

SECTION 5: TECHNICAL SPECIFICATIONS

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CHAPTER I**GENERAL SPECIFICATION OF MATERIALS****GENERAL**

1. All materials to be used shall conform to the relevant specifications as per the latest edition of Indian Standard, unless otherwise stated in the detailed specifications of items of work.
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. Tests for materials shall invariable be got carried out by the contractor when the same are specified in the specifications. Tests shall also have to be carried out, even though the same are not specifically mentioned in the specifications. If in the opinion of the Engineer-in-charge, the same are required to be carried out. All such tests shall be got carried out in Government or as approved laboratories and cost there of shall be entirely boned by the Contractor.
4. No collection of materials shall be made before it is got approved from the Engineer-in-charge.
5. Collection of approved materials shall be done at site of work in a systematic manner. Materials shall be stored in such a manner as to prevent deterioration or intrusions of foreign matter and to ensure the preservation of their quality and fitness for the work.
6. Materials, if rejected by the Engineer-in-charge, shall be immediately removed from the site of work. If they are not removed within twenty-four hours of receiving such intimation, Engineer-in-charge shall get the same removed at contractor's cost. The Engineer-in-charge shall dispose off such materials in a manner as he chooses and the contractor shall not be entitled to any compensation for the cost of such materials.
7. Approval to the samples of various materials given by the Engineer-in-charge will not absolve the contractor from the responsibility of replacing the defective material brought on site or materials used in the work found defective at a latter date. The contractor shall have no claim to any payment or compensation whatsoever on account of any such materials being rejected by the Engineer-in-charge.

8. The contractor must ensure to observe the laws, rules and regulations imposed under the “Mineral Acts” and such other laws and rules prescribed by Government from time to time and seek permission wherever required and pay royalties before taking materials from queries as any unlawful doings may render him to face legal actions for which he himself will be responsible.

MTL-1 Water:

Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material, which will either weaken the mortar or concrete or cause efflorescence or attack the steel in RCC. Container for transport, storage and handling of water shall be clean.

If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests soundness time of setting and mortar strength as specified in IS-269-1976. Any indication of unsoundness, change in time of setting by 30 minutes or more or decrease of more than 10 percent in strength of mortar, prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

Water fit for drinking is generally suitable for mortar or concrete.

Water for curing to mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements, which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during or those produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.

Hard and bitter water shall not be used for curing. Potable water is generally suitable for curing of mortar or concrete.

MTL-2 Cement:

Cement shall be ordinary Portland cement as per I.S. 269 or Pozzolona cement as per IS 1489. The cement for works under the contract or may be procured by the contractor directly from the manufacturer or from the dumps of the company to ensure quality.

The contractor shall take every precaution to store the cement properly so that it is not spoiled by dampness etc. Cement required for use shall be fresh at possible and stored on planks raised 15 to 20 cms. above the floor and stacked 30 cms. away from the wall in suitable closed weatherproof godown at the site of work. Cement shall be stored in such a way to allow the removal and use of cement in chronological order of receipt i.e. first

received being first used. Not more than 15 bags shall be stacked vertically in one pile and maximum width of the piles should not be more than 3 meters. Any cement, which has deteriorated, caked or which has been set or partially set shall not be used. When temporarily stored in open for use, it shall be kept on a suitable platform and suitably protected as necessary.

Different brands of cement or cement of the same brand from different factories shall be stored in separate groups and shall not be mixed during use. Cement shall be kept in a store under double locking arrangements. A board indicating stock and daily transactions of cement shall be kept in each room of the cement store. Daily account of receipt and use of cement bags shall be maintained by the Contractor in the Performa prescribed by the Engineer-in-charge and shall be available on site for checking and inspection.

The cement shall be measured by one bag for all use in concrete (except otherwise stated) and masonry etc. For calculation for the proportion, the volume of the cement bag shall be taken as 0.0342 Cu.m. (1.20 cft.) and measuring box of size of 30 cms x 30 x 38 cms for concrete works. If weigh-batch concrete is to be used, the cement shall have to be used as per actual weight and the contractor shall not be entitled for any compensation for loss in weight due to shifting of bags or on account of any other reasons.

MTL-3 Sand:

Sand shall be natural and, clean, well graded, hard, strong durable and gritty particles free from injurious amounts of dust, clay, kankar nodules, or of flaky portion shall alkali, salts organic matter loam mica or other deleterious substances and shall be got approved from the Engineer-in-charge. If sand is covered with dust, it shall be washed with water to make it clean.

- (A) The sand to be used in cement mortar for masonry works and first coat of plaster should generally satisfy the following grading.

I.S. Sieve	Percentage by weight passing sieve
480	100
230	80-95
120	70-90
60	40-85
30	5-50
15	0-10

- (B) The fineness modulus shall not exceed 3.0 Sand to be used in cement mortar for stone sled lining work, pointing and second coat of plaster may have the following gradings

I.S. Sieve	percentage by weight passing through
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480	100
240	100
120	75-100
60	40-85
30	5-50
15	0-10

The fineness modulus shall not exceed 1.6

- (C) Sand to be used for concrete works shall be of grades as specified in I.S. 383 fineness modulus varying from 2.6 to 3.6 as per requirement.

MTL-4 Stone Dust:

This shall be obtained from crushing hard black/blue trap-stone. It shall not contain more than 8% of silt determined by field test with measuring cylinder. The method of determining silt contents by field is given as under:

A sample of stone dust to be tested shall be placed without drying in 200 mm measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm mark. The mixture shall be stirred vigorously and the content allowed settling for 3 hours.

The height of silt visible as settled layer above the stone dust shall be expressed as percentage of the total height of the stone dust. The stone dust containing more than 8% silt shall be washed so as to bring the silt content within the allowable limit.

The fineness modulus of stone dust shall not be less than 1.80.

MTL-5 Stone Grit:

Grit shall consists of crushed or broken stone and be hard, strong dense, durable clean of proper gradation and free from skin or coating likely to prevent proper adhesion of Mortar. Grit shall generally be cubical in shape and as far as possible flaky elongated pieces shall be avoided. It shall generally comply with the provision of IS-383-1970. Unless special stone of particular quarries are mentioned, aggregate shall be broken from the best black trap stone as approved by the Engineer-in-charge. Stone shall have no deleterious reaction with cement.

The grit shall conform to the following gradation as per sieve analysis.

I.S. Sieve Designation	Percentage passing for sieve
12.50mm	100%
10.00mm	85-100%
4.75mm	0-20%
2.36mm	0-5 %

The crushing strength of grit will be such as to allow the concrete in which it is used to built-up the specified strength of concrete.

The necessary test for grit shall be carried out as per the requirements of IS: 2386(revised) from time to time as per instructions of the Engineer-in-charge.

MTL-6 Cinder:

Cinder is well burnt furnace residue, which has been fused or sintered into lumps of varying sizes.

Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only. It shall be sound and clean and free from clay, dirt, ash or other deleterious material.

The average grading for cinder aggregates shall be as mentioned below.

I.S. Sieve designation	Percentage passing
20 mm	100
10 mm	86
4.75 mm	70
2.36 mm	52

MTL-7 Stone Grit for Plain and ordinary Reinforced Concrete.

Coarse aggregate shall be of machine crushed stone of black/blue trap and be hard strong, dense durable, clean and free in skin and coating likely to prevent proper adhesion of mortar. The aggregates shall generally be cubical in shape. Unless special stones or particular quarries are mentioned, aggregates shall be machine crushed from the best black/blue trap stone as approved by the Engineer-in-charge. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars or 6 mm less than the cover whichever is smaller.

TABLE – 1

L.S. Sieve Designation	Percentage aggregate 40mm	Passing for single of Nominal size 20mm	Sized 16mm
40 mm	85-100	100	100
20 mm	0-20	85-100	100
16 mm	-	-	85 – 100

12.5 mm	-	-	-
10 mm	0.5	0-20	0-30
4.75 mm	-	0-5	0-5
2.36 mm	-	-	-

Note : This percentage may be varied some what by the Engineer-in-charge whom considered necessary for obtaining better density and strength of concrete.

Single size coarse aggregates conforming to the requirements in table No.1 above, or following nominal sizes shall be used at site with the other ingredients of concrete as indicated below. The mixing shall be in a mixture or on the 1:2:4 and C.C. 1: 1 ½:3 mixing with the other ingredient of concrete shall be done in the mixture only except for small work.

- | | | | |
|-----|--------------|---|---------------------------------|
| (1) | C.C. 1:5:10 | - | Nominal size of aggregate 40 mm |
| (2) | C.C. 1:4:8 | - | Nominal size of aggregate 40 mm |
| (3) | C.C. 1:3:6 | - | Nominal size of aggregate 40 mm |
| (4) | C.C. 1:2:4 | - | Nominal size of aggregate 20 mm |
| (5) | C.C. 1:1 ½:3 | - | Nominal size of aggregate 20 mm |

The grading test shall be taken in the beginning and at the change at the source of materials. The necessary test indicated in IS – 383 and IS – 456 shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner to prevent the inter-mixing of different aggregates. If the aggregates are covered with the dust, it shall be washed with water to make it clean. The coarse/aggregates for plain and reinforced concrete shall be measured by volume in the steel or wooden boxes prepared as per the direction of the Engineer-in-charge.

MTL-8: Selected Earth

The selected earth shall be that obtained from excavated material or shall have to be brought from outside as indicated in the item. If item does not indicate anything the selected earth shall have to be brought from outside.

The selected earth shall be good yellow soil and shall be got approved from the Engineer-in-charge. In no case black cotton soil or similar greatly expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones or bats. The cold shall be broken to a size of 50 mm or less. Contractor shall make his own arrangement at his own cost for land for borrowing selected earth. The stacking of material shall be done as directed by the Engineer-in-charge in such a way as not to interfere with any construction activities and in decent stacks.

When excavated material is to be used, only selected stuff got approved from the Engineer-in-charge shall be used. It shall be stacked separately and shall comply with all requirements of selected earth mentioned in above Para.

MTL-9: Black trap/blue stone coarse aggregates for controlled reinforced concrete

Coarse aggregate shall be of machine-crushed stone of black/blue trap and be hard strong, dense, and durable clean and free from skin and coating likely to prevent proper adhesion of mortar.

The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, black trap stone as approved by the Engineer-in-charge. Aggregate shall have no deleterious reaction with cement.

In proportion concrete, the quantity of coarse aggregates shall be determined by weight only. Obtaining the aggregate in different sizes and blending them in the right proportions as per concrete mix design approved by the Engineer-in-charge shall control the grading of coarse aggregate. The different sizes shall be stocked in separate stockpiles; the grading of aggregates shall be checked as frequently as possible. The frequency for verification of the grading shall be as directed by the Engineer-in-charge to ensure that the grading is maintained uniform with that of the samples used in the preliminary tests.

The necessary test indicated in IS - 383 and IS - 456 shall have to be carried out to ensure the acceptability of the material.

If aggregate is covered with dust it shall be washed with water to make it clean.

MTL-10: Bricks: First Class Bricks

- (A) The bricks shall be hand or machine moulded and made from suitable soils and kiln burnt. They shall be free from cracks, flaws, modules of free lime. Bricks shall have smooth rectangular faces with sharp corners and shall be of uniform colour.

The size of modular bricks shall be 190 mm x 90 mm and shall conform to I.S. 1077 in respect of tolerance for sub-class A bricks. Bricks of size 9"x4-1/2"x 3" can also be used.

The crushing strength of the bricks shall not be less than 35 kg/sq.cm. The average water absorption shall not be more than 20 percent by weight. Necessary tests for crushing strength and water absorption shall be carried out as directed by the Engineer-in-charge.

- (B) Second Class Bricks

The second class bricks shall be similar to first class bricks except that they may be permitted to have slight distorted and rounded edges provided no difficulty shall arise on this account in laying of uniform courses.

MTL-11: Mild Steel Bars

Mild steel bars reinforcement for R.C.C. work shall conform to IS. 432 and be of tested quality. It shall also comply with relevant part of IS. 456.

All the reinforcement shall be clean and free from dirt, oil, paint, grease, mill scale or loose or thick rust at the time of placing.

Reinforcement steel shall be stored such as to avoid distortion and sags of long length and shall be protected as far as possible from surface deterioration. All bars of the same designation shall be stacked separately as far as possible and distinctly marked.

For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable worked out at the rate specified below.

(1)	6 mm	0.22 Kg/Rmt.
(2)	8 mm	0.39 Kg/Rmt.
(3)	10 mm	0.62 Kg/Rmt.
(4)	12 mm	0.89 Kg/Rmt.
(5)	14 mm	1.21 Kg/Rmt.
(6)	16 mm	1.58 Kg/Rmt.
(7)	18 mm	2.00 Kg/Rmt.
(8)	20 mm	2.47 Kg/Rmt.
(9)	22 mm	2.98 Kg/Rmt.
(10)	25 mm	3.85 Kg/Rmt.
(11)	28 mm	4.83 Kg/Rmt.
(12)	32 mm	6.31 Kg/Rmt.
(13)	36 mm	7.99 Kg/Rmt.
(14)	40 mm	9.86 Kg/Rmt.

MTL-12: High Yield Strength Steel Deformed Bars:

High yield strength steel deformed bars shall be either cold twisted or hot rolled and shall conform to IS-1786 and IS-1139 respectively or as revised from time to time. These bars shall be preferred over plain steel M.S. Bars mentioned in MTL-12

Other provisions and requirements shall conform to specification No.MTL-12 for Mill Steel bars.

MTL-13: Mild steel Binding Wire:

The mil steel wire shall be of 1.63 mm or 1.22 mm (16 or 18 gauge) diameter and shall conform to IS-280 or as revised from time to time.

The use of black wire will be permitted for binding reinforcement bars. It shall be free from dust, oil, grease or any other undesirable coating, which may prevent adhesion of cement mortar.

Storage: The wire coils shall be stored such as to avoid deterioration.

Measurement: No measurement will be taken of the wire used for tying reinforcement bars. The rate for reinforcement steel and its fabrication shall include the cost of binding wire.

MTL-14: Structural Steel:

All structural steel shall conform to IS-226 and IS-800 or as revised from time to time. The steel shall be free from the defects mentioned in IS. 226 and shall have a smooth finish. The Material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability Rivet bars shall be conforming to IS-1148.

Structural steel shall be stored such as to avoid distortion of section of long length and shall be protected as far as practicable from surface deterioration. It should be so stored and handled that material would not be subjected to excessive stress and damages. All deformed structural material will be properly straightened by methods, which are not injurious, punched or otherwise worked in the shop. Sharp kinks and bends shall be a cause for rejection.

If the steel has been supplied by a dealer, test certificate of the manufactures shall be produced, if so required by the Engineer-in-charge. If further test be necessary, they will be done according to IS-226 and IS-23 or as revised from time to time.

MTL-15: Shuttering:

The shuttering shall be either of wooden planking of 30mm minimum thickness with or without steel sheet lining or of steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical ballies properly cross-braced together so as to make the formwork rigid.

The form work shall be sufficiently strong and shall have camber, so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration of live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement slurry.

If at any stage of work during or after placing concrete in the structure the form work sags or budges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequate rigid form work. The

complete form shall be got inspected by and approved from the Engineer-in-charge before the reinforcement bars are placed in position.

If wooden props are used, the props shall consist of ballies having 100 mm minimum diameter measured at mid length and 80 mm at thin end and shall be placed at 1 to 1.20m spacing. These shall rest squarely on wooden pole pieces 40 mm thick and minimum bearing area of 0.10 sq.m. laid on sufficiently hard base.

Double wedges shall further be provide between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jarring the concrete.

The timber used in shuttering shall not be so dry as to absorb water from concrete and neither swell budge nor so green or wet as to shrink after erection. The timber shall be properly swan and planed on the sides and the surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel shall be permitted.

As far as practicable clamp shall be used to hold the forms together and use of nails and spikes avoided.

The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface.

The shuttering for beams and slabs shall have camber of 4 mm per meter (1 in 250) or as directed by the Engineer-in-charge so as to offset the subsequent deflection. For cantilever the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-Charge.

The period that shall elapse after the concrete has been laid before easing and removal of centring and shuttering as under taken shall be as follows.

	Part of structure	Period
1.	Sides of Foundation, Columns beams & walls.	24 to 48 hours.
2.	Undersides of slabs up to 4.5 m span.	7 days.
3.	-do- above 4.50 m and under side of Beams and arches up to 6 m span.	14 days.
4.	-do- above 6 m span & upto 9 m. span	21 days.
5.	Inner sides of beams and arches over 9 m span.	28 days.
6.	Domes, shell & other structures of special nature.	As per instruction

Work damaged through premature or careless removal of forms shall be reconstructed.

The period for striking the form work shall be 2 times more in case of Puzzoloana Cement if used than that of the ordinary Portland Cement and the contractor shall not entitle for any extra claim for the same.

MTL-16: Expansion Joints, Pre-moulded Filler.

The item provides for expansion joints in RCC frame structure for internal joints, as well as for exposed joints with the use of pre-moulded bituminous joint filler.

Pre-moulded bituminous joint filler i.e. pre-formed strip of expansion joint filler shall not be deformed or broken by twisting bending or other handling when exposed to atmospheric condition. Pieces of joint filler that have been damages shall be rejected.

Thickness of the pre-moulded joints filter shall be 25 mm unless otherwise specified.

Pre-moulded bituminous joints filler shall conform to IS 1938 or as revised from time to time.

MTL-17: Expansion Joints Copper Strips and Holdfasts:

The item provides for expansion joints in R.C.C. frame structure for internal joints as well as for exposed joints with the use of necessary copper strip and holdfasts.

Copper sheet shall be of 2 mm thick and of 1 mm or required width with the "U" shape in the middle. Copper strip shall have holdfast of mm diameter copper rod fixed to the plate shouldered on strip at intervals of about 30 or as shown in the drawing or as directed by the Engineer-in-charge. The width of each flange (horizontal side) of the copper plate to be embedded in the concrete work shall be 25 mm. Depth of "U" to be provided in the expansion joint in the copper plate shall be 25 mm.

