

# Ahmedabad Municipal Corporation

E-TENDER NOTICE NO. 02/2026-2027

TENDER NO. 3

**Tender Documents  
For  
Laying of Water Supply Distribution Network and  
Providing and Laying Sewerage Network in Different  
Chawls/Area with laying of Paver Block and RCC Road in  
Gomtipur Ward of East Zone in AMC area (Phase-II)**

**Volume I :- Technical Bid  
Part – II : Technical Specifications & Drawings  
Section : – D Technical Specifications  
Section : – E Drawings**

- (1) Date of download Tender Documents : From website on [www.tender.nprocure.com](http://www.tender.nprocure.com)
- (2) Pre-bid Meeting : --
- (3) Last date of online Tender Submission : Dt. **13/07/2026** Upto **18.00** hours
- (4) Last Date of submission of Blank tender document, EMD & Tender Fee and Other documents. : Dt. **14/07/2026** up to **16.00** hours by Speed Post or Registered Post AD, by courier or Hand delivery.
- (5) Date of e-Tender (Technical Bid) Opening : Dt. **14/07/2026** at **17.00** hours

**Authority**

Deputy Municipal Commissioner (East Zone)  
Ahmedabad Municipal Corporation  
East Zone Office  
Harubhai Mehta Bhavan,  
Viratnagar Char Rasta- Nikol  
Ahmedabad – 382415

**Engineer**

Additional City Engineer (East Zone)  
Ahmedabad Municipal Corporation  
East Zone Office  
Harubhai Mehta Bhavan,  
Viratnagar Char Rasta- Nikol  
Ahmedabad – 382415

**June - 2026**

## TECHNICAL SPECIFICATION

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## DETAILS SPECIFICATION OF MATERIAL

### M-1 WATER :

- 1.1 Water shall not be salty or brackish and shall be clean reasonably clear and free from objectionable quantities of silt and tract of oil and injurious alkalis, salts, organic mater and other deleterious materials which will either weaken the mortar or concrete or cause efflorescence of attach the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S. 456-1978.
- 1.2 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 for soundness, time of setting and mortar strength as specified in I.S. 269-1976. Any indication of unsoundness, change in time of setting of 30 minutes either 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.
- 1.3 Water for curing mortar, concrete or masonry should not be too acidic and also not 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 curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.
- 1.4 Hard and bitter water shall not be used for curing.
- 1.5 Potable water will be generally found suitable for curing mortar for preparing or concrete.

### M-2 CEMENT :

- 2.1 Cement shall be Ordinary Portland, Ordinary Portland cement as per I.S. 269-1976 or Portland slag cement as per I.S.455-1976.or Sulphate Resistant Cement as per IS-12330 latest Revision.
- 2.2 Testing of Cement : It should be specifically noted that the cement brought by the contractor at site of work shall be used after the same is tested at the approved laboratory as per the direction of the Engineer-in-charge. Such approved laboratory may be located at Ahmedabad. All the charges for transport and testing of the samples shall have to be borne by the contractor. The frequency of testing of such materials shall be in accordance to the relevant Indian standard as directed by the Engineer-in-charge.

### M-3 SAND :

- 3.1 Sand shall be natural sand, clean, well graded, hard strong, durable and gritty particles free from injurious of dust, clay, kankar nodules, soft or flaky particles shale, alkali salts, organic matter, loam, mica or other deleterious

substances and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary the sand shall be washed to make it clean.

### 3.2 COARSE SAND :

The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse shall be as under:

I. S. Sieve Designation	Percentage by weight passing sieve	I. S. Sieve Designation	Percentage by weight passing through sieve.
4.75 mm	100	600 Micron	30 - 100
2.36 mm	90 - 100	300 Micron	5 - 70
1.18 mm	70 - 100	150 Micron	0 - 50

### 3.3 FINE SAND :

The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under :

I. S. Sieve Designation	Percentage by weight passing through sieve	I. S. Sieve Designation	Percentage by weight passing through sieve.
4.75 mm	100	600 Micron	40 - 85
2.36 mm	100	300 Micron	5 - 50
1.18 mm	75 - 100	150 Micron	0 - 10

### M-4 STONE GRIT :

- 4.1 Grit shall consist 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 for as possible flaky elongated pieces shall be avoided.

It shall generally comply with the provisions of I. S. 383-1970. Unless special stone of particular quarried is mentioned. Grit special stone of particular quarries is mentioned. Grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer - in - charge. The grit shall have no deleterious reaction with cement.

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

I. S. Sieve Designation	Percentage passing through sieve	I. S. Sieve Designation	Percentage Passing through sieve
12.50	100%	4.75	0.20%
10.00	85 - 100%	2.36	0.25%

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

4.4 The necessary tests for grit shall be carried out as per the requirements of I. S. 2386 (Parts I to VIII) 1963, as per instruction of the Engineer-in-charge. The necessity of test will be decided by the Engineer-in-charge.

#### **M-5A STONE COARSE AGGREGATE FOR NOMINAL MIX CONCRETE :**

5A.1 Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

5A.2 The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, Aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. 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 reinforcement cement concrete the maximum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars of 6 mm. less than the cover whichever is smaller.

**TABLE**

I.S. Sieve Designation	Percentage Passing for single sized aggregates of nominal size			I.S. Sieve Designation	Percentage Passing for single sized aggregates of nominal size		
	40 mm	20 mm	16 mm		40 mm	20 mm	16 mm
80 mm	-	-	-	12.5 mm	-	-	-
63 mm	100	-	-	10.0 mm	0.5	0.20	0.30
40 mm	85-100	100	-	4.74 mm	-	0.50	0.50
20 mm	0-20	85-100	100	2.35 mm	-	-	-
16 mm	-	-	-	85-100	-	-	-

NOTE :- The percentage may be varied by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

5A.3 The grading test shall be taken in the beginning and at the charge of source of materials. The necessary tests indicated in I.S. 383-1970 I. S. 456-1978 shall

have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the inter mixed on different aggregates. If the aggregates are covered with dust, they shall be washed with water to make them clean.

**M-5B BLACK TRAP OR EQUIVALENT HARD STONE COARSE :**

- 5B.1 Aggregate for Design Mix concrete : Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard, strong, dense, durable clean and free from skin and coating likely to prevent proper adhesion of mortar.
- 5B.2 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 or equivalent hard stones as approved. Aggregate shall have no deleterious reaction with cement.
- 5B.3 The necessary tests indicated in I. S. 383-1970 and I.S.456-1978 shall have to be carried out to ensure the acceptability of the material.
- 5B.4 If aggregate is covered with dust it shall be washed with water to make it clean.

**M-6 BRICKS :**

- 6.1 The bricks shall be hard or machine moulded and made from suitable soils and kiln burnt. They shall be free from cracks and flaws and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colour.

The bricks shall be moulded with a frog of 100 mm x 40 mm and 10 mm to 20 mm deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600 mm.

- 6.2 The size of modular bricks shall be 190 mm x 90 mm.
- 6.3 The size of the conventional bricks shall be as under :

$$\left( 9'' \times \frac{4\frac{3}{4}''}{4} \times \frac{2\frac{3}{4}''}{4} \right) 225 \times 110 \times 25 \text{ mm.}$$

- 6.4 Only bricks of one standard size shall be used on one work. The following tolerance shall be permitted in the conventional size adopted in a particular work.

Length : = 1/8" (3.0 mm) Width : = 1/16" (1.50 mm)  
Height : = 1/16" (1.50 mm)

- 6.5 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 etc. shall be carried out as per I.S. 3495 (Part-I to IV) - 1976.

**M-6A FLY-ASH LIME BRICKS :**

The fly ash lime bricks shall conform to Grade-1 or Grade-2 of IS-3812-1981. The frog of the 80 to 100 mm x 40 mm x 10 to 20 mm size.

The size of modular bricks shall be 190 mm x 90 mm x 90 mm.

The size of conventional brick shall be 225 mm x 110 mm x 75 mm.

Only bricks of one standard size shall used on one work. The following tolerances shall permitted in the conventional size adopted in a particular work:

Length : + 3 mm

Width : + 3 mm

Height : + 2 mm

The physical characteristic of bricks shall be as follows.

