (ii) Test for Normal Consistency,
- (iii) Test for Setting Time,
- (iv) Test for Soundness,
- (v) Test for Tensile Strength,
- (vi) Test for Heat of Hydration (by experiment and by calculations) in accordance with BIS or any other approved standard for cements.

Test on sand shall include:

- (i) Sieve Test
- (ii) Test for Organic Impurities
- (iii) Decantation Test for Determining Clay
- (iv) Specific Gravity Test

(v) Test for Sieve Analysis and Fineness Modulus.

Tests on coarse aggregate shall include:

- (i) Sieve Analysis
- (ii) Specific Gravity and Unit Weight of Dry Loose and Rodded Aggregate (Bulk Density Test)
- (iii) Determination of Yield of a Dry Mixture
- (iv) Petrographic Examination of Deleterious Minerals in Aggregates.
- (v) Test for Aggregate Crushing Value and 10% Fine Value Test.
- (vi) Aggregate Impact Value
- (vii) Toughness Test
- (viii) Soundness Test
- (ix) Hardness Test
- (x) Alkali Aggregate Reaction
- (xi) Deleterious Material

Any or all these test would normally be ordered to be carried out, if the specified concrete strengths are not obtained, at the Contractor's cost. If the works cubes do not give the stipulated results, the Engineer reserves the right to ask the Contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standard stipulated at his (Contractor's) cost. It shall be very clearly understood by the Contractor that no extra claims shall be entertained by the Owner for excess use of cement over the minimum quantity stipulated to give the works cubes of required strength. The unit rate for design and test cubes, works cubes, testing them as per specifications, optional tests etc.

Unless otherwise stipulated, the concreting, testing, etc. shall be carried out as directed by the Engineer and to the appropriate BIS Specifications. In the event of any work being suspected of faulty materials or workmanship or both, the Engineer before requiring its removal and reconstruction, may order, or the contractor may request, that it should be load tested in accordance with the following provisions.

LOAD TEST ON MEMBERS OR ANY OTHER TEST AS PER IS-456-2000:

The test load shall be 125 percent of the specified super imposed load for which the structure was designed in addition to the full dead load (self weight of structure members plus weight of finishes and walls or partitions, if any as considered in the design). Such test load shall not be applied before 28 days after the time of placing of concrete.

During the tests, struts strong enough to take the whole load shall be placed in position leaving a gap under the members. The test load shall be kept for 24 hours before removal.

If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75 percent of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 80 percent of the maximum deflection shown during the second test.

If during the test, or upon removal of the load, the structure shows signs of weakness, undue deflection or faulty construction it shall be reconstructed or strengthened as necessary.

Any other test, e.g. taking out concrete cores, examination and test on such cores removed from such parts of the members in an approved manner and as directed by the Engineer shall be carried out by the Contractor at his own cost, if so directed.

TESTING CONCRETE OF TANKS FOR LEAKAGE:

In addition to the structural test given in clause above, structures (tanks, chests, pits, etc.) to be used for storage of liquids shall also be tested for water tightness at full storage level as described below:

(a) In case of structure whose external faces are exposed such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry over the period of observation of seven days after allowing a seven days period for absorption after filling with water.

(b) In case of structures whose external faces are backfilled and are not accessible for inspection, such as underground tanks, the tanks shall be filled with water and after the expiry of seven days after the filling; the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hours over a period of 7 days. The total drop in surface level over a period of seven days shall be taken as an indication of the water tightness of the tank. The Engineer shall decide on the actual permissible rate of this drop in the surface level, taking into consideration whether the tanks are open or closed and the corresponding effect it has on evaporation losses. Backfilling shall be withheld till the tanks are tested if directed by the Engineer

Costs of Tests:

The entire cost of tests as specified, in clause above shall be borne by the Contractor.

Unsatisfactory Test:

If the results of any test prove unsatisfactory, the Contractor shall remove and rebuild the member or members involved or carry out such other remedial measures as may be required by the Engineer or his representative. The Contractor shall bear the cost of so doing, unless the failure of the member or members to fulfil the test condition is solely due to faulty design.

PLACING:

The procedure for placing of concrete shall be as follows:

(a) Preparation before placing of concrete shall be as given below.

(i) **Engineer's Approval of Equipment & Method:**

Before any concrete is placed, the entire placing programme, consisting of equipment, layout, proposed procedure and methods shall be submitted to the Engineer for approval if so demanded by the Engineer and no concrete shall be placed until the Engineer's approval has been received.

(ii) Hardened concrete and foreign materials should be removed from the inner surface of the conveying equipments.

(iii) Form work shall have been completed; snow, ice and water shall have been removed. Reinforcement shall have been secured in place, expansion joint material, anchors and other embedded items shall have been positioned and the entire preparation shall have been approved.

(iv) No concrete shall be placed on watered surface.

(v) Rain or Wash Water:

No concrete shall be placed in wet weather and any concrete that has been washed by heavy rains shall be entirely removed, if there is any sign of cement and sand having been washed away from the concrete mixtures. To guard against damage which may be caused by heavy rains, the works shall be covered with gunny bags immediately after the concrete has been placed in position on the surface of the newly placed concrete

and shall be removed by approved means and no further concrete shall be placed thereon.

(b) Time interval between mixing and placing:

Concrete shall be placed in the forms within 30 (thirty) minutes as rapidly as practicable, after addition of water to cement and aggregate, unless otherwise authorised by the Engineer.

(c) Concrete placing by manual labour:

Except when otherwise approved by the Engineer, concrete shall be placed in the shuttering by shovels or other approved implements and shall not be dropped from a height or handled in a manner, which will cause segregation. Accumulation of set concrete shall be avoided. Concrete shall be placed directly in its permanent position and shall not be worked along the shuttering to that position.

(d) Avoiding segregation:

Concrete shall, in all cases, be deposited as nearly as practicable directly in its final position, and shall not be caused to flow in a manner, which will cause segregation, loss of materials and impair its strength. For locations where direct placement is not possible, and in narrow forms, the Contractor shall provide suitable drop chutes and "Elephant Trunks" to confine the concrete in movement.

(e) Concrete placing by Mechanical Equipment:

The following specification shall apply where placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of the work involved.

The control of placing shall begin at the mixer discharge. Concrete shall be discharged by the vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in the structures.

(f) Type of Buckets:

Central bottom dump buckets of a type that provides for positive regulation of the amount and rate of deposit of concrete in all dumping positions shall be employed.

(g) Operation of Bucket:

In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall just clear the concrete already in place and the height of drop shall not exceed 1.00 M. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing, or in any manner which results in segregation of ingredients or disturbances of previously placed concrete will not be permitted.

(h) Placement in Restricted Forms:

Concrete placed in restricted forms by borrows, buggies, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or falling.

(i) Chuting:

Where it is necessary to use transfer chutes between mixer, containers or hoppers, and point of deposit in the forms, specific approval of the Engineer must be obtained as regards the type, length, slopes, baffles and vertical terminals. Concrete shall not be permitted to

fall from the end of the chutes or tube more than 1.00 M. Chutes, when approved for use shall have slope not flatter than 1to3 and not steeper than 1to2.

(j) Placing by Pumping:

Concrete may be conveyed and placed by mechanically operated pressure equipment only with the written permission of the Engineer. Water cement ratio may not be increased above that for the same class of concrete placed by bucket and the slump shall be held to the minimum necessary for conveying concrete by this method.

(k) Bonding Mortar:

Immediately before concrete placement begins, prepared surfaces except formwork, which will be in contact with the concrete to be placed, shall be covered with a bonding mortar as specified.

(l) Thickness of Layers:

Concrete shall be placed in successive horizontal layers ranging in thickness from 15 to 90 mm. as directed by the Engineer the bucket loads, or other units of deposit shall be potted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum of shovelling. Any tendency to segregation shall be corrected by shovelling stones into mortar then mortar on the stones. Such a condition shall be corrected by redesign of mix or other means, as directed by the Engineer.

(m) Bedding of layers:

Bedding planes shall be approximately horizontal unless otherwise instructed.

(n) Compaction:

Concrete shall be compacted with approved mechanical vibrating equipment until the concrete has been consolidated to the maximum practicable density, and is free of pockets of coarse aggregate, and fits tightly against all form surfaces and embedded materials.

TYPE OF VIBRATORS:

- (i)** Vibrators shall be the internal or immersion high frequency type, with speed of not less than 6000 revolutions per minute when immersed in the concrete. Vibrators shall be used in sufficient number of units and power of each unit shall be adequate to properly consolidate the concrete.

(ii) Use of Vibrators:

Vibrators shall be inserted in a vertical position at intervals of about 600 mm depending upon the mix; the equipment used, and continued experience on the job. Vibrators shall be withdrawn slowly. In no case shall vibrators be used to transport concrete inside the forms.

(iii) Successive Batches:

In placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, blending of the concrete between the succeeding batches.

(iv) Vibrator Penetration of under layer:

The vibrator shall penetrate the layer being placed and also penetrate the layer below while under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

(v) Vibrating Against Reinforcement:

Care shall be taken to prevent contact of vibrators against reinforcement steel. Vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. Vibrators shall not be allowed to come in contact with forms of finished surface.

(vi) Use of form attached Vibrators:

The use of form attached Vibrators shall be used only with specific authorization of the Engineer.

(vii) Use of Surface Vibrators:

The use of surface vibrators will not be permitted under ordinary conditions. However, for thin slabs such as highways, runways, and similar construction surface vibration by specially designed vibrators may be permitted, upon the approval of the Engineer.

(viii) Stone pockets and Mortar Poundage's:

The formation of stone pockets and mortar poundage in corners and against form face shall not be permitted. If these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for the rough blending, as directed by Engineer.

CONSTRUCTION JOINTS AND KEYS:

Concrete shall be placed continuously unless otherwise specified.

If stopping of concreting becomes unavoidable anywhere, the construction joint shall be made, where the work is stopped, concrete that is in the process of setting shall not be disturbed or shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and bonding keys shall be located and shall conform in details to the requirements of the plans unless and otherwise directed by the Engineer. Where not described, the joint shall be in accordance with the following:

(a) Column joint:

In a column, the joint shall be formed 75 mm. below his lowest soffit of the beams joining to it.

(b) Beam and Slab joint:

Concrete in a beam shall be placed throughout without a joint but, if the provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidable, the joint at right angles to the principal reinforcement, shall be vertical and at the middle of the span.

CURING, PROTECTING, REPAIRING AND FINISHING:

All concrete shall be cured by keeping it damp for the period of time required for complete hydration and hardening to take place.

Certain types of finish, or preparation for overlaying, concreting must be done at certain stages of the process and special treatment may be required for specific concrete surface finish.

(i) Curing with water:

Fresh concrete shall be kept continuously wet for a minimum period of at least 21 days since lapse of 24 hours after laying concrete. Quantity of water supplied shall be controlled so as to prevent the erosion of freshly placed concrete.

(ii) Continuous Spraying:

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances of hose (sprinklers to be used), unless otherwise specified or approved by the Engineer.

(iii) Alternate Curing Methods:

Whenever, in the judgement of the Engineer, it may be necessary, the continuous spray method may be omitted and a covering of sand, or other approved mulching such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which should strain or damage the concrete during or after curing period. Covering shall be kept continuously wet during the curing period.

(iv) Curing compounds:

Surface coating type-curing compounds shall be used only by special permission of and under the direction of the Engineer. Curing compounds shall be colourless / pigmented, liquid type, conforming to approved specifications. No curing compound shall be used on surfaces where future blending with concrete or painting is specified.

(v) Ponding:

For curing of concrete in pavement, sidewalks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by the Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water.

(vi) Curing Equipment :

All equipment and materials required for curing shall be on hand and ready for the use before concrete is placed.

(vii) Protection of Fresh Concrete:

Fresh concrete shall be protected by leaving forms in place for an ample period as specified later in this specification. Newly placed concrete shall be protected by approved means from rain, sun and winds. Steps as approved by the Engineer shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion or other materials etc. that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, the Engineer may require that bridges be placed over the area.

(viii) Repair and Replacement of Unsatisfactory Concrete:

Immediately after the shuttering is removed, the surface of concrete shall be very carefully one over and holes noticed shall be filled up and made good with mortar composed of one part of cement to one part of sand after removing any loose stones adhering to the concrete. Concrete surfaces shall be finished as described under the particular items of work. Superficial honeycombed surfaces shall be made good immediately after removal of shuttering, in presence of Architect's representative and superficial water and air holes shall be filled in. Unless otherwise instructed by the Engineer, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fins or other irregularities.

Unsatisfactory concrete shall be cut out and replaced with new concrete, as soon as practicable after removal of forms. Anchors, tees, or dovetail slots shall be provided wherever necessary to attach the new material securely in place. Surface of prepared voids shall be wetted for 24 hours immediately before the patching material is placed. Use of an epoxy for blending fresh concrete used for repairs will be permitted upon written approval of the Engineer. Epoxies shall be applied in strict accordance with the instructions of the manufacturer.

FINISHING - GENERAL:

The specification is intended to cover the treatment of concrete surfaces of all structures. Area requiring special finish not covered by this specification may be clearly indicated on the drawings and specifications will be furnished.

(a) Finish for Formed Surfaces:

The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified by the Engineer:

(i) Cement plaster finish:

The concrete shall be properly roughened immediately after the shuttering is removed, taking care to remove the laitance completely without disturbing concrete. The roughening shall be done by hacking. Before the surface is plastered, it shall be cleaned and wetted so as to give good bond between concrete and plaster.

- (ii) For surface against which backfill or concrete is to be placed, 'no' treatment is required except tie holes & repair of defective areas shall be patched with cement mortar.
- (iii) For surfaces below grade, which will receive waterproofing treatment, the concrete shall be free of surface irregularities, which would interfere with proper application of the waterproofing material, which may be specified for use.
- (iv) Surfaces which will be exposed when the structure is in service shall receive no special finish except repair of damaged or defective concrete, removal of fins and abrupt irregularities, filling of holes left by form ties and rods, and clean up of loose or adhering debris.

(b) Finishing:

Finishing of exposed concrete surface shall conform to the following.