MTL-18: Teak Wood:

The teak wood shall be of good quality as required for the item to be executed. When the kind of wood is no specifically mentioned good Indian teak wood as approved by the Engineer-in-charge shall be used.

Teak wood shall generally be free from large, loose, dead or cluster knots, flaws shakes, wraps, twists bends or any other defects. It shall generally be uniform in substance and of straight fibres as far as possible. It shall be free from rot, decay, harmful fungi and other damage of harmful nature which will affect the strength, durability or its usefulness for the purpose for which it is required. The colour shall be uniform as far as possible. Any effort like painting use and adhesive or resinous materials, made to hide the defects shall render the pieces liable to rejection by the Engineer-in-charge.

All scantling, planks, etc. shall be sawn in straight lines and planes in the direction of grains and of uniform thickness.

The tolerance in the dimension shall be allowed at the rate 1.5 mm are face to be planned.

MTL-19: Glass:

All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes, blisters and other defects. The kind of glass to be used shall be as mentioned in the item or specifications or in the special provisions or as shown in detailed drawings. Thickness of glass panes shall be uniform. The specification of different kinds of glasses shall be as under:

Sheet Glass:

In absence of any specified thickness or weight in the item or detailed specifications of the item of work, sheet glass shall be weighing 7 kg/sq.m. up to 600 mm x 600 mm.

For panes larger than 600 mm x 600 and up to 800 mm x 800 mm the glass weighing not less than 8.75 kg/sq.m. shall be used. For bigger panes up to 900 mm x 900 glass weighing not less than 11. kg/sq.m. shall be used.

Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to I.S. 2835. Sheet glass of the specified colours shall be used, if so shown on detailed drawings or so specified. For important building and for panes with any dimension more than 900 mm plate glass of specified thickness shall be used.

Plate Glass

When plate glass is specified, it shall be "polished patent plate glass" of best quality. It shall have both the surfaces ground flat and parallel and polished to obtain clear undisturbed vision and reflection. The plate glass shall be of the thickness mentioned in the item or as shown in the details drawings or as specified or as directed by the Engineer-in-charge. Tolerance of 0.55 to 0.88 mm shall be admissible.

Obscured Glass

This type of glass transmits lights so that vision is partially or almost completely obscured. Glass shall be plain rolled or double rolled, figured, ribbed or fluted or frosted glass as may be specified or required. The thickness and types of glass shall be as detailed on drawings or as specified or as directed by the Engineer-in-charge.

Wired Glass

Glass shall be with wire netting embedded in a sheet or plate glass Electrically welded 13 mm. Georgian square mesh shall be used. Thickness of glass shall not be less than 6 mm. Wired glass shall be of type and thickness as specified.

MTL-20: Fixtures and Fastenings:

General: The fixtures and fastenings, hinges, tee and strap hinges, sliding door bolts, tower bolts, door latch, bathroom latch, handles, doorstoppers, casement window fasteners, casement stays and ventilators, catch shall be made of the metal as specified in the item or its specifications.

They shall be of iron, brass, aluminium, chromium plated iron, and chromium plated brass, copper, oxidized iron copper, oxidized brass or anodized aluminium, as specified or as directed by the Engineer-in-charge.

The fixtures shall be medium type. The fixtures and fastenings shall be smooth finished and shall be such as will ensure ease of operations.

The samples of fixtures and fastenings shall be got approved as regards quality and shape before providing them in position.

Their sizes shall conform to those prescribed or as directed by engineer-in-charge. In respects of other dimensions not specified, they shall conform to relevant I.S.

Holdfasts

Holdfast shall be made from mild steel flat 50 mm width and minimum 6mm thickness and length based on site of fitting, one end of the holdfast shall be bent at right angle and two nos. holes shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite direction.

Butt Hinges

Medium type iron butt hinges shall be as specified.

Tee and strap hinges shall manufacture from M.S. sheet as specified in the item.

Sliding Door Bolts (Aldrops)

In case of single leaf door, where iron socket plate or brass or aluminium fixing bolt (or sliding door bolt) cannot be fixed. A hole of suitable size shall be drilled in the doorframe and a countersunk plate not less than 1.5 mm thick cut to shape shall be fixed at the face of the hole.

Tower Bolts (Barrel Type)

Mild steel door bolts shall be made in one piece. Knobs of tower bolts shall be cast and knob fixed in the bolt.

Door Latch:

The size of door latch shall be taken as the length of latch.

Door Stoppers:

Doorstoppers shall be either floor doorstopper type or door catch type. Floor doorstopper shall be of overall size as specified and shall have a rubber cushion.

Door Catch:

Door catch shall be fixed at a height of about 900 mm, from the floor level such that one part of the catch is fitted on the inside of the shutter and the other part is fixed in the wall with necessary wooden plug arrangement for appropriate fixity. The catch shall be fixed 20 mm inside the face of the door for easy operation of catch.

Casement window fastener:

Casement window fastener for single leaf window shutter shall be left or right handed as directed.

Casement stays (straight peg stay)

The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully or partially as directed. Size of the stay shall be 50 mm to 300 mm as directed.

Pivot:

The base and socket pivot shall be made from minimum 3 mm thick plate, and projected pivot shall not be less than 10 mm diameter and 12 mm diameter and 12 mm length and shall be firmly riveted to the base plate in case of iron pivot.

MTL-21: Paints:**(a) Oil Paints:**

Oil paints shall be of the specified colour and shade, and approved by the Engineer-in-charge. The ready mixed ISI marked paints shall only be used. However, if it ready mixed paint of specified shade or tint is not available white ready mixed paint with approved strainer will be allowed. In such a case, the contractor shall ensure that the shade of the paint so allowed shall be uniform.

All the paints shall meet with the following general requirements:

- (i) Paints shall not show excessive setting in a freshly opened full can and shall easily be re-dispersed with a paddle to a smooth homogeneous state. The paints shall show no curdling, leveraging, caking or colour separation and shall be free from lumps and skins.
- (ii) The paint as received shall brush easily, possesses good levelling properties and show no running or sagging tendencies.
- (iii) The paint shall not skin within 8 hours in a three quarters filled closed container.
- (iv) The paint shall dry to a smooth uniform finish free from roughness, grit, unevenness and other imperfections.

Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures whatsoever.

(b) Enamel Paints:

The enamel paint shall satisfy in general requirements as mentioned in specifications of oil paints. Enamel paint shall conform to I.S.2993-1975 or its latest revision.

MTL-22: French polish:

The French polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials.

- (i) Denatured spirit of approved quality.
- (ii) Chandras.
- (iii) Shellac.
- (iv) Pigment

The French polish so prepared shall conform to I.S. 348-1968 or its latest revision.

MTL-23: Marble Chips for Marble Mosaic Terrazzo

The marble chips shall be Makrana white or Chittor pink, yellow, green and black Jaisalmer yellow Baroda green, Dehradun white, gray (Surat) and Alwar black or as specified. It shall be hard, sound, dense and homogeneous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains cracks, decay and weathering.

The sizes of various colours of Marble chips ranging from the smallest upto 20 mm shall be used where thickness of top wearing layer in mm size. The marble chips of approved quality and colours only as per grading as decided by the Engineer-in-Charge shall be used for Marble oasis tiles or works.

The marble chips shall be machine crushed. They shall be free from foreign matter, dusts etc. Except as above, the chips shall conform to IS 2114 or as revised from time to time.

MTL-24: Flooring Tiles:

a. Plain Cement Tiles:

The plain cement tiles shall be of general-purpose type. These are the tiles in the manufacture on which no pigments are used.

The tiles shall be manufactured from a mixture of cement and natural aggregates by pressure process. During manufacture the tiles shall be subjected to a pressure of not less than 140 kg/sq.cm. The proportion of cement to aggregate in the backing of the tiles shall be no lesser than 1:3 by weight. The wearing face, though the tiles are of plain cement shall be provided with stone aggregates of 1 to 2 mm size. The proportions of cement to the aggregate in wearing layer of the tiles shall be three parts of cement to one part of chips by weight. The minimum thickness of wearing layer shall be three parts of cement to one part of chips by weight. The minimum thickness of wearing layer shall be 3 mm. The colour and texture of wearing layer shall be uniform throughout its face and thickness. On removal from mould, the tiles shall be kept in moist condition continuously at least for seven days and subsequently if necessary, for such period that would ensure their conformity to requirements of IS 1237 regarding strength resistances to wear and water absorption.

The wearing face of the tiles shall be plain, free from projections depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.

The size of the tiles shall generally be squared shape size 24.85 cm. x 24.85 cm. or 25 cm x 25 cm. The thickness of tiles shall be 20 mm.

Tolerance on length and breadth shall be plus or minus one millimetre. Tolerance on thickness shall be plus 0.5 mm.

The tiles shall satisfy the stress as regards transverse strength, resistance to wear and water absorption as per IS 1237. The contractor shall be carry out necessary tests.

b. Plain Coloured Tiles

These tiles shall have the same specification as per plain cement tiles as per (a) above except they shall have a plain wearing surface wherein pigments are used. They shall conform to IS 1237

The pigment used for colouring cement shall not exceed 10 percent by weight of cement used in the mix. The pigments, synthetic or otherwise used for colouring tiles shall have permanent colour and shall not contain materials detrimental to concrete.

The colour of the tiles shall be as specified in the item or directed by the Engineer-in-charge.

c. Marble Mosaic Tiles:

These tiles shall have the same specifications as per plain cement tiles except the requirements as stated below.

The marble mosaic tiles shall conform to IS 1237. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free from projection, depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.

Chips used in the tiles shall be up to 6 mm sizes. The minimum thickness of wearing layer of tiles shall be 6 mm. For pattern of chips to be had on the wearing ace, few samples (with or without their full size photographs as directed by the Engineer-in-Charge) shall be presented to the Engineer-in-charge for approval.

Any particular samples, if found suitable shall be approved by the Engineer-in-charge, or he may ask for few more samples to be prepared indicating roughly the particular sized chips to be more or less in the sample presented. The samples shall have to be made by the contractor till a suitable sample is finally approved for use in the work. The contractor shall ensure that the tiles supplied for the work shall be in conformity with the approved sample only, in item of its dimensions thickness of backing layer and wearing surface material ingredients, colour, shape chip distribution etc. required.

The tiles shall be prepared from ordinary Portland cement or pozzolona cement or coloured Portland cement generally depending upon the colour or tiles to be used or as directed.

d. Chequered Tiles:

Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per (a) above and the latter as per marble mosaic tiles as per (c) except as mentioned below

The tiles shall be of nominal size of 250 mm x 250 mm or as specified. The centre-to-centre of chequer shall not be less than 25mm and not more than 50 mm. The overall thickness of the tiles shall be 20 mm.

The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain, coloured or mosaic as specified.

(e) Chequered Tiles for Stair Cases:

The requirements of these tiles shall be the same as chequered tiles as per (d) above except in following respects.

1. The length of a tiles including nose shall be 330 mm.
2. The minimum thickness shall be 28 mm.
3. The rising shall have the same wearing layer as at the top.
4. The edge at nose shall be rounded.
5. The front portion of the tiles for a minimum length of 75 mm from and including the nosing shall have grooves running parallel to nosing and at centres not exceeding 25 mm beyond that the tiles shall have normal chequer pattern.

MTL-25: Kota Stone:**(a) Rough Kota Stone:**

The Kota stones shall be hard, even sound and regular in shape and generally uniform in colour. Brown or yellow coloured stones shall not be allowed for use. They shall be without any soft veins, racks or flows.

The sizes of the stones to be used for flooring shall be of size not less than 600 mm x 450 mm preferably 600mmx600mm as directed. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern. Thickness shall be as specified.

(b) Polished Kota Stones:

Polished Kota stone shall have the same specifications as per rough Kota stone as per (a) above except as mentioned below.

Tolerance of minimum 30 mm on account of Chisel dressing of edges shall be permitted for length as well as breadth.

The edges of stones shall be truly chiselled and truly rubbed, with coarse sand before paving. All angles and edges of the stone shall be at right angle and free from chipping and the surface shall be double and plain.

The stone shall have machine polished smooth surface. As brought on site, the stones shall be double polished.

MTL-26: White Washing:

Following materials shall be used for preparing white wash.

- (i) Fresh burn white stone lime or sell lime.
- (ii) Gum-Arabic 2.0 kg/Cmt. of lime.
- (iii) Indigo as required.

It shall conform to relevant I.S. specifications:

MTL-27: Distemper:

Oil bound washable, distemper of approved band and colour and shade shall be used. It shall conform to IS 27. Distemper shall be used according to the manufacturer's instructions only.

MTL-28: White Glazed Tiles:

The tiles shall be of second class quality as approved by the Engineer-in-charge. They shall be flat and true to shape. They shall be free from cracks, crazing, spots, chipped edges and corners. The glazing shall be of uniform shade.

The tiles shall be of nominal size of 150 mm x 150 mm unless otherwise specified. The maximum variation from the started sizes, other than the thickness of tiles, shall be plus or minus 1.5 mm. The thickness of tiles shall be 6 mm. except as above the tiles shall conform to IS 777.

MTL-29: Galvanized Iron Pipes and Fitting:

Galvanized iron pipe shall be of the medium type and of required diameter and shall comply with IS. 1239. The specified diameter of the pipes shall refer to the inside diameter of the bore. Clamps, screws all galvanized Iron fittings shall be of the standard "R" or equivalent make.

MTL-30: Bib Cock and Stop Cock:

A bibcock is a drawn off with a horizontal inlet and free outlet. A stopcock is a valve with a suitable means of connection for insertion in a pipe line for controlling stopping flow.

They shall be of screw down type and of brass chromium plated and of diameter as specified in the description of the item. It shall conform to IS. 781 or a revised from time to time and they shall be of best Indian make. They shall be polished bright.

The minimum finished weight of bib cock and stop cock shall be as given below:

Diameter	Bib cock	Stop cock
8 mm	0.25 Kg.	0.25 Kg.
10 mm	0.30 Kg.	0.35 Kg.
15 mm	0.40 Kg.	0.40 Kg.
20 mm	0.75 Kg.	0.75 Kg.

MTL-31: Gun Metal Wheel Valve

The gun metal wheel valve shall be of approved quality. It shall be of the gun metal fitted with wheel and shall be of gate valve opening full way and of the size as specified. They shall conform to IS. 78.

MTL-32: White Glazed Porcelain Wash Basin:

Washbasin shall be of white porcelain of approved quality best Indian make and it shall conform to IS 771 or as revised from time to time. The size of the washbasin shall be as specified in the item. Washbasin shall be of the one-piece construction with continued over flow arrangements. All internal angles shall be designed so as to facilitate cleaning. Washbasin shall have single tap hole as specified. Each basin shall have a circular waste hole, which is either rebated or bevelled internally with 65 mm diameter at top 10 mm depth to suit the waste fitting. The necessary stud slot to receive the bracket on the under side of the basin shall be provided. Basin shall have an internal soap holder recess which shall fully drain in to the bowl. Necessary waste plug, couplings shall be provided. The pillar cock for washbasin shall conform to IS 1275 or as revised from time to time. The height from the floor to top of the rim of basin shall be 750 to 800 mm as directed.

MTL-33: European Type Water Closet with low level flushing:

The European type water closet with level enamel flushing tank shall be white glazed porcelain second quality and shall be of wash down type conforming to IS 2556 and IS 771 or as revised from time to time.

"S" trap shall be provided as with water seal not less than 50 mm. The solid plastic seat and cover shall be of the best Indian Make conforming to IS 2548 or as revised from time to time. They shall be made of moulded synthetic materials which shall be tough and hard

with high resistance to solvents and shall be free from blisters and other surface defects and shall have chromium plated brass hinges and rubber buffer four number of suitable size Low level enamel flushing tank of 15 liters capacity shall conform to IS 774 or as revised from time to time.

MTL-34: Orissa type water closet:

The specification of Orissa type white glazed water closet of second quality shall be same as per specification of Indian type water closet except than pan will be with integral squatting plate of size 580 x 440 mm with raised footrest.

MTL-35: Indian type water closet:

The Indian type white glazed water closet of second quality shall be of size as specified in the item conforming to IS 771 and IS 2556. Each pan shall have integral flushing ring of suitable type with adequate number of holes all round as directed to have satisfactory flushing. It shall also have an inlet at back or front for connecting flush pipe as directed by the Engineer-in-charge. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and surface shall be uniform and smooth without any eruptions anywhere.

Pan shall be provided with 100 mm diameter "P" or "S" trap with approximately 50 mm water seal and 50 mm diameter Vent horn.

A pair of white glazed earthen ware rectangular foot rests of size as per relevant IS Code.

MTL-36: Cast Iron Pipes and Fittings:

All soil, waste vent and anti siphoning pipes and fittings shall conform to IS 1970 (latest version). The pipes shall have spigot and socket ends with head on spigot end. The pipes and fittings shall be true to shape, smooth, cylindrical, their inner and outer surfaces being a nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully fettled.

The ends, of pipes and fittings shall be reasonable square to their axis.

The sand cast iron pipes shall be of the diameter as specified in the description and shall be in length of 1.5, 1.8 m and 2 m. including socket ends of the pipe unless shorter length are either specified or require at junctions etc. The pipes and fittings shall be supplied without ears unless specified or directed otherwise.

Tolerances:

The standard weights and thickness of pipes shall be as shown in the following table:

A tolerance up to minus 10 percent may however be allowed against these standard weights.

Sr.	Nominal dia. of bore	Thickness	Overall length excluding ears.	Weight	of pipe No.
			1.5 m	1.8 m	2 m
1.	75 mm	5.0 mm	13.83 kg.	16.52 kg.	18.37 kg.
2.	100 mm	5.0 mm	18.14 kg.	21.67 kg.	24.15 kg.

A tolerance upto minus 15 percent in thickness and 20 mm in length will be allowed. For fittings, tolerance in lengths shall be plus 25 mm and minus 10 mm.