The minimum compressive strength of fly ash lime bricks shall not be less than 75 Kg/Sq.Cm. and the test shall be conform to IS-3495 (Part-I):1992.

The average drying shrinkage of the brick when tested by the method described in IS 4139-1989 being shall not exceed 0.15 percent.

The averages water absorption not more than 20 percentage by mass and the test shall conform to IS-3495 (Part-3):1992.

**M-7 MILD STEEL BARS :**

7.1 Mild steel bars reinforcement for R.C.C. work shall conform to I.S. 432 ( Part-II ) 1966 and shall be tested quality. It shall comply with relevant part of I.S.456-1978.

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

7.3 For the purpose of payment the bar shall be measured correct upto 10 mm length and weight payable worked out the rate specified below :

1. 6 mm	0.22 Kg./Rmt.	8. 20 mm	2.47 Kg./Rmt.
2. 8 mm	0.39 Kg./Rmt.	9. 22 mm	2.98 Kg./Rmt.
3. 10 mm	0.62 Kg./Rmt.	10. 25 mm	3.35 Kg./Rmt.
4. 12 mm	0.89 Kg./Rmt.	11. 28 mm	4.83 Kg./Rmt.
5. 14 mm	1.21 Kg./Rmt.	12. 32 mm	6.31 Kg./Rmt.
6. 16 mm	1.58 Kg./Rmt.	13. 36 mm	7.31 Kg./Rmt.
7. 18 mm	2.00 Kg./Rmt.	14. 40 mm	9.86 Kg./Rmt.

**M-8 TMT FE-500 STEEL BARS FOR REINFORCEMENT :**

- 8.1 Reinforcement bars shall conform to IS-432, IS-226 or IS-1786 with its latest amendment and welded wire fabrics to IS : 1566. Only TMT bars for reinforcement in RCC duct shall be used which shall be clean, free from pitting, oil, grease, paint, loose mill scale, rust, dirty dust or any other such substance that will destroy or reduce bond.

It permitted by the Engineer-in-charge reinforcement shall be done in accordance with IS-2751 or IS-9147 as applicable.

- 8.2 Other provision and requirements shall conform to specification No. M-7 for mild steel bars.

**M-9 MILD STEEL BINDING WIRE :**

- 9.1 The mild steel wire shall be of 1.63 mm or 1.22 mm (16 or 18 gauge) diameter and shall conform to I.S. 280-1972.

- 9.2 The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust, oil paint grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

**M-10 STRUCTURE STEEL :**

- 10.1 All structural steel conform to I.S.226 - 1965. The steel shall be free from the defects mentioned in I.S. 226-1975 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 conform to I.S. 1148-1973.

- 10.2 When the steel is supplied by the contractor test certificate of the manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

**M-11 SHUTTERING :**

- 11.1 The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel 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 centering rigid. In places of bullie props, brick pillar of adequate section built in mud mortar may be used.

- 11.2 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 grout.



- 11.3 If at any stage of work during or after placing concrete in the structure, the form sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete form work shall be got inspected by and got approved from the Engineer-in-charge, before the reinforcement bars are placed in position.
- 11.4 The props shall consist of bullies having 100 mm minimum diameter measured at mid length and 80 mm at thin end and shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm thick and minimum bearing area of 0.10 Sq.m. laid on sufficiently hard base.
- 11.5 Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.
- 11.6 The timber used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so wet to shrink after erection. The timber shall be properly sawn and planned on the sides and the surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted.
- 11.7 As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.
- 11.8 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 raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.
- 11.9 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 of subsequent deflection for cantilevers the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-charge.

#### **M-12 HARD DRAWN WIRE :**

The Hard drawn steel wire should confirming to IS-432 (Part 2), Hard drawn steel wire shall be manufacture and its chemical composition should be as per para 3.0. The finished wire should be free from defects and finished in a workman like manner. Nominal sizes, Tolerances, Physical requirements are as per IS : 432 (Part-II) latest edition. Hard drawn steel wire should be tested as specified in IS : 432 (Part-II) latest edition.

Note : All the B.I.S. mentioned above shall be with its latest addition as well as amendment.



## **D-1 : EXCAVATION FOR PIPELINE TRENCHES**

### **SECTION - D: 1**

#### **D.1.1 GENERAL :**

- D.1.1.1 Any soil which generally yields to the application of pickaxes and shovels or jumpers or scarifiers, phawaraa rakes or any such excavating implement or organic soil, gravel, silt, sand, tuff loam, clay, peat etc., fall under this category.

#### **D.1.2 CLEARING OF SITES :**

- D.1.2.1 The site on which the drain is to be laid as shown on plan and the area required for setting out and other operation shall be cleared and all obstructions, loose stones and materials, rubbish of all kinds, stumps, brushwood as well as all trees, shall be removed as directed. The roots shall be entirely grubbed up.
- D.1.2.2 The products of the clearing to be stacked in such a place and in such a manner, as directed by the Engineer-in-charge.
- D.1.2.3 In Jungle clearings, all trees not specially marked for preservation, bamboos, Junglewood and brushwood shall be cut and their roots grubbed-up. All wood and material from the clearing shall be the property of AMC and shall be arranged as directed the AMC Engineer or his authorised agent. The materials found to be usefully by the Engineer will be conveyed and properly stacked as directed within the specified limit. Useless materials will be burnt or otherwise disposed off as directed, by the Engineer-in-charge.
- D.1.2.4 All holes or hollows, whether originally existing or produced by drawing-up roots, shall be carefully filled up with earth, well rammed and leveled off, as may be directed.

#### **D.1.3 SETTING OUT :**

- D.1.3.1 All the centre line of drain trenches shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks etc. and maintain them as long as required true to line, level, curve & slopes. The contractor shall assume full responsibility for alignment, elevation and dimensions of each and all parts of the work. The labour, materials etc. required for setting out and establishing bench marks and other reference marks shall be arranged by the contractor at his own cost.

#### **D.1.4 EXCAVATION :**

- D.1.4.1 The excavation for the drain trenches shall include removal of all materials of whatsoever nature and whether wet or dry, necessary for the laying of pipe lines and sub-structure exactly in accordance with lines, levels, grades and curves shown on the plans L-sections or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width at of lowest portion of the trench and the side slopes as (1:0.5). The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed.
- D.1.4.2 Excavation shall be carried out in stratas specified in item of schedule `B'. The lift will be also as specified in Schedule `B'. Tunneling in case of laying of deep sewers in place of open excavation shall be allowed up to 2 metre length with the permission by the Engineer-in-charge. Contractor shall, as far as possible avoid tunneling at the joints of pipes. In such case, the levels and gradients of drain to be laid shall be properly attained and shall be got thoroughly checked by the contractor through the Engineer-in-charge. Payment of tunneling shall be made as per the rate for open excavation including dewatering etc. as mentioned in the item specification. No deduction or extra payment shall be made in case of tunneling. Excavated material shall be stacked at a minimum distance of 1.5 meters away from the edge of the trench or as directed. Sight rails and boning rods shall be used for checking the gradients of bed or trenches. Before the trench excavation is started, sight rails made of good timber shall fixed truly vertical at a uniform height, above the invert as per the instruction of the Engineer-in-charge. The centre line shall be clearly marked on the sight rails. Depth of excavation shall be checked by boning rods of suitable size and length as per instructions of the Engineer-in-charge. All the sight rails shall be painted alternatively with two different colours so as to provide better visibility.
- D.1.4.3 The bottom of the trenches shall be leveled both longitudinally and transversely or stepped as directed by the Engineer. The contractor shall, at his own cost, remove such portion of boulders or rock, as required to make the bottom of the trench level. No filling shall be allowed to being the bottom of the trench in level. If by contractor's mistake, Excavation is made deeper that shown on the plan ordered by the Engineer, the extra depth stuff duly watered and rammed as directed by the Engineer as at the cost of the contractor. All rock or other hard foundation shall be cleared off, all soft and loose material cut to a firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and elevation of bottom of trenches and may be deemed necessary to secure satisfactory laying of pipe lines. The contractor shall at his own expense, make provision for all pumping, dredging bailing out of draining water and the trenches shall be kept free of water, during construction work.
- D.1.4.4 After each excavation is completed, the contractor shall notify the Engineer to that effect and no trench will be allowed to be filled up until the Engineer or his authorised agent approved the depths and dimensions of excavation and

the nature of the strata met with and the level and/or measurements are recorded.