Smooth form finish:

The form facing material shall produce a smooth, hard, uniform texture on the concrete; it may be plywood or other approved material capable of producing the desired finish. All ties, burns and fins are to be removed. Mix one part of Portland cement and one part fine sand with sufficient water to produce a stiff mortar. The mortar after drying shall match the rest of the surface in colour. Before application of mortar, concrete surface is to be dampened. Mortar is to be applied by firm rubber float or trowel, filling all surface voids. Compressing mortar into voids by using carborundum stone shall be continued till uniform colour and texture is produced. If the mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with a sprayer. Quoted rate of exposed shuttering shall be inclusive of this treatment.

(c) Finish for Unformed Surfaces:

Surfaces which will be exposed to the weather and which would normally be a specified level, a horizontal surface or shows the slope required, the tops of narrow surfaces, such as stair treads, walls, curbs and parapets shall be sloped approximately 10mm in 300mm width, broader surfaces such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, sub-floors to be covered with concrete topping, terrazzo or quarry tile, and similar surfaces shall be smooth screened and levelled to produce even surfaces. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside desks, floors of galleries and sumps, parapet, gutters, sidewalks and slabs shall be consolidated, screened and flattened. Flattening may be done with hand and started as soon as the screened has attained a stiffness to permit finishing operations, and shall be the minimum required to produce surface uniform in texture and free from screened marks or other imperfections.

Joints and edges shall be tooled as called for on the drawings or as directed by the Engineer.

(d) Protection:

All concrete shall be protected against damage until final acceptance by the Architect or his representative.

CONCRETING IN HOT WEATHER:

Concreting in extreme hot weather shall be avoided. Special care shall be exercised and measure undertaken when temperature on site exceeds 105° F or 40° C. Such measures shall include:

- (i) Provision of a shade for coarse aggregate so that the same do not absorb heat from the directly indenting rays of sun.
- (ii) Continuously wetting coarse aggregates to keep their temperature down, fog sprays.
- (iii) Providing a shade for the mixing machine.
- (iv) Depositing the concrete from the machine as quickly as possible.
- (v) Adjusting water proportions throughout the day to account for water in the wet aggregate, giving desired strength and workability.
- (vi) (Covering the deposited concrete by a membrane as soon after the placing as possible without damaging the fresh concrete.
- (vii) Wet gunny bags shall be laid immediately after two hours of concreting on the top surfaces of slab and shall be kept wet for curing period.
- (viii) Use of retarder (2% of Calcium Chloride).
- (ix) Use of Zero Heat Portland Cement or even the Portland Pozzolana Cement.
- (x) Use of higher water cement ratio.
- (xi) Keep moist, the formwork continuously for the period of 2 hours at least.

On such days of hot weather, concreting records shall be kept of the atmospheric temperature and corresponding temperatures of concrete discharged from the mixing machine.

CURING OF DIFFERENT ITEMS:

For all the time during construction, curing shall be carried out especially from 7.00 AM to 7.00 PM even on holidays with proper manpower, necessary pumps and pipe lines, connections, etc.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, hessian or similar material and kept constantly wet for at least seven days from the date of placing concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather conditions. In the case of concrete where mineral admixtures or blended cements are used it is recommended that above minimum periods may be extended to 14 days. For the concretes containing PPC or Portland Slag Cements, period of curing may be increased.

FORM WORK:

General:

The form work shall conform to the shape, lines and dimensions as shown on the drawings and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete and shall be sufficiently tight to prevent loss of slurry.

- (a) All forms shall be checked frequently during the concreting operations and until removed so that they may be driven up if any settlement occurs.

The design, fabrication and erection of formwork are solely the responsibility of the Contractor. The formwork should be safe and stable to withstand dead load of concrete, men etc. Further, the form should yield security to the structure or its members.

(b) Materials:

The selection of materials suitable for formwork shall be based on economy and consistency with safety and quality required in the finished work. Formwork shall be of timber, plywood, steel or any other materials as approved by Architect/Engineer-in-Charge whose decision in this respect shall be final. Props and shores shall be of steel, timber posts, bullies or any other material as approved by Architects.

- (c) Chamfer strips shall be placed in corner of forms to produce bevelled edges on permanent exposed surface, if specified.
- (d) Temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.

(e) Mould Oil:

Care should be taken to see that the formwork is perfectly cleaned and two coats of mould oil or any other approved material is applied before placing the concrete. Such coating shall be insoluble in water, non-staining and non-injuries to the concrete. It shall not become flaky or be removed by rain or wash water. Block boards or equivalent shall be used for shuttering columns, beams, etc. and steel sheets for slab shuttering will be allowed.

(f) Chamfers and fillets:

All concrete and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 20 mm. Care should be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be placed or surfaced to the same textures as the forms to which it is attached.

(g) Vertical construction joint chamfers:

Vertical construction joints on faces, which will be exposed at the completion of the project, shall be chamfered as above except where not permitted by the Engineer for structural or other reasons.

(h) Reuse of Forms:

Before reuse, all forms shall be thoroughly scraped, cleaned, joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of the Engineer. The Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

- (i) The contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from. Striking of forms in the case of sides of beams, columns and slabs can be carried out after 24 hours of concreting. The striking of forms shall be done as para 2.12.4. Striking shall be done with utmost care without shock or vibration by gently

easing the wedges. If, after removing the formwork, it is found that the timber is embedded in the concrete, it has to be cut out and made good with fine concrete. Due care shall be given to the provision of correct form work for holes and openings in the slabs, inserts, grounding cables, conduits and pipe sleeves, foundation or anchor bolts etc. as per approved drawings or as directed by the Engineer.

CLEANING AND TREATMENT OF FORMS:

The forms shall be carefully examined to see that they are vertical and horizontal and the joints are properly closed. If forms are to be reused, they should be carefully examined before such reuse, properly aligned and open joints shall be repaired and coated with crude oil. The centring planks for columns shall be joined together and provided with threaded bolts and nuts.

The centring and props for the various members shall be fixed in a workman like manner to be approved by the Engineer-in-Charge. They shall be of such size as the Engineer-in-Charge thinks fit and proper. The centring shall be removed only after the permission has been obtained from the Engineer-in-Charge. Props shall be supported on wedges placed on planks and the planks shall be 25 mm thick.

All rubbish, particularly chippings, shavings and saw dust shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetted or treated with an approved composition. Care shall be taken that such approved composition is kept out of contact with the reinforcement.

- (a) In columns of any forms where access to the interior is not available otherwise, a sufficient area of one side shall be left loose so that it may be removed for cleaning out all chips, dirt, sawdust and other extra materials.
- (b) Where the shoring bores on the ground, the Contractor shall spread the load from shores by suitable brick platforms in order to prevent settlement.

ARCHITECTURAL EXPOSED REINFORCED CEMENT CONCRETE:

(i) General:

Generally specification for reinforced cement concrete work shall also apply to this type of work and additional specification set-forth below.

(ii) Materials:

- (i) Cement used for such work shall be of a uniform colour and obtained from one source of manufacture.

(ii) Aggregate:

a) Fine Aggregates:

Colour being an important consideration for exposed concrete, colour of sand used shall also be uniform through out the entire construction. Preferably total quantity required for the work shall be collected and well mixed together to a uniform shade.

b) Coarse Aggregate:

The colour of the aggregate shall be maintained the same through out. Unless otherwise specified, exposed concrete in walls, fences and parapets which are no-load bearing and are less than 120 mm. in thickness the maximum size of coarse aggregate shall be limited to 12 mm for which nothing extra shall be admissible. Flat and flaky pieces shall not be allowed.

(iii) Reinforcement & Cover of the Concrete:

Correct placing of the reinforcement with proper cover is important in all exposed work to avoid discolouration by rusting. The minimum cover specified in the Specification shall be maintained throughout.

Concrete blocks or spacers shall be sparingly used at exposed surfaces. When used, such blocks shall preferably be cast on vibrating tables or in some other similar manner so that it may match the concrete surface in texture and colour. Cover blocks of materials other than precast blocks shall not be allowed to be used.

(iii) Construction of shuttering:

All centring and framework shall be rigid and of robust construction. All vertical props shall be cut square at ends and shall rest on double wedges, placed on continuous horizontal runners on firm natural soil. Resting of props or runners on made up soil shall not be permitted on any account. All members of the formwork shall be closely fixed without any gap between them so as to safeguard against any settlement or displacement of shuttering at the time of concreting.

i) Timber Shuttering:

Formwork for exposed work shall be of seasoned wrought hard wood timber planks free from loose knots. The planks shall be 50 mm thick, 100 to 125 mm wide with tongue and groove joints, assembled to a pattern approved by the Architect. The formwork shall be so constructed, braced, and stayed as to remain absolutely rigid and true during and after concreting. The boards shall be planed to a suitable thickness in order that the surface against the concrete shall not be broken at joints between boards. Chamfers, grooves, drips mouldings, bevelled edges etc. shall be made in the form itself to the size, profiles and details called for on the drawings.

ii) Plywood Shuttering:

The contractor shall provide shuttering quality plywood not less than 12 mm thickness as per IS.4990 (type-I) of approved make or equivalent approved by the Architect in place of timber plank shuttering mentioned above for such location as called for by the Architects. The joints in plywood shuttering shall be located as directed by the Architects. Shuttering, centring and form work for all exposed concrete work like exposed columns, beams, ribs, slabs, chajjas, facia, walls etc. shall be of such finish and rigidity as to produce all faces fair and smooth, true to line level and plumb. No rendering or touching shall be permitted on these faces.

iii) Steel shuttering:

Steel shuttering for exposed concrete work shall be made of shuttering plates of standard sizes and to suit the pattern of exposed concrete indicated in Architect's drawings. The shutter plates used will be made of steel sheets strengthened at the edges and in middle to prevent sagging or any deflection and concrete deformity or dents and should fit with each other properly without any space or groove being left between adjacent plates to avoid and leakage of concrete slurry. If any concrete projects out between plates this will be neatly cut away.

The contractor shall be required to produce details of working showing the general construction of formwork and panels with details such as nail position and holes for supports that may be required; nail heads shall be positioned as instructed by the Architects. Grooves and chamfers shall be formed as shown on the drawings without any extra cost.

Any holes for the supports, which the contractor may need, shall be permitted only if approved by the Architects. All such holes shall be subsequently filled in carefully as to match with the other surface. Walls, columns etc. shall generally be cast to the full height

in one operation and the formwork shall be provided accordingly. If permitted by the Architects, these may be completed in two or more heights when the formwork shall be carefully and correctly raised for further height so as to ensure a neat joint without disturbing the pattern. Any groove desired by the Architect at the joint shall be provided by the Contractor at no extra cost. .

(iv) Coating for shuttering:

Shuttering oil, colourless and emulsifiable in water shall be used for oiling the woodwork, when only a thin film shall be neatly applied avoiding collection at one place. Any mark left by the shuttering oil shall be washed clean.

(v) Measurements and proportioning of concrete materials:

This shall be as laid down generally for R.C.C. work. In no case extra dust or sand or additional water shall be allowed with the intention of getting better finish, which shall only be obtained by erecting centring as specified above and proper vibrating of the mix after placing. In no case, the slump limit, specified in the Specification shall be exceeded.

(vi) Preparation for placing concrete:

Special care is essential to see that all saw dust, chips, nails or any foreign material is washed out or otherwise removed from the shuttering.

(vii) Mechanical vibration:

All concrete for exposed concrete work shall be vibrated, using needle vibrators -30/32 mm. Surface or trough vibrators may be permitted to be used for thin slabs. External vibrators for walls may be allowed but this shall be done carefully to safeguard the displacement of the shuttering. Vibrators shall only be operated by skilled labour; over or under vibration shall not be permitted. Any spillage, or leakage, which is unavoidable and which flows down the exposed concrete surfaces, shall be immediately washed away with clean water and brush. Exposed concrete members shall be finished to desired surface while the concrete is still green.

(viii) Curing and protection of concrete:

Curing will be done with clean water, so as not to discolour the concrete. All exposed concrete work shall be properly protected by Alkathene film, gunny bags, wooden boards etc. so the surfaces and edges are not damaged or discoloured till the entire construction is handed over, at no extra cost. All such damages shall be set right or replaced by the contractor at his own cost; the contractor is deemed to have considered this in quoting his rate.

(i) Removal of shuttering:

Striking and removing of formwork for exposed concrete shall be done very carefully without damaging the surface or edges. All such damages shall be set right or replaced by the contractor as his own cost.

(ii) Finishing:

Finishing of exposed concrete surface shall be as specified.

Exposed concrete surface shall on no account be permitted to any sort of repairs or patching after striking the formwork. In the event of any portion not coming up to standard, this shall be taken down by the contractor at no extra cost. Decision of the Architects as to the rejection of such work shall be final and binding on the contractor.

STRIPPING TIME:

In normal circumstances (generally where temperatures are above 20° C) and where Ordinary Portland Cement is used, forms may generally be removed after expiry of following periods:

Type of Formwork		Minimum Period Before Striking Formwork
(a)	Vertical formwork to columns, walls, beams	16 - 24 h
(b)	Soffit formwork to slabs (Props to be refixed immediately after removal of formwork)	3 days
(c)	Soffit formwork to beams (props to be refixed immediately after removal of formwork)	7 days
(d)	Props to slabs:	
	(a) Spanning up to 4.5 m. (b) Spanning over 4.5 m.	7 days 14 days
(e)	Props to beams and arches:	
	(a) Spanning up to 6 m (b) Spanning over 6 m	14 days 21 days

The number of props left under, their sizes, load and disposition shall be such as to be able to safely carry the full dead of the slab, beam or arch as the case may be together with live load likely to occur during curing or further construction.

However, this period may be increased or decreased at the discretion of Architects. In case when the cube strengths at seven days are found to be low or in the cases when other cements are used, the curing period and stripping time for forms and removal of props may have to be extended. This shall be decided by the Architect and the contractor shall not claim any extra costs for such increased periods of curing and stripping of forms etc. Special care shall be taken while removing the cantering of cantilever slab, canopies, portal frames, folded plates construction etc. Stripping time for such special structure as shell roofs etc. shall be determined from tests of stripping cubes taken especially for the purpose. These cubes shall give strength of 75% of the 28 days strength.