The thickness of fittings, and their socket and spigot dimensions shall confirm to the thickness and dimensions specified for the corresponding size of straight pips. The tolerances in weights and thickness shall be the same as for straight pipes.

MTL-37: Nihani Trap:

Nahni trap shall be of cast iron and shall be sound and free from porosity or other defects which effect serviceability .The thickness of the base metal shall be not less than 6.5 mm .The surface shall be smooth and free from craze, ships and other flaws or any other kind of defect which affect serviceability. The size of nahni trap shall be as specified and shall be of self-cleaning design.

The nahni trap shall be of quality approved by the Engineer-in-charge and shall generally confirm to the relevant Indian Standards.

The nahni trap provided shall be with deep seal, minimum 50 mm, except at places where trap with deep seal cannot be accommodated. The cover shall be provided on the trap of appropriate size.

MTL-38: Gully Trap:

Gully trap shall conform to IS-651.It shall be sound free from defect such as fire cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear noise when struck with light hammer. There shall be no broken blisters.

The size of gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have water tight C.I. cover with frame inside dimension 300x300mm, the cover with frame inside dimension 300mmx300mm; the cover weighing not less than 4.53kg. and the frame not less than 2.72kg.The grating cover and frame shall be of sound and good casting and shall have truly square machine seating faces.

MTL-39: G.I. Specials:

The G.I. Pipes of 20 mm dia. shall be medium quality and specials shall be of "R" Brand or equivalent brand of best-approved quality.

The pipes shall have length as required for the thickness of wall in which it is fixed, and at the outside end one tee and bend cut at half the length shall be provided and at other end coupling shall be provided to have better fixing.

MTL-40: Asbestos Cement Pipe (A.C. Pipe):

The asbestos cement pipe of diameter s specified in the description of the item shall conform to IS 1626, or as revised from time to time. Specials like bend, shoes, cowls, etc. shall conform to relevant I.S. The interior of pipe shall have a smooth finish, regular surface and regular internal diameter. It shall be straight within tolerance limit.

MTL-41: Selected Earth:

MTL-42: Rolling shutters:

The rolling steel shutter shall be of approved make and design and shall be suitable for fixing in position as directed by the Engineer-in-charge.

The shutter shall be built up of interlocking lathe section formed from cold rolled strips. The size of different component shall be as per IS 6248.

The cold rolled steel strip shall be rolling shutter lathe section conforming to IS 4030

The self-rolling type rolling shutter shall be raised or lowered manually by means of a pulling applied to the pulling handle. Fixed on the bottom lock plate. The length of pulling hook shall be adequate to push the bottom lock plate to the topmost position with ease.

The thickness of steel sheets from which the lathe sections have been rolled shall be not less than 0.9 mm for shutter up to 3.5 mm width and not less than 1 mm for shutter above 3.5 m. width.

The lathe section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm. Each lathe section shall be continuous single place without any welded points.

The depth and width of guide channel shall be as under:

Clear width of shutter
Upto 3.5 m

Min. depth of guide channel
65 mm

3.5 to 8 m	75 mm
8 M and above	100 mm

Width of guide channel shall be 25 mm for lathe section with bridge depth of about 12 mm and 32 mm for lathe section with bridge depth of about 16 mm. Size of bracket plate for different height of different rolling shutter shall be as follows:

Clear height Mt.	Size of Bracket plate minimum mm x mm x mm
Upto 2.3	300 x 300 x 3.15
Above 2.3 & upto 2.6 mt.	325 x 325 x 3.15
Above 2.6 & upto 3.00	350 x 350 x 3.15
Above 3.0 & up to 3.5	375 x 375 x 3.15
Above 3.5 & upto 4.5	400 x 400 x 6.00
Above 4.5 & upto .5.5	450 x 40 x 6.00
Above 5.5 & upto 6.5	500 x 500 x 10.00

Size of shat pipe shall be as given below:

Width	Size of pipe
Upto 2.0	32 mm nominal bore
Upto 3.0 m	40 mm nominal bore
Upto 6.0 m	50 mm nominal bore.

Hood cover shall be made of mild steel not less than 0.9 mm thick.

MTL-43: Urinal:

Urinal shall be of 2nd class quality white porcelain of approved quality, best Indian make and it shall conform to IS 1556 with suitable size of side collar for fixing in position. The size of urinal shall be as specified in the item. Urinal shall be of one piece construction. All internal angles shall be designed so as to facilitate cleaning. Urinal shall have single tape hole as specified. Urinal shall have a circular waste hole which is 65 mm dia and 100 mm deep to suit the waste fitting.

Necessary C.P. brass stop cock with PVC connection of specified size shall conform to IS 78. Necessary PVC reducer with PVC waste pipe of 25 mm dia shall be designed to make height from the floor to the top of the rim of the urinal 550 to 00 mm as directed.

MTL-44: Galvanized Iron sheet:

The galvanized iron sheet shall be plain or corrugated as specified in item. The G.I. sheet shall conform to IS-277-1985. The sheet shall be undamaged in carriage and handling either

by rubbing of zinc coating or otherwise they shall have clean and bright surface and shall be free from dents, holes and rust or white powder deposit.

The length and width of G.I. sheet shall be as directed as per site condition.

MTL-45: Steel Windows and Ventilators:

Steel used in the manufacture of rolled steel section shall conform to IS 1977

The dimension of rolled steel sections viz. E7, T6, F4B, F4B, F7B, etc. shall conform to IS 1038, subject to tolerance and weight per running meter as under :

Section	Wt/metre in kg.
E27	1.92 kg/m
1	08.8
F4B	2.08
F7B`	1.532

Rolling tolerance on length and breadth + 0.4 mm and thickness 0.2 mm, shall be allowed. (Measurement given to the nearest 0.1 mm).

The rolled steel section shall be free from rolling defects and shall be suitable for punching and welding.

Screw threads of machine screws used in the manufacture of steel windows and ventilator shall conform to the requirement of IS 1362.

Fixing lugs shall have a standard slot 8 mm, wide for MS SCREW OF 6 mm dia and 12 mm long with square nuts, as indicted in IS 1038. Total 4 Nos. of lugs of size 3 x 16 x 15 mm for each window shall be provided.

Both fixed and opening frames shall be constructed of sections, which have been cut to length and width. The corners of fixed and open in frames shall be smooth welded to form a solid and true right angle and all frames shall be square and flat.

Casement shall be fitted to their frames so as to provide continuous contact for weathering on the inside and outside and shall be secured in closed position by the fittings, which shall have been properly checked and adjusted.

For fixing steel things, slots shall be cut in the fixed frame and the hinge inserted inside and welded to the frame. The hinges shall be normally of the projected type and not less than 65 mm. and not more than 75 mm. The hinge pin shall be of electro-galvanized steel or aluminium alloy 51 S-WP of suitable thickness.

The handle for side-hung shutter shall be of steel projected against rusting and shall be mounted on steel handle plate. The handle plate shall be welded to the opening frame in

such a manner that it could fixed before the shutter is glazed and may not be easily removed after glazing.

MTL-46: Mild Steel frame for door:

Steel used in the manufacture of rolled steel section shall conform to IS 1977.

The dimensions of rolled Section viz. angle EZ7 etc. shall conform to IS 108 subject to tolerance and weight per running meter as under:.

Section	Wt /M in kg.
Angle 40 x 40 x 5 m	3.90
EZ-7	1.92

Rolling tolerance on length and breadth ± 0.4 mm and thickness ± 0.2 mm shall be allowed (Measurement of the nearest 0.1 mm).

The rolled steel section shall be free from soling defects and shall be suitable for punching and welding.

Screw threads of machine screws used in the manufacture of steel doors shall conform to the requirement of IS 1362.

Fixing lugs shall have a standard slot of mm wide of M.S. Screw of 6 mm dia and 12 mm long with square nuts as indicated in IS 1038. Total nos. of lugs of size 3 x 16 x 150 mm for each door frame shall be provided.

Frame shall be constructed of sections, which have been cut to length and width. The corner of frame shall be smooth welded to form a solid and true right angle. The welding shall conform to IS 2751.

Three nos. of hinges 100 mm long for single leaf shutter and six nos. of hinges 100 mm long shall be welded to frame for double leaf shutter. The suitable pieces shall be welded for the locking arrangement such as door latches and sliding door bolts etc. The frame shall be applied with one coat of anticorrosive paints after fabricating the same.

MTL-47: Rubble for Stone Masonry:

The common types of natural building stones, which generally used are granite and other indigenous rocks, limestone, sand stone etc. For the properties of these stones reference may made to IS. 123.

The stone used for building purposes shall be strong, hard and durable. The stone shall be free from defects like cavities, cracks, flaws, sand holes, veins, patches of soft or lose materials etc. The percentage of water absorption shall generally not exceed 5 percent.

Generally the stone should not contain crystalline silica or chert, mica or any other deleterious material like iron oxide, organic impurities etc.

The strength of building stone should be adequate to carry the anticipated loads.

For coarse and uncoarse rubble masonry the strength shall conform to IS 1905 and shall be given below:

Crushing strength of stones.

Sr. No.	Type of stone	minimum crushing Strength in kg/cm ²
i.	Basalt	400
ii.	Limestone (Except very soft stone)	200
iii.	Sand stone	300
iv.	Laterite	30

For random rubble masonry, the strength value shall be specified on the basis of local experience. If tool marked are visible and the edges and corners are still sharp and the surface is hard and shows no signs of deterioration the stone is durable.

Normally, stones used in rubble masonry should be small enough to be lifted and placed by hand. The length of the stone shall not exceed three times the height and breadth and base shall not be greater than three fourth or the thickness of wall not less than 1 cm. The height of stone for rubble masonry may be up to 30 cm.

MTL-48: Stone Pitching/Revetment on Slopes

Description

This work shall consist of covering the slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer or granular material called filter. While river side slopes are given this protection against river action, the rear slopes, not subjected to direct attack of the river, may be protected against ordinary wave splashing by 0.3-0.6 metre thick cover of clayey or silty earth and turfed.

Pitched

The pitching shall be provided as indicated in the Drawings. The thickness and the shape of stone pitching shall be shown on the Drawing.

The stone shall be sound, hard, durable and fairly regular in shape. Quarry stone should be used. Round boulders shall not be allowed. The stones subject to marked deterioration by water or weather shall not be accepted.

The size and weight of stone shall conform to **Clause 5.3.5.1 of IRC: 89**. No stone, weighing less than 40 kg shall, however, be used. The sizes of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching.

Where the required size stones are not economically available cement concrete block in M15 grade conforming to relevant IS or stones in wire crates may be used in place of isolated stones of equivalent weight. Cement concrete blocks will be preferred wherever practicable.

Filter Media

The material for the filter shall consist of sand, gravel, stone or coarse sand. To prevent escape of the embankment material through the voids the stone pitching/ cement concrete blocks as well as to allow free movement of water without creating any uplift head on the pitching, one or more layers of graded materials, commonly known as a filter media, shall be provided underneath the pitching.

The gradation of the filter material shall satisfy the following requirements:

Provision of a suitably designed filter is necessary under the slope pitching to prevent the escape of underlying embankment material through the voids of stone pitching/ cement concrete blocks when subjected to the attack of flowing water and wave action, etc. In order to achieve this requirement, the filter may be provided in one or more layers satisfying the following criteria:

- Ratio of D 15 (Filter) to D85 (Base) shall be less than 5;
 - Ratio of D 15 (Filter) to D15 (Base) shall be within the limits of 4 and 20;
- and
- Ratio of D 15 (Filter) to D85 (Base) shall be less than 25.

Notes:

1. *Filter design may not be required if embankment consists of CH and Ch soils with liquid with greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching.*
2. *In the foregoing, D 15 means the size of that sieve which allows 15 per cent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85.*
3. *If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as a base material for selection of coarser filter.*
4. *The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm.. Where filter is provided in two layers, thickness of each layer shall be 150 mm.*

Construction Operations

Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 meters to ensure regular straight work and a uniform slope throughout. Depressions shall be filled and thoroughly compacted.

The filter granular material shall be laid over the prepared base and suitably compacted to the thickness specified on the Drawings.

The lowest course of pitching shall be started from the toe wall and built-up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to relevant IS code, in case of dry rubble pitching and shall be in nominal mix cement concrete (M 15) in case of cement concrete block pitching.

The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the Drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.

When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing.

When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals and all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

Toe Protection

In conformity with **Clause 5.3.7 of IRC: 89**, a toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to protect the slope pitching from falling even when the apron is not laid at low water level. The toe wall shall be in dry rubble masonry (uncoursed) conforming to relevant IS in case of dry rubble pitching or pitching/ revetment with stones in wire crates and in nominal mix cement concrete (M 15) in case cement concrete blocks have been used in pitching. For protection of toes of bank slopes terminating either in short aprons at bed levels or anchored in flooring/rocky bed, the provisions of **Clause 8.2.2 of IRC: 89** may be complied with. The relevant Specifications of the protective works for individual components will be followed.

MTL-49: Under-Rim Piles for Piles Foundation:

Cement used in concrete pile shall be ordinary Portland cement conforming to IS 269 or where requirements specially demand rapid hardening cement conforming to IS 455.

Steel reinforcement shall conform to IS 226, IS 432, IS 1139 or IS 1786. Sand shall conform to MTL-3.

Coarse aggregate shall conform to MTL-5.

Water shall conform to MTL-1.

MTL-50: Glaze Stone Ware Pipe and Fitting

The pipes and fittings shall be of best quality as approved by the Engineer-in-charge. The pipe shall be of best quality manufactured from stoneware of fire clay, salt glazed thoroughly burnt through the whole thickness, of a close even texture, free from air blows, fire blisters, crack and other imperfections, which effect the serviceability. The inner and outer surfaces shall be smooth and perfectly glazed. The pipe shall be capable to withstand pressure of 1.5m lead without showing sign of leakage. The thickness of the wall shall not be less than $1/12^{\text{th}}$ of the internal dia. The depth of socket shall not be less than 38mm. The socket shall be sufficiently large to allow a joint of 1 mm around the pipe.

The pipes shall generally conform to relevant IS 651.

CHAPTER II GENERAL SPECIFICATION OF WORKS

A. CIVIL WORKSGENERAL:

- (1) The method of the 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 is applicable.
- (2) Wherever a reference to any Indian Standard appears in the code, it shall be taken to mean as a reference to the latest version of the Standard.
- (3) Work Tests shall invariably be got carried out by the Contractor, when the same are specified in this Code. Tests shall also have to be carried out, even though the same may not have been specifically mentioned in the Code, if in the opinion of the Engineer-in-charge, they are required to be carried out. All the tests shall be got carried out in Government or approved laboratories and cost there of shall be entirely borne by the Contractor.

All moulds, equipments, etc. required of preparing specimens for tests 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 be, sent to the Laboratory along with the representative of the Engineer-in-charge and the copy of the test certificates shall be submitted to the engineer-in-charge or the laboratory concerned should be instructed to directly send the test certificates to the engineer-in-charge.

- (4) Satisfactory test results shall not absolve the Contractor, from dismantling and re-doing any work revealed to be 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.
- (5) The work shall be carried out in true line and level, and in conformity with the detailed drawings and specified patterns.
- (6) All work shall be carried out in a workman-like manner and as per the best techniques for the particular item.

- (7) All tools, templates, 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 site of work.
- (8) All installations pertaining to water supply, fixtures as well as drainage lines and sanitary fittings shall be deemed to be complete only after giving satisfactory test by the Contractors.
- (9) Scaffolding shall be provided by the Contractor at his own cost for such of the items for the execution of which it is essential.

CW-1 Site Clearance & Excavation:

General :

In all sorts of soil, sand, gravel, soft murrum and other similar soft or loose material.

Clearing the site :

The site on which the structure is to be built shall be cleared and all obstructions loose stones, materials and rubbish of all kind, bush, wood and trees shall be removed as directed. The materials so obtained shall be the property of the owner and shall be removed from site or disposed as per directions of the Engineer-in-charge.

Setting Out :

After clearing the site the centrelines will be given by the Engineer-in-charge. 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 benchmarks and shall maintain them as long as required.

Excavation:

It shall be all sorts of soil, sand gravel, soft murrum or other similar sort of loose materials or it can be in soft, medium or hard rock..

(a) Ordinary alluvial soil: The excavation will generally refer to the open excavation or foundation

The excavation 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 as directed by the Engineer-in-charge. The contractor shall do the necessary shorting and strutting or slopes to a safe angle, 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 levelled 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 lifts.

(b) Excavation in Hard murrum:

Same as W-1 (a) except that the excavation shall be in hard murrum.

© Excavation in Hard murrum and boulders:

Same as W-1 (a) except that the excavation shall be in hard murrum and boulders.

(d) Excavation in soft rock:

Same as W-1 (a) except that the excavation shall be in soft rock.

(e) Excavation in Hard rock:

Same as W-1 (a) except that the excavation shall be in Hard Rock.

CW-2: Landscaping

Land scaping involves beatification of sites of works by cultivating Lands, Plants and Trees of environmental value and suitably modifying the appearance of the site. It shall add scenic value to the site and to obtain maximum visual impact.

Contractor has to develop proper Landscaping on all the sites where a particular land has been acquired and a compound is required to be developed like places of pumping stations, Sewage Treatment Plant, Solid Waste Landfill Site etc.

CW-3 Plain Cement Concrete/Lean 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 aggregate 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 size 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 1.50 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 arrangements and ladders etc. required for the facility of concrete shall be provided by the contractor and removed on completion of work. The scaffolding hoisting, arrangements and ladders shall allow easy approach to the work and afford easy inspection.

Formwork:

The formwork shall be provided if necessary as directed by the Engineer-in-charge and shall be as per IS 451 or revised from time to time.

Transporting and 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.

Compacting

The concrete shall be thoroughly compacted by hammers or by vibrators if required 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 ponding for a period of not less than 7 days from the date of placement.

CW-4: Filling in Plinth with selected Materials:

The code provides for filling in plinth with selected materials, laying 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, bushes roots of trees etc.