- D.1.4.5 The work measured shall be maintained till completion and in case of collapse of sides or bottom of trenches due to any reasons, it shall be made good without any extra cost.

**D.1.5 PROTECTION :**

- D.1.5.1 The drain trenches, shall be strongly fenced and red light signals shall be kept at night in charge of watchmen to prevent accidents. Sufficient care and protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution Boards etc. shall be provided by the Contractor. The wooden planks for crossing trenches by public as per requirement shall be provided by the contractor without any extra cost.

**D.1.6 ADDITIONAL REQUIREMENTS :**

- D.1.6.1 At the joints drain the trench shall be excavated to an additional depth of 15 cms. and width of 30 cms. and length of 15 cms. beyond the edge of collar on both the sides or as directed by Engineer-in-charge. The rate includes for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of trench shall be kept as per invert level or as directed. In obtaining formation on the bottom trench, the usual method of sight rails and boning rods shall adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

- D.1.6.2 If contractor fails or makes delay to give the hydraulic test of the pipe line laid line any of the section, without any genuine reasons, he shall be responsible to get reexcavate any part of the length of trenches refill in such case (i.e. before testing for safety of pedestrian and / or vehicular traffic) as found necessary be the Engineer-in-charge without any extra cost, if found necessary and as directed by the Engineer-in-charge. The contractor shall have to excavated the refilled trenches, during hydraulic test without any extra cost.

- D.1.6.3 In case of excavation across a road, permission of road authorities shall have to be obtained. At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipe line making it suitable for the traffic. The contractor shall provided diversion when the pipe line is to be laid along the road as required and shall maintain the diversion or any part of it, of damaged without any extra cost. At all road crossings, the pipe shall be laid below the crust of the road.

- D.1.6.4 The contractor shall break the road surface by Excavation of chiseling to the exact width and length as shown on the drawing or as directed by the

Engineer-in-charge. Separate provision for additional labour in breaking, removing of pavement is made and under this item quantities of excavation shall be including depth of such pavement removed.

- D.1.6.5 The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at no objectionable place or as directed by the Engineer-in-charge.
- D.1.6.6 The contractor shall have to make his own arrangements for taking trial pits etc. at his own cost, as directed by the Engineer-in-charge.
- D.1.6.7 If necessary, temporary arrangements shall have to be made to divert or convey across all natural water ways or build up drains etc. without any extra cost.
- D.1.6.8 All water pipes, cables, any structure shall be protected by the contractor as directed by the Engineer-in-charge, if met during excavation. Any damage caused shall be rectified without any extra cost.
- D.1.6.9 Breaking of brick structures/R.C.C. works, cement concrete etc. coming in excavation shall be considered as excavation in strata shown in the item, as above and will be paid at the same rate.
- D.1.6.10 All safety precautions shall have to be made by the Contractor including shoring and strutting.
- D.1.6.11 The excavation in narrow streets, lanes shall have to be carried out with full precautions so as that no property may be damaged. Any compensation to be paid to the other party will be paid by the contractor for which the AMC will not be responsible.
- D.1.6.12 All obstacles, structures etc. shall be removed and made good without further claim or extra cost.

#### **D.1.7 CLASSIFICATION OF STRATA :**

- D.1.7.1 The decision regarding classification of strata shall rest with the Engineer-in-charge and his decision shall be final and binding to the contractor.
- D.1.7.2 All the materials encountered in the excavation shall be classified as under.
- D.1.7.3 All sorts of soil, sand, gravel and other similar soft and loose materials these will include all materials of an earthy or sandy nature which can be easily ploughed or small shingle and gravel which can be easily removed of shall boulders not exceeding 0.30 Cu.m. or 30 litres (about one Cft.) occurring in such strata will be included in the rate for this item.
- D.1.7.4 **Soft Murrum :**

D.1.7.4.1 This shall include materials which can be easily removed with the shovel after loosening with a pick.

**D.1.7.5 Hard Murrum :**

D.1.7.5.1 This shall include all kinds of disintegrated rock or shale or inundated clay from boulders, larger than 0.30 Cu.m. or 30 litres (about one Cft.) and which can be removed with pick and shovel though not without some difficulty any which do not require blasting.

**D.1.7.6 Hard Murrum and Boulders :**

D.1.7.6.1 This shall include all kinds of disintegrated rock or shale or inundated clay interspersed with boulders less than half (0.5) a cubic meter (about half Ci.cft.) and large than 0.30 Cu.m. or 30 litres (approx. one Cft.) which do not normally require blasting and can be removed with pick, bar wedge and hammer.

Boulders bigger than 0.5 Cu.m. will be paid for as soft or hard rock according to as it is soft or hard-rock.

**D.1.7.7 Soft Rock :**

D.1.7.7.1 This shall include all materials which is rock or hard conglomerate, all decomposed and watered rock, highly fissured rock, old masonry and also soft rock boulders bigger than 0.5 Cubic meter and other varieties of rock which do not require blasting and which can be removed with rock, crow bars, wedges and hammer with some difficulty.

**D.1.7.8 Hard Rock (Blasted)**

D.1.7.8.1 This shall include all rocks, occurring in masses which could best be removed blasting and where in the opinion of the Engineer, blasting is necessary and is permissible.

**D.1.7.9 Hard Rock (Chiseled, Wedge or Line Drilled)**

D.1.7.9.1 This shall include all rock, occurring in masses or boulders bigger than half cubic meter size each, which can best be removed by blasting but which owing to the proximity or structures, possibility of shattering the rock below or for any other reasons should be cut by means of cold chisels or wedges or line drilling.

**D.1.7.10 Laterite :**

D.1.7.10.1 This shall include laterite rock soft and hard which can be removed with hammer, chisels, crow or by blasting. Lateritic murrum which has not hardened into stone shall be classified as hard murrum.

- D.1.7.10.2 The classification of various, stratas met with during excavation will be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.
- D.1.7.10.3 Rock referred to above would include Basalt, Trap, Granite, Quartzite, Gneiss, laterite and other types.
- D.1.7.10.4 The use of explosive in excavation will not be considered as a reason for other classification then the above unless clearly necessary in the opinion of Engineer-in-charge.

**D.1.8 DISPOSAL OF EXCAVATED STUFF :**

- D.1.8.1 The surplus excavated earth, after backfilling the trenches shall have to be removed from the site as directed.
- D.1.8.2 After compaction and consolidation, if any short fall of earth is found then contractor has to bring the same to the required quantity in order to meet shortfall at his own cost. More over, if any settlement of road after reinstatement is observed during the defect liability period of the work. Contractor shall be fully responsible for the defective work and patches / depression / settlement shall be repaired with quarry spoil or metal at contractor's own cost. If contractor fails to repair the patches/ depression / settlement in time, AMC will repair it at all risk and cost of contractor.
- Surplus earth shall not be disposed off in a way that leads to nuisance to the public or AMC.
- D.1.8.3 The site should be cleared off all debries on completion of work.

**D.1.9 MEASUREMENT AND PAYMENT :**

- D.1.9.1 The payment of a various classes of excavation, depending upon the depth of excavation, shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer limited to dimensions shown in the sanctioned plans L-Section or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured nor paid for and if so ordered by the Engineer. The contractor shall have to fill up the excess depth with selected excavated stuff duly watered and rammed as directed by the Engineer-in-charge without any extra payment to the Contractor.
- D.1.9.2 Dimension shall be measured correct to two places of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.
- D.1.9.3 The rate for the item of excavation shall include (Unless and otherwise mentioned).
- (a) Clearing of site.