For rapid hardening cement 3/7 of the above period will be sufficient in all cases except vertical sides of slabs, beams and columns, which should be retained for 24 hours.

Note:

The props left under shall mean that the form work for slabs and beams soffits at 3 days and 7 days respectively can be removed only if the same can be done without disturbing the props which are required to support the slab or beam completely. In normal cases this will mean that period for removal of formwork for slabs and beam soffits will be 7 days and 14 days respectively.

PROCEDURE WHEN REMOVING THE FORMWORK:

All formwork shall be removed without such shock or vibration as would damage the reinforced concrete. Before the soffit and struts are removed, the concrete surface shall be exposed, where necessary, in order to ascertain that the concrete has sufficiently hardened. Proper

precautions shall be taken to allow for the decrease in the rate of hardening that occurs with all cements in the cold weather.

CAMBER:

It is generally desirable to give forms an upward camber to ensure that the beams do not have a sag when they have taken up their deflection, but this should not be done unless allowed for in the design calculation of the beams.

TOLERANCES:

The Contractor shall, before putting any concrete in any unit, check all dimensions according to the drawing governing the accuracy of the dimension of all the units and the necessary formwork shall be approved by the Engineer-in-charge and if any error is found in dimensions, the Engineer-in-charge will not allow in any case more than the tolerances specified as below and any unit which does not comply will be liable to rejection at the discretion the Engineer-in-charge.

The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances as given below. The tolerances in footings apply to concrete dimensions only and no to positioning of vertical reinforcing steel or dowels.

(a)	Deviation from specified dimensions of cross sections of columns and beams	- 6 mm +12 mm
(b)	Deviation from dimensions of footings:	
	(i) Dimensions in plan	-12 mm
	(ii) Eccentricity	0.2 times the width of the footing in the direction of deviation but not more than 50 mm.
	(iii) Thickness	+0.05 times the specified thickness

TRANSPORTING AND PLACING OF CONCRETE:

The concrete shall be mixed in quantities required for immediate use and shall be deposited on the sub-grade/sub-base to the required depth and width of the pavement section in successive batches and in continuous operation without the use of intermediate form between the joints. Care shall be taken to see that no segregation of materials results whilst the concrete is being transported from the mixer to the place where it is to be deposited. The spreading shall be as uniform as possible to avoid re-handling of concrete. Where, however a certain amount of redistribution is necessary, it shall be done with shovels and not with the rakes.

While being placed the concrete should be rodded with suitable tools so that formation of voids or honeycomb pockets is prevented. The concrete shall be well placed and tamped against the forms and along all joints.

COMPACTION OF FLOOR CONCRETE:

The concrete at the side of the forms and between the reinforcements at joints and at corners to be compacted with internal vibrator (needle vibrators) to avoid honeycombing and to get perfect compaction at these locations.

The vibrating screed shall rest on side forms and it shall be lowered vertically on the concrete surface, (evenly spread to an appropriate level above the base) to provide the required surcharge for compaction; allowed to remain in position for few seconds until compaction is completed, then lifted vertically and lowered on to the adjacent strip of un-compacted concrete. The amplitude of vibration of the screed shall not be less than 1.5 mm and speed of travel not more than 0.60 m per minute. The screed shall again be taken slowly over the surface, sliding with its axis slightly fitted away from the direction of sliding and operation repeated until the required dense, close knit textured finish surface is obtained.

Notes: Precautionary measures to be taken before starting concrete floor.

(a) The working of vibrators shall be regularly checked and standbys shall always be maintained for emergency use.

(b) The segregated particles of coarse aggregates which collect in front of the tamper or screed shall be thrown outside the forms. Under no circumstances shall such segregated particles be carried forward and pushed on to the base in front of the mass.

CONCRETE FLOOR FINISHING:

Immediately after completing the compaction by screed vibrator and excess water has disappeared but while the concrete is still plastic, the floor top surface shall be tested for true-ness with a 3.65 M long straight edge (Aluminum Box Section).

The straight edge shall be held in successive positions parallel to the guide channels in contact with top surface of floor laid and the whole area gone over from the one side of the floor to the other. Advance along the floor shall be in successive stages of not more than one half length of straight edge. Any area of the depressions found shall be scooped to a depth of 40 to 50 mm filled immediately with freshly mixed concrete, struck, compacted and refinished. High areas shall be cut down and refinished. The straight edging and re-floating shall continue until the entire surface is found to be free from observable departures from straight edge and top surface has the required levelled surface.

The floor top surface shall be re-tested for trueness before the concrete begins to set with the 3.60 M long master straight edge (Aluminum Box Patti). Any irregularity in surface to be rectified.

PREPARATION OF SURFACE AND USE OF FLOOR HARDNER (FIRST DRY SHAKE):

Following types of floor hardeners are used for increasing strength of concrete floors.

- Ironite based
- Silica / Quartz based
- Carborandum based

The quantity of floor hardener shall be used as specified by the Consultants (or as per manufacturers specification) and according to light / medium / heavy-duty floor as specified.

Scrap the concrete deposited, if any, on the top of side form during concreting. As soon as concrete is firm enough to support the weight of workmen and their equipment and no water is observed on surface; apply first shake of hardener evenly using 2/3 of total mix e.g. 2/3 of 7.5 Kg./Smt. Treat areas adjacent to walls and columns first, spread the materials evenly by sprinkling at right angles in two passes close to floor level. Do not broadcast (spread) the hardener from a station position but use a wooden scraper to spread the hardener. Alternatively, a mechanical spreader can be used for better application.

FLOATING: (With Finishing Machine Having DISC)

Power float the shake application promptly, work near wall, columns and door area first. Avoid excessive floating but ensure that the shake application is completely wetted and incorporated in to the base slab.

C-6 Form work for “off the form exposed concrete surfaces having board marked pattern and time texture.”

Relevant specification of form work above (Given in C-5 above) shall be made applicable.

Concrete surface, which are to be “form finish shall be cast in an approved form work and shall be free from honey combined, fine, projections, and air holes. All external angles to form finish concrete surfaces shall be chaffed if and as directed. All interesting flush surfaces, surfaces horizontally or vertically between columns and beams of other structural

members shall be separated by grooves if and as directed by the Engineer-in-charge.

The pattern of the form boards, the disposition of construction joints and lifts, and the incorporation of recessed or raised joints shall be carefully studied by the contractor for its proper implementation.

The contractor shall submit shuttering drawings and details of pattern and the method of forming joints in the exposed (form finish) concrete to the Engineer-in-charge. For his approval and all changes and modification specified by the letter shall be appropriated by the former and final approval whereof obtained from the Engineer-in-charge.

No work of form finished exposed concrete shall be carried out until the contractor has produced acceptable sample of shuttering and concrete to the approval of the Engineer-in-charge.

Utmost care shall be then be constantly exercised by the contractor in the :

- a. Design workmanships and fixing of form work.
- b. Control of concrete ingredients, mixing and placing.
- c. Adequate technical supervision of all process involved.

Listed below are some form work specifications, for form finished exposed concrete to be used on site as directed by the Engineer-in-charge.

i. Smooth Board Surfaces :

The smooth board marked surfaces are produced by new dressed tongued and grooved boards of uniform thickness of not less than 45 mm. These boards should be brought and dressed on both faces as well as on all side.

ii. Rough Board Surfaces :

A rough texture is obtained by the use of new sawn boards with dressed square edges.

Steel Mould Surface:

Steel moulds must be rigid enough are perfectly plane and clean. They must be painted with a protective point and absolutely free from rust or have a special section at their edges to prevent cement leakage and produce a water tight joint.

This type of form work is to be entrusted to a skilled and specialized manufacture who has produce satisfactorily similar form work and who must be approved by the Engineer-in-charge.

In all type of form work to form finished exposed concrete. Only non-staining mould oil supplied by an approved manufacturer will be used.

The repetitive usages of the same form work to cast form finished exposed concrete shall be as decided by the Engineer-in-charge and no case form work not guaranteed to produce the required form finish to the satisfaction of the Engineer-in-charge shall be used.

The exposed concrete shall have uniform finish. The finish of the concrete when shuttering and form work is removed will generally be without blemish and will be such as will not require touch up. Slight touch up a small work or two if necessary shall be carried out immediately on removal of form work by 1:1 proportions. This shall be carried out expertly on removal of form work with entire surface.

C-7 Fabricating placing reinforcement in position :

Fabrication:

The reinforcement bars shall be out to be required length including necessary bends hooks, overlaps, etc. as shown on the plan or as directed by the Engineer-in-charge and shall conform to I.S. 2502-1963 or as revised from time to time. Details of length and bending diagrams shall be got approved from the Engineer-in-charge.

Placing and Binding:

All reinforcement shall be accurately placed in position with spacing as shown in the drawing and firmly held so during placing and setting of concrete. The bars shall be tied diagonally both ways, at all inter-sections with M.S. binding wire of 1.22mm or 1.63mm dia (16 or 18 gauge). Spot welding instead of tying brass by wires will be permitted by the Engineer-in-charge, if required. Spacing of bars shall be maintained by means of stays, blocks, tiles, spacers, hangers or other approved supports or devices at sufficiently close intervals.

All bars protruding from concrete to which other bars are to be spliced and which are likely to be exposed for indefinite period shall be protected from rusting by thin coat of cement wash.

Welding:

Welding (instead of overlaps) by gas or electricity will be permitted under suitable conditions and with suitable safe-guards. In case such permission is granted, relevant Indian Standards for welding of steel reinforcement bars including carrying out necessary tests shall be followed.

Inspection:

No concrete shall be deposited unless the Engineer-in-charge has inspected the reinforcement work, recorded measurements, and given permission to place the concrete. After the approval of the reinforcement by the Engineer-in-charge, it will be the contractor's responsibility to see that reinforcement is not disturbed from its position till the concreting is completed.

C-8 Fixing Expansion Joints :

The expansion joints shall be provided in R.C.C. structural members:

1. For the joints between twin internal beams of RCC frame structure, copper strip of 1.5mm thickness and width and shape as shown in the detailed drawing shall be placed near the bottom in the first beam such that one Kg. of the specified width is embedded in the beam and "U" fold (of 80mm depth unless otherwise specified) will come in the joint.

The "U" shape gap of the copper strip shall be filled with poured bituminous joint filler and nearly finished on top. Before casting of the jointing member pre-molded bitumen joint filler or required thickness shall be placed in position as directed and concrete then cast, embedding the other leg.
2. The joint between the twin terrace beam shall be prepared in a manner similar to (1) above except that the raised concrete edge shall be provided and the copper plate shall be fixed in the raised edge as directed. It shall be covered by lead flushing 1.5mm thick fixed to one seat with copper screws to the wood blocks embedded in the concrete as shown in the detailed drawing.
3. For the joints between twin internal or external columns, white casting the first column, one leg of each of the copper strips of 1.5mm thickness shall be embedded into the column and "U" fold will come in the joints nearer the exterior faces of the column. The copper strips shall be fixed with hold fast of copper rod as shown in the detailed drawing. Before casting the second column pre-molded bituminous joint

filler shall be placed against the face of the first column all along between the two steps as directed by the Engineer-in-charge.

C-9 Constructing Brick masonry :

Classification of brick work :

The bricks work shall be classified as first sort or second sort according as first class and second class brick respectively are used.

Wetting of Bricks:

Bricks required for masonry shall be thoroughly wetted with clean water for at least two hours before use or as directed by the Engineer-in-charge. The cessations of bubbles, when the bricks are wetted with water, are an indication of through wetting of bricks.

Lying:

Bricks shall be laid in English bond directed otherwise.

Half or cut bricks shall not be used except when necessary to complete the bond. Closers in such cases shall be cut to required size and used near the ends of walls. A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set home by gentle tapping with handle or wooden mallet. Its inside face shall be flashed with mortar before the next brick is laid and pressed against it. On completion of course, the vertical joints shall be fully filled from the top with mortar.

The walls shall be taken up truly plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate course will generally directly one over the other. The thickness of brick courses shall be kept uniform. The bricks shall be laid with frogs upwards. A set or tools comprising of wooden straight edge, masons spirit level square half meter cub and pins string and plumb shall be kept on the site of work for frequent checking during the progress of work.

Both the faces of thickness greater than 23 cm shall be kept in proper plane. All the connected brick work shall be carried up nearly at the level and no portion of the work shall be left more than one meter below the rest of the work. Where this is not possible, the work shall be racked back according to bond (and not left toothed) at angle not steeper than 45 degrees.

All fixtures, pipes, outlets of water hold fasts of doors and windows etc. which are required to be built in wall shall be embedded in cement mortar.

Joints:

Bricks shall be so laid that all joints are quite flush with mortar. Thickness of joints shall not exceed 12 mm. The face joints shall be racked as directed by racking tool, daily during the progress of work, when the mortar is steel green so as to provide key for plaster or pointing to be done.

The face of brick work shall be cleaned on the same day the brick work is laid and mortar dropping shall be removed.

Curing:

Green work shall be protected from rain suitably. Masonry work shall be kept moist on all the faces for a period of seven days, the top of masonry work shall be kept well wetted at the close of the day.

Scaffolding:

The supports or scaffoldings shall be sound and strong tied together with horizontal

pieces over which the scaffolding planks shall be fixed. Single scaffolding shall be allowed normally in this case inner end of the horizontal scaffolding pole shall rest in a whole header course only. Only one headed for each pole shall be left out. Such holes shall not however, be allowed in pillars under one meter in width. The holes left in masonry shall be filled and made good before plastering.

The contractor shall be responsible for providing and maintaining sufficient strong scaffolding so as to withstand all loads likely to come upon it.

C-10 Construction of brick masonry partition walls :

The partition walls shall be half brick.