The approved selected materials shall be cleared of all rubbish, large size stones etc. clods broken down to a size of 50 mm or less and conveyed to size of work of filling. The material shall be laid and layers of about 200 mm as directed by the Engineer-in-charge. Each layer shall be watered and compacted with heavy rammers 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 no be endanger the foundation columns, plinth walls, etc. already built up. Under no circumstances, black cotton soil shall be used for filling the plinth.

CW-5 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 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 200 mm as directed by the Engineer-in-charge. Each layers shall be watered and compacted with heavy rammers before 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

CW-6 Ordinary Cement Concrete Plain or Reinforced:

Cement Mortar:

Cement: Cement shall conform to specification mentioned in MTL-2

Water: The water shall conform to specification mentioned in MTL-1.

Sand: The sand shall conform to specification mentioned in MTL-3.

Proportion of Mix: Cement and sand shall be mixed to specified proportion. Sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50 kg./bag of cement being equal to 35 liters or 0.032 cu.m. The mortar may be hand mixed or machine mixed as directed by the Engineer-in-charge.

Preparation of Mortar:

In hand mixed mortar, cement and sand in the specified proportion shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour, so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio may be adopted as directed by the Engineer-in-charge.

The mortar so prepared shall be used within 30 minuets of adding water. Only such quality of mortar shall be prepared as can be used within 30 minutes. The mortar remaining unused after that period or mortar which has partially hardened or damaged shall not be re-tempered or remixed. It shall be destroyed or thrown away.

I.S.456 or as revised from time to time shall be followed in general. Cement sand by black/blue 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 than 1.5 minutes.

When hand mixing is permitted by the Engineer-in-charge in case of small work or in case of breakdown of machineries and in the interest of the work it shall be carried out on watertight 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 places of mixing to the final position as quickly as practicable by methods which will prevent segregation or loss of ingredients. In one case operation shall take 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 commences. Method of placing shall be such as to avoid segregation, approved by the Engineer-in-charge.

Concreting shall be carried out continuously upto construction joints, the position and the designer shall predetermine the arrangement of which.

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 cement slurry.

When the concrete has not fully hardened, all laitance shall be removed by scrapping the wet surface with wire brushes, 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 slurry. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness and shall be well compacted against old work. Particular attention being paid to 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 formwork. Compaction 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 ponding and kept constantly wet for twenty-one days from the date of placing concrete. Curing by ponding shall preferably be done by erecting suitable dykes of sand or soil.

Form work:

General:

The formwork 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. The contractor shall make adequate arrangements to safeguard against any settlement of the formwork during the course of concreting and after concreting. The design of the formwork & the centring shall be got approved from Engineer-in-charge before erection.

Cleaning and Treatment of Forms:

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 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 an vertical side Beams.	24 to 48 hours as maybe decided by the Engineer-in-charge.
(b)	Side of slabs	3 days.
(c)	Beam soffits.	7 days.
(d)	Removal of props to slabs. (i) Slabs spanning upto 4.5 M (ii) Spanning over 4.5 M	7 days.

		14 days.
(e)	Removal of props to beams and arches.	
	(i) Spanning upto 6 M.	14 days.
	(ii) Spanning over 5 M.	21 days.

Procedure when removing the formwork:

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

Centring:

The centring to be provided shall be got approved from the Engineer-in-charge. It shall be sufficiently strong to ensure absolute safety of the formwork and concrete work before, during and after pouring concrete. Watch should be kept to see that behaviour of centring 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 centring shall be provided on firm foundation or base of sufficient strength to carry the loads without settlement.

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

Scaffolding:

All scaffolding, hoisting arrangement and ladders 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 arrangements 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 workman etc.

The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.

CW-7 Controlled concrete:**Grade:**

The concrete shall be designated as M-100, M-150, M-200, M-250, M-300, M-350 and M-400 prescribed in IS 456 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 materials at site of work. Field tests for determining the contents 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 tests shall be maintained till the completion of the work.

Obtaining the fine and coarse aggregate in different size and blending them in right proportions as per the design for the different sizes being stocked in separate stockpiles shall control the grading of aggregate. 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 dosing the mix for different grades of concrete required in the work, submit details in respect of proportion of cement and aggregates water cement ratio 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 of aggregates by weight per 50kg. of cement shall not exceed 450 kg. Except where otherwise specifically permitted by the Engineer-in-charge.

Batching and Mixing:

Concrete materials shall be batched by weight, where combined batching and mixing plants are not available, weight batches of adequate capacity shall be used for weighing of aggregates and cement. In the later case the contractor shall have additional weight batches as stand by. The contractor shall use power driven mechanical concrete mixers of adequate capacity in conjunction with weight batches.

Dry weights per unit volume of fine and coarse aggregate shall be determined by experiments. Water shall be either measured by volume in calibrated tanks or weighed.

Whereas cement will be issued in bags and twenty bags will be treated to weight one tone. Cement shall be actually weighed during batching and any difference in standard weight and actual weight of cement shall be contractor's account and no extra payment shall be made for such a difference.

Water cement ratio:

It is most important to maintain the water cement ratio at its correct value. To this end, determination of moisture content in both fine and coarse aggregate shall be made as frequently as possible the frequency for a given job being determined by the Engineer-in-charge according to weather and site conditions. The amount of the added water shall be adjusted to compensate for any observed variations in the moisture contents. Determination of moisture contents in aggregate shall be done as per IS 2386 Methods or test for aggregate for concrete part: III (Specific gravity, density, absorption and bulking). To allow for the variation in weight of aggregate due to variation in the moisture contents, suitable adjustments in the weight of aggregates shall also be done.

No substitution in materials used on the work or alterations in the established proportions except as permitted in the previous paragraph is made without additional tests to show that quality and strength are satisfactory. Work ability of the concrete shall be checked at frequent intervals by the slump test.

CW-8: Sampling & Testing of Concrete:

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

Table 1: No. of samples required for strength test

Qty. of work in M ³	Nos. of samples.
1-5	1
6-15	2
16-30	3
31-50	4
51 & above.	4+1 for each additional qty. of 50 M ³ or part there of.

The contractor shall make his own arrangement for taking samples and testing of the sample in the Government or the approved laboratories. The tests shall be carried out in accordance with I.S.516-1959 or as revised from time to time. A register of cubes shall be maintained at the site of works in the prescribed proforma. The contractor shall submit the results of the cubes to the Engineer-in-charge.

- Note: 1. At least three samples shall be taken from each shift.
 2. Each sample consists of three test specimens for testing one at 7 day and two at 28 days.

Additional cubes may be required for various purposes such as to determine the strength of concrete at the time of striking the formwork 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 1:2 (1 cement: 2 sand).

The minimum number of specimen for preliminary test and criteria for acceptance of test strength shall confirm to table V. Acceptance criteria for concrete of IS 456.

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 dosing shall be maintained as part of record of the contract.

Strength requirements of concretes:

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

Table2 Required Cube Strength for different grades of concrete

Grade of Concrete	Compressive strength of 15 cms cubes conducted in accordance with IS 516	
	At 28 days After mixing in Preliminary test. (kg./cm ²)	At 7 days after mixing In work test (Kg./cm ²)
		At 28 days after mixing in works test. (Kg./cm ²)

1.	2.	3.	4.
M 10	135	70	100
M 15	200	100	150
M 20	260	135	200
M 25	320	170	250
M 30	380	200	300
M 35	440	235	350
M 40	500	270	400

Compression test: (Work test)

The tests shall be carried out in accordance with IS 516. A register of cubes shall be maintained at the site of work. The cost of casting of cubes, concrete used for cubes and all other incidental charges such as curing, and cost of testing, carriage to the testing laboratories etc. shall be borne by the contractor. The testing shall be got carried by the contractor in Government or any other approved laboratory at his own cost.

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 strength of concrete at 7 days or at the time of striking the formwork or to determine the duration of curing or to check the testing error.

When defective or rejected work can not be replaced because of operational or other reasons (decision of the Engineer-in-charge in this respect shall be final and binding on) payment shall be made for such rejected work but cost of dismantling and removal shall be recovered from the contractor when such defective work is subsequently replaced by the Corporation or not. The decision of Engineer-in-charge shall be final and regards the cost of dismantling and removal.

Consumption of cement:

Co-efficient for cement consumptions shall be determined by the Engineer-in-charge for various mixes based on the accepted proportion for these mixes. The theoretical qty. of cement to be used for the works shall be calculated on the basis of these co-efficient.

As regards formwork, curing, stripping time, centring etc. not covered here shall be as per W-3 ordinary cement concrete for RCC.

CW-9: Form work & its effect on texture of concrete

Concrete surface, which are to be “form finish”, shall be cast in an approved formwork and shall be free from honeycombing, fins, projections and air holes. All external angles to form finish concrete surfaces shall be charm good 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 formwork boards, the disposition of construction of joints and lifts, the incorporation of recessed, the contractor for its proper implementation shall carefully study raised joints.

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 latter shall be appropriately incorporated 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 samples of shuttering to the approval of the Engineer in-charge.

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

- a. Design, workmanship in fixing of formwork,
- b. Control of concrete ingredients, mixing and placing.
- c. Adequate technical supervision of all processes involved.

Listed below are some formwork 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. This board 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.

(iii) Steel Mould Surface:

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

This type of formwork is to be entrusted to a skilled and specialized manufacturer who has produced satisfactorily similar formwork and who must be approved by the Engineer-in-charge.

In all types of formwork to form finished exposed concrete, only non-staining mould oil supplied by an approved manufacturer will be used.

The repetitive usage of the same form work to cast form finished exposed concrete shall be as decided by the Engineer-in-charge and in no case the 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 formwork is removed will generally be without any blemish and will be such as will not require touch up. Slight touch up for a small work or two, if necessary, shall be carried out immediately on removal of formwork by 1:1 proportions. Expert masons on removal of formwork with entire surface shall carry this out.

CW-10 Fabricating and Placing Reinforcement in Position:

Fabrication:

The reinforcement bars shall be cut to the 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 its latest revision. 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 drawings 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 1.22 mm or 1.3 mm dia. (1 or 18 gauge) Spot welding instead of tying bars 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 safeguards. 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 concreting shall be done 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 complete.

CW-11 Fixing Expansion Joints:

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

- (1) For the joints between twin internal beams of R.C.C. frame structure, copper strip of 1. mm thickness and width and shape as shown in the detailed drawing shall be placed near the bottom in the first beam such that one leg of the specified width is embedded in the beam and U fold (of 80 mm 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 joining member, pre-moulded bitumen joint filler of 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. .5 mm thick fixed to one seat with copper screws to the wood block embedded in the concrete as shown in the detailed drawings.

- (3) For the joints between twin internal or external columns, while casting the first column, a leg of each of the copper strips of 1.5 mm 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 drawings. Before casting the second column, pre-moulded bituminous joint filter shall be placed against the face of the first column all along between the two strips as directed by the Engineer-in-charge.

CW-12 Brick Masonry Work:

Classification of brickwork:

The brickwork shall be classified as first sort or second sort according as first class or second-class brick respectively 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 cessation of bubbles, when the bricks are wetted with the water, is 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 trowel or wooden mallet. Its inside face shall be flushed with mortar, before the next brick is laid and pressed against it. On completion of course, the vertical joint 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 frogs upwards. A set or tools comprising of wooden straight edge, masons spirit level square half meter rub, and sting and plumber shall be kept on the site of work for frequent checking during the progress of work.

Both the faces of walls of thickness greater than 23 cms shall be kept in proper place. All the connected brickwork shall be carried up nearly at one level and no portion of the work shall be left more than one meter below the rest of the work. Where this work is not possible, the work shall be racked back according to the 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 still green so as to provide key for plaster or pointing to be done.

The face of brickwork shall be cleaned on the same day the brickwork is laid and all 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. Tee top of masonry work shall be kept well wetted at the close o the day.

Scaffolding:

The supports or scaffolding shall be sound and strong tide 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 hole header course only. Only one header 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.

W-13: Brick Masonry Partition Walls:

(a) The partition walls shall be half brick. All the bricks shall be laid stretcher wise, breaking joints with those in the upper and lower courses. The wall shall be taken truly plumb. 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 into brick work while laying only and at the correct levels and positions. Holes of required size and shapes shall be left in the brick work for fixing pipes, or service lines, etc. After service line etc. are fixed, the extra hollow left in the hole shall be filled with 1:3 cement mortar or 1:6 cement concrete. A set of mason's tools shall be bonded into the sidewalls where necessary joints, curing and scaffolding shall be as per w-8 of specifications of work.

(c) Two mild steel reinforcement bars of 6 mm diameter shall be used longitudinally at every fourth course of the brickwork. The first reinforcement shall be placed on the top of bottom most course where reinforcement is placed shall admit the mortar cover of at least 5 mm thickness of the reinforcement.

CW-14: Application of Cement Plaster Finish:

Preparatory Work :

Smooth surface of concrete shall be suitable roughed to provide necessary bond. All dirt, soot, oil, or any other material that might interfere with satisfactory be shall be removed The surface shall be cleaned and scrubbed with fresh water and kept wet for six hours prior to plastering. It shall be kept damp during the progress of the work.

Gauge :

Patches of plaster 150 mm x 150 mm shall be put on about three meters apart as gauge 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 levelled with a flat wooden rule to given 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 rounded 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 masonry surface firmly when set and there shall be no hollow when struck. Cement plastering shall be done in squares of strips as directed. Plastering shall b done form top down-wards. All exposed angles and junctions with doorframes etc. shall be carefully finished.

(B) Finishing : Coat Not for sheds.

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 face of a wall, finishing treatment should be carried out continuously and day-to-day breaks mode to coincide with architectural breaks in order to avoid unsightly junctions.

Scraping and washing at the end of each day's work shall clean all tools and accessories used in plaster works after use. Metal tools shall be cleaned after operation.

Watering & Curing :

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

CW-15 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 specification no.W-14 above. Except that while preparing the cement mortar, the approved water proofing compound at the rate of 1 kg/ 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 materials shall be mixed in dry cement and sufficient care shall be taken while mixing to see that the water proofing material gets integrally mixed with the cement and does not run out separately when water is added.

CW-16 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 12 mm apart and about 3 mm deep when the mortar is still plastic.

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 proportion and thickness. The coat shall be applied evenly true line and level by using approved quality of coarse and the surface shall be finished with a wooden float. The necessarily 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.

CW-17 White washing or colour washing:

White Wash :

Lime shall be dissolved with sufficient quantity of water (about 4 to 5 litres per kg. of Lime) thoroughly mixed and stirred to attain consistency within screen. The wash shall be strained through a clean coarse cloth. Clean colour dissolved in hot water shall then 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 wire on fibre brush or any

other suitable means as directed by 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 to left to right. Each coat must be allowed to dry before the next coat is applied. Appropriate number of such coats as specified shall be 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 to the white wash, which has been strained and prepared as above. Other provisions as mentioned in white wash shall apply for colour wash.

CW-18 Laying and Fixing Galvanized iron Pips with Fittings

Excavation:

The trench for laying the pipes shall be excavated true to lines and levels 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 damage 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 and fixing :

The complete lay out of the water supply system shall be got approved from the Engineer-in-charge. The pipes shall be laid plumb, and in straight and paralleled lines disposed otherwise. In making the joints few turns of the fine hemp smeared with white zinc shall be taken over the threaded end of the pipes and the socket shall be fastened with 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 meter or as directed.

Wherever, 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 asphalt if required by the Engineer-in-charge.

Testing:

On completion of laying the pipeline 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.

CW-19. Doors, windows, and ventilators teak wood panelled Glazed or partly panelled and partly glazed.

Frames:

All members of frames shall be exactly at right angle. The 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 surfaces well planed on the three sides exposed at right angles to each other. The surfaces touching the wall may not be planed unless it is required in order to straighten up the member or to obtain the overall sizes within tolerances 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 100 mm. On upper floors the vertical posts shall be fixed in the floor by forming notches 10 mm deep slight adjustment of spacing as necessary shall be done to have the holdfasts in the joints of masonry course. The frame shall be erected in position and held plumb with strong supports from both sides and built in masonry

as it is being built. The transom shall be through tenoned into the mortises of the jamb post to the full width of the jamb post and the thickness of tenon shall be not less than 15mm. The tendons shall be closely fitted into the mortises and suitably pinned with wood dowels not less than 10mm diameter. The depth of rebate for housing the shutter shall be as shown in the detailed drawings or as directed by the Engineer-in-charge.

The contact surface of tenon and mortise 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 face shall be properly treated by applying a coat of approved primer. Coal tar shall not be used for this purpose.

Shutter:

Panelled shutters shall be constructed in the form of timber framework of style 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 style and rails shall be jointed to each other by mortise and tenon joint at right angles.

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

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

CW-20 Fixing of steel Window/Ventilators:

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

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.

CW-21: Fixing of Steel Rolling Shutter :

Fixing or rolling shutter shall be done in a workman like manner so that the operation of the shutter is easy and smooth. The hold fast shall be embedded in C.C. 1:2:4 (2 cement: coarse sand. 4 graded stone aggregate 20 mm nominal size) and shall be properly fixed with 100 mm long catch bolts o 10 mm. Al 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 or fixing.

The bracket plate shall be fitted at the center. U shaped 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 shear force and it shall be held in position rigidly by means of suitable foundation bolts.

When the bracket is to be fixed on concrete the angle is suitably bent and fixed to the concrete beam or lintel with anchor bolts of at least 16 x 75 mm size. The pipes of the suspension shaft, which are clamped to the bracket, shall be fitted with rotatable cast iron pulleys to which the curtain is attached. The spring to counterbalance 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 anticorrosive paint as directed by Engineer-in-charge.

CW-22 Construction of Rubble Stone Masonry:

Pucca approved stone of approved size for rubble masonry shall be collected on site. The rubble shall be laid on broad faces. Earthy or discoloured weathered of water worn 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 or 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 neighbouring stone. The bushing on the face shall not be more than 40 m on a exposed face.