- (b) Setting out work including all materials and labour.
- (c) Refilling the pipeline trenches.
- (d) Light compaction of bottom of the trench if required.
- (e) Excavation & removal, sorting and stacking of all excavated stuff as directed.
- (f) Necessary protection arrangements including labour, materials equipment etc. to ensure safety and protection against risk or accident.
- (g) Providing facilities for inspection and measurements at any time by the concerned AMC Officials.
- (h) Compensation for injury to life and damage to property if caused during progress of work.
- (g) No stacking of excavated earth will be allowed on the road during the execution. The contractor will have to cart the earth to designated stacking plot to be arranged by the contractor and will have to be re-cart the back fill material after laying and jointing of pipe is completed. No extra payment for carting and re-carting will be made and this shall be deemed to be part of item for excavation i.e. item no. 1 & 9 of bill of quantities.

D.1.9.3.1 The measurement of item shall exclude the quantity of excavation carried out for Machinehole.

**D.1.9.4 Penalty :**

Penalty for no barricading shall be Rs. 200 per Rmt. In case the contractor does not provided barricading and other safety measures. The same shall be carried out by AMC at risk and cost of contractor. 1.5 times the actual cost incurred shall be recovered.

## **D-2 : BACKFILLING**

### **SECTION - D: 2**

#### **D.2.1 GENERAL**

- D.2.1.1 All fill material will be subject to Engineer's approval. If any material is rejected by Engineer, contractor shall remove the same forthwith from the site at no extra cost to the owner. Surplus fill material shall be deposited / disposed off as directed by Engineer after the fill work is completed upto a distance of 5 Km for which separate payment will be paid under the corresponding item.
- D.2.1.2 No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by Engineer.

#### **D.2.2 MATERIAL**

- D.2.2.1 To the extent available, selected surplus soils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the bounders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth fill up the voids and the mixture used for filling.
- D.2.3 If any selected fill material is required to be borrowed, Contractor shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of Engineer. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish etc, top soil containing salts / sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by Engineer. Contractor shall make necessary access to borrow areas and maintain the same, if such access road does not exist, at his cost.

#### **D.2.4 FILLING IN PITS AND TRENCHES AROUND FOUNDATIONS OF STRUCTURES, WALLS ETC.**

- D.2.4.1 As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleaned of all debris, and filled with earth in layers not exceeding 20 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Engineer. Earth shall be rammed with approved mechanical compaction machines if instructed. Usually no manual compaction shall be allowed unless Engineer is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to proper profile as directed by Engineer or indicated on the drawing.

## **D.2.5 FILLING IN TRENCHES**

- D.2.5.1 Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.
- D.2.5.1.2 Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centreline of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the centreline of the pipe shall also be done with selected earth by hand compaction or other approved means in layers not exceeding 20 cm.
- D.2.5.1.3 In case of excavation of trenches in rock, the filling upto a level 30 cm above the top of the pipe shall be done with fine materials, such as earth, moorum etc. The filling up of the level of the centreline of the pipe shall be done by hand compaction in layers not exceeding 20 cm. Also the filling above the centreline of the pipe shall be done by hand compaction or approved means in layers not exceeding 20 cm. The filling from a level 30 cm. Above the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 20 cm mixed with fine material as available to fill up the voids.
- D.2.5.1.4 Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

## **D.2.6 GENERAL SITE GRADING**

- D.2.6.1 Site grading shall be carried out as indicated in the drawings and as directed by Engineer. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as specified elsewhere unless otherwise indicated below.
- D.2.6.2 If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 200 mm and leveled uniformly and compacted as indicated in before the next layer is deposited.
- D.2.6.3 To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by Contractor at his cost.
- D.2.6.4 Field compaction test shall be carried out at different stages of filling and also after the entire height has been completed. This shall hold good for embankments as well.
- D.2.6.5 Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, Contractor shall remove the affected material and make good the slip at his cost.

- D.2.6.6 The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.
- D.2.6.7 If specifically permitted by Engineer, compaction can be obtained by allowing loaded trucks conveying fill or other material to ply over the fill area. Even if such a method is permitted, it will be for contractor of demonstrate that the desired / specified compaction has been obtained. In order that the fill may be reasonably uniform throughout, the material should be dumped in place in approximately uniform layers. Traffic over the fill shall then be so routed to compact the area uniformly throughout.
- D.2.6.8 If so specified, the rock as obtained from excavation may be used for filling and leveling to indicate grades without further breaking. In such an event, filling layers not exceeding 50 cms approximately. After rock filling the void in the rocks shall be filled with finer materials such as earth, broken stone etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken materials and earth shall be laid and consolidation carried out by a 12 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.
- D.2.6.9 Fill Density- deleted**
- D.2.6.9.1 The compaction, only where so called for, in the schedule of quantities / items shall comply with the specified (Standard Proctor / modified Proctor) density at moisture content differing not more than 4 percent from the optimum moisture content. Contractor shall demonstrate adequately at his cost, by field and laboratory tests that the specified density has been obtained.
- D.2.6.10 Lead**
- D.2.6.10.1 Lead for deposition / disposal of excavated material, shall be as specified in the respective item of work. For the purpose of measurement of lead, the area to be excavated or filled or area on which excavated material is to be deposited / disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centerlines shall be taken as the lead which shall be measured by the shortest straight line route taken by Contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed material had to be transported over marshy or 'katcha' land / route.
- D.2.6.11 Measurement and Payment**
- D.2.6.11.1 No extra payment shall be made for refilling The cost of backfilling is included in rate of excavation.

D.2.6.11.2      Penalty for improper watering and compaction will be Rs. 350/Tanker required and rent for roller @ Rs. 20 per sq.m.

In case the watering and compaction of the backfilled material is not as per the specifications, AMC will carry out the same through own resources. A rate of Rs. 350 per water tanker and Rs. 20 per sq.m. for rolling and compacting will be recovered from the contractor.

## **D-3 : SHORING AND STRUTTING**

### **SECTION - D: 3**

#### **D.3.1 GENERAL :**

- D.3.1.1 This item is applicable only when the trench having more than 5.0 mt. depth and if the sides of trenches cannot be sloped or stepped due to any reason and the Engineer-in-charge feel the necessity for safety of trench and adjacent property and traffic. The Contractor should have to take previous approval from Engineer-in-charge before commencing this item.

#### **D.3.2 MATERIALS :**

- D.3.2.1 Sheathing, planks, wales, struts etc. required for shoring and strutting shall be of approved quality of wood or structural steel as per requirements of IS-3764-1966.

#### **D.3.3 WORKMANSHIP :**

- D.3.3.1 The Contractor before execution shall get approval of design of shoring from Engineer-in-charge. The shoring shall be of sufficient strength to resist side pressure and ensure safety from slips and below and to prevent damage to work and to prevent injury to persons. It shall be removed after getting permission of Engineer-in-charge, after all items for which it is required area completed. Shoring and strutting shall conform to IS - 3764 - 1966 or its latest version.
- D.3.3.2 The sheeting shall be placed against the side of trench so that length of each piece of sheeting is vertical. The sheeting shall be held securely in place against the Wales by ensuring that sheeting is kept firmly placed against the wall of the trench. Where the trench is excavated in loose, sandy or soft soil or soil which has been previously excavated or soil which is under hydrostatic pressure, each piece of sheeting shall be driven into the bottom of trench so has to be firmly held in place.
- D.3.3.3 Where two or more pieces of sheeting are used one above another, the sheeting shall be so arranged that the lower piece of sheeting overlap the lowest Wales supporting the pieces of sheeting next above next above it. These pieces of sheeting shall be firmly driven in to the soil and securely supported by Wales and struts as the trench is made deeper.
- D.3.3.4 The wales shall be supported parallel to the bottom or the proposed bottom of the trench. Each wale shall be supported on cleats spliced to the sheathing or by posts set on the wales next below it and in the case of lowest wale on the bottom of the trench itself. Where necessary, wedges may be provided between a wale and sheathing is supports to that roughly uniform support is given to all individual pieces of sheathing.