(A) All the bricks shall be laid stretcher wise breaking joints with those in the upper and lower course. The wall shall be taken truly plumbed. All courses shall be laid truly horizontal and all of vertical joints will be truly vertical. The bricks will be laid with frog upwards. Fixtures, plugs holdfasts, frames of doors, windows etc. shall be housed in the brick work while laying only and at the correct levels and position. Holes of required size and shapes shall be left in the brick work for fixing pipes or service lines etc. After service lines etc. are fixed, the extra hollow left in the hole shall be filled with 1:3 cement mortar or 1:3:6 cement concrete. A set of mason's tools shall be maintained on work as required for frequent checking. The ends of walls shall be bonded into the side walls where necessary joints, curing and scaffolding shall be as per C-10 of code of practice.

(B) Laying 2 numbers of mild steel bars of 6mm diameter in brick masonry partition walls. Two mild steel reinforcement bars of 6mm diameter shall be used longitudinally at every fourth course of the brick work. The first reinforcement shall be placed on the top of bottom most course. The bars shall be fully embedded in the mortar and the end shall be properly bonded in the vertical joints of brick work or to the main wall as directed by the Engineer-in-charge. Bars shall be of length equal 45 times diameter of mild steel bars. The joints in the course, where reinforcement is placed, shall be admitted the mortar cover of at least 5mm in thickness of the reinforcement.

C-11 Constructing Brick Masonry Cavity Walls :

General:

The cavity wall shall be constructed with 2 Nos. 90mm thick reinforced brick partition with cavity of 50mm in between wall shall be connected with metallic walls ties.

Reinforced Brick Partition:

Wall ties shall be of mild steel bars of 6mm dia of the shape as directed by the Engineer-in-charge. The wall ties shall be placed at not more than 800mm apart horizontally and not more than 500mm vertically and shall be placed staggered. Before placing the ties same shall be dripped in hot tar and sanded to protect from rust. The additional ties shall be placed at the opening.

Construction:

The bond used for each skin or leaf of a cavity wall shall be stretcher bond. Flemish bond or any other arrangement of bricks shall not be used during erecting of wall. Sufficient care shall be taken to keep the wall ties and cavity free from mortar dropping, 25mm thick and 40mm wide teak wood batten shall be placed across the wall ties and raised as each row of ties are raised for reducing the mortar dropping in the cavity. The temporary openings shall be provided to permit the daily removal of mortar dropping from the bottom of cavity. At the points where the two leaves of the hollow wall come into contact or above the lintels of doors and windows and at solid at jambs, necessary damp proof membrane of approved quality shall be provided as per the direction of Engineer-in-charge. Except as above the work in general shall be executed as per

- provision of I.S. 2212-1962 or as revised from time to time so far applicable.
- C-12** **Preparing and fixing doors, windows and ventilators, teak wood paneled or Glazed or partly paneled and partly glazed.**

General:

The code covers the requirement of preparation of doors, windows, & ventilators with frames and their supply and fixing.

They shall be made on site of work only.

Frames:

All members of frame shall be exactly at right angle shall be checked from inside surface of the respective members.

All members of frames shall be straight without any warp and shall have smooth surface well planned on the three sides exposed at right angle to each other. The surface touching the wall may not be planned unless it is required in order to strengthen up the members or to obtain the overall sizes within tolerance as specified.

Frames shall have overall joints when ventilator is included it shall be provided by having full length one piece post for door or window and ventilator extending the frame on top of the head to the required extent. Horns shall not be provided in the head of the frame when no sills are provided the vertical post of the frame in the ground floor shall be embedded in the sill masonry for 100mm. On upper floors the vertical posts shall be fixed in the floor by forming notches 10mm deep. Slight adjustment of spacing as necessary shall be done to have the holdfasts in the joints of masonry course. The frame shall be done to have the holdfast in the joints of masonry course. The frame shall be erected in position to hold plumb with strong supports from both sides and built in masonry as it is being built. The transom shall be thoroughly trenched into the mortises of the jamb post to the full width of the jamb post and the thickness of the tendon shall be not less than 15mm. There shall be closely fitted into the mortise and suitably pinned with wood dowels not less than 10mm diameter. The depth of rebate for housing the shutter shall be as shown in detailed drawings or as directed by the Engineer-in-charge.

The contact surfaced or tendon and mortises shall be treated before putting together with an adhesive of approved make.

M.S. hold fasts shall be protected with a coating of primer. The surface of frame abutting the masonry or concrete faces shall be properly treated by applying a coat of approved premier coal tar shall not be used for this purpose.

Shutter:

Paneled shutters shall be constructed in the form of timber frame work of styles and rails with panel inserted of type as specified in the item of work. Panel shall be fixed by providing grooves in the style and rail. The styles and rails shall be jointed to each other by mortise and tendon joint at right angles.

All members of the shutters shall be straight without any warp or bow and shall have smooth well planned faces of right angles to each other.

Styles and rails of shutters shall be made out of one piece only.

Schedule of fixtures and fastening for Doors, Windows, Ventilators, Wardrobe, and Cupboards.

Notations.

Da- Teakwood doors fully paneled or fully glazed or partly paneled and partly glazed.

Db- Bathroom & W.C. door with single shutter.

Si- Single shutter.

B- Breadth of door shutter.

T- Thickness of door shutter.

900mm & below

900 above 970 mm

Sr. No.	Particular of Fixture & Fastening.	Size in mm	Da. SI:B:900 T-38	Da. SI:B:900 T-38	Db.SI
1	Hold fast	150x16x3m	4	6	4
2	But hinges	10	3	3	3
			4		
3	Sliding door bolts	300x16 250x16	1	-	-
4	Tower bolts (Barrel bolts)	200x10	1	1	-
5	Tower bolts (Barrel bolts)	150x10	-	-	-
6	Door latch	260x16x5	1	1	1
7	Handles	100	2	2	2
8	Door stopper	75	1	1	-

Timber Paneling:

Thickness of the panel shall be as specified in item. When made from more than one place, as shown in the drawing or as directed by the Engineer-in-charge, the places shall be finished as shown in the detailed drawings and shall be jointed with specified size of plywood filled. The end pieces of the panel and the top and bottom of the panel shall be provided with continuous tongue to frame is into groove of the frame of shutter. An air space of 15mm will be left groove of frame of shutter while framing the panels in it.

The faces of the panel as well as various pieces of the panel shall be closely fitted to the side of the grooves.

Finishing of the corners of raised panel edges shall be done as shown on drawings or as directed by the Engineer-in-charge.

Glass Paneling:

The glass panels shall be embedded putty and secured to the rebate of wooden beads or moldings of shape and size as approved with counter sunk screws of suitable size.

Fixtures & Fastenings:

All fixtures and fastenings shall be fixed with appropriate screws in sound and efficient manner to ensure easy operation. They shall be appropriately positioned and shall be truly horizontal or vertical as required.

Height of the shutter shall be such as not allow clearness of more than 6mm above the flooring level.

C-13 Lime Brick bat Concrete :

This shall be as per C-2 of code of practice. The brick bats shall conform to M-12.

C-14 Glazing :

The glass panels shall be properly cut to fit the rebates of the frames and sashes truly with a slight minus margin of about 1.5mm on all sides. Before glazing, the frames shall

be primed and prepared for painting so that wood may not draw oil out of putty. The rebate shall be putted to an extent to provide bedding all around the glass edges.

The glass shall then be bedded in putty and fitted with wooden beads or molding as directed and secured with counter sunk screws.

The size of the rebate in the frame and size and shape of beads or moldings shall be as per detailed drawings or as directed by the Engineer-in-charge. The beads or moldings shall have mitred corners. The glazing in metal frame shall be done in the same way as in wooden frames. Except as stated above glazing in metal frames shall be done as specified in I.S. 1081-1960 pr as revised from time to time.

C-15 Oil Painting / Synthetic Enamel Painting :

Preparation of surfaces:

The surface to be painted shall be thoroughly.

The screw shall be spaced not more than 100mm from each corner and not more than 200mm apart clean and rubbed smooth with sand paper to bring it is none plane, when finished. No scratches for sand paper should be shown.

Application:

This shall be applied in 2 coats as per normal practice. After preparing surface as above one coat of white oil paint shall be applied as priming coat. After priming coat, all small holes, cracks, open joints and similar other minor defects of every kind shall be stopped with putty made from pure whiting mixed to the appropriate consistency with raw linseed oil little white lead being worked in after mixing to help in hardening of putty.

The work shall be little rubbed down smooth with sand paper and the consequent coats of paint of the specified shade approved by the Engineer-in- charge shall be applied. The paint shall be applied with brush. It shall be spread as smoothly as possible. Final coat shall be very carefully crossed and laid off, so that brush marks are not visible.. Each coat of paint shall be allowed to dry thoroughly and shall be little rubbed down for the next one is laid. Finished surface shall now show any hair marks, ridges or dry patches of paints and no puddles shall be left in the corner of panels' angle of molding etc.

C-16 French Polishing :

French polish to be used shall conform to I.S. 348-1968 in the requirement of quality.

Preparation of surface:

All unevenness shall be rubbed down to smoothness with sand paper and the surface shall be well dusted. The wood to be polished should be first painted with a filler by mixing whiting in hyphenated spirit to obtain a good glossy surface shall be again rubbed down perfectly smooth with paper.

Application:

The number of coats of polished to be applied shall be as specified in the item. On the wood work thus treated a thin coat of French polish shall be applied by a pad of woolen cloth covered by fine cloth. The pad shall be moisture with polish rubbed hard on the surface in a series of over lapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad facilitates that operation. The surface shall be allowed to dry and the remaining coats applied in the same way to finish off the pad should be covered with a fresh piece of clean fine cloth, slightly dumped with mentholated spirit, and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

C-17 Laying in Situ Cement Concrete Flooring (I.P.S.) :

The flooring shall be provided with ordinary cement concrete 1:2:4 (1- cement: 2- coarse sand & 4- graded stone aggregate 20 mm nominal size). The work of plain cement concrete 1: 2: 4 shall be carried out as per C-2 above. The thickness flooring shall be specified in the item of work.

The surface of the sub-grade shall be cleaned and all loose materials and moistened immediately before laying flooring.

The concrete shall be laid immediately after mixing white being placed, the concrete shall be vigorously sliced and spaced with suitable tools to prevent formation of voids or honey comp pockets. The concrete shall be brought to the specified levels by means of heavy straight edge resting on the side forms and drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with small lateral shifts immediately after laying concrete the surface shall be checked for high or low spots and any needed corrections made up by adding or removing the concrete. After striking off the surface it shall be compacted with wooden float. The blows shall be fairly heavy in the beginning but as consolidation takes place light rapid strokes shall be given to complete the ramming. The floating shall be followed by steel traveling after concrete has hardened sufficiently to prevent excess of fine material from working to the surface. The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with a straight edges. Dry cement or mixture of dry cement and sand shall not be sprinkled directly on the surface to absorb moisture or to stiffen the mix. After the concrete has dried, sufficiently to allow rendering to a thin floating coat of neat cement slurry uniformly floated.

If so specified in the item of a work approved mineral colour, pigment shall be added to cement mortar to give mortar rendering is sufficiently stiff lines may be marked on it so specified or directed. With strings or any other devices to give the appearance of 250 mm x 250mm tiles of any other size diagonally or square as directed. The junctions of floor with the walls shall be rounded off, if so directed.

Curing:

Curing shall start on the next day after finishing and shall be continued for fourteen days.

C-18 Laying In-Situ Terrazzo Flooring :**Under layer of cement concrete:**

The under layer shall be laid as described in C-17 of the code of practice except that only black trap grit shall be used in place of coarse aggregate and no finishing shall be done to make the surface smooth. The compacted thickness of concrete under layer shall be as specified in the item. This layer shall be laid to the require level and grade. The top surface of the under layer concrete shall be kept sufficiently rough to form a key to the top layer.

Dividing strips shall be fixed on the base to the exact surface level of floor so as to divide the surface of the base into the required arrangement of panels. Anchorage arrangement shall be provided either by fixing 4 cms. Long cross nails through the strips or by cutting the edge as directed.

Before spreading the under layers the base shall be cleaned of all dirt laitance or loose material and than well wetted with water without forming any water pools on the surface it shall then be smeared with cement slurry just before the spreading of under layer.

After application of cement slurry, the under layer shall be spread and leveled with a

Screening board. This slightly rough surface left by the screening board will form a satisfactory key for the terrazzo.

Mixing of Materials:

Mixing shall be done manually in a tub. To avoid variation in colour the complete quantity of cement and pigment required for one operation shall be mixed at the beginning of the work and stored properly.

Where the different colour chips are used they shall be well mixed in required proportion of various colour and size. Coloured cement may be ready mix or properly mixed at site. White cement (with or without pigment as directed) or colour cement and marble powder shall be in the proportion of 3 parts of cement and 1 part of marble powder by weight. For every part of this marble mix, the proportion of the aggregate by volume shall be $\frac{1}{2}$ parts.

While mixing the aggregates care shall be taken not to get the materials into a heap as this would result in the coarsest chips failing to the edge of the heap and the cement working to the centre at the bottom. The materials shall be kept, as far as possible in an even layer during mixing.

After the materials have been through mixed in the dry state, water shall be added in small quantities; preferably in a fine spray while the materials are being proper consistency is obtained. The mixing shall be plastic but not so wet that it will flow; a rough indication for the addition of proper quantity of water in the mix is that it shall be capable of being molded when squeezed in hand without water flowing out. The mix shall be used in the work within half an hour of the addition of water during preparation.

Laying Terrazzo Topping:

Terrazzo topping shall be laid while the under layer is still plastic but it has hardened sufficiently to prevent cement from rising to the surface, this is normally achieved between 18 to 24 hours after the under layer has been laid. A cement slurry preferably of the same colour as the topping shall be brushed on the surface immediately before laying is commenced. If possible, the entire work of laying the topping shall be completed at one stretch.

The terrazzo mix shall be placed on the screed bed and be compacted thoroughly by tamping or rolling and toweled smooth. The time interval allowed between each successive toweling is important at only that much toweling which is just sufficient to give a level surface is needed immediately after laying. Further compacting shall be carried out at intervals, the amount depending upon the temperature and rate of set of the cement. Excessive trowelling or rolling in early stages shall be avoided as this will tend to work up cement to the surface which produce a finish liable to cracking and will also necessitate more grinding of surface to expose the marble chips.