Chips and spalls of stone shall be used wherever necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are

left any where in the masonry. The chips shall not be used below hearing stones to bring these up to the level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones inhering and these shall not exceed 20 percent of the quantity of a stone masonry.

The hearing or interior filling of a wall face shall consist of rubble stone not less than 150 mm in any direction carefully laid hammered down with a wooden mallet in the position and solidly bedded in mortar. The hearing should be laid nearly level 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 $\frac{2}{3}$ in the wall. Each bond stone shall be provided for every $0.5M^2$ of the wall surface.

Quoin stone shall not less than $0.03M^3$ in volume. The plum stone at about 90 cm interval is 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 extended and bond well in the back. These shall be arranged to break joins as much as possible and to avoid long vertical lines of joints.

The cement mortar of proportion as specified in the item shall be spread over width and the tone shall be well embedded in it. Joints in the surface shall be flush or raked cut 25 mm deep during construction as directed. The work shall be carried out in line, level plump and of dimension as mentioned in the drawing. Te 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.

SEWERAGE WORKS

CW-23 REINFORCED CEMENT CONCRETE PIPES

Scope

This specification covers the requirements for manufacturing, testing, supplying, jointing and testing at work sites of Reinforced Cement Concrete (RCC) pipes, of both pressure and non pressure varieties used for pumping mains, sewers and storm water drains. Lying of pipes and fittings

/ specials is covered as shown below. Data Sheet – A covers the specific requirements for the project. The two parts are complementary and are to be read together for a correct interpretation of the provisions of this specification. Where the requirements of the two sections conflict, those of Data Sheet - A shall govern.

Applicable codes

The manufacturing, testing, supplying, jointing and testing at work sites of RCC pipes shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of this specification conflict with the requirements of the codes and standards, this specification shall govern.

Materials

- | | | | |
|-----|----------|---|--|
| (a) | IS: 458 | - | Specification for concrete pipes (with and without reinforcement. - latest edition 1988) (where mentioned it should be latest revised code.) |
| (b) | IS: 3597 | - | Method of tests for concrete pipes. |
| (c) | IS: 5382 | - | Specification for rubber sealing rings for gas mains, water mains and sewers. |

Codes of Practice

- | | | | |
|-----|---------|---|---|
| (a) | IS: 456 | - | Code of practice for plain and reinforced concrete. |
| (b) | IS: 783 | - | Code of practice for laying of concrete pipes. |

Design

Design of RCC pipes shall be in accordance with the relevant clauses of IS 458.

The details of reinforcement shall be as per clause 5.2 of IS: 458.

The ends of pipes shall be in accordance with relevant clauses of IS: 458.

MANUFACTURING

Materials

Cement

Cement used for the manufacture of RCC pipes and collars shall conform to IS: 269 or IS: 455 or IS: 1489. Sulphate resistant cement shall be used in manufacture of pipes. The use of pozzolona as an admixture to Portland cement shall not be permitted.

Aggregate

Aggregate used for the manufacture of RCC pipes and collars shall conform to IS: 383. The maximum size of aggregate should not exceed one-third the thickness of the pipe or 20 mm, whichever is smaller.

Mixing & Curing Water

Water shall be clean, colourless and free from objectionable quantities of organic matter, alkali, acid, salts or other impurities that might reduce the strength, durability or other desirable qualities of concrete and / mortar.

Reinforcement

Reinforcement used for the manufacture of the RCC pipes and collars shall be mild steel Grade I or medium tensile steel bars conforming to IS: 432 or hand-drawn steel wire conforming to IS: 432. A reinforcement cage for pipes and collars shall be as per relevant requirements of IS: 458.

Concrete

Concrete used for the manufacture of RCC pipes and collars shall conform to IS: 456. The minimum cement content and minimum compressive strength of concrete shall be as per relevant requirements of IS: 458. Compressive strength tests shall be conducted on 15 cm cubes in accordance with the relevant requirements of IS: 456 and IS: 516.

Curing

Pipes manufactured in compliance with IS: 458 shall be either water cured or steam cured in accordance with the relevant requirements of IS: 458.

Dimensions

The internal diameter, wall thickness and length of barrel and collar of pipes, reinforcement (longitudinal and spiral), type of ends and minimum clear cover to reinforcement and strength test requirements shall be as per the relevant clauses / tables of IS: 458 for different class of pipes.

The tolerances regarding overall length, internal diameter of pipes or socket and barrel wall thickness shall be as per relevant clauses of IS: 458.

The method of manufacture shall be such that the form and the dimensions of the finished pipes are accurate within the limits specified in relevant IS: 458. The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis. An extra ring of reinforcement to avoid breakage during transportation shall further reinforce the ends of the pipes.

The RCC pipes and collars / rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.

Owner / Engineer In-Charge shall at all reasonable times have free access to the places where the pipes and collars / rubber rings are manufactured for the purpose of examining and testing the pipes and collars / rubber rings and of witnessing the test and manufacturing.

All tests specified either in this specification or in the relevant Indian Standards shall be performed by Supplier / Contractor at his own cost and in presence of Owner / Engineer In-Charge if desired. For this, sufficient notice before testing of the pipes shall be given to Owner / Engineer In-Charge.

If the test is found unsatisfactory, Owner / Engineer In-Charge may reject any or all pipes of that lot. The decision of Owner / Engineer In-Charge in this matter shall be final and binding on Contractor and not subject to any arbitration or appeal.

Markings

Each pipe shall have cast, stamped or indelibly painted on it the following appropriate marks.

1. Manufacturers name or identification mark
2. The nominal diameter
3. Class reference
4. Mass of pipe
5. The no. of the Indian standard and
6. The year of manufacture.

Marking may be done the outsides of the sockets or towards the end of barrels of pipes.

Workmanship & finish

The outside and inside surfaces of the pipes shall be smooth, dense and hard, and

The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.

The pipes shall be free from local dents or bulges greater than 300 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

The deviation from straight in any pipes throughout its effective length, tested by means of a rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameter 3 mm for every meter run.

Testing

All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under the criteria of tolerances as mentioned in IS: 458.

During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by Owner / Engineer In-Charge the results of compressive tests of concrete cylinders or cubes made from the concrete used for the pipes.

The specimen of pipes for the following tests shall be selected in accordance with clause 9.1 of IS: 458 and tested in accordance with the methods described in IS: 3597;

1. Hydrostatic test.
2. Three edge bearing test or sand bearing test.
3. Absorption test.
4. Bursting test.

Note: Three edge bearing strength to produce 0.25 mm crack in case of special design of pipes shall be as per Table-A below.

Sampling & Inspection

In any consignment, all the pipes of same class and size and manufactured under similar conditions of production shall be grouped together to constitute a lot. The conformity of a lot to the requirements of this

specification shall be ascertained on the basis of tests on pipes selected from it.

The number of pipes to be selected from the lot shall be in accordance with column 1 and 2 of Table 9 of IS: 458.

Pipes shall be selected at random. In order to ensure randomness, all the pipes in the lot may be arranged in a serial order and starting from any pipe, every r the pipe be selected till the requisite number is obtained, r being the integral part of N/n where N is the lot size and n is the sample size.

All the pipes selected, as shown above shall be inspected for dimensional requirements, finish and deviation from straight.

The number of pipes to be tested for tests shall be in accordance with column 4 of Table 9 of IS: 458. These pipes shall be selected from pipes that have satisfied the necessary requirements mentioned in latest relevant IS code.

A lot shall be considered as conforming to the requirements of IS 458 if the following conditions are satisfied.

- (a) The number of defective pipes (those not satisfying one or more of the requirements for dimensions, finish and deviation from straight) shall not be more than the permissible number given in column 3 of Table 9 of IS: 458.
- (b) All the pipes tested for various tests shall satisfy corresponding requirements of the tests. The Contractor shall inform the Engineer-in-Charge about the lot of pipes to be brought at site. The pipe brought as specified in IS code 458 (Latest Revision). From the lot brought on site any one pipe at random will be selected and will be broken and quality of concrete and quantity of steel (reinforcement) will be checked. If any deviation i.e. poor quality of concrete or less steel is found, the whole lot of pipes will be rejected and the Contractor shall remove the same from the site. No payment shall be made for pipe, which is broken for checking and clearing, rejected lot of pipes from the site.
- (c) In case the number of pipes not satisfying requirements of any one or more tests, one or two further sample of same size shall be selected and tested for the test or tests in which failure has occurred. All these pipes shall satisfy the corresponding requirements of the test.

Jointing

Jointing of RCC pipes shall be done as per the requirements of following specifications and as per the relevant IS. The type of joints shall be as per 'Data Sheet - A'. After jointing extraneous material if any, shall be removed from the inside of the pipe and newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS 5382.

Spigot & Socket joint (Rigid)

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion as specified in Data Sheet - A, which shall be rammed with caulking tool.

Collar joint (Rigid)

After laying the RCC pipes at proper alignment and gradient their abutting faces shall be coated with hot bitumen in liquid condition by means of a brush. The wedge-shaped groove in the end of the pipe shall then be filled with a tarred gasket in one length for each joint. The collar shall then be slipped over the end of the pipe and the next pipe butted well against the tarred gasket by suitable appliances approved by Owner / Engineer In-Charge so as to thoroughly compress the tarred gasket into the grooves, care being taken that the concentricity of the pipes and levels are not disturbed during this operation. The collar shall then be placed symmetrically over the end of the two pipes and the space between the inside of the collar and the outside of the pipe filled with mixture of cement and sand tempered with just sufficient water to have a consistency of the semi dry conditions well packed and thoroughly rammed with caulking tools. The joints shall be finished off with a filled sloping at 45° to the side of the pipe. The finished joints shall be protected and cured thoroughly as directed by Owner / Engineer In-Charge. Any plastic solution or cement mortar that may have been squeezed into the inside of the pipe shall be removed so as to leave the inside of the pipe perfectly clean.

Spigot & Socket joint(Semi flexible)

This joint is composed of specially shaped spigot and socket ends on the RCC pipes. A rubber ring shall be lubricated and then placed on the spigot, which is forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement

and mortar as specified in Data Sheet - A, shall then be filled into the remaining annular space and rammed with a caulking tool.

Collar joint (Semi flexible)

This joint is made up of a loose collar, which covers two specially shaped pipe ends. Each end shall be fitted with a rubber ring as specified as per relevant IS code, which when compressed between the spigot and collar, seal the joints. Stiff mixture of cement mortar, shall then be filled into the remaining annular space and rammed with a caulking tool.

Spigot & Socket joint (flexible)

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipes. The spigot and socket type and rubber rings, and the manufacturer's instructions shall be used, and the manufacturer's instructions shall be deemed to form a part of these specifications. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

Flush joint (Internal)

This joint shall be generally used for culvert pipe of 60-cm. diameters and over. The ends of the pipes are specially shaped to form a self-centering joint with an internal jointing space 1.3-cm wide. The finished joint is flush, with both inside and outside with the pipe wall. The jointing space is filled with cement mortar in the proportion as specified in Table-A, mixed sufficiently dry to remain in position when forced with a trowel or rammer.

Flush joint (External)

This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar as specified in Table - A, sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

Cleaning of pipes

As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by Owner / Engineer In-Charge, contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipeline shall be securely closed as may be directed by Owner / Engineer In-Charge to prevent entry of mud or slit etc.

If as a result of the removal of any obstruction Owner / Engineer In-Charge considers that damages may have been caused to the pipelines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory contractor shall amend the work and carry out such further tests as area required by Owner / Engineer In-Charge.

It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Engineer In-Charge is absolutely clear and without any obstruction by means of visual examination of the interior of the pipe line suitably enlightened by projected sunlight or otherwise.

Testing at work site

After laying and jointing of RCC pipes is completed the pipeline shall be tested at work site as per the following specifications and as directed by Owner / Engineer In-Charge. All equipment for testing at work site shall be supplied and erected by contractor's responsibility and shall be rectified by him / her to the full satisfaction of Owner / Engineer In-Charge.

The water required for the flow test should have to be brought by the contractor at his own cost. The entire section of the pipeline laid by the contractor shall be given flow test. The stretch from manhole to manhole or as directed by Engineer in charge be given water test. Any earths, mud, rubbish, dummy walls etc., in the pipeline or manhole be removed and whole pipeline shall be clean before testing is given.. The water shall be poured in first manhole and it should runs smoothly from manhole to manhole up to last manhole without any pounding. There shall not be accumulation of water inside the pipeline. If it accumulates in certain stretch, the laid pipeline shall have to be removed and be laid again in gradient as specified. If this being not attended the payment for the same stretch of pipeline shall not be paid and shall be recovered in the final bill. Necessary certificates for cleaning of pipeline in all respect have to be given in writing before the contractor gives hydraulic flow test on site.

In case of pressure pipeline the completed stretch of pipeline shall be tested for site test pressure as specified in Table - A. The site test pressure should not be less than the maximum operating pressure plus the

calculated surge pressure, but in no case it should exceed the hydrostatic test pressure, as specified in IS: 458.

Measurement

All RCC pipes shall be measured accordingly to the work actually done and no allowance will be made for any waste in cutting to the exact length required. The measurement for pipes shall be in running metres nearest to a cm. of length along the centre line of pipe as actually laid at work sites.

The rate for providing, laying and jointing of RCC pipes shall be deemed to include the cost of collars / rubber rings, jointing material, testing and the extra excavation required for ordinary bedding of pipes and also for collars and pipe sockets if any.

Notes

If any damage is caused to the pipeline during the execution of work or while cleaning / testing the pipeline as specified, contractor shall be held responsible for the same and shall replace the damaged pipeline and retest the same at his own cost to the full satisfaction of Owner / Engineer In-Charge. Water for testing of pipeline shall be arranged by contractor at his own cost.

Table – A: Field Test Results of R. C. C. Pipes

Sr. No.	Item	Specification
1.	Monsoon period.	First week of June to 30 th September each year.
2.	Width of the trench from invert level of pipe up to the top (Bt) and cross-section of trench.	OD + 300 mm OR 600 mm As per given profile at the time of execution.
3.	Three edge bearing strength to produce 0.25 mm crack for NP2, NP3 & NP4 class pipes.	As per latest IS Code
4.	Type of joints	Collar joints (Rigid)
5.	Proportion of cement use mortar for use in jointing of pipes.	(1:1)
6.	Hydraulic test pressure.	0.70 kg / sq. cm

LAYING OF PIPES AND FITTINGS / SPECIALS

Scope

This specification covers the requirements for laying of pipes and fittings / specials below ground. Data Sheet - A covers the specific requirements for the

project. The two parts are complementary and are to be read together for a correct interpretation of the provisions of this specification. Where requirements of the two sections conflict, those of Data Sheet - A shall govern.

Applicable Codes

The laying of pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / codes shall be referred to. If requirements of this specification conflicts with the requirements of the standards / codes, this specification shall govern.

Codes of Practice

- | | | | |
|-----|---------|---|---|
| (a) | IS 783 | - | Code of practice for laying of concrete pipes. |
| (b) | IS 3114 | - | Codes of practice for laying of cast iron pipes. |
| (c) | IS 3764 | - | Safety codes for excavation work. |
| (d) | IS 4127 | - | Code of practice for laying of glazed stoneware pipes. |
| (e) | IS 5822 | - | Code of practice for laying of welded steel pipes for water supply. |
| (f) | IS 6530 | - | Code of practice for laying of asbestos cement pressure pipes. |

Carting & Handling

Pipes and fittings / specials shall be transported from the factory to the work sites at places along the alignment of pipeline as directed by Owner / Engineer In-Charge. Contractor shall be responsible for the safety of pipes and fittings / specials in transit, loading / unloading. Every care shall be exercised in handling pipes and fittings / specials to avoid damage. While unloading, the pipes and fittings / specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber with steadying ropes or by any other approved means. Padding shall be provided between coated pipes, fittings / specials and timber skids to avoid damage to the coating.

Suitable gaps between pipes should be left at intervals in order to permit access from one side to the other. In case of spigot socket pipes while unloading, as far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or scaling of pipe) while unloading and shall be sorted out for reclamation. Any pipe, which shows sufficient damage to preclude it from being used, shall be discarded. Dragging of pipes and fittings / specials along concrete and similar pavement with hard surface shall be prohibited.

Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid length wise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stack shall not exceed 1.5m.

Fittings / specials shall be stacked under cover and separated from pipes.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they are not left out on the ground in the sun or overnight under heavy frost or snow conditions.

LAYING

Excavation

Before excavating the trench the alignment of pipeline shall be approved by Owner / Engineer In-Charge. The excavation of trenches and pits for manholes / chambers shall be carried out in accordance with the specification and shall be done such that it does not get far ahead of the laying operation as approved by Owner / Engineer In-Charge.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for the traffic to use the roadways. The relevant Indian Standards and the rules and regulations of local authorities in regard to safety provisions shall be observed.

Suitable fencing shall be provided along the sides of trenches and pits. The posts of fencing shall be of timber securely fixed in the ground not more than 3m apart and they shall not be less than 75 mm in diameter or less than 1.2 m above the surface of the ground. There shall be two rows, one near the top of the posts and the other about 450 mm above the ground and each shall be from 50 mm to 70mm in diameter and sufficiently long to run from post to post to which shall be bound with strong rope. The method of projecting rails beyond the posts and trying them together where they meet will not be allowed on any account. All along the edges of the excavated trenches a bank of earth about 1.2 m high shall be formed where required by Owner / Engineer In-Charge for further protection.

The road metal and also the rubble packing shall first be stripped off for the whole width of the trench / pit and separately deposited in such place or places as may be determined by Owner / Engineer In-Charge.

During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench and pit or as may be necessary to prevent the sides of the trench / pit to slip or fall or at such a distance and in such a manner as to avoid covering fire hydrants, sluice values, manhole covers, etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service Organisation or otherwise as Owner / Engineer In-Charge may direct.

Contractor shall take into account additional excavation if any as Owner / Engineer In-Charge may require in order locating the position of water pipes, drains, sewers, etc. or any other works which may be met with, in or about the excavation of trenches / pits while quoting the rates for excavation. Such services lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as Owner / Engineer In-Charge may direct, and shall be protected by Contractor from damage during the progress of the work. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure / pipe line of water, gas, sewage, etc.