- D.3.3.5 Struts shall be horizontal and at right angles to the wales of sheathing supported thereby. Struts shall be cut to the proper length required to fit in tightly between wales, where necessary, the struts shall be held securely in place by wedges, driven between struts and the wales. Struts shall be placed on cleats spliced or bolted to posts supporting wales.
- D.3.3.6 The sizes and spacing of sheathing, wales struts and wedges used for shoring and timbering for different depth shall conform the requirement of IS-3764-1966 or its latest version.
- D.3.3.7 The extra width of excavation that may be deemed necessary for the purpose of shoring and strutting will be under-stood to be covered in the rate for item of shoring and strutting for drain side.
- D.3.3.8 The contractor shall have to make all the necessary arrangements while removing shoring strutting. However, if contractor fails to remove the shoring strutting safely, the AMC shall not be responsible for any type of damages and contractor shall have to bear all the cost for the same and the AMC shall not pay any extra payment for the same.
- D.3.3.9 Shoring and strutting shall be close or open depending on the nature of soil and the depth of trench. The type of shoring and strutting shall be determined by the Engineer in charge. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches from collapse. Engineer in charge should take guidance from IS : 3764-1966 for designing the shoring and strutting arrangements and specifying the profile of excavation.
- D.3.4 Measurement :**
- D.3.4.1 The item includes all labours, materials, equipments, tools etc. complete for whole the period for satisfactory completion of the item.
- D.3.4.2 No extra payment shall be given for shoring & strutting. The shoring & strutting is included in item of excavation.
- D.3.4.3 No payment shall be made to any wood which has been left out by the contractor while removing the shoring, strutting etc.

## **D-4 : DEWATERING**

### **SECTION - D: 4**

#### **D.4.1 SCOPE**

- D.4.1.1 This specification covers the general requirements of dewatering excavations in general.

#### **D.4.2 GENERAL**

- D.4.2.1 All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. Contractor shall remove by pumping or other means approved by Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keep all excavations dewatered until the foundation work is completed and backfilled. Sumps made for dewatering must be kept clear of the excavations / trenches required for further work. Method of pumping shall be approved by Engineer but any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction.

- D.4.2.2 Contractor shall visit the site and carry out necessary tests to work out the cost. AMC will not be responsible for subsoil survey or any data given in tender document. Contractor is deemed to have inspected and examined the site and its surroundings and to have satisfied himself to the nature of site before submitting his tender.

- D.4.2.3 When there is a continuous inflow of water and quantum of water to be handled is considered in the opinion of Engineer, as large, well point system – single stage or multistage, shall be adopted. Contractor shall submit to Engineer his scheme of well point system including the stages, the spacing, number and diameter of well points, heads etc. and the number, capacity and location of pumps of approval. Unless separately provided for in the schedule of prices the cost of dewatering shall be included in the item rate for excavation.

#### **D.4.3 MEASUREMENT**

Dewatering is deemed to have been included in the unit rates quoted for excavation.



## **D-5 : EXCAVATION OF ASPHALT PAVEMENT REINSTATEMENT OF PAVEMENT**

### **SECTION - D: 5**

#### **(A) EXCAVATION OF ASPHALT PAVEMENT**

- D.5.1 Under this item contractor shall demolish existing asphalt or WBM pavement met with during laying of RCC pipe.
- D.5.2 Only area of pavement intercepted in pipe laying shall be demolished. If excess area is demolished same shall be reinstated by the contractor.
- D.5.3 Demolished material like asphalt pavement lump and metal shall be stacked separately as directed by the Engineer, so that it can be reused in doing the pavement on completion of laying the pipe.
- D.5.4 Work done to the extent of requirement for laying of pipeline and as per specifications shall be measured in sq.m. and paid at the tender rate.

#### **(B) REINSTATEMENT OF ASPHALT PAVEMENT :**

##### **D.5.5 SCOPE**

##### **D.5.6 General**

The scope includes the reinstatement of asphalt Pavement of design thickness crossing the sewerage pipelines.

##### **D.5.7 Reinstatement**

After the work of laying and jointing of pipeline is completed, the earthwork, murrum surface,soiling and asphalt surface will be reconstructed as per the designed thickness as directed and using with old metalling material for soling and Any extra metal required shall be brought to contractor at own cost this includes necessary excavation ,watering, consolidation using excavated road materials like spouls ,metals including carting/recarting the material.

On the prepared soiling surface BUSG shall be carried out with New black trap metal,Key aggregate Bitumen as per MoRTH clause 506. The surface will be maintained till the work is completed. The measurement will be paid on square meter basis for all the types of surfaces constructed including earthwork.

##### **D.5.8 The payment for reinstatement of asphalt road payment will be made on sq.mt. basis of the work carried out as per the design and direction of engineer –in-charge**

- D.5.9 Penalty for incomplete reinstatement work shall be recovered @ 1.5 times the actual expense incurred by AMC.

## **D-6 : JUNCTION MACHINEHOLE, SCRAPER MACHINEHOLE & FRC MACHINEHOLE SEAT AND COVER**

### **SECTION - D: 6**

#### **D.6.0 MATERIALS :**

Water shall conform to M-1, Cement Conform to M-3, Stone coarse aggregate of 20 mm nominal size shall conform to M-12, Grit shall conform to M-8, Steel reinforcement shall conform to M-18-19. Flyash brick shall conform to M-15A, Cement mortar of specified perportion shall conform to M-11.

Machinehole cover with frame of required size and weight shall be procured by the contractor.

#### **D.6.1 WORKMANSHIP :**

The Machinehole of different types and sizes as specified shall be constructed in sewer line at such place and to such levels and dimension as shown in drawing or as directed.

**Excavation :-** The excavation for construction of Machinehole including dismantling of all types of roads surface guarding, barricading, lightening the trenches, dewatering if required, removing and replacing, shifting of telephone/electric cables, pipe line etc. and all other safety provisions like shoring and strutting etc. till refilling of trenches and completion of Machinehole construction, stacking of excavated stuff within the specified lead, back filling of selected excavated earth, watering and consideration etc. complete shall be carried out as per relevant specification of Excavation.

**Concrete work :-** The bed concrete in P.C.C. (1:4:8), benching concrete for channel in C.C. (1:2:4) and RCC slab in (1:2:4) by volume with necessary centering and shuttering work shall be provided. It should be placed deemed and or vibrated and cured as directed by engineer in charge.

#### **D.6.2 REINFORCEMENT :**

All the reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed No. 1 binding wire not less than 1 mm is size and by using stay block or metal chair spacers, metal hangers, supporting wires or other approved devices it sufficiently close intervals. Bars shall not be allowed to bag between supports nor displaced during concrete of any other operation of the work. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings.

Bars shall be bent cold to specified shape and dimensions or as directed, attain proper radius of bends, Bars shall not be bent or straightened in a manner that will injure the materials. Bars bent during transport or handling shall be straightened before being used on the work. Unless otherwise specified for mild steel a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement.

In case which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The cold twisted steel bars shall be used with or without hooks at the ends. Deformed bars without hooks shall however, comply with relevant anchorage requirements.

Bars crossing each other where required shall be secured by binding wires (annealed) of size not less than 1 mm in such a manner that they do not slip over each other at the time of fixing and concreting.

As far as possible bars of full length shall be used. In case this not possible overlapping of bars shall be done as directed. The overlaps shall be staggered for different bars and located at points along the span where shear not bending moment is maximum.

When permitted or specified on the drawings joints of reinforcement bars shall be butt welded so as to transmit their full stresses. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work.

### **D.6.3 BRICK MASONRY WORK :**

Before masonry is to be laid on concrete footing the top of concrete shall be cleaned and moistened. The contractor shall obtain the Engineer's approval for one foundation, bed, before foundation masonry is started.

**Wetting of Bricks :** The brick required for masonry shall be thoroughly wetted with clean water for amount two hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is an indication of thorough wetting of bricks.

Brick shall be laid in English bond unless directed otherwise. Half or out bricks shall not be used except when necessary to complete to bond. Closers in such case shall be cut to required size and used at 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 gently tamping with handle of trowel of wooden mallet. Its inside face shall be flushed with mortar the next brick is laid and pressed against it. On completion of course, the vertical joints shall be fully silled from the top with mortar.

The wall shall be taken up truly in plumb. All corners shall be laid truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of brick course shall be kept uniform.

The brick shall be laid with from up wards. A set of tools comprising of wooden straight edges, monsoon spirit level, square half meter rub, and pins string and plumb shall be kept on the site of work for frequent checking during the progress of work.

Both the faces of walls of thickness greater than 23 cms. shall be kept in proper place. All the connected brick work shall be kept not more than one meter over the rest of the work. Where this is not possible the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45 degrees.