The surface shall then be rammed in order to consolidate the terrazzo, it is not sufficient just to "float" lightly, as this would cause depression which have to be filled with mortar. A piece of smooth marble stone of size 15 cm x 2.5 cm may be advantageously used for ramming. Following the rammer a trowel may be used. When using the trowel, the object should be make the surface level smooth with a little use of the float as possible relying upon pressure rather than upon a trowelling action to achieve this end. Rolling will be easier than tamping and patting, but a rolled terrazzo is more like to crack since the roller would draw the cement to the surface unless the mixture is very dry. The best results will be obtained by tamping combined with a minimum of trowelling. The compaction shall ensure that air bubbles are cleared from the mix.

Curing:

The surface shall be left dry for air curing for duration of 12 to 18 hours depending upon atmospheric temperature conditions. It shall then be cured by allowing water to stand in pools over it for a period of not less than four days. Precautions shall also be taken to prevent the floor from being subject to extreme temperature.

Grinding:

The grinding processing and polishing of terrazzo may be commenced not less than 7 days from the time of completion of laying. The grinding shall be done by machine only. The filling shall be done with a grout using the same coloured cement (without marble powder) as it is original max for terrazzo topping and a portion of the coloured cement shall be kept for this purpose when the floor is laid and this will make sure that patches do not differ in appearance from the remainder of the floor.

After the first grinding is done, the surface shall be washed clean and grouted with neat coloured or white cement grout as the case may be of creak like consistency. It shall be allowed to dry for 24 hours and watered for 4 days. The second, third and fourth grinding shall be done in the above manner excepting that the grinding shall be done with finer carborundum stones as directed for each successive grinding.

The floor shall finally be washed clean with dilute oxalic acid solution and dried. In case wax polished surface is required by the Engineer-in-charge. The wax polish shall be sparingly applied with soft Indian on the clean and dry surface then the polishing machine fitted with bobs shall be run over it. Clean saw dust shall then be spread over the floor and polishing machine again applied, mopping up surplus wax and leaving glossy surface. Care shall be taken that the floor is not slippery.

C-19 Laying and finishing of Marble / granite slab Flooring :

General:

The marble stone flooring shall be laid on the cement mortar bedding with neat cement finishing.

Proportion of mix:

The cement mortar bedding shall be as per **M-9** of specification of materials in 1:6 proportions of cement and sand by volume unless otherwise specified in item of work.

Preparation of Bed of cement Mortar:

The bed of cement mortar shall be laid on the compacted base to reasonably true plane surface and to the required slopes. Care shall be taken in preparing the mortar bed to ensure that there are no hard lumps that would interfere with the sub-floor or base shall be cleaned of all dirt, scum, or laitance and of loose materials and then well wetted without forming any pool of water on the surface. All points of level for the finished paying surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with slabs within half an hour. The thickness of the mortar bedding shall not be less than 20 mm and not more than 25mm. The required slope shall be given to the bed.

Fixing stone slab:

Before laying the marble stone slab shall be thoroughly wetted with water, neat cement grout of honey like consistency shall be spread on the mortar bed over as much area as could be covered with the slab within half an hour. Marble slab shall be laid on the neat cement float and shall be evenly and firmly bedded to the required level and slope on the mortar bed. Each slab shall be generally tapped with a wooden mallet till it is firmly and properly bedded. There shall be no hollows left. If there is a hollow sound on gently

tapping of the slab such slab shall be removed and reset properly. The joints shall be of uniform thickness and in straight line. The joint shall not be more than 1.5mm thick and filled solidly with mortar, for their full depth. The joints shall be struck smooth but there shall be no smearing or mortar over the slabs. The slabs shall be laid so as to give continuous parallel long joint with cross joint at right angles to them. The edges of the adjoining slabs shall be in one plane when the slabs cover open edges of the floor or window, sills the edges shall be neatly rounded off.

Pointing:

When pointing is to be done the joints shall be pointed with cement screening of the colour matching the colour of the marble stone slabs. The cement mortar spread on the marble slabs shall be cleared immediately after pointing.

Curing:

The flooring shall be kept well wetted with the damp & or water fourteen days.

Polishing:

The polishing shall be done generally by polishing machine. After the floor is completely dry a hot mixture of turpentine and bees wax (4:1 by weight) shall be applied to the surface and rubbed clean with cotton waste.

Wherever big area of floor are to be tiled the level of the central portion of the floor shall be kept about 10 mm higher than the level marked at the walls unless specified otherwise.

C-20 Laying Kotah stone flooring paving :

Bedding:

Before spreading the mortar, the sub base of the floor shall be cleaned of all dirt, scum, and loose materials and then well wetted without forming any pools of water on the surface.

In case of R.C.C. floors, the top shall be left a little rough. All points of level for the finished surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base. Bedding layer of cement mortar in proportion 1:6 or 1:3 shall not be less than 20 mm or 12 mm average.

Laying:

Before laying the stones, they shall be thoroughly wetted with water. Neat cement grout of required consistency shall be spread on the mortar bed. The stones shall be laid on the neat cement fiber and shall be evenly and firmly bedded to the required level and slope. There shall be no hollows left the joints shall be uniform thickness and in straight lines. They shall be filled solidly with a mortar / cement slurry for the full depth. The points shall be struck smooth. But there shall be no smearing of mortar over the stones. When pointing is to be done, the joints shall be raked out for not less than the width of the joints while the mortar is steel green. The flooring shall be in true plane.

The thickness of joints shall normally be as follows unless otherwise specified or :

- (i) Polished kotah stone with fine chisel 1.55mm dressed edges.
- (ii) Rough kotah stone with dressed 8 mm to 12 mm edges.

Curing:

The flooring shall be kept wetted with damp sand or water for fourteen days. It shall be kept undisturbed at least for seven days.

Cleaning:

Flooring shall be thoroughly cleaned as directed by the Engineer-in- charge.

Polishing:

The polishing shall be done generally by polishing machine. After the floor is completely dry a hot mixture of turpentine and bees wax (4:1 by weight) shall be applied to the surface and rubbed clean with cotton waste.

Wherever big area of floor are to be tiled the level of the central portion of the floor shall be kept about 10 mm higher than the level marked at the walls unless specified otherwise.

C-21 Laying Dholpur Stone paving :

This shall be as per **C-20** of code of practice as applicable to rough kotah stone. The stone in this case shall be Dholpur stone.

C-22 Laying and finishing of cement concrete flooring tiles :

The work shall be carried out as per IS 1443-1972 or as revised from time to time as far as is applicable.

Bedding:

Before laying the tiles they shall be thoroughly wetted with water. Neat cement grout of required consistency shall be spread on the mortar bed. The tiles shall be laid on the neat cement float and shall be evenly and finally bedded to the required level and slope as per pattern given during the execution of the work. There shall be no hollows left. The joints shall be of uniform thickness and in straight line as per the pattern.

Joints:

The flooring shall be kept wetted with damp sand or water for fourteen days. It shall be kept undisturbed at least for seven days.

Polishing:

After the tiles are properly cured, it shall be polished by machine and shall be waxed to give thoroughly polished even surface. If any part of the building like doors, windows etc. is spoiled or damaged, it shall be repaired to its original condition by the contractor at his own cost.

C-23 Laying & Finishing to marble/ granite skirting or dedo :

The work consists of laying of marble stone slab, skirting or dedo in cement mortar.

Preparation of surface:

Before fixing marble stone slab on brick or concrete wall the wall surface shall first be wetted with water. Thereafter about 10mm thick backing of cement mortar in the specified proportion shall be applied on the surface in true line and level generally as per C-31 or practice.

Fixing:

The back of each marble stone slab, to be fixed shall be smeared with cement paste of matching colour and the marble stone slab shall then be gently tapped against wall with a wooden mallet. The skirting shall be done only after the flooring is completed. Any pipe coming out of the wall through the marble stone slab of dedo or skirting shall be approximately so positioned that its centre shall only be at the intersection of horizontal and vertical joints. The tiles shall not have staggered joints, the joints shall be true to

centre line both way and the vertical joints shall be in line with the joint is in the marble stone flooring. The joints shall not be more than 1.5 mm thick. Each marble stone slab shall be fixed as close as possible to the one adjoining and any difference in the thickness of the marble stone slab shall be even out in the cement paste. So that the entire tile faces are set in conformity with one another. The skirting shall project uniformly and not more than half the tile thickness beyond the finished surface above.

Curing:

Curing shall be done as per C-22 of Code of practice.

Finishing:

Skirting and dedo will be hand polished to have an even smooth and shining surface chamfering shall be done on the junction of cement plaster and cement tiles.

C-24 Laying and finishing of kotah stone skirting or dedo :

This shall be carried out as per C-20 of code of practice except that the skirting or dedo in this case shall be of polished kotah stone and joints shall be 15mm in case of stones with machine cut edges and 3 mm in case of fine chiseled dressed edges.

C-25 Laying & finishing of in Situ Terrazzo Skirting or Dedo :

Under layer of concrete mixing of materials laying terrazzo topping curing and grinding shall be as per C-18 of Code of practice except that the grinding will have to be done manually and the skirting / dedo shall not project more than 7mm and the plaster at the junction at top shall be leveled suitably.

C-26 Laying & Finishing of cement concrete tiles skirting or dedo :

This shall be carried out as per C-23 of code of practice except that the skirting or dedo in the case will be of cement concrete tiles and that joints shall be fitted in with slurry of matching colour cement.

C-27 Laying White Glazed Tiles / Ceramic vitrified tiles flooring :

Bedding:

Mortar shall give sufficient plasticity for laying and there shall be no hard lumps that would interfere with the evenness of bedding. The base shall be cleaned and well wetted. The mortar then shall be spread in thickness not less than 12 mm and not more than 20mm to have a required slope.

Fixing Tiles:

The tiles before laying shall be soaked in water for at least two hours. Neat cement grout of honey like consistency shall be spread over the mortar beddings as directed. The edges of the tiles shall be smeared with neat white cement slurry. The tiles shall be well pressed and gently trove with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints between the tiles shall not exceed 1.0 mm.

The tiles shall not have staged joints. The joint shall be true to centre line both way. The nahn trap coming in the flooring shall be positioned that its grating shall replace only one tile. After fixing the tiles finally in an even plane, the flooring shall be kept wet and allowed to mature undisturbed for 14 days.

Cleaning:

The surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set it shall be carefully washed cleaned by dilute acid and dire proper precautions and measures shall be taken to ensure that the tiles are not

damaged any way till the completion of the construction work.

C-28 Laying White glazed tiles / vitrified tiles skirting or dedo :

This shall be carried out as per C-27 of code of practice except that the skirting or dedo in this case shall be of white glazed tiles and the edges of the tiles shall be smeared with and fixed in with neat white cement slurry.

C-29 Laying Tar felt treatment :

General:

The tar felting shall be done on smooth surface previously preparing for making them water proof and damp proof.

Prepare of surfaces:

The surface on which the tar felt is to be laid shall be cleaned with brush and all dust and foreign materials removed. Any cracks in the surface shall be cut to V- section, cleaned and filled up flush with cement and slurry or a suitable grade of bitumen or both.

Laying:

The five layers of the treatment shall be laid as under.

Premier coat:

The first coat of bitumen primer shall be applied as directed by the Engineer-in- charge. The second and fourth coats shall be of hot blown bitumen of approved grade applied at the rate of 1.5 kg. Per sq.mtr.

The third layer shall be of the fiber base self finished felt. The felt shall be laid as mentioned below:

- (a) The felt shall be first cut to required length, brushed clean of dusting materials and laid out flat on a level, dry and clean surface.
- (b) After the surface has been prepared and cement rendering and the corner fillets have set and a primer coat has been applied, the strip of tare felt for laying is rolled up.
- (c) The rolled up felt is laid on one end of the floor, the hot bonding materials is prepared on to the floor in front of it across the full width of the felt, which is then unrolled gradually with a slight pressure to squeeze out the excess bitumen fit and final coat shall be of screened grave or grit laid at the rate of 0.008 cmt / sq.cmt.

The water proofing treatment shall be continuous through out as far as possible. However, where the points are unavoidable the minimum over lapping shall be 100mm and the joints shall be made perfectly water tight.

C-30 Cement pointing :

The joints shall be brushed clean of dust and loose particles with a stiff brush. The area shall be washed and the joints thoroughly wetted before pointing is commenced. The racking out of joint shall be 20mm deep. The surface shall be applied with two coats of Geru wash.

The racked out joints shall be filled with cement mortar as specified in the item. The mortar shall be of required consistency & well pressed and rubbed smooth. The pointing shall be flush or as directed by the Engineer-in-charge.

C-31 Application of cement plaster finish :

Preparatory work:

The smooth surface of concrete / masonry shall be suitable roughened to provide necessary bond. All dirt, swat, oil, or any others material that might interfere with satisfactory be shall be removed. The surface shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work.

Gauge:

Patches of plaster 150mm x 150mm shall be put on above 3 mtr. Apart as gauges to ensure even plastering in one plane.

Plastering: (a) BASE COAT:

In all plaster work, the mortar shall be firmly applied with some what more than required thickness and well pressed into the joints and the surface rubbed and leveled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to ensure a perfectly plane and even surface. All corners shall be finished their true angles or founded as directed by the Engineer-in-charge. The surface shall be finished to plane or curved surface as shown on the plan or as directed by the Engineer-in-charge and shall present a neat appearance. The mortar shall adhere to the concrete surface firmly when set and there shall be no hollow when struck. Cement plastering shall be done in squares or strips as directed. Plastering shall be done from top down wards. All exposed angles and junctions with door frame etc. shall be carefully finished.

(b) FINISHING COAT:

Finishing coat shall be provided to the plaster as specified. A coat of cement slurry shall be applied to the plaster surface with a trowel to provide uniform texture while the base coat is still plastic. In any continuous faced of a wall, finishing treatment should be carried out continuously and day to day breaks made to coincide with architectural breaks in order to avoid unsightly injunction. All tools and accessories used in plaster work shall be cleaned by scraping and washing at the end of each day's works after use. Metal tools shall be cleaned after operation.

(c) Watering & Curing:

All plaster work shall be kept damp continuously for a period of fourteen days.