If the work for which the excavation has been made is not complete by the expected date of the setting of monsoon as stipulated in 'Data Sheet - A' or the setting in of rain whichever is earlier, or before the day fixed by Owner / Engineer In-Charge for filling in any excavation on account of any festival or special occasion, contractor shall backfill such excavation and consolidate the filling.

Utmost care shall be taken to see that the width of the trench at the top of pipe is not more than specified in 'Data Sheet - A'. In case additional width is required it shall be provided only in the top portion from the ground level up to 30 mm above the crown of pipe. If any extra width is provided in the area below this portion, Contractor shall have to provide remedial measure in the form of lime concrete or rubble masonry or otherwise at the discretion and to the satisfaction of Owner / Engineer In-Charge. If rock is met with, it shall be removed to 15cm below the bottom of pipes and fittings / specials and the space resulting shall be refilled with granular materials and properly consolidated. Bottom of trenches / pits shall be saturated with water well rammed wherever Owner / Engineer In-Charge may consider it necessary to do so.

Wherever a socket or collar of pipe or fitting / special occurs a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand; all around the socket in order to make the joint and the grip shall be maintained clear until the joint has been approved by Owner / Engineer In-Charge.

The excess excavated material shall be carried away from site of works to a place up to a distance as directed by Owner / Engineer In-Charge. This shall be done immediately so as not to cause any inconvenience to the public or traffic. If the instructions from Engineer In-Charge are not implemented within seven days from the date of instructions to cart the materials and to clear the site, the same shall be got done by Owner / Engineer In-Charge at the cost of the contractor and any claim or dispute shall not be entertained in this respect.

Dewatering

During the excavation, if subsoil water is met with Contractor shall have to provide necessary equipment and labourers for dewatering the trenches / pits by bailing out water or water mixed with clay; if pumping out subsoil water is found to be necessary, Contractor shall provide sufficient number of pumps for the same. In both the above cases the excavation shall be done to the required level and the pipes shall be laid to proper alignment and gradient. Contractor shall also make necessary arrangement for the disposal of drained water to nearby storm water drain or in a pit if allowed by Owner / Engineer In-Charge. In no case the water shall be allowed to spread over the adjoining area/road/passage. Before discharging this water into public sewer/drain. Contractor shall take necessary permission from the local authorities.

Special Foundation in poor soil

Where the bottom of the trench at sub grade is found to consist of material which is unstable to such a degree that in the opinion of Owner / Engineer In-Charge, it cannot be removed and replaced with and approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, timbers or other materials, in accordance with relevant drawings and as instructed by Owner / Engineer In-Charge shall be constructed.

Wooden Shoring

Contractor shall suitably design polling boards, walling and struts to meet different soil conditions that might be encountered in excavating trenches / pits. The horizontal and vertical spacing of struts shall be such that not only the sides of trenches shall be prevented from collapse out also easy lowering of pipe in trenches shall be ensured without creating undue obstructions for the excavation of the work. Any inconvenience and / or delay that might be caused in lowering pipes in trenches as a result of adopting improper spacing of struts by Contractor shall be his sole responsibility. No part without obtaining permission from Owner / Engineer In-Charge. While taking out shoring planks the hollows of any form must simultaneously be filled in with soft earth well rammed with rammers and with water.

Owner / Engineer In-Charge may order portions of shoring to be left in the trenches / pits at such places, where it is found absolutely necessary to do so as avoid any damage which may be caused to buildings, cables, gas-mains, water-mains, sewers, etc. in close proximity of the excavation, by pulling out the shoring from the excavations. Contractor shall not claim, on any reason, whatsoever for the shoring which may have been left in by him / her at the own discretion.

Sheet Piling

Where the subsoil conditions are expected to be of a soft and unstable character in trench / pit excavation the normal method of timbering may prove insufficient to avoid subsidence of the adjoining road surfaces and other services. In such circumstances contractor will be required to use steel trench sheeting or sheet piling adequately supported by timber struts, waling, etc., as per the instructions, manner and method directed by Owner / Engineer In-Charge. Contractor shall supply, pitch, drive and subsequently remove trench sheeting or piling in accordance with other items of the specification.

Boning Rods & Sight Rails

In laying the pipes and fittings / specials the centre for each manhole / chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 mm x 100 mm x 1800 mm) at each

manhole / chamber or junction of pipe lines at nearly equal distance from the peg and at sufficient equal distance there from to be well clear of all intended excavation, so arranged that a sight rail when fixed at a certain line of the manhole / chamber or pipe lines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by Owner / Engineer In-Charge.

Boning staves of 75 mm x 50 mm size shall be prepared by Contractor in various lengths, each length being of a certain whole number of metres and with a fixed tee-head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top-edge of this tee-head at a distance equal to the outside diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of pipe, etc. as the case may be.

The sight rails of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The centre line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the centre lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically paralleled with the bed of the pipe and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of the sight from rail to rail.

The post and rails shall be perfectly square and planned smooth on all sides and edges. The rails shall be painted white on both sides, and the tee hands and cross piece of the boning staves shall be painted black.

For the pipes converging to a manhole / chamber at various levels, there shall be rail fixed for every different level. When a rail comes within 0.60 m of the surface of the ground, higher sight-rail shall be fixed for use with the rail over the next point.

The posts and rails shall be in no case be removed until the trench is excavated, the pipes are laid and Owner / Engineer In-Charge gives permission to proceed with the backfilling.

Bedding

The bedding for pipe shall be provided as per direction of Owner / Engineer In-Charge.

CW-24 ANCILLARY WORKS OF MANHOLES

Scope

This specification covers the requirements for providing and construction of circular type manholes ancillary works such as manholes, scraper manholes etc.

Applicable Codes

The following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of this specification conflict with the requirements of the codes and standards, this specification shall govern.

- (a) IS: 4111 Code of practice for ancillary structures in (Part I) sewerage system manholes.
- (b)ASTMD – 4101 Plastic moulded reinforced steps for manhole.
- (c) IS: 1077 Common burnt clay-building bricks.
- (d) IS: 3102 Classification of burnt clay bricks.
- (e) IS: 3495 Method of sampling and testing clay building bricks.
- (f) IS: 2212 Code of practice for brickwork.

Manholes

Location

Manholes shall be constructed at places as shown on Layout Plans drawings and as directed by Owner / Engineer In-Charge.

Excavation

Excavation shall be done in accordance specification. The rate quoted for manhole shall be inclusive of excavation and backfilling, bailing or pumping out water and shoring

Bed concrete

The bed concrete shall be done in accordance with specification of W-3 Concrete. As such the aggregate shall be of good quality, free from earth, debris, etc.

Brick Work

Bricks used in works shall conform to the relevant Indian Standards. They shall be sound, hard, and homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep red cherry or cropper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing ungrounded particles and / or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 40-kg/sq. cm. unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS 3102.

The size of the brick shall be 23.0 x 11.5 x 7.5 cm unless otherwise specified; but tolerance upto + 3 mm in each direction shall be permitted. Only full size brick shall be used for masonry work. Brickbats shall be used only with the permission of Owner / Engineer In-Charge to make up required wall length or for bending. Sample bricks shall be submitted to Owner / Engineer In-Charge for approval and bricks supplied shall conform to approval samples. If demanded by Owner / Engineer In-Charge brick sample shall be got tested as per IS: 3495 by Contractor at no extra cost to Owner. Bricks rejected by Owner / Engineer In-Charge shall be removed from the site of works within 24 hours.

Cement Mortar

Mortar for brick masonry shall be prepared as per IS: 2250. In ordinary manholes, brickwork shall have cement mortar (1:5); in scraper manholes, brickwork shall have cement mortar (1:5) or as specified in the tender item. Gauge boxes for sand shall be of such dimensions that one bag containing 50 kgs. of cement forms one unit. The sand shall be, free from clay, shale, loan, alkali organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Owner / Engineer In-Charge sand shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry conditions. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

Workmanship

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work

of manholes shall be in the proportion 1:5. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115-mm thick brick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45°. But in no case the level difference between adjoining walls shall exceed 1.25M. Workmanship shall conform to IS: 2212.

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plaster or pointing to be done. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If mortar in the lower courses has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid. No extra payment will be made for raking joints.

Cement Plasterwork

All joints in masonry shall be raked to a depth of 12 mm with a hooked tool made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease, etc. and thoroughly wetted for 6 hours before plastering work is commenced.

Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

The proportion of the cement mortar shall be as specified on relevant drawings. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain workable consistency. The quality of water, sand and cement shall be as per relevant I.S. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to stand for more than 25 minutes after mixing with water.

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. The decision as to when the plaster had hardened will be given by Owner / Engineer In-Charge. Curing shall be done by continuous applying water in a fine spray and shall be carried out for at least 7 days.

20 mm plastering work shall be carried out in 2 layers, the first layer being 14 mm thick and the second layer being 6 mm thick. The first layer shall be dashed against the prepared surfaces with trowel to obtain even surfaces. The second layer shall then be applied and finished leaving an even and uniform surfaces, trowel finished unless otherwise directed by Owner / Engineer In-Charge.

C. C. Channel

Cement concrete channel be constructed in C.C. of M15 grade. Both sides of the channel shall be taken up to the level of the crown of the outgoing sewer. They shall be benched up in concrete and rendered in cement mortar (1:1) 20 mm. thick and formed to a slope same as that of outgoing sewer.

Safety of pipe at edges in manhole

Whenever a pipe enters or leaves a manhole, bricks on edge must be out to a proper form and lay around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13-mm thick between it and the bricks.

Fibre Reinforced Frame & Cover (Polycrete reinforced cover & frames)

Heavy-duty fibre reinforced concrete manhole covers and frames shall be provided capable of withstanding loads of 35 tonnes. The frame shall be fixed in cement concrete of M15 grade all around and finished with neat cement. The fibre-reinforced frame shall have a clear opening 560 mm dia having clear circular frame of 860 mm dia and 175 mm thickness. The cover will have a minimum thickness of 100-mm having over all size of 710 mm. The composite unit weight will be approximate weight of 276 kg. The fibres shall constitute 1% of the weight of the concrete in the form

of 50 mm to 100-mm metallic threads. For the cover sheet lapping of 18 gauges M.S.flat to avoid damage to the edge is provided and to protect this flat from corrosion anti corrosion black paint is used.

The plastic moulded reinforced steps of required size shall be used. The size shall be such that it can be well placed and embedded in the wall firmly in C.C. as directed such that it does not come out from the wall. The steps shall be manufactured with the best quality of plastic & shall have regular shape & size. The surface shall be made rough for firm rigidity. The plastic moulded reinforced steps of approved pattern shall be build in the brick wall in C.C. at the interval of 350 mm vertically & 350 mm horizontally in zigzag fashion for ease in getting down into the manhole.

CW-25: MANHOLE SLAB

Plain & Reinforced Concrete

In general, plain and reinforced concrete work for manholes shall be carried out in accordance with the specification of plain and reinforce concrete W-3 in general specification unless otherwise specified in this specification.

Sampling for strength of concrete details given in W-5 shall be followed. For concrete used in brick masonry manholes, encasing of pipes, foundation for vent shaft etc. such tests may be called for at the discretion of Engineer In-Charge.

The size of aggregates for plain cement concrete shall be 40 mm downgraded and for RCC work this shall be 20 mm downgraded unless otherwise shown on relevant drawing.

The top slab of manhole shall be cast with shutters lined with plywood and shall be smooth finished. as per specification of form work in general specification.

To avoid surface cracks due to variation in atmospheric temperature and exposure to direct sunlight, R.C.C. slab of manholes after casting shall be kept wet by providing water. Contractor should take this aspect into consideration and quote accordingly. No extra claim on this account shall be entertained.

Bar bending schedule for reinforcement shall be prepared by contractor and got approved from Engineer In-Charge before proceeding with the work.

The interior of manholes shall be cleared of all debris after construction and before testing the same for water tightness.

M20 grade of concrete used for construction of R.C.C. slab of manholes shall have minimum cement content of 330 kg/Cum. of concrete. In case as per mix design the cement required is more than 330 kg/Cum. of concrete Contractor will have to provide the same at his cost.

Plastic moulded reinforced steps:

The plastic moulded reinforced steps using polypropylene conforming to ASTM D – 4101 specification with injection moulded around 12 mm dia. steel reinforcing bars shall be used. It shall be capable to take load upto 225 kg as per IS-5455. The size of plastic moulded reinforced steps shall not be less than 265 mm in length, 175 mm in breadth and 25 mm thickness as per detailed drawing.

CW-26: VENT SHAFTS

General

Vent shafts shall be erected at such places as directed by Owner / Engineer In-Charge.

R.C.C. Ventilating Columns

R.C.C. vent shaft shall be of 6 inches (150 mm) dia. and 40 feet (12.2 m) height from ground level with M.S. ornamental cap. This shall be fixed firmly and encased in C.C. (M 10) with necessary foundation.. The vent shaft shall be connected to manhole by 6" (150 mm) dia. R.C.C. NP2 pipe as directed by Owner / Engineer In-Charge.

CW-27: Centrifugally Cast Iron Pipes

Scope

This Specification covers the requirements for manufacturing, supplying, laying, jointing and testing at works site, of Centrifugally Cast Iron pipes (Spun Iron pipes) used for water supply, sewerage and storm water drains.

Applicable Codes

The laying of CI pipes and fittings/ specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflicts with the requirements of the standards/ Codes, this Specification shall govern.

IS: 1536	Specification for Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage.
IS: 1538	Specification for Cast Iron fittings for Pressure Pipes for Water, Gas and Sewage.
IS: 11606	Methods for Sampling of Cast Iron Pipes and Fittings.
IS: 3114	Code of Practice for Laying of CI Pipes.

Other IS Codes not specifically mentioned here but pertaining to the use of CI pipes form part of these Specifications.

Manufacture

The spun iron pipes shall be of CI, casted centrifugally and shall be of class L.A. A, B or as specified.

The metal used for the manufactured of pipes shall be of quality not less than that of grade 15 of IS: 210-1970 or its latest revision.

The pipes shall be stripped with all necessary precautions necessary to avoid warping or shrinking defects. The pipes shall be free from defects, other than any avoidable surface imperfections which result from the method of manufacture and which do not affect the use of the pipes.

All Cast Iron (Spun) pipes and fittings shall be of approved brand conforming to IS: 1536 and IS: 1538 respectively and free from flaws, air bubbles, cracks, sand holes and other defects and truly cylindrical and of uniform thickness. These shall not be brittle but shall allow ready cutting, chipping and all joints shall be double flanged joints and shall be air and watertight.

CW-28 Hydrostatic tests at Works

1. For hydrostatic tests, the pipes shall be kept under pressure for 15 seconds; they may be struck moderately with a 700 g hammer. They shall withstand pressure test without showing any leakage or any other defect of any kind. As far as possible the hydrostatic test shall be conducted before giving any coating to the pipes. These pipes shall be used up to half the hydraulic test pressure as given in the following table. The hydraulic test pressure for Centrifugally Cast Iron pipes as per IS: 1536, shall be as given below:

Test of Pipes	Test pressure in kg/cm ² (meter head)		
	Class LA	Class A	Class B
Spigot and socket pipes in all diameters	12 (120)	18 (180)	24 (240)
Flanged pipes up to 600 mm diameter	-	18 (180)	24 (240)

2. The specials shall conform to IS: 1538(latest Revision). The hydraulic test pressure of each class of specials shall be as follows:

Nominal Diameter	Test pressure in kg/cm ² (meter head of water)	
	Specials without branches or with branches not greater than half the principal diameter	Specials with branches greater than half the principal diameter
Up to and including 300 mm	25 (250)	25 (250)
Over 300 mm to 600 mm	20 (200)	20 (200)
Over 600 mm up to 1500 mm	15 (150)	15 (150)

3. The Contractor shall arrange water of approved quality for testing.

Testing at Site

The following tests are to be carried out after a new pipe is laid, jointed and partially back filled. Portions of the line shall be tested by subjecting the pressure test as the laying progresses before the entire line is completed (the test stretch should not generally exceed 500 m), to identify any error of workmanship which can be detected and corrected at minimum cost. For all these tests water of approved quality has to be arranged by the Contractor.

Pressure Test

Pressure test at a pressure of at least double the maximum working pressure shall be carried out. Pipes and joints shall be absolutely watertight under the test. The procedure for pressure testing shall be as follows:

1. Each valve section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through the hydrants and blow offs. If there are not

available at high places, necessary taping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.

2. Sufficient backfill shall be placed on the pipe to resist the movement due to pressure while testing. Trench shall be partially backfilled such that the joints, couplings, valves, hydrants of any other fittings shall be left exposed for observations during testing. The specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to pipe in a manner satisfactory to the Engineer. The duration of the test shall not be less than 5 minutes.
3. During testing, all exposed pipes; fittings etc. should be carefully examined. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the Engineer. Any cracked or defective pipes, fittings, valves or hydrants etc. discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the Engineer.

Leakage Test

After the successful completion of the pressure test, Leakage test shall be conducted at a pressure to be specified by the Engineer for a duration of two hours. The procedure for Leakage test shall be as follows:

1. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valves section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
2. No pipe installation shall be accepted until the leakage is less than the number of cm^3/hr , as determined by the following formula:

$$ql = (ND\sqrt{P})/3.3$$

where

ql	=	the allowable leakage in cm^3/hr .
N	=	number of joints in the length of the pipeline,
D	=	diameter of pipe in mm, and
P	=	average test pressure during the leakage testing kg/cm^2

3. Should any test of the pipe laid in position disclosed leakage greater than that obtained by the above formula, the defective joints shall be replaced until the leakage is within the specified allowance.

Rate

The rate shall include the cost of materials and labour involved in all the operations described above except for the items measured/ enumerated separately under clause 'Measurements', which shall be paid for separately.