All fixtures like pipe inlet and outlet, PVC steps, Machinehole cover and frame etc. which are required to be built in wall shall be embedded in cement mortar.

Brick shall be so laid that all joints shall not exposed 12 mm. The face joints shall be raked out as directed by raking 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.

For the face of brick work, plastering is to be done joints shall be raked out to a depth not less than thickness of joints. The face of brick work shall be cleaned and mortar dropping removed on very same day that brick work is laid.

#### **D.6.4 PLASTER WORK :**

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is not hard any by backing if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work. The surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface. Trimming of projections on brick/concrete surface where necessary shall be carried out to get an even surface.

The work shall be soaked but only damped evenly before applying the plaster. If the surface become dry, such areas shall be moistened again.

The plaster about 15 x 15 cms. shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surface of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel of wooden float accordingly excessive trowelling or over working the float shall be avoided. All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, junctions etc. shall be carried out with proper templates the size required.

Cement mortar for plaster shall be used within half an hour after addition of water. And mortar for plaster which is partially set shall be rejected and removed forthwith from the site.

In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically, when recommencing the plaster the edge of the old work shall be scraped clear and wetted with cement putty before plaster is applied to the adjustment areas to enable the two to properly together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm. to any corners or arrises. It shall not be closed on the body of features such as plaster bends and cornices not at the corners or arrises. Horizontal joints in plaster work shall not also occur on walls and copings these invariably leads to leakage. No portion of the surface shall be left out initially to be packed up latter on.

#### **D.6.5        FIXING OF POLY PROPYLENE STEPS AND MACHINEHOLE COVER :**

During the construction of masonry wall of the Machinehole the cement mortar of required proportion shall be used for embedding the Poly propylene steps in the wall masonry. The spacing of steps in the masonry shall be 300 mm centre to centre in the staggered position in the vertical direction with two staggered rows at 385 mm centre to centre in the horizontal direction the top of the Machinehole shall not be more than 300 mm above the benching and the centre line of two staggered rows shall be the centre line of the shorter side of Machinehole frame in the roof of chamber.

The detailed specifications for the "Poly propylene steps as below:

The Polypropylene conforming to an ASTM D-4101, injection molded around a 12 mm dia. IS 1786 grade Fe-500 steel reinforcing bar and should meet the load required 225 Kg. as per IS-5455. The measurement should be as per

attached drawing. The tolerance in the length and width is  $\pm 5$  mm and  $\pm 1$  mm in thickness. The weight of the steps should not be less than 0.900 Kg.

Unchequered portion of the step shall be inserted with the risk cement mortar during the course of masonry work so constructed around the steps as to keep the step on its right position. The non-slip gap chequered portion of the steps shall be well kept outside the masonry.

During fixing of the steps, the wall should not be damaged and shall not vibrate or shall not shake during ascents and descents otherwise they shall have to be refixed correctly as per the drawings or as mentioned above.

Machinehole frame shall be firmly and securely laid on top of shafts of conical tops in 25 mm thick cement mortar and shall be embedded in 200 mm the cement concrete of proportion 1:2:4 (1 Cement : 2 coarse sand : 4 Kapchi as aggregate of 20 mm nominal size) in such a way that the top of M.H. frame shall be flush with concrete surface and top surface neatly finished 25 mm thick with cement mortar 1:3 in conformity with ground or road levels.

#### **D.6.6 OTHER REQUIREMENTS :**

As per line and level and size of the Machinehole pit shall be excavated as per drawing or as ordered by the Engineer.

The foundation concrete 1:4:8 with required thickness as per drawing or as directed shall be laid after compacting the bottom of the pit. The cement concrete shall conform to specified specification of Cement Concrete.

The clear inside chamber size of opening shall be as per the drawing or as directed by the Engineer-in-charge.

The masonry wall shall be plastered inside with 20 mm thick 1:3 cement mortar and outside 15 mm thick in C.M. (1:3) above coping level. The off set for the concrete foundation shall be 300 mm on all sides beyond walls of chamber.

Whenever pipes enter or leave the masonry chamber bricks on edge must be so laid around the upper half of the pipes so as to form the arch to prevent the weight of the masonry chamber over it.

On the top of masonry walls 1:5 cement mortar shall be laid and then R.C.C. slab of grade 1:2:4 necessary and as directed by the Engineer with coarse aggregate of trap metal of 20 mm nominal shall be laid necessary from work and centering shall have to be provided by the contractor at his own cost as per relevant specification of cement concrete.

In the bottom of Machinehole the channel and benching shall be done in C.C. 1:2:4 (1 Cement : 2 Coarse sand : 4 graded stone aggregate of 20 mm

nominal size) rising at a step in line from edge of the channel, the channel of the bottom of the chamber shall be plastered 20 mm thick in c.m. 1:3 (1 Cement : 3 fine sand) and steel trowel smooth.

Channels shall be in semi circular in the bottom half and a diameter equal to the sewer. Above the horizontal diameter, the side shall be extended vertically to the same level as the crown of the out going pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junctions with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given.

For conical shaft of Machinehole necessary conical portion shall be treated from 750 mm below the bottom of concrete of slab for fixing of Machinehole cover and frame.

The item includes curing of all the cement work for 14 days.

#### **D.6.7           MODE OF MEASUREMENTS & PAYMENTS :**

Payment shall be made on the basis as per number of masonry Machineholes chamber Constructed with all constructing materials labours, excavation refilling curing, finishing providing and fixing PVC steps constructing laying half round gutter fixing R.C.C. Machinehole cover etc. complete in all respect.

The item will be paid per No. of construction of complete masonry Machinehole chamber as shown in the drawing upto the depth specified and shown in the type design drawing.

The measurements shall be made for such number of chambers construction. The surplus excavated stuff shall be disposed of as directed by Engineer-in-charge.

The depth of Machineholes shall be the distance between the top of Machinehole and the invert level of the main drain. The rate includes all labours, materials, tools and plant etc. required for satisfactory completion of this item as directed above.

The item includes :-

- (i)     Excavation for Machinehole
- (ii)    Bed concrete slab concrete and coping with necessary reinforcement.
- (iii)   Necessary brick work with cement plaster inside and outside.
- (iv)    Providing and fixing polypropylene steps.
- (v)     Carting, conveying and fixing of Machinehole frame cover with necessary concrete and finishing.
- (vi)    Refilling with necessary watering and consolidation.

(vii) Curing for 14 days.

#### **D.6.8 FIBRE REINFORCED CONCRETE :**

**Frame and Cover** – The fibre reinforced concrete frame and cover shall be 560 mm dia. Heavy duty type (circular-HD-20) as per IS:12592-2002. The dimensions of frame shall as per table-1 of clause 5.2 of IS-12592. The load test shall be as per table-2 of IS : 12592-2002.

**Table No. 2 – Test Load and Diameter of Block**

<b>Grade of Cover</b>	<b>Type</b>	<b>Load</b>	<b>Diameter of Block</b>
LD-2.5	Rectangular, square or circular	25	300
MD-10	Rectangular or circular	100	300
HD-20	Rectangular, square or circular	200	300
EHD-35	Rectangular, square or circular	350	300

The cover should have suitable lifting arrangement. The FRC frame and cover shall be paid on number basis of completed item at site.



## **D-7 : CONCRETE WORK**

### **SECTION - D: 7**

#### **D.7.1 SCOPE**

D.7.1.1 This Specification covers the general requirements for concrete using on-site production facilities including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing, transporting, placing, curing, protecting, repairing, finishing and testing of concrete; form work; requirements in regard to the quality, storage, bending and fixing of reinforcement; grouting as well as mode of measurement and payment for complete works.

D.7.1.2 It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all work shall have to be carried out in accordance with the relevant standards and codes of practices or in their absence in accordance with the best accepted current engineering practices or as directed by Engineer from time to time. The decision of Engineer as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on Contractor and no claim whatsoever will be entertained on this account.

#### **D.7.2 APPLICABLE CODES AND SPECIFICATIONS**

D.7.2.1 The following specifications, standards and codes, including all official amendments / revisions and other specifications and codes referred to therein, should be considered a part of this specification. In all cases the latest issue / edition / revision shall apply. In case of discrepancy between this specification and those referred to herein below or other specifications forming a part of this bid document, this specification shall govern.