C-32 Application of Water proof cement plaster :

The cement plaster of specified thickness shall be provided in cement mortar with integral cement water proofing compound of approved quality.

The plastering work of specified thickness shall be done as per C-31 of Code of practice. Except that while preparing the cement mortar, the approved water proofing compound at the rate 1 kg / 1 bag as per manufacturers specifications of cement shall be added while mixing the mortar. The contractor shall bring the water proof materials to site of work in their original packing the water proofing material shall be mixed in dry cement and sufficient care shall be taken while mixing to see that the water proofing materials gets integrally mixed with the cement and does not run out separately when water is added.

C-33 Application of sand faced plaster :**Base coat:**

The base coat plaster shall be of cement mortar of specified properties and thickness. The base coat shall be laid in a similar manner of laying plaster as per **C-31** of code of practice. However, instead of finishing the top surface smooth keys shall be formed on

the surface by thoroughly combing it with way horizontal lines about 12mm apart and about 3 mm deep when the mortar is still plastics. The base coat shall be cured for minimum 2 days.

Second coat:

Second coat shall be cement mortar with specified kind of cement and specified preparation of thickness. The coat shall be applied evenly in true lines and level by using approved quality of coarse and the surface shall be finished with a wooden float. The necessary rubber sponge as approved by the Engineer-in-charge shall be applied over this coat to obtain the surface textures as per previously approved sample.

When the finishing coat has hardened, the surface shall be kept watered continuously for 14 days.

C-34 Application of coloured cement plaster :

The plaster shall be applied in two coats namely base coat and finishing coat. The base coat of thickness specified in the item shall be applied as per that under C-31 of Code of Practice. The finishing coat shall be thickness as specified in the item and shall be carried out as per that under C-31 of Code of Practice except that cement of colour and shade as approved by the Engineer-in-charge shall be used.

C-35 Laying and finishing stone veneering / Lining :

The code covers the requirement of preparing the Dholapur stone of machine polished machine cut edge for stone veneering, lining including laying and finishing.

The exposed veneering / lining face of the stones shall be double machine polished patches or streaks on the face shall not be allowed. The machine cut machine polished stones shall be provided with appropriate six rectangular groove on the top edge to receive one leg of gun metal cramp.

The groove shall be positioned centrally thickness wise or as directed by the Engineer-in-charge.

Circular holes of appropriate depth in the vertical edges shall be provided to receive 6mm diameter copper pin dowels of 75mm length. The holes shall be positioned as directed by the Engineer-in-charge.

The samples of stones prepared as above shall be first got approved from the Engineer-in-charge. In case wax polished surface is designed the wax polish shall be sparingly applied with soft linen on the clean and dry surface and clean saw dust shall then be spread over the surface, and the sample wax mopped up, leaving glossy surface. Care shall be exercised to see that the wax shall not at all stain the edges.

The stones shall be well wetted before laying while applying mortar for fixing the stones in position, no chips or filling of any short shall be used. The surface to be veneered shall be cleaned of all dirt, maintenances of loose materials and then will wet with water.

The stones shall be secured to the backing by channeled shape gum metal cramps, 30 cm long, 25mm wide and 6mm thick. The legs of the channel shall be 25 cm high. The adjoining stone shall be secured to each other by 6mm dia 75mm long copper pin dowels. The swamps and pin dowels shall be spaced not more than 600mm apart. The samples of pin, dowels and cramps shall be got approved form the Engineer-in-charge. One end of the cramp shall be positioned in the groove in the top edge of the stone and the other end in the joint of the brick masonry at the back.

The pin dowel shall remain inserted in the adjoining stone so that equal length remains in each stone.

The pin dowels and cramps shall be laid in cement mortar of cement and fine sand in proportions as specified in the item.

While laying face work all care shall be taken to see that the edges and corners of the stones are not damaged in any way and that the stone face are not disfigured or stained or any indentation formed on the face if any stone is damaged in any of the above way the same shall be replaced by unblemished and work redone.

The pattern of stone veneering shall be as per the detailed drawing or as directed by the Engineer-in-charge. Few samples of finished stone veneering shall be prepared by the contractor for the approval of the Engineer-in-charge. The work shall be carried out solely in conformity with the approved sample.

The backing joints shall be filled with cement mortar of appropriate proportion and shall be of thickness not more than 10 mm. All these joints shall be full of mortar if any hollow sounding is detected by tapping the stone this shall be taken out and re-laid properly without hollow. The backing joint shall be carried out simultaneously with the face work.

The thickness of the face joints shall not exceed 5mm or as directed by the Engineer-in-charge. The face joints shall be uniform throughout. A uniform recess of 10mm depth from face shall be left with the help of steel plates sections. The cement to be used for face joints shall be of matching colour and shade as approved by the Engineer-in-charge.

In case of cement concrete backing, the stone shall be secured with backing after it has set and got cured. The cramps shall be fixed in concrete in the required position while laying.

The method of executing this work shall be got approved from the Engineer-in-charge in all its details such as scaffoldings, method of handling, transporting, keeping in position of stones, manner and operational phasing of applying the back joints etc. in submitting the data, the contractor shall give due weightage and consideration to the fact that the work is to be carried out at a very great height and such other critical factors.

The curing shall be carried out continuously for 14 days and if possible curing may be carried out by providing perforated pipes horizontally laid.

The face work shall be cleaned off all mortar markings, stain etc.

The face joints of the veneering shall be neat, true to line i.e. perfectly horizontal and perfectly vertical. The face work shall be truly in plane. It shall present a neat appearance.

C-36 Application of flat paint :

The surface on which the flat paint is to be applied shall be thoroughly cleaned of all mortar droppings, dust, algae, grease, and other foreign matter by brushing. The holes and undulations shall be filled up with plaster of Paris and rubbed smooth. The surface so prepared shall be got approved from the Engineer-in-charge prior to painting work is commenced.

Application of paint :

Primer coat :

The specified primer shall be applied with brush in a uniform layer over the surface prepared as above.

Painting coats:

Flat paint shall be applied with brushes when the surface is dry, Paint shall be applied in

even and uniform layers. The number of coats shall be specified in the item of work. Each coat shall be allowed to dry overnight and lightly rubbed with very fine grade of sand paper and loose particles shall be brushed off before the next coat is applied. The paint shall be applied evenly and smoothly by brushes with crossing and laying process. The crossing and laying process shall consist of covering the area over with paint and then painting alternatively in opposite direction two or three times and then finally painting lightly in a direction at right angle to the same. This entire process of crossing and laying shall constitute one coat.

No hair marks or clogging of paint puddle in corners etc. shall be left on the surface.

All wood work, glazing, floors etc. shall be protected by covering and stains meals, splashing, if any shall be removed and any damage done shall be made good by the contractor at his cost.

C-37 While Washing or Colour Washing :

White wash:

Lime shall be dissolved with sufficient quantity of water (about 4 to 5 liters per kg. of lime) thoroughly mixed and stirred to attain consistency within screen. The wash shall be strained through a clean cloth. Clean colour dissolved in hot water shall be added in suitable proportion Indigo will be added to obtain required white tint.

Preparation of Surface:

The surface shall be prepared by removing the mortar droppings and foreign matter and thoroughly cleaned with a wire or fiber brush or any other suitable means as directed by the Engineer-in-charge. All loose pieces and scale shall be scrapped off and holes filled with mortar.

Application of white wash:

On the surface so prepared the white wash shall be laid with brush. The first coat shall be from top downwards, and similarly second coat shall be from the right to the left or to right. Each coat must be allowed to dry before the laid it shall present smooth and uniform finish free from brush marks and it should not come off easily when rubbed with finger.

Splashing and dropping, if any, on the doors, windows, ventilators etc. shall be removed and the surface cleaned.

Colour Wash:

Colour wash shall be prepared by adding necessary approved colour matter of the white wash which has been strained and prepared as above. Other provisions as mentioned in white wash shall apply for colour wash.

C-38 Constructing Cooking Platform: (Kitchen, Pantry, Services etc.)

The code covers constructing platform for kitchen service meant for other similar work purpose.

The cooking platform shall have following components.

(a) Raised Masonry platform of specified height and width as required :

The vertical face of masonry shall be covered with 12mm thick plaster. The top surface work, cement plaster and I.P.S. specified thickness. The masonry work, cement plaster and I.P.S. shall be as per C-9, C-31 & C-17 respectively of this code of practice.

(b) Partition wall :

Hall brick partition wall duly plastered on the faces as per detailed drawings or as directed by the Engineer-in-charge shall be carried out as per C-12 and C-31 of code of practice.

(c) **Cooking Platform Proper:**

This shall be of R.C.C. slab topped with Double polished Telephone black Granite Stone with exposed machine cut edges. The size of various components and kind of stone shall be as specified as per detailed drawings or as directed by the Engineer-in-charge.

The work of cement concrete and reinforcement for 75mm thick slab shall be executed as per C-4, C-6 and C-7 of code of practice.

The vertical exposed face of the slab shall also be veneered with matching stone. The top of the slab shall be suitably slopped towards sink as directed. The veneering shall be provided such that the edge of the veneering shall not be less than 10 mm above the finished surface of the platform.

C-39 Application of Anti Termite Treatment :

The purpose of providing the treatment is to create a chemical barrier between the ground from where the termites come and wood work cellulose material and other components of building, which may form food for the termite. The treatment is expected to provide complete chemical barrier all around, which will prevent the termite from reaching the super structure of the building and its contents, it may, therefore be understood clearly and distinctly that this is a very important treatment is to be given to the building and therefore has to be carried out through specialized firms only having established reputation and reputed past performance. The name of such specialized firms shall have to be got approved from the Engineer-in-charge. Use of chemical and method of treatment shall be as detailed below:

(1) **Chemical and Preparation :**

- (a) The chemicals used for soil treatment shall be any one or a combination of the following with the concentration shown against each in emulsion :

Chemicals	Concentration
Aldrin	0.51% (by weight)
Chlordane	1.0%
Dieldrin	0.5%
Heptachlor	0.5%

- (b) The dilution guide for preparing the emulsions is given below :

Emulsion liters				
Aldrin 30 EC	Dieldrin 18 EC	Chlordane 75 BC	Heptachlor 29 EC	20 EC
1267	2280	1000	500	2500

(2) **Treatment of column pits, wall, trenches & basement excavation :**

The bottom surface and (up to a height of 300mm from the bottom) of the excavation made for column pits, trenches, and basements shall be treated with the chemical emulsion mentioned above at 5 lit. As per sq.mtr of surface area.

(3) **Treatment to backfill earth :**

After the column foundation, wall foundation, and retaining walls of the basement

come up the backfill in immediate contact with the foundation structure shall be treated with the chemical emulsion at the rate of 15 lit. Per sq.m. of the vertical surface of the structure for each side. The selected earth is to be refilled in layers and the treatment shall be carried out in similar stage. Chemical emulsion shall be directed towards the concrete or masonry surface of the columns and walls so that the earth in contact with this surface is well treated with the chemical.

(4) **Treatment of top surface of plinth filling :**

After the earth filling is completed with plinth area and before dry sand packing of sub grade is laid, the entire surface of the filled earth shall be treated with chemical emulsion at 5 lit. per sq.m.

Light rodding of the surface may be carried out to facilitate proper absorption of the emulsion.

(5) **Treatment at junction of walls and floor :**

Special care shall be taken to establish continuity the vertical chemical barrier on inner wall surface from the ground level (where it has stopped with the treatment described in 3 above) up to the level of the filled earth surface. To achieve this a small channel 3x3 cm shall be made at all the junctions of wall and columns with the floor (Before laying the sub-grade) and rod holes made in the channel up to the ground level 15 cm apart and the rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 45 lit. per sq.m. of the area of the vertical surface of the sub- structure so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.

(6) When the building is completed in all respects or when the plinth protection work is commenced. Whichever is earlier, the earth around the external perimeter of the building up to a depth of 30 cm. shall be finally treated at the rate of 4.5 liters per running meter of the plinth wall. To facilitate this treatment, solid M.S. rods should be driven into the soil as close as possible to the plinth wall at intervals of 15 cm. and up to a depth of 30 cm. and the rods moved backward and forward in a direction parallel to the wall to break up the earth so that the chemical emulsion mixes immediately with the soil.

(7) **Treatment of soil surrounded pipes wastes and conduits :**

When the pipes wet and conduits enter in side the area of the foundation, the soil surrounding the point of entry must be loose around in such pipe, waste of conduit for a distance of 15 cm. and up to a depth of 7.50 cm. before treatment is commenced. When they enter the soil external to the foundation, they shall be similar treated unless they stand clear of the walls of the building by about 7.5 cm. for a distance of over 30 cm.

(8) **Spraying Equipment :**

A pressure pump shall be used to carry out spraying operations to facilitate proper penetration of chemical into earth.

Guarantee of Anti-Termite Treatment:

The treatment against termite infestation shall remain fully effective for a period of not less than ten years from the date of issue of the final certificate of completion of the work. If at any time during this period, any defect in any part of the building or structure is noticed, the contractor shall have to rectify defects within fifteen days of receipt of the notice from Engineer-in-charge. On the contractor's failure to do so the Engineer-in-charge may get the same rectified through any other agency at the contractors risk and

cost and the decision of the Engineer-in-charge as the cost payable by the contractor for the same shall be final and binding to the contractor.

A guarantee bond on appropriately stamped papers shall be given by the contractor to the department in the manner and form as prescribed below:

Form of Guarantee Bond:

I/We (contractor) hereby guarantee that the work will remain unexpected and will not be in any way damaged by white ant or any other germs of similar types for a period of 10 (ten) years after completion of the work of anti-termite treatment as per terms and condition of the contract and the contractor hereby identifies and agree to save harmless and GIDC from any loss and /or damage that might be caused on account of white ant and/or other similar type of germs and hereby guarantees to make good and loss or damages suffered by GIDC and further guarantees to redo the defective work without claiming any extra cost.

This guarantee shall remain in force for the period of 10 years from the completion of the work under the contract and it shall remain binding the contractor for the said period of 10 (ten) years.

The deposit at the rate of 5% of the cost of this item from the running and final bill shall be recovered and shall be refunded only after the completion of the guarantee period.