Specials and Fittings

CI specials and fittings used for CI pipes shall conform to IS: 1538. The methods for sampling of CI pipes and fittings shall conform to IS: 11606.

Dimensions and Tolerances

The dimensions of pipes, sockets, spigots and flanges and their tolerances shall conform to the sizes specified in relevant clause of IS: 1536.

Inspection of Pipes

The pipe and fittings shall be inspected for defects and be rung with a light hammer, preferably while suspended, to detect cracks. Smearing the outside with chalk dust helps the location of cracks. If doubt persists further confirmation may be obtained by pouring a little kerosene on the inside of the pipe at the suspected spot. If a crack is present the kerosene seeps through and shows on the outer surface.

Any pipe found unsuitable after inspection before laying shall be rejected.

Laying and Jointing of CI Pipes and Fittings

The laying of CI pipe lines shall, in general be in accordance with Clause 15.7 Specifications given in IS: 3114 shall be followed as applicable.

Rubber ring Tyton joints shall be used for joining of CI pipelines outside the buildings and other external water supply installations. They shall be used strictly in accordance with the manufacturer's instructions. Wherever required, for internal water supply piping arrangements with CI pipes, pipes shall be connected by flanged joints.

LAYING OF PIPES AND FITTING / SPECIALS

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure / pipe line of water, gas, sewage, etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Owner /

Engineer In-Charge. Pipes and fittings / specials shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings / specials shall be made by Contractor. In no case pipes and fittings / specials shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings / specials shall be used to lift and lower the coated pipes and fittings / specials. The pipes and fittings / specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect crack. If doubt persists, further confirmation shall be done by pouring a little paraffin on the inside of the pipe at the suspected spot. No sign of paraffin should appear on the outside surface. Pipes and fittings / specials damaged during lowering or aligning shall be rejected by Owner / Engineer In-Charge.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipeline runs uphill in which case the socket ends should face the upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centred in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings / specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings / specials of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Owner / Engineer In-Charge, during the period that plug is on, the contractor shall take proper precautions against floatation of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plan, to avoid obstructions or where long radius curves are permitted, the deflection allowed at joints shall not exceed $2\frac{1}{2}^{\circ}$. In the case of pipes, with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes.

The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe-cutting machine shall be used.

JOINING

Joining for pipes and fittings / specials shall be done in accordance with the relevant specifications depending on type of pipes being used.

TESTING AND COMMISSIONING

Testing and Commissioning of pipes shall be done in accordance with the relevant specification.

BACKFILLING

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline. The tamping around the pipe shall be done by hand or other hand operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Back filling shall be consolidated by watering, ramming, care being taken for no damage to the pipeline. In case of mild steel pipes / specials, the spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipeline to aid alignment, these timbers shall be removed before backfilling.

REINSTATEMENT OF ROAD / FOOTPATH

Reinstatement of road / footpath shall be done as per the requirements of local authorities and the relevant specifications after the completion of work.

DISINFECTION OF WATER MAINS

The mains intended for potable water supplies should be disinfected before commissioning them for use.

The mains shall be chlorinated with a liquid chlorine solution (that is liquid chlorine gas and water mixture). The disinfection shall be considered to have been achieved if a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe. If this requirement is met with, the main should be thoroughly flushed with clean water.

If the treatment specified as above is not possible, enough chlorinate lime; calcium or sodium-hypo-chlorite should be introduced to produce the required concentration of chlorine in the solution. The solution should then be allowed to stand for not less than 24 hours, after which it should be tested for residual chlorine, which should not be less than 10 ppm. If

found satisfactory, the mains should be thoroughly flushed with clean water.

CW-32:MS Ladders with hand railing

Sturdy MS ladders, 450 mm wide, using angle iron 65mm x 65mm x 8mm size and 20mm MS bars at 25cms c/c with necessary supports of same angle iron as directed including hand railing on both sides with 25mm dia GI pipes with angle iron props at 2m intervals and 0.50m height with two coats of non-poisonous anticorrosive bituminous paint. It shall include the cost of all material, skilled and unskilled labour, fabrication, transportation, painting etc.

B.ELECTRICAL AND MECHANICAL WORKS

The bidder has to submit complete technical specifications, details including all design calculations for sizing of all machinery's along with his tender, for the engineer to check the adequacy of the equipment.

EMW-1: Structural Supports, Platforms

Whether specifically mentioned above or not, the tenderer shall provide all necessary structural platforms, ladders, supports, access etc. for the various equipment.

These shall be so designed taking into account the various heights as required and the maintenance of equipments. All platforms and ladders shall have necessary safety guards.

EMW-2: Painting and Coating

All M.S. materials shall be shot blasted/sand blasted before proceeding with manufacture. Pickling is to be carried out on all M.S. Sheets used for various equipments.

The parts/components, which do not come in direct contact with sewage, shall be painted with two coats of Zinc rich epoxy primer (35 microns each coat) and two coats of epoxy based final paint of approved colour (20 microns each coat).

The bidder shall give a detailed scheme for the same.

EMW-3: Motors

Suitable HP, squirrel cage induction motors continuous rated with "F" class insulation conforming to latest IS : 325 suitable for operation on 3 phase 50 c/s, 415 V AC supply. The motor shall be provided with proper bearings at top to take care of the thrust due to self-weight of the rotor and provided with labyrinth ring seal in the bearing housing to prevent the entry of dust or water as per ISS 4691 standards. The rotor shall be dynamically balanced. The motor shall be provided with non-reversible ratchet. The motors shall be suitable for the duty conditions and as per tender specifications and requirements. The ratings of motors shall be not less than the minimum specified.

EMW-4: Power Transformer

The transformer shall have minimum specifications as mentioned below:

Oil filled, naturally air cooled, step down transformer, copper wound, each of capacity as mentioned above suitable for out door installation, 11 KV / 433 volts, with off load tap changer in steps of 2.5% from (-) 7.5% to (+) 7.5% shall be provided. The windings shall be connected as per Vector Group DYN 11, solidly earthed and complete with first filling of oil. Suitable cable boxes for H.T. and L.T. side be provided.

EMW-5: Main L.T. Panel Board

Suitable L.T. Panel Board 415 V, 50 c/s, 3 phase AC supply, sheet steel fabricated in cubicle pattern floor mounting type in single tier formation with 3 nos. bus bars of suitable rating and neutral of half the capacity sectionalised through a bus section and with a breaking capacity of 34 MVA, shall be provided.

Required number of outgoing panels of suitable rating for feeding the various drives, power correction panel for meeting the LT load requirements including internal and external lighting, street lighting, sufficient number of spare feeders etc., to complete the work on turnkey basis. Each outgoing panel shall have an ammeter suitably scaled, cable boxes and glands suitable for single or multi core cables for each phase and another cable for neutral. The LT Main Panel board and the distribution boards shall be complete with all internal wiring, dust, insect and vermin proof.

The location, layout and ratings of various feeders shall have to be got approved from the employer before starting the execution of work.

In respect of LT switch gears up to 100 Amps SFU with HRC fuses shall be used, above 100 Amps and up to 400 Amps MCCB shall be used. Above 400 Amps ACBs of suitable ratings shall be used.

Specifications for HT & LT Switch gear and Distribution Board

The cubicles for the LT switch gear shall be as per specifications

EMW-6: Sheet Metal Work

- a) Sheet steel used for fabrication of distribution boards, switch gear cubicles shall be cold rolled.
- b) All cubicles, starter panel and boards shall comprise rigid welded structural frame made of structural steel sections or of pressed and formed sheet steel of not less than 3 mm thickness. The frames shall be enclosed by steel sheets of thickness at least 2 mm cold rolled or 2.5 mm hot rolled smoothly finished, levelled and free from flaws. Stiffeners shall be provided wherever necessary.
- c) All doors, panels, removable covers, gland plates etc. shall be gasketed all round the perimeter.
- d) All panel edges shall be reinforced against distortion by rolling, bending, or by the addition of welded reinforcing members.
- e) All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.
- f) All floor mounting panels / boards shall be provided with 50 mm high channel base frame. Total height of all floor mounting cubicles / panels shall be 2500 mm (maximum).

EMW-7: Marshalling Box

Marshalling box shall be of either the floor mounting type or wall mounting type, depending on the size. Marshalling box shall be provided with a removable, hinged front door.

EMW-8: Distribution Boards

- a) Distribution boards shall comprise an incoming isolating switch and requisite number of feeder circuits protected by HRC fuses/MCB. Three phase and neutral bus bars, as well as an earth bus bar shall be provided in the distribution board.
- b) Distribution boards shall be provided with a hinged front door. The incoming switch of the door shall be mounted in such a way as to facilitate operation from the front, without opening the door.
- c) Distribution boards shall be wall/floor mounted.

EMW-9: Metal Clad Switch gear

- a) Separate, segregated compartments shall be provided for circuit breakers, bus bars, cable boxes, voltage transformers, wire ways, relays, instruments and control devices. Cable boxes shall be mounted inside the switchgear cubicle. Metal Clad switch gear cubicles/modules shall be provided with hinged doors in the front, with facility for padlocking door handles.
- b) Switch gear shall be extensible on both sides.
- c) Switch gear enclosures shall be provided with a degree of protection not less than IPH-3 for H.T. switch gear, and IP52 for LT Switch gear in accordance with IS: 13947.
- d) Vent openings shall be covered with grills so arranged that gases cannot be discharged through them in a manner that can injure the operating personnel.
- e) Instruments, relays, and control devices shall be mounted flush on hinged door of the metering compartment located in the front portion of the cubicles.
- f) Each switch gear cubicle shall be fitted with a label on the front and rear of the cubicle. Each switch gear shall also be fitted with a label indicating the switch gear rating and duty.
- g) Each relay, instrument, switch, fuse and contractor shall be provided with a separate label.
- h) Wording of all labels shall be approved by the Engineer
- i) Switch gear shall be complete with inter panel wiring.
- j) High voltage Metal Clad switch gear shall comprise separate vertical sections for each circuit.
- k) Medium voltage Metal Clad switch gear shall comprise separate, segregated modules for each circuit. More than one module may be arranged in the same vertical section. Medium voltage switch gear circuits not controlled by circuit breakers shall be of the fixed type, semi drawout or drawout type as specified in the 'Equipment Parameters'.

- l) The fixed type module shall have all the circuit components mounted in the compartment, with bolted type of power and control connections after removing the connections and the component fixing bolts.
- m) The semi-drawout modules shall have the circuit components mounted on with drawable type steel chassis,. All control circuits shall be wired to terminal blocks mounted on the fixed portion of the switch gear. It shall be possible to completely withdraw the chassis-mounted circuit components after disconnecting the control circuits.
- n) The fully drawout modules shall comprise all the circuit components mounted on withdrawable type steel chassis. All power and control connections shall be of the drawout type. It shall be possible to withdraw the chassis-mounted circuit components without disconnecting any connections.
- o) Bus ways, cable ways and wire ways in medium voltage switch gear shall be run in separate segregated compartments.
- p) Alarm and annunciation for OTL, WT1 and Buchhotz relay shall be provided in LT panel.

EMW-10: Bus Bars

- a) Switchgear shall be provided with three phase or three phase and neutral bus-bars as required.
- b) Bus-bars shall be of aluminium.
- c) Bus-bar joints shall be of the bolted type and shall be insulated. Spring washers shall be provided to ensure good contact at the joints.
- d) Bus-bars shall be located in air insulated enclosures. Direct access to or accidental contact with busbars and primary connections shall not be possible. All aperture and slots shall be protected by baffles to prevent accidental shorting of busbars by the entry of maintenance tools. To provide a tight seal between cubicles, bushings or insulating panels shall be provided for busbars crossing from one cubicle into another.

EMW-11: Circuit Breakers

Switch and Fuse Isolators

- 1. Medium voltage air-break switches shall be of the load break, fault make, group operated type. For use on 3-phase system, the switches shall be of the triple pole type with a link for neutral wire. For use on single phase system and DC systems, the switches shall be of the two pole type.
 - Switches shall be of the heavy duty, quick make and quick break type. Switch contacts shall be silver plated, and contact springs shall be of stainless steel. Switch handles shall have provision for locking in both fully open and fully closed positions. Mechanical ON-OFF indication shall be provided on the switches.
 - Switches for controlling motor circuits shall be of the load break, fault make type, and shall be capable of breaking locked rotor current of the associated motor.
 - Medium voltage switches and composite units of switches and fuses shall comply with the requirements of IS: 13947 - Part 3
- 2. Medium voltage composite units of switches and fuses shall be provided with the

following interlocks so that

- The fuses are not accessible unless the switch is in fully open condition.
- It is not possible to close the switch when the fuse cover is open, but an authorised person may override the interlock and operate the switch. After such an operation, the cover shall be prevented from closing if the switch is left in the 'ON' position.

Fuses and links shall be provided to enable any circuit to be isolated as necessary for maintenance and test purposes without isolating the whole panel.

All fuses shall be of the HRC cartridge type, mounted on plug-in type of fuse bases. Fuses shall be provided with visible indicators to show that they have operated. Current vs. time characteristics of all types of fuses shall be furnished for the approval of the Consulting Engineer. Fuses shall comply with the requirements of IS: 9224-part 2.

Fuse carriers and solid link carriers and bases shall be made of plastic moulded insulating material of an approved make. Ceramic materials will not be accepted. All accessible live connections shall be efficiently shrouded. Wherever fuses with high current ratings are directly plugged-in to the circuit terminals, without their having to be mounted in fuse carriers, un-shrouded terminals may be provided. However, in such cases and insulated fuse removal handle shall be furnished for each size of un-shrouded fuse for the circuit live without danger of contact with live metal. The fuses shall be rated to give maximum protection to the apparatus in circuit and the rating shall be inscribed on the fuse label.

Earthing and neutral links in main supply circuits shall be of silver plated solid copper and be of the bolted pattern.

Fuses and links functionally associated with the same circuit shall be mounted side by side.

An adequate number of spare fuse cartridges for each rating shall be supplied and fitted in clips inside the panel.

EMW-12: Current Transformers

1. Current transformers shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block.
2. Current transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary duties of the switch gear.
3. CT core laminations shall be of high-grade silicon steel.
4. Current transformers for high voltage equipment shall be of the resin cast type.
5. Where Multi-ratio current transformers are provided, a label shall be provided, clearly indicating the connections required for the alternative ratios. These connections shall also be shown on panel wiring diagrams.
6. Identification labels shall be fitted giving type, ratio, rating, output and serial numbers and duplicate rating labels are to be fitted on the exterior of the mounting chambers suitably located to enable reading without the removal of any cover or metal sheeting forming part of the structure of the switchboard.

7. Magnetisation characteristics, calculated performance and protection settings shall be provided by the Contractor.

EMW-13: Voltage Transformers

1. Secondary windings of voltage transformers shall be rated for a three phase line voltage of 110V.
2. Voltage transformer windings shall have a minimum rated burden of 50 VA.
3. Voltage transformer windings for metering purposes shall be of accuracy Class 1.0.
4. Voltage transformer windings for protective purposes shall be of accuracy Class 3.0.
5. Primary protection for high voltage windings shall be provided with limiting fuses. All other windings of voltage transformers shall be provided with HRC fuses. Primary fuses for voltage transformers shall be rated to interrupt short circuit currents corresponding to the switch gear rating.
6. Voltage transformers for use with high voltage switch gear shall be of the resin cast type.
7. It shall be possible to replace voltage transformer fuses easily without having to de-energise the main busbars.

EMW-14: Relays

1. All relays shall be enclosed in rectangular shaped, rustproof cases.
2. All relays shall be suitable for flush mounting, with only the dust-tight covers projecting from the front of the panel.
3. All relays shall be accessible for setting and resetting from the front. Access to setting devices shall be possible only after the front covers of the relays are removed. Resetting facilities shall however be accessible external to the relay case.
4. All protective relays shall be of the drawout type, where it is not possible to provide protective relays of the drawout pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.
5. Voltage relays shall have sufficient thermal capacity for continuous energisation, using external resistors if necessary.
6. No control relay which would trip a circuit breaker when deenergised shall be used.
7. Auxiliary relays shall be rated to operate satisfactorily between 70% and 110% of the rated voltage. Tripping relays shall be rated to operate satisfactorily between 50% and 110% of the rated voltage.

EMW-15: Control and Selector Switches

1. Control and selector switches shall be of the rotary type, having enclosed contacts, which are accessible by removal of the cover.
2. Control and selector switches for instruments shall be flush mounted on the front of the panels and desks. Local/Remote selector switches when located on switch gear cubicles, shall be mounted inside the relay compartment at an accessible location.
3. All control switches shall be of the spring return to normal type. Circuit breaker control switches on switch gear cubicles shall be lockable in the 'trip' position.

4. Control switches shall have momentary contacts. Circuit breaker control switches shall be provided with a sequencing device to prevent repetitive closing operations without first moving to the trip position.
5. Selector switches shall be of the stay-put, maintained contact type.
6. Control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knurled handles. All handles shall be black in colour.
7. Properly designated escutcheon plates clearly marked to show the operating positions shall be provided with all switches.

EMW-16: Indication Instruments and Meters

1. Electrical indicating instruments shall be either 144 mm square with 270 degrees scale or 110 mm square with 240 degrees scale. Taut band type of instruments are preferred. Taut band moving coil instruments for use on ac systems shall incorporate built-in-transducers.
2. Indicating instruments shall be mounted flush on the panels with only flanges projecting outside the panel.
3. Instrument dials shall be white with black numbers and lettering. Dials shall be parallax free.
4. All indicating instruments shall have provision for zero adjustment outside the cover.
5. Normal maximum meter reading shall be of the order of 60% normal full scale deflection.
6. Watt-hour meters shall be of the induction type, and shall be provided with reverse running stop.
7. Instruments shall have an accuracy of Class 2.0.

EMW-17: Indicating Lamps

1. Indicating lamps shall be of the filament type, with low watt consumption. Indicating lamps shall be of the double contact, bayonet cap type rated for operation on either a 240V AC or a 30V DC system as applicable. Indicating lamps shall be provided with series resistance's to avoid short circuiting of control supplies in the event of fusing of the filament. Lamps shall be provided with translucent lamp covers.
2. Bulbs and lenses shall be interchangeable and easily replaceable from the front.