##### **D.7.2.2 Code for Materials**

1. IS : 269 - Specification for 33 grade ordinary portland cement
2. IS : 455 - Specification for portland slag cement
3. IS : 1489 - Specification for portland pozzolana cement  
(Part 1 and 2)
4. IS : 8112 - Specification for 43 grade ordinary portland cement.
5. IS : 12330 - Specification for sulphate resisting portland cement
6. IS : 383 - Specification for coarse and fine aggregates from natural sources for concrete.
7. IS : 432 - Specification for mild steel and medium tensile  
(Part 1 and 2) steel bars and hard drawn steel wires for concrete reinforcement.
8. IS : 1786 - Specification for high strength deformed steel bars and wires for concrete reinforcement.

9. IS : 1566 - Specification for hard drawn steel wire fabric for concrete reinforcement.
10. IS : 9103 - Specification for admixtures for concrete.
11. IS : 2645 - Specification for integral cement water proofing compounds.
12. IS : 4990 - Specification for plywood for concrete shuttering work.
13. IS : 12269 - Specification for 53 grade ordinary portland cement.

#### **D.7.2.3 Code for Material Testing**

1. IS : 4031 - Methods of physical tests for hydraulic cement.  
(Parts 1 to 15)
2. IS : 4032 - Methods of chemical analysis of hydraulic cement.
3. IS : 650 - Specifications for standard sand for testing of cement.
4. IS : 2430 - Methods for sampling of aggregates for concrete.
5. IS : 2386 - Methods of test for aggregates for concrete.  
(Parts 1 to 8)
6. IS : 3025 - Methods of sampling and test (physical and chemical) water used in industry.
7. IS : 6925 - Methods of test for determination of water soluble chlorides in concrete admixtures.

#### **D.7.2.4 Code for Materials Storage**

1. IS : 4082 - Recommendations on stacking and storing of construction materials at site.

#### **D.7.2.5 Code for Concrete Mix Design**

1. IS : 10262 - Recommended guidelines for concrete mix design.
2. SP : 23 - Handbook on Concrete Mixes.  
(S&T)

#### **D.7.2.6 Code for Concrete Testing**

1. IS : 1199 - Method of sampling and analysis of concrete.
2. IS : 516 - Method of test for strength of concrete
3. IS : 9013 - Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.
4. IS : 8142 - Method of test for determining setting time of concrete by penetration resistance.
5. IS : 9284 - Method of test for abrasion resistance of concrete.
6. IS : 2770 - Methods of testing bond in reinforced concrete.

#### **D.7.2.7 Code for Equipment**

1. IS : 1791 - Specification for batch type concrete mixers.
2. IS : 2438 - Specification for roller pan mixer.
3. IS : 4925 - Specification for concrete batching and mixing plant.
4. IS : 5892 - Specification for concrete transit mixer and agitator.
5. IS : 7242 - Specification for concrete spreaders.
6. IS : 2505 - General Requirements for concrete vibrators : Immersion type.
7. IS : 2506 - General Requirements for screed board concrete vibrators.
8. IS : 2514 - Specification for concrete vibrating tables.
9. IS : 3366 - Specification for pan vibrators.
10. IS : 4656 - Specification for form vibrators for concrete.
11. IS : 11993 - Code of practice for use of screed board concrete vibrators.
12. IS : 7251 - Specification for concrete finishers.
13. IS : 2722 - Specification for portable swing weigh batchers for concrete (single and double bucket type).
14. IS : 2750 - Specification for steel scaffoldings.

#### **D.7.2.8 Codes of Practice**

1. IS : 456 - Code of practice for plain and reinforced concrete.
2. IS : 457 - Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
3. IS : 3370 - Code of practice for concrete structures for storage of liquids.  
(Parts 1 to)
4. IS : 3935 - Code of practice for composite construction.
5. IS : 2204 - Code of practice for construction of reinforced concrete shell roof.
6. IS : 2210 - Criteria for the design of reinforced concrete shell structures and folded plates.
7. IS : 2502 - Code of practice for bending and fixing of bars for concrete reinforcement.
8. IS : 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.
9. IS : 2751 - Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
10. IS : 9417 - Specification for welding cold worked bars for reinforced concrete construction.
11. IS : 3558 - Code of practice for use of immersion vibrators for consolidating concrete.
12. IS : 3414 - Code of practice for design and installation of joints in buildings.
13. IS : 4326 - Code of practice for earthquake resistant design and

construction of building.

14. IS : 4014 - Code of practice for steel tubular scaffolding.  
(Part 1 a)
15. IS : 2571 - Code of practice for laying in-situ cement concrete flooring.
16. IS : 7861 - Code of practice for extreme weather concreting.  
(Part – 1) - Recommended practice for hot weather concreting.  
(Part – 2) - Recommended practice for cold weather concreting.

#### **D.7.2.9 Code for Construction safety**

1. IS : 3696 - Safety code for scaffolds and ladders.  
(Parts I and III)
2. IS : 7969 - Safety code for handling and storage of building materials.
3. IS : 8989 - Safety code for erection of concrete framed structures.

#### **D.7.2.10 Code for Measurement**

1. IS : 1200 - Method of measurement of building and engineering works.  
(Part 1 to 28)
2. IS : 3385 - Code of practice for measurement of Civil Engineering works.

### **D.7.3 GENERAL**

D.7.3.1 Engineer shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer's approval obtained, prior to starting of concrete work. This shall, however, not relieve Contractor of any of his responsibilities. All materials which do not conform to this specification shall be rejected.

D.7.3.2 Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes / standards shall generally be used, other materials may be used after approval of the Engineer and after establishing their performance suitability based on previous data, experience or tests.

### **D.7.4 MATERIALS**

#### **D.7.4.1 Cement**

- D.7.4.1.1 Unless otherwise specified or called for by the Engineer, cement shall be OPC/SRC confirming to latest IS as per Schedule-B.
- D.7.4.1.2 Where Portland pozzolana or slag cement are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.
- D.7.4.1.3 Only one type of cement shall be used in any one mix. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from Engineer.
- D.7.4.1.4 Cement which is not used within 90 days from its date of manufacture shall be tested at a laboratory approved by Engineer and until the results of such tests are found satisfactory, it shall not be used in any work.

#### **D.7.4.2 Aggregates (General)**

##### **D.7.4.2.1 General**

- D.7.4.2.1.1 “Aggregate” in general designates both fine and coarse inert materials used in the manufacture of concrete (vide BIS 456 & BIS 383) and conforming to tests as per BIS 2386 (Part I to VI).
- D.7.4.2.1.2 “Coarse Aggregate” is aggregate most of which is retained when passed through on 4.75 mm BIS sieve.
- D.7.4.2.1.3 All fine and coarse aggregates proposed for use in the works shall be subject to the Engineer-in-Charge’s approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer-in-charge.
- D.7.4.2.1.4 Aggregates shall consist of natural sand, stone (crushed or uncrushed) and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, non-flaky, strong, hard, durable against weathering, or limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the “mix design” and preliminary tests on concrete specified later. The aggregates shall be brought from the source as mentioned in Volume–I Clause C.1.39.

##### **D.7.4.2.2 Sampling and testing**

- D.7.4.2.2.1 Samples of the aggregates for mixed design and determination of suitability shall be taken under the supervision of the Engineer-in-charge and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests, which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to Engineer-

in-charge in advance of the work, for use in determining aggregate suitability. The costs of all such tests, sampling etc. shall be borne by the contractor.

#### **D.7.4.2.3 Storage of aggregates**

D.7.4.2.3.1 All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign material and earth during storage and while heaping the materials shall be avoided. The aggregates must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer. Rakers shall be piled in layers not exceeding 1.20 m in height to prevent coning or segregation. Each layer shall cover the entire area of stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected.

#### **D.7.4.2.4 Specific Gravity**

D.7.4.2.4.1 Aggregates having a specific gravity below 2.4 (saturated surface dry basis) shall not be used.