C-40 Laying and fixing Galvanized Iron Pipes with fittings :

The trench of laying the pipes shall be excavated true to lines and levels as shown on the plans or as directed by the Engineer-in-charge. The bed of the trench shall be made even. Unless otherwise specified as instructed by the Engineer-in-charge. The trenches shall be excavated 30 cms. Wide and not less than 45 cms. Deep. All pipes, water mains, cables etc. met in the excavation shall be carefully protected and supported. Any damages done shall be made good by the contractor at his own cost. The refilling work in the trenches shall be done in layers and shall be properly rammed except at joints. The refilling at joints shall be done after satisfactory testing of joints and on approval of the Engineer-in-charge. Suitable additional filling shall be done to account for subsequent settlement. Any surplus excavated stuff shall be disposed off as directed.

Laying & Fixing:

The completed lay out of the water supply system of the building shall be got approved from the Engineer-in-charge. The pipes shall be laid plumb, and in straight and parallel lines unless directed otherwise.

In making the joints few turns of line hemp smeared with white zinc shall be taken over the threaded end of the pipes and the socket shall be fastened with a pipe wrench. When the pipe is to be fixed clear to the walls, it shall be fixed with standard brackets or clips held by wooden blocks. The supporting brackets clips etc. for the pipes shall be spaced at an interval of 1 mtr. Or as directed.

Whenever such pipe is to be taken through wall or slab, suitable square hole shall be driven in the wall or slab carefully without damaging the reinforcement or slab. After the pipe is laid, the hole shall be made good with cement concrete and cement mortar. Finishing shall be done similar to wall and slab finishing.

Painting:

The pipes laid under ground shall be painted with one coat of hot asphalt.

Testing:

On completion of laying the pipe line shall be tested for any leakage at the joints. The

defects if any revealed after test shall be remedied to the satisfaction of the Engineer-in-charge.

C-41 Fixing Wash basin :

The code covers fulfilling of wash basin including assembling and fixing brass chromium plated pillar cock, cast iron cantilever brackets, rubber plug, chromium plated brass chain, chromium plated brass stop cock, chromium plated brass waste coupling 32mm diameter, P.V.C. bottle trap, P.V.C. connection etc.

The wash basin shall be fixed on the wall at the location and level as shown on the detail drawing or as directed by the Engineer-in-charge. The wash basin shall be supported on brackets fixed to the wall with wooden cleats and screws. The size of the brackets shall be as per detailed drawings or as directed by the Engineer-in-charge. The brackets shall be securely fixed to the wall and the basin fixed on the brackets.

The PVC bottle trap and union shall be fixed in the hole waste kept at the bottom of wash basin. It shall be ensured that the joints are water tight. This bottle trap shall be then coupled with the waste water pipe.

The waste pipe of required length shall run through the wall. If holes are not left in the wall, they shall be cut and the chase surrounding the pipe made good after fixing the pipe.

C.P. brass stop cock of required size shall be fixed in the supply line. PVC flexible pipe of required diameter shall be provided for supply of water from stopcock to pillar cock. The joints of PVC connections shall be made water tight. The pillar cock shall be fixed on the hole provided in the wash basin. Chain and rubber plug shall be fixed in the hole provided in the wash basin.

The exposed pipe & CI brackets shall be painted with one coat of red lead and three coats of approved oil paints as per C-15 of this code.

The wash basin shall be with one tap hole unless otherwise specified in the item or as directed by the Engineer-in-charge and the case when the tap holes are more than one, equivalent number of taps and allied provisions shall be provided & appropriately connected as directed by the Engineer-in-charge.

C-42 Fixing Indian Type Water Closet :

(a) W.C. pan:

The water closet pan shall be fixed into the place indicated on the drawing or as directed by the Engineer. The vent and soil pipe shall run through the holes left in wall and the wall made good. If holes not left in the wall, they shall be cut and the cavity surroundings the pipe made good properly after fixing the pipes. The pan shall be placed into position with the trap jointed in cement mortar 1:11 and the connecting pipes duly connected including the flush pipes from the flush cock. The jointing of cast iron pipes with the trap shall be with 1:1 cement mortar as directed.

Brick bat cement concrete 1.5:10 shall be cast and pressed around the embedded surface of the pan fittings and pipes to get a solid embedment without any hollows. The whole are for W.C. shall be provided with 1.5:10 blocks bat cement concrete. The pan shall be fixed at slightly lower level than the floor level of the general flooring which should slope on side towards the pan. The pan shall be fixed such that its top glazed ring around under the surrounding flooring shall be in the same level. After the flooring is completed the rectangular foot rests shall be fixed in cement mortar 1:1

C-43 Fixing Orissa Type Water Closet Pan :

The work shall be carried out as per C -41 of the code of practice except that the Orissa

type water closet pan shall be provided instead of Indian type water closet pan and that the separate foot rests are not provided.

C-44 Fixing European Type Water Closet:

The European type water closet pan and the low level flushing tank shall be fixed at the places indicated on drawing or as directed by the Engineer-in-charge. The vent and soil pipe shall run through the holes left in the wall and floor. If the holes are not left in wall and floor, they will be cut. The cavity surrounding the pipes shall be made good properly after fixing the pipe. The pan shall be fixed into the position in cement mortar 1:1 (1-cement: 1-sand) with connecting pipe duly connected including flush pipe from the cistern. The joints at the lid then shall be fixed to the pan with chromium plated hinges. The brackets shall be painted with white enamel paint.

C-45 Fixing of urinal :

This code includes fixing of floor mounted wall type urinal necessary spreader arrangement chromium plated pipe connection with stop cock and C.P. brass tap etc. The wall urinal shall be fixed on to the wall as per the detailed drawing or as directed by the Engineer-in-charge in mortar. The floor slab in not shall be suitably sunk to receive the wall urinal. Where the floor slab is not sunk, the wall urinal shall be provided over platform. The lip of the wall urinal shall be flushed with the finished plan level adjacent to it. The wall urinal shall be laid over a fine sand cushion of average 25mm thickness. A space of not less than 3 mm shall be provided all around in front and side and filled with water proofing compound of approved quality.

The C.P. brass trap shall be fixed as directed by the Engineer-in-charge and the trap shall be connected with necessary C.I. waste pipe, the waste pipe shall run through the wall or outside of the wall if necessary.

C.P. brass stop cock of specified diameter shall be provided as shown in the detailed drawing or as directed by the Engineer-in-charge. Chromium plated flushing pipe of specified diameter and length shall be provided and fixed with the stop cock and spreading arrangement.

Spreading arrangement shall be made by providing a spreader nozzle at the end of flushing pipe.

C-46 Fixing Nahni Trap :

The Nahni trap with bend and pipe price up to the outside face of the wall and grating as specified shall be fixed as per drawing or instruction of the Engineer-in-charge. The joints shall be sealed with cement mortar.

The hole shall be kept in the floor and masonry if not left and the same be made good properly after the nahni trap and pipe are fixed. The nahni trap in the white glazed tiles flooring shall be positioned that its grating shall replace only one tile.

C-47 Fixing of Gully Trap :

The gully trap shall be set into 1:4:8 cement concrete extending 300 mm beyond the trap on three sides over which shall be constructed one brick masonry chamber of the dimensions indicated on the drawings or as directed by the Engineer-in-charge. The building wall will be the fourth side. The brick masonry shall be constructed in cement mortar 1:3. The inside shall be plastered with cement mortar 1:3. The top lid of pre-cast concrete cover of 40mm thickness of required size shall be provided on the chamber as directed. The trap in the chamber shall have cast iron grating.

C-48 Fixing Cast Iron Pipes :

The code covers fixing of pipes on walls, filling joints with cement mortar 1:1. Cast iron

pipe shall be secured to the face of wall at all joints by standard holder bat clamp.

The bat clamps shall consist of a cast iron base with a projecting shaped lug, to the web of which the 2 semi circular halves of the flat iron clamps are bolted. The base of the holder bat clamps shall be screwed on a pair of wooden plugs fixed in the wall with wood screws driven through the holes in the base. The screws shall be not less than 75mm long for 80mm diameter pipe and 100 mm long for 100 mm dia pipe. The plugs shall be fixed in the wall to depth of 150mm in cement mortar 1:2 (1-cement: 2- fine sand) centrally to the holes in the base in the base of the bat clamps and with the front face projecting to such a length from the brick face that when the bat clamps is fixed the outer face of its base shall be flush with the plaster face of wall. The plugs shall be 110 mm x 50 mm wide at face increasing to 160mm x 70mm wide at rear and shall be 70 mm deep throughout.

Laying of pipe & specials:

The pipes before being laid, shall be examined to see that there are no cracks or defects. Care shall be taken to clean the pipes inside of the socket and outside of the spigot. Spigot of the upper pipe shall be properly fitted in the socket of the lower pipe. The depth of the annular space between socket and spigot shall be filled in with cement mortar 1:1. The joints shall be finished smooth and shall be flush with the top ring or the socket.

The joints of the horizontal pipes running below flooring shall also be filled with cement mortar 1:1. The joints ends of the pipe coming out of the wall shall be provided with required specials, such as Tees, "Y" bends etc. with or without inspection eyes as required and all the joints shall be filled with cement mortar 1:1 as above.

The pipe lines shall be truly vertical or to lines and slopping as directed and shall be at a uniform distance of 20mm from the finished face of the wall.

C-49 Fixing Asbestos Cement pipes :

The provision made in C-48 of code of practice shall be followed in this case also excepting the following changes:

- (1) Instead of cast iron pipes, this code provides for fixing of asbestos cement pipes.
- (2) The joints shall be filled in with stiff cement mortar 1:1 (1-cement: 1- fine sand) instead of lead joints.
- (3) The joints shall be finished smooth at top at an angle of 45 degree sloped up with cement mortar and will be cured for period of 7 days by tying piece of gunny bags to the joints keeping it wet.

C-50 Laying & stoneware pipe :

Excavation:

The trench shall be excavated to the exact grading and 450mm wide or as directed by the Engineer-in-charge. The bottom of the trench shall be trimmed off to present a plane surface and excavation below joints shall be taken sufficiently deep so as to accommodate the socket of pipe and all irregularities shall be removed.

Laying:

Before laying the pipes all pipes and fittings shall be inspected and shall be rung with a light hammer to detect cracks. The pipe shall then be laid in trench to the alignment, levels and gradients as shown. The spigot end of one pipe shall be centered in the socket and of other pipe with socket up the gradient. The cutting of pipe for inseting fit or close pipe shall be done in neat and workmanship like manner.

Jointing of pipe:

The stoneware pipe shall be jointed with cement mortar 1:1 (1-cement: 1- sand). The jointing shall be done as follows:

In each joint spun yarn soaked in a neat cement slurry shall be passed round the joint and inserted in it by means of a caulking tool. Yarn so rammed as shall not occupy more than $\frac{1}{4}$ the of the depth of socket. Cement mortar 1:1 (1-cement: 1-sand) prepared as per M-11 of specification of materials. The mortar shall be slightly moistened and shall be inserted by hand into remaining space of the joint after yarn. The mortar shall then be caulked into the jointed with a caulking tool. More cement mortar shall be added until the space of the joint has been completely filled with tightly.

The joint shall then be finished off neatly outside the socket at angle of 45 degree.

Curing:

The cement mortar joint shall be cured for seven days.

Testing:

The pipe line shall be tested for leakage before refilling of the trenches etc.

Back Filling:

After satisfactory testing the trenches shall be back filled as per C-53 of code of practice.

C-51 Constructing Inspection Chamber:

This code covers excavation for foundation, laying of cement concrete bedding brick masonry wall with cement plaster on inside surface, cement concrete, benching (channel) fixing of inspection chamber frame and cover R.C.C. slab etc.

The inspection chamber shall be of size as specified in the item or as shown on the drawing or as directed by the Engineer. The various components shall be executed as detailed below.

Excavation:

The excavation shall be done as per C-1 of code of practice or as directed by the Engineer-in-charge so as to have at least 150mm offset from outside face of the brick masonry.

Cement concrete:

The bedding of 150mm thick cement concrete shall be done as per C-2 of code of practice.

Brick masonry:

One thick brick masonry wall in cement mortar 1:6 shall be done as per C-10 of code of practice.

Benching:

Plain cement concrete for benching (channel) of required thickness shall be done as per C-17 of code of practice.

Cement plaster:

Cement plaster work shall be carried out as per C-31 of code of practice, cast iron frame shall be fixed in the slab and then concrete shall be cast. Concrete work shall be finished with cement mortar 1:3 (1-cement: 3 sand)

Pre-cast RCC slab with C.I. manhole cover & Frame:

C.I. manhole cover shall be placed into the CI frame fixed in the slab. It shall be painted with one coat of red lead paint and two coats of black oil paint.

Cement plaster:

Cement plaster work shall be carried out as per C-31 of code of practice. Cast iron frame shall be fixed in the slab and then concrete shall be cast. Concrete work shall be finished with cement mortar 1:4 (1-cement: 4- sand).

C-52 Filling in plinth with selected materials :

The code provides for filling in plinth with selected materials lying and layers of uniform thickness, watering ramming etc.

The ground over which the filling is to be done shall be cleared of all grass, loose stones, rubbish of all kind as well as trees, roots of trees etc.

The approved selected materials shall be cleared of all rubbish; larger size stones etc clods broken down to a size of 59mm or less and conveyed to site of work of filling. The material shall be laid and layers of about 200mm as directed by the Engineer-in-charge. Each layer shall be watered and compacted with heavy hammers before the upper layer is laid till the final level is reached so as to form a thoroughly compacted base.

The process of filling in plinth, watering and compaction shall be carried out in such a way as not be endanger the foundation, columns, plinth, walls etc. already built up. Under no circumstances, black cotton soil shall be used for filling the plinth.

C-53 Fixing of Steel Rolling Shutters:

Fixing of rolling shutter shall be done in a workmanship like manner so that the operation of the shutter is easy and smooth. The hold fast shall be embedded in CC 1:2:4 (1-cement: 2- coarse sand: 4- graded stone) aggregate 20mm nominal size and shall be properly fixed with 100mm long catch bolts of 10mm. All the works disturbed of cut away shall be made good.