EMW-18: Push Buttons

1. 'Start' and 'Stop' push buttons shall be coloured green and red respectively. All other push buttons shall be of black colour.
2. All push buttons shall be of the 'push to actuate' the contact type.
3. Emergency stop push buttons shall be lockable in the operated position. The key shall be released from the push button in both 'released' and 'operated' positions, and operation of the push button shall be possible in the key released position. Push button knobs for emergency stop-push buttons shall be recessed to prevent accidental operation.

EMW-19: Space Heaters

1. Adequately rated anti-condensation space heaters shall be provided, one for each vertical cubicle of switch gear, for each separate control panel, for each distribution

board, for each switch gear, for each separate control panel, for each distribution board, for each switchboard, and for each marshalling box.

2. Space heaters shall be of the strip type, rated for operation on a 240 V, 1-phase, 50 Hz AC system.
3. Each space heater shall be complete with a rotary type 'On' - 'Off' switch, HRC fuse in the phase, link in the neutral, and a control thermostat.

EMW-20: Cubicle Lighting

Each switch gear cubicle, control panel, control cabinet, and marshalling box shall be provided with suitable interior lighting and a switch.

EMW-21: Safety Arrangements

1. All terminals, connections, relays and other components, which may be 'live' when from access doors are open, shall be adequately screened. It shall not be possible to obtain access to an adjacent cubicle or module when any door is opened.
2. Switchboard components on which provision is made for padlocking and on which the padlock is normally fitted under service conditions (e.g. withdrawable type voltage transformers, circuit breakers, control switches, etc.) shall each be supplied with a padlock. The padlock for each type of component shall be provided.
3. Where provision is made for the padlocking of components under specific conditions (e.g. safety shutters, earthing selectors, etc.) one padlock shall be supplied for each cubicle and each shall have a different lock change number with two keys being provided.

EMW-22: Alarm / Annunciation

Alarm & Annunciation schemes shall be included.

The alarm & annunciation panel shall be separate cubicle fabricated in 2mm thick Ms sheets and the fabrication, wiring and all other relevant works shall be carried out as specified for various other panels in this specification.

The alarm and annunciation scheme shall comprise of basically indicating the failure of any of the machinery namely

- Failure of power to a particular feed drive
- failure of movement of the connected mechanical equipment.
- overload trip
- failure of hydraulic systems controlling any of the drive
- Fire hazard

The alarm system shall comprise of hooters with a minimum sound of 100db at 5 metre distance.

A minimum of 6 hooters shall be strategically located in various locations.

EMW-23: Power and Control Cable Terminations

1. Cable boxes shall be of approved design with adequate clearances between phases and between phases and earth, in accordance with relevant standards.
2. Cable boxes for use on system with rated voltages upto 11 KV shall be suitable for cold setting epoxy resin type of compound filling.
3. Boxes shall be complete with combined armour and earthing clamps.
4. Provision shall be made for earthing the body of each cable box.

5. Equipment terminal blocks for power connections shall be complete with adequate phase segregating insulating barriers and suitable crimping type of lugs for connecting the insulated cable tails.
6. Where more than one core is terminated on each phase, unnecessary bending of cable cores shall be avoided, without decreasing the length of the insulated cable tail and the electrical clearances which would normally be obtained when using one core per phase.
7. Brass wiping glands shall be provided with cable boxes for paper insulated, lead sheathed cables. Compression type cable glands shall be provided for all other power and control cables.
8. All switchboards shall, unless otherwise specified, facilitate bottom cable entry. Removable gland plates shall be mounted at least 300 mm above the base of the panel. If the gland plates are provided inside the switchboard cubicles, entries in the base of the cubicle must be adequately vermin proofed, hardwood boards being the preferred means.
9. The individual cores of power and control cables shall be neatly dressed and supported at regular intervals inside the switchboards, before connecting them to the relevant terminals.

EMW-24: Wiring for Control and Protective Circuits

1. All wiring for control, protective, alarm, and indication circuits on all equipment shall be carried out with at least 1100 V grade, PVC insulated, stranded, tinned copper, 1.5 sqmm conductors.
2. All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel.
3. All wiring shall be taken to terminal blocks without joints or tees in their runs.
All wiring shall be colour coded as follows:

EMW-25: Instrument transformer

A-C circuits - Red, Yellow or Blue determined by the phase with which the wire is associated.

A-C phase wire	-	White
A-C neutral	-	Black
D-C circuits	-	Grey
Earth connections	-	Green

1. Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire and each core of multi core cables terminated on the panels. Ferrules shall fit tightly on the wires, without falling off when the wire is removed. Ferrules shall be of white color with black lettering.
2. All wires forming part of a tripping circuit shall be provided with an additional red ferrule marked 'T'. Each wire shall be identified by a letter to denote its function followed by a number to denote its identity, at both ends. Unused cores of multi core cables shall be ferruled U1, U2 etc., at both ends and connected to spare terminals.
3. Spare auxiliary contacts of electrical equipment shall be wired to terminals blocks.
4. Wiring for future equipment shall be provided as far as possible and all wires shall be terminated.

EMW-26: Control Wiring Terminal Blocks

1. Terminal blocks shall be of the 650 V grade, stud type. Brass studs of at least 6 mm dia with fine threads shall be used and securely locked within the mounting base to prevent turning. Each terminal shall comprise two threaded studs, with a link between them, washers, and matching nuts and lock nuts for each stud. Insulated barriers shall be provided between adjacent terminals. Not more than two wires shall be connected on any one stud. Where duplication of terminal block is necessary, suitable solid bonding links shall be incorporated in the design of the terminal block. Provision shall be made to insert terminal labels or shrouds between two successive insulating barriers. Connections to the terminals shall be at the front.
2. Terminals shall be numbered for identification and grouped according to function, and engraved black-on-white labels shall be provided on the terminal blocks describing the function of the circuit.
3. Terminals for circuits with voltage exceeding 125 V shall be shrouded. Terminal blocks at different voltages shall be segregated into groups and distinctively labelled.
4. Current transformer secondary leads shall be brought to terminal blocks, where a facility shall be provided for short circuiting and grounding the secondary.
5. Terminal blocks shall be arranged with at least 100 mm clearance between any two sets.
6. Separate terminal stems shall be provided for internal and external wiring respectively.
7. All wiring shall be terminated on terminal blocks, using crimping type of lugs or claw type of terminations.

EMW-27: Test Terminal Blocks

1. Test terminal blocks shall be provided for secondary injection and testing of relay equipment. A suitable metering block shall be provided where specified for the connection of a portable precision instrument to be operated when required for specific plant testing purposes.
2. The terminal blocks shall be provided with suitable shorting links or alternatively shall be of the type suitable for use with a portable test plug-in arrangement.

EMW-28: Earthing of Switch gear/Distribution boards

1. Each switch gear/Distribution board shall be provided with an earth bus bar running along its entire length. The earth bus-bar shall be located at the bottom of the board/panel.
2. Earth bus bars shall be of galvanised iron or copper. Earth bus bars shall be rated to carry the rated symmetrical short circuit current of the associated board/panel for one second. Earth bus bars shall be supported to withstand stresses generated by the momentary current of the value equal to the momentary rating of the associated switch gear/distribution boards.
3. Positive connection of all the frames of equipment mounted in the switch gear/distribution board to the earth bus bar shall be maintained through insulated conductors of size equal to the ground bus bar or the load current carrying conductor,

whichever is smaller. Earthing of draw out equipment frames shall be achieved through a separate plug-in contact.

4. All instrument and relay cases shall be connected to earth bus bar by means of 650 V grade, PVC insulated, stranded, tinned copper, 2.5 sq mm conductor looped through the case earth terminals.

The range of the amp. meter will be double than the connected load current. The L.T. volt meter will have a range of 0 to 500 volts. The amp. meter and volt meters to be provided wherever necessary suitable CTs and PTs will be provided for proper functioning of the amp. meter and volt meter.

The scope of work will also include the rubber matting required to be spread in front of all the panels.

The matting shall have a minimum thickness of 12.5 mm. and shall have dielectric strength suitable for the panels.

EMW- 30: Specifications for Valves

This specification covers the design, performance, manufacture, and construction features, testing at manufacturer's works, packing and forwarding to site of following specials:

Sluice Valves and

Non-Return Valves

Code and Standards

The design, manufacture and performance of valves and special shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Indian / British / US standards / or equivalent International standards.

Sluice Valve 50 mm to 1200 mm dia size: IS 14846

Non - Return Valves: IS 5312 (Part - I)

Sluice Valve: Construction Features.

The feature of construction shall generally conform to above specifications and rating. The Valves shall be suitable for installation with the valve shaft in any position. Valve flange shall be parallel to each other and flange face should be at right angle to the valve centreline. Backside of the valve flanges shall be machined or spot faced for proper seating of bolt head and nut.

Sluice valves shall be double flanged non-rising stem type. The valves shall be provided with hand wheel. The valves shall close with clockwise rotation of the hand wheel. The direction of closing or opening shall be marked on the hand wheel.

For sluice valves guides and lugs shall be provided to guide the wedge through its full travel. The guides and lugs shall be lined with Brass or bronze. The clearance between guides and lugs shall not be more than 3mm.

Suitably designed RCC/CC or structural steel supports shall be provided underneath the valves. Cost of support shall be deemed to be included in cost of the valve.

The tolerance on the valve dimensions shall be as per relevant standards / code and not exceeding the following

- a) Face to Face : ± 3 mm
- b) OD of Flanges : ± 3 mm
- c) Bolt circle diameter : ± 2 mm
- d) Thickness of flanges : ± 2 mm

Dimensional tolerance on casting shall be as indicated in IS 5519.

EMW-31: Non Return Valves:

Construction Features

The feature of construction shall generally conform to above specifications and rating.

Valve flange shall be parallel to each other and flange face should be at right angle to the valve centreline. Backside of the valve flanges shall be machined or spot faced for proper seating of bolt head and nut.

The valves shall be suitable for smooth functioning under the maximum design pressure. The valves shall have non-slam closing characteristics without external dampening arrangement.

Suitably designed RCC/CC or structural steel supports shall be provided underneath the valves. Cost of support shall be deemed to be included in cost of the valve.

The tolerance on the valve dimensions shall be as per relevant standards / code and not exceeding the following

- a) Face to Face : ± 3 mm
- b) OD of Flanges : ± 3 mm
- c) Bolt circle diameter : ± 2 mm
- d) Thickness of flanges : ± 2 mm

Dimensional tolerance on casting shall be as indicated in IS 5519.

Materials of Construction of various components shall be as under:

Sluice Valves:

Body and Gate: CI, conforming to IS 210 Gr FG 200

Body Seat rings & wedge facing ring: Lead tin bronze conforming to IS 318 LTB2

Spindle: Stainless steel conforming to IS 6603 (04Cr 18Ni 10)

Bolts and nuts: carbon steel, IS 1367 class 4.6

Bonnet gasket: Rubber, IS 638 type B.

Non Return Valves

Body and Doors: CI IS 210 Gr FG 200

Face and seat rings: Leaded tin bronze, IS 318 LTB 2

Bearing bushes: Leaded tin bronze IS 318 Gr LTB-2

Bolts and nuts: carbon steel IS 1367 class 4.6

Hinges: Grey cast iron IS 210, FG 200.

Hinge pin, door pin and door suspension: High tensile brass IS320, HT2

Door face: Natural rubber

Painting and Corrosion Protection

A shop coat of paint shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion, after release has been given for painting and before dispatch. All parts shall be adequately protected for rust prevention. Grease shall not be used on mechanical surfaces.

Drawings and Manuals

Bidder shall furnish along with his bid 6 copies of the following drawings of all the equipments.

Dimensional outline drawings.

Cross section Drawing.

Instruction manual shall be furnished by vendor after award of the contract.

Sluice Valve

Sluice valves shall be provided for isolating the sections of the pipelines and in the valley portions of the alignment for scouring, at the locations shown in the drawings. These sluice valves shall be of respective sizes as mentioned in the respective bill of quantities volume of this Bid Document and as shown in the drawings. The valves shall be of double flanged type, which will be installed on the pipe by flanged joints and with a dismantling joint wherever required as directed by the Engineer. Flanges of the valve shall be drilled to conform IS: 1538. The sluice valve shall be suitable for handling the sewage water and generally conform to IS: 14846. The valves shall be of non-rising spindle type and close in the clockwise direction. The direction of closing shall be marked on the hand wheel.

The sluice valves used as scour valves shall have a special scour tee with flanged joints. The design and locations of scour valves are shown on the

drawings. The Engineer with regard to topography shall determine exact positioning. At least 3m length of the washout pipe, inclusive of the isolating valve, measured from the centre line of the pipeline including tee with vertical pipe and semi circular bend as shown in the drawing, shall be laid at the same time as the pipeline and suitably capped to prevent ingress of foreign material. The minimum gradient for the scour valve pipe shall be 1 in 100, if not shown in drawings.

The specifications for the sluice valves are:

Type	:	Non-Rising Spindle
Working Pressure	:	10 kg/cm ² and 15 kg/cm ²
Size	:	80mm to 900mm as required
Operation	:	Manual
Material of construction		
Body, Bonnets, Wedge	:	CI as per IS:210 Grade FG 260
Spindle	:	SS AISI 431
Seat Ring / Wedge Ring	:	SS ASTM A296 CF8M
Back seat bush	:	Bronze as per IS:318 Grade LTB 2
Fasteners	:	SS AISI 304

CHAPTER III

SPECIFICATIONS FOR OTHER ITEMS OF WORK

MW-1: site clearance, levelling & clearing organic & inorganic waste

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other area as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling or pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications. However no trees shall be cut without obtaining written permission of the Engineer-in-Charge

MW-2: Lawn Plantation

Require excavation for plantation and preparation of soil should be made including breaking of clods removal of grass roots and cleaning as directed. Necessary good clay should be filled and bed of loam or river silt of approved quality mixed with manure at rate of 5 cum for 100 sqm. area laid on plantation area before lawn plantation. Land should be ploughed with tractor and level as directed and should be made ready for sowing. Farm yard manure at the rate of 5-cum per 100 sqm. Area should be sprayed over bed and mixed. Planting the grass for the lawn should be preferably *Cynodon dactyl* or Bermuda grass. The lawn must be prepared by one of the approved methods like from seeds, by turfing, by turf plastering or by dibbling roots. Suckers of pure Dhoro (doob) grass of approved quality at 10x10cm distance including proper watering. Lawns should be drained with great care in order to keep it lush with green. The soil should be drained effectively and water should not be allowed to be collected in pools. Before monsoon the ground must dug up to a depth of 30-45 cms to remove stones with weeds and the soil should be exposed to sunlight for proper sterilization. Lawns once formed should be subjected to regular rolling, mowing, watering, and restoration of patches. In the absence of rain the lawn must be provided with every 5 days, heavily soaking the soil to a depth of at least 15 cms. To keep the lawns in perfect condition it should be seeded once a month with liquid manure by dissolving 45 gms of Ammonium sulphate or 20 gms of Urea in 5 litres of water. Bone meal at the rate of 100 kgs per 1000 sqm is recommended in one year. Neem cake should also be applied once or twice a year at the rate of 200 kgs per 1000 sqm. Raking and scraping for thatch control must be carried out. Weed control measures should also be undertaken during the twelve months of defect liability period

MW-3: Plantation of Flowers

Flowerbeds are of Parranial types flowers to add a special charm to any place. They should be simple in design, either square, rectangular, circular or oval. The number and size of the flowerbeds are determined by its extent with type. The tallest growing species should be planted at the back of borders or in beds on lawns far away from the structures. The medium sized plants should be planted in the central area of the garden and the dwarfish ones should be planted in front. There should be a harmonious blending of colours to

create a pleasing appearance. Flowerbeds should be dug up at least 15-20 days before sowing or bedding out small plants. For most annuals it would be enough as the soil is worked to a depth of 45 cms but for deep rooting plants such as Sweet Peas, Cannas etc., the bed should be dug up to 60 cms. A basket of 10 kg of manure should be applied for about 2 sq. metres of flowerbed area. The bed should be levelled in such a way that it slopes slightly with uniformly from the centre to the edge. A clear space of 7 to 15 cms should be left unfilled by plants by the edge of the bed.

MW-4: Plantation of shrubs

Shrubs are plants, generally with woody stems, rather smaller than trees with bigger than most herbaceous plants. In a typical shrub, there are several woody stems arising from the same root. Shrubs are either deciduous or evergreen. A well-designed shrub border should consist of a suitable admixture of choice deciduous with evergreen shrubs. The preferred shrubs are Ixora, Thuja, Bougainvillea, and Euphorbia leucocephala, Poinsettia, Mussaenda etc. Shrubs should be planted by preparing cubic pits of 60 cm. pits about a metre each away should be filled with good soil mixed. With 2 to 4 baskets each of well decomposed manure. The ground should be well prepared in between by digging it about half metre deep with removing all weeds. They should be spaced at suitable distances so that when they mature and reach their maximum growth. They should not be allowed to grow straggly or form clumps by throwing suckers from the base. Manure should be applied to the shrubs at least once a year by providing plenty of compost materials.

MW-5: Plantation of Trees

Plantation is to done all along the boundary wall just to provide a green barrier. Big trees should be planted 3m apart from each other within a range of 5m wide. Space adjustment should be done taking the site condition into consideration. Cubical pit of 60cm should be proposed and should be filled with good soil mixed with 2 to 4 baskets of 5 kg each of well-decomposed manure. The ground should be well prepared in between by digging it about half meter deep with removing all stones weeds. The trees should be planted suitable distances so that when they mature and reach their maximum growth.

All works should be carried out as per the instruction and details shown above. Watering for at least 45 days is

MW-5: Roads and Patri

All the roads and patri in around the dwelling blocks shall be constructed as MoRTH specifications.