The guide channels, shall be attached to the jams in plumb and true either in the over lapping fashion, projection fashion or embedded in grooves, depending on the method of fixing.

The bracket plate shall be fitted at the centre. A "U" shape cast iron or mild steel clamp riveted or welded to it. Since the bracket plate carries the full load of the shutter it should have sufficient cross sectional area to resist the force and it shall be held in position rigidly by means of suitable foundation bolts. When the bracket is to fix on concrete the angle is suitable bent and fixed to the concrete beam of lintel with anchor bolts of at least 16x75 mm size. The pipes of the suspension shaft which are crimped to the bracket shall be fitted with rotted cast iron pulleys to which the curtain is attached. The pulleys and the pipe shaft be connected by means of pretension helical spring to counter balance the weight of the curtain and to keep the shutter in equilibrium in any partly opened position.

The hood cover shall be fixed to the bracket plate by means of angle cleats and supported at the top at suitable intervals for preventing sagging.

Rolling shutter shall be painted with two coats of approved oil paints of approved shades on anti-corrosive paint as directed by Engineer-in-charge.

C-54 Fixing of Urinal :

The fixing of flat back lip type urinal a wall include of PVC connection with stop cock and waste pipe etc.

Urinal shall be fixed on the wall as per the detailed drawing or as directed by Engineer-

in-charge. Urinal shall be fixed to the wall wooden putty previously embedded in walls and screw of suitable size.

The C.P. brass stop cock shall be fixed as directed by the Engineer-in-charge and PVC connection of suitable length be provided and connected with G.I. pipe of water supply. PVC reducer shall be connected with PVC waste of specified size and fixed on wall properly with CI clamp, screw etc. The waste pipe run through the wall of outside of the wall as per instruction of Engineer-in-charge.

After fixing of urinal all the floor and wall shall be made good to the satisfaction of the Engineer-in-charge.

Fixing of remaining procedure shall be reversed.

C-55 Fixing of Windows / Ventilators :

Fixing of window and ventilators shall be done workmanship like manner. The hold fast shall be embedded in CC 1:2:4 of size 10 cm x 10 cm x 10 cm (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size)

The window frame shall be erected in position and held plumb with strong support from both sides and built in masonry as it is being built.

The glass paneling shall be carried out as per C-14 of Code of Practice or as directed and oil painting shall be carried out as per C-15 of Code of Practice.

All fixtures and fastening shall be fixed with appropriate screws in sound and efficient manner to ensure ease of operation. They shall be appropriately positioned and shall be truly horizontal or vertical as required.

Oil painting shall be carried out with one coat of primer and 2 coats of approved oil paints of approved shade and shall conform to C-15 of Code of practice.

C-56 Fixing of Door frame :

Fixing of door frame shall be done in workmanship like manner. The hold fast shall be embedded in CC 1:2:4 of the size 10 cm x 10 cm x 15 cm (1- cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size).

The door frame shall be erected in position and held plumb with strong support from both sides and built in masonry as it is being built.

The shutter shall be prepared as per the detail drawing and shall conform to C-13 of Code of practice or as directed.

Timber/PVC/Aluminum paneling shall be carried out as per C-13 of Code of practice or as directed.

All fixtures and fastening shall be fixed with appropriate screws. Nos. of fixtures and fastening shall be provided as per C.

Oil painting shall be carried out with one coat of primer and 2 coats of approved oil paints of approved shade and shall conform to C-15 of Code of practice.

C-57 Construction of Rubble Uncoursed Stone Masonry :

Pucca approved stone of approved size for un-coursed rubble masonry shall be collected on site. The rubble shall be laid on broad faces. Earthy or dis-coloured weathered or weatherworn stone shall not be used.

The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 15 cm. The height of stone for rubble masonry may be up to 30 cm.

Stone shall be hammer-dressed on the face, the sides and the beds to enable it to come in proximity with the neighboring stone. The bushing on the face shall not be more than 40 mm. on an exposed face.

Chips and spalls of stones shall be used wherever necessary to avoid thick mortar beds or joints and it shall be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stones to bring these upon level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 20 percent of the quantity of a stone masonry.

The hearting or interior filling of a wall face shall consist of rubble stone not less than 150mm in any direction carefully laid hammered down with a wooden mallet in the position and solidly bedded in mortar. Treating should be laid nearly with facing and backing.

Though bond stones shall be provided in the walls up to 60 cm. thick, in case of highly absorbent type of stone (Limestone or sand stones) the bond stone shall extend about 2/3 in the wall. Each bond stone shall be provided for every of 0.5 m² of the wall surface.

Quoin stone shall not be less than 0.03 m³ in volume.

The plum stone at about 90 cm. interval shall be provided.

The masonry shall be laid with or without courses as the case may be as per general requirement. The quoins shall be laid header and stretcher alternatively. Every stone shall be carefully fitted to the adjacent stone so as to form neat and close joint. Face stone shall be extend and bond well in the back. These shall be arranged to break joints as much as possible and to avoid long vertical lines of joints.

The cement mortar or proportion as specified in the item shall be spread over width and the stone shall be well embedded in it. Joints in the surface shall be carried out in line level plum and of dimensions as mentioned in the drawing. The stone shall be used only after spreading plenty of water over it. No side filling shall be done without obtaining permission of Engineer-in-charge. The work shall be kept wet at least fourteen days.

C-58 Filling of plinth with selected sand :

The code provides, for filling in plinth with sand of approved quality, laying in layers of uniform thickness, watering ramming etc. The ground over which the filling is to be done shall be cleared of all grass, loose stones, rubbish of all kind, as well as trees, roots of trees etc. The approved quality of sand shall be cleared of all rubbish and shall be conveyed to site of work of filling the sand shall be laid in layers, of about 200mm as directed by the Engineer-in-charge. Each layers shall be watered and compacted with heavy rammer before of the upper layers is laid, till the final level is reached, so as to form a thoroughly compacted base.

The process of filling in plinth, watering and compaction shall be carried out in such a way as not to endanger the foundation columns, plinth walls etc. already built up.

C-59 Application of Water proofing cement paint :

The surfaces shall be thoroughly wetted with clean water before cement water proofing paint is applied. Cement paint shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brushable consistency. Generally, equal volumes of paint powder and water make a satisfactory paint. In all cases, the manufacturer's instruction shall be followed. The paint shall be mixed in such quantities as can use of within a hour of mixing as otherwise the mixture will set and thickness, affecting flowing and finish. The libs of cement paint drums shall be kept

tightly when not in use. To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket. For undecorated surface, the surface shall be treated with minimum two coats of water proof cement paint. Not less than 20 hours, shall be allowed between two coats. Next coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used if hot dry weather, the preceding coat shall be allowed between two coats. Next coat shall not be started until the preceding coat has become sufficient hard to resist the marking by the brush being used. In hot dry weather, the preceding coat slightly moistened before applying the subsequent coat. The finish surface shall be even and uniform in shade, without patches, brush marks, paint drops etc. The cement paint shall be applied with a brush with relatively short stiff hob or fiber bristles. The paint shall be brushed in uniform thickness and shall be free from excess heavy brush mark. The lamps shall be well brushed out. The water proofing cement paint shall not be applied on surface already treated with white wash, colour wash, distemper, dry or oil bound varnishes paint etc. It shall not be applied on gypsum, wood and metal surface. Painted surface shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after the application.

C-60 Construction of bela or block in course rough dressed stone masonry:

The work shall be carried out with pucca approved white stone bela of uniform size and well dressed. Earthly or discolored, weathered or water worn stone shall not be used. The size of bela stone to suit the width of wall, shall be as directed by the Engineer. The corner stones and quoins shall be of good quality stones dressed to correct angle.

The cement mortar of proportion specified in the item shall be spread for full width of wall. The stone shall be placed in it. Joint in the surface shall be flushed or raked out 20mm deep during construction as directed by Engineer. The work shall be carried out, in line, level, and plumb & of the dimensions as mentioned in the drawing. The stones shall be used only after spreading, plenty of water over it. The work shall be kept wet for at least 14 days. The scaffolding shall be provided as per **C-9** of code of practice.

C-61 Application of plastic emulsion paint :

The work of preparing the surface shall be carried out as per C-36.

The scaffolding work shall be carried out as per the C-9.

Preparation of mix:

This shall be done as per the Manufacturer's instruction. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added shall be as per Manufacturer's instruction or as directed by the Engineer.

Application:

Before putting into small containers for use, the paint shall be stirred thoroughly in its container. When applying also, the paint shall be continuously stirred in the small container, so that its consistency is kept uniform.

The paint shall be laid on evenly and smoothly by means of crossing and laying of the crossing and laying of consist of covering the area over with paint, brush the surface hard for the first time over and then brushing alternately in opposite direction two or three times and then, finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying of is finished. No hair marks from the brush clogging of paint puddles in the corner of panels, angle of moldings etc. shall be left on the work. The full process of crossing and laying off will constitute one

coat.

The paint shall be applied with brush or rollers. For undercoated surface, the surface shall be treated with minimum two coats of cement water proofing paint. The second or substitute coat shall not be started until the preceding has before sufficiently hard to resist marking by brush being used.

The surface on finishing shall present a flat velvety smooth finish. It shall be even a uniform in shade without patches, brush marks, paint drops etc.

Precautions:

Old brushes, if they are to be used with emulsion paints, shall be completely dried of turpentine oil paint by washing in warm soap water.

Brushes shall be quickly washed in water immediately after use and kept emerged in water during break period to prevent the paint from hardening of the brush.

In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes, etc.

Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

The washing of surface treated with emulsion paint shall not be done within 3 to 4 weeks of application.

C-62 Fixing of Asbestos cement corrugated sheet roofing:

Fixing accessory such as J-bolts, L-bolts, roof washers etc. shall conform to IS – 730-1956.

The sheet shall be laid with a side lap of half corrugation. For normal roof pitches (that is inclinations greater than or equal to 18). The end laps in sheet shall not be less than 150mm. For low roof pitches (that is inclinations less than 18) or for normal pitched on roof exposed positions the end laps shall be increased.

The side lap shall as far as possible be sheltered from the prevailing wind direction. The free over-hang at eaves measured as the length of sheet from its lower edge to the center of bolt holes shall not be more than 300mm for 6mm thick and 400mm for 7mm thick sheets.

Wherever four corners of sheets overlap to of them shall be mitred in order to secure a perfect fit.

All A.C. sheets shall be stored and protected from any damage.

No persons other than workman employed shall be permitted access to any area over which the sheeting is being laid.

Ridge purlins shall be fixed with suitable type of bolt 75mm to 115mm from the apex of the roof.

Sheets shall be cut as necessary with a wood saw. Holes in the sheets shall be drilled, they shall on no account be punched. The holes for fixing shall be 2mm larger than the diameter of the fixing bolts, and shall always be drilled through the crown of the corrugation and not on the valleys. No hole shall be nearer the 40mm to any edge of a sheet or an accessory.

Galvanized iron J-type hook bolts or cranked hook bolts, and nuts bearing on galvanized iron washers and bitumen washers shall be used for fixing sheets on angle iron purling.

It is essential that the bolts holes are made water tight by the use of bituminous felt washers in conjunction with suitable galvanized iron washers.

The length of bolts shall be 75mm longer than the depth of the purling for single sheet fixing and 90mm longer than the depth purling where two sheets overlap or where ridges or other accessories are to be fixed with the sheet. The number and length of bolts and number of bitumen and galvanized iron washers for fixing asbestos cement corrugated sheet shall be as given in table below.

Number and Length of Bolts and Number of Bituminous Felt and galvanized iron washers.

Sr.No	Situation	No. of Bolts and Bituminous washers and Galvanized Iron washer.	Length of bolts.
i	At horizontal (end) laps of sheets at eaves when filler pieces are used. At rigid non- corrugated sheets and ridge pcs. Are secured by the same bolts.	Twice the number of sheets in one horizontal course	Depth of purling plus 90mm
li	At eaves when filler pieces are not used at ridge when corrugated sheet and ridge pieces are not secured by the same bolt.	Twice the number of sheets in one horizontal course	Depth of purling plus 75mm
lii	At intermediate purling where horizontal laps do not occur.	Twice the number of sheets in one horizontal course	Depth of purling plus 75mm.

Asbestos cement corrugated sheets shall be laid starting at the caves, either from left to right or from right to left depending upon the prevailing direction of the wind. If laid from left to right, the first sheet shall be laid uncut, but the remaining sheets in this bottom row shall have the top left hand corners cut or mitred. The sheet in the second and other intermediate rows shall have the bottom right hand corner of the first sheet cut all other sheets except the last sheet shall have both the bottom right hand corner and top left hand corner cut; the last sheet shall have only the top left hand corner cut. The last or the top, row sheets shall have the bottom right hand corner cut with the exception of the last sheets which shall be laid uncut. If the sheets are laid from right to left the first sheet shall be laid uncut and the remaining procedure shall be reversed.

C-63 Structural steel work

All steel shall be tested and Indian approved manufacturers. One sample would with exact dimensions of all the members of the truss shall be got approved by the Engineer before erecting and fixing the same. Welding shall be properly done to the exact length and shall be got approved by the Engineer and welding shall conform to IS – 816-1956 or as revised from time to time. This items including providing, supplying, fabricating and erecting the same in proper position.

The entire steel surface shall be made clear and free from rust, scales, dust etc. before painting. All the steel work shall be painted with one coat of anti-corrosive paint and two coats of approved enamel paint and shade complete as directed.

There shall be no holes left after welding. The welding shall be carried out by welders, well experienced in the job and possessing certificate. The cutting should be smooth and the steel shall be made perfectly straight as required. The bolts, nuts, washers, etc.

used shall be of best approved quality. After welding is done the welding surface shall be made clear by removing all the flux by cheeping hammer wire brush.

The entire steel structure after erection shall be in perfect line and level and plumb and shall structure after erection shall be in perfect in line and level and plumb and shall be approved by the Engineer-in-charge before the sheeting work is started.

Signature of contractor

**Executive Engineer
GIDC, Ahmedabad**