#### **D.7.4.3 Fine Aggregate**

D.7.4.3.1 Fine aggregate shall consist of natural or crushed sand conforming to IS 383 conforming to tests as per IS 2386 part I to IV. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities / strength/ durability of concrete.

D.7.4.3.2 Screening and Washing : Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fraction.

D.7.4.3.3 Foreign Material limitations : The percentage deleterious substances in sand delivered to the mixer shall not exceeding the following :

<b>Sr. No.</b>	<b>Foreign Material</b>	<b>Percentage by weight</b>	
		<b>Uncrushed</b>	<b>Crushed</b>
1	Material finer than 75 micron IS sieve	3.0	15.0
2	Shale	1.0	--
3	Coal and Lignite	1.0	1.0
4	Clay Lumps	1.0	1.0

D.7.4.3.4 Gradation : Unless otherwise directed or approved by the Engineer-in-charge, the grading of sand shall be within the limits indicated hereunder.

<b>IS : Sieve Designation</b>	<b>Grading Zone-I</b>	<b>Grading Zone-II</b>	<b>Grading Zone-III</b>	<b>Grading Zone-IV</b>
10 mm	100	100	100	100
4.75 mm	99 – 100	90 – 100	90 – 100	95 – 100
2.36 mm	60 – 95	75 – 100	85 – 100	95 – 100
1.18 mm	30 – 70	55 – 90	75 – 100	90 – 100

600 microns	15 – 34	35 – 59	60 – 79	80 – 100
300 microns	5 – 20	8 – 30	12 – 40	15 – 50
150 microns	0 – 10	0 – 10	0 – 10	0 – 15

- D.7.4.3.4.1 Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 microns IS sieve, by total amount not exceeding 5%, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve on the coarser limit of grading zone I or the finer limit of grading zone IV. Fine aggregates conforming to grading zone IV shall not be used. Mix designs and preliminary tests shall show its suitability for producing concrete of specified strength and workability.

#### **D.7.4.3.5 Fineness Modulus**

The sand shall have a fineness modulus of not less than 2.2 or more than 4.2. The fineness modulus is determined by adding the cumulative percentages retained on the following IS sieve sizes (4.75 mm, 2.35 mm, 1.18 mm, 600 microns and 150 microns) and dividing the sum by 100.

#### **D.7.4.4 Coarse Aggregate**

- D.7.4.4.1 Coarse aggregate for concrete, except as noted above, shall conform to IS 383 and IS 2386. This shall consist of crushed stone and shall be clean and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

- D.7.4.4.2 Screening and Washing : Crushed rock shall be screened and or washed for the removal of dirt or dust coating, if so requested by the Engineer-in-charge.

#### **D.7.4.4.3 Grading**

- D.7.4.4.3.1 Coarse aggregate shall be either in single size or graded, in both cases the grading shall be within the following limits :

IS Sieve Size (mm)	Percentage passing for single sized Aggregate of normal size					Percentage passing for graded aggregate of normal size			
	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
63	100	--	--	--	--	--	--	--	--
40	85–	100	--	--	--	95–	100	--	--
20	0–20	85–	100	--	--	30–70	95–	100	100

IS Sieve Size (mm)	Percentage passing for single sized Aggregate of normal size					Percentage passing for graded aggregate of normal size			
	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
16	--	--	85–	100	--	--	--	90–	--
12.5	--	--	--	85–	100	--	--	--	90–
10	0 – 5	0–20	0–30	0–45	85–	10–35	25–55	30–70	40–85
4.75	--	0–5	0–5	0–10	0–20	0–5	0–10	0–10	0–10
2.36	--	--	--	--	0–5	--	--	--	--

D.7.4.4.3.2 The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only within tolerance limits which will not affect adversely the strength and or durability of concrete. The maximum size of coarse aggregate shall be 40 mm for M7.5 and M10 and 20 mm for M15 to M20 concrete, or as directed by the Engineer-in-charge or specified otherwise. The maximum size of coarse aggregate shall be the maximum size specified above but in no case greater than  $\frac{1}{4}$ <sup>th</sup> of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. For plain concrete the maximum size of aggregate shall be of 40 mm. for heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover reinforcement whichever is smaller.

#### **D.7.4.4.4 Foreign material limitations**

D.7.4.4.4.1 The percentage of deleterious materials in the aggregate delivered to the mixer shall not exceed the following :

Sr. No.	Foreign Material	Percentage by weight	
		Uncrushed	Crushed
1	Material finer than 75 micron IS sieve	3.0	3.0
2	Coal and lignite	1.0	1.0
3	Clay lumps	1.0	1.0
4	Soft fragments	3.0	--



**D.7.4.5 Water**

- D.7.4.5.1 Water used for both mixing and curing shall conform to IS : 456. Potable water is generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

**D.7.4.6 Reinforcement**

- D.7.4.6.1 Reinforcement bars shall conform to IS : 432, IS : 226 or IS : 1786 and the welded wire fabric to IS : 1566 as shown or specified on the drawings.
- D.7.4.6.2 All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirty dust or any other substance that will destroy or reduce bond.
- D.7.4.6.3 If permitted by Engineer, welding of reinforcement shall be done in accordance with IS : 2751 or IS : 9417 as applicable.
- D.7.4.6.4 Reinforcement shall be TMT Fe-500.

**D.7.4.7 Admixtures**

- D.7.4.7.1 Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS : 9103 and integral water proofing admixtures to IS : 2645.
- D.7.4.7.2 Admixtures may be used in concrete as per manufacturer's instructions only with the approval of Engineer based upon evidence that with the passage of time neither the compressive strength nor its durability is reduced. An admixture's suitability and effectiveness shall be verified by trial mixes with the other material used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.
- D.7.4.7.3 Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

**D.7.4.8 Wastage**

- D.7.4.8.1 No wastage allowance for cement and steel shall be considered and paid for.

**D.7.5 SAMPLES AND TESTS**

- D.7.5.1 All materials used for the works shall be tested before use.

D.7.5.2 Manufacturer's test certificate shall be furnished, for each batch of cement / steel and when directed by Engineer samples shall also be got tested by the Contractor in a laboratory approved by Engineer at no extra cost to Client. However, where material is supplied by Client, all testing charges shall be borne by Client; but transportation of material samples to the laboratory shall have to be done by Contractor at no extra cost.

D.7.5.3 Sampling and testing shall be as per IS : 2386 under the supervision of Engineer. The cost of all tests, sampling etc. shall be borne by Contractor.

D.7.5.4 Water to be used shall be tested to comply with requirement of IS : 456.

D.7.5.5 Contractor shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed the admixture shall be got tested and approved laboratory at no extra cost.

## **D.7.6       STORING OF MATERIALS**

D.7.6.1 All material shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works. Requirements of IS : 4082 shall be complied with.

D.7.6.2 Contractor will have to make his own arrangements for the storage of adequate quantity of cement even if cement is supplied by Client. Cost of such rejected cement, where cement is supplied by Client, shall be recovered at issue rate or open market rate whichever ever is higher. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by Engineer. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order or receipt.

D.7.6.3 Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

D.7.6.4 Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.

D.7.6.5 The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground / water. Each type and size shall be stacked separately.

## **D.7.7       CONCRETE**

### **D.7.7.1     General**

Concrete grade shall be as designated on drawings. In concrete grade M15, M20, M25 etc. the number represents the specified characteristic compressive

strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS : 456. Concrete in the works shall be **“Design Mix Concrete”** or **“Normal Mix Concrete”**. All concrete works of **grade M5, M7.5, M-10 and M15 shall be Nominal whereas all other grades, M20 and above, shall be Design Mix Concrete.**

## **D.7.7.2 Design Mix Concrete**

### **D.7.7.2.1 Mix Design and Testing**

D.7.7.2.1.1 For Design Mix Concrete, the mix shall be designed according to IS : 10262 and SP: 23 to provide the grade of concrete having the required workability and characteristics strength not less than appropriate values given in IS : 456. The design mix shall in addition be such that it is cohesive and does not segregate and should result in dense and durable concrete and also capable of giving the finish as specified. For water retaining structures, the mix shall also result in water-tight concrete. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

D.7.7.2.1.2 Unless otherwise specifically mentioned, the minimum cement content for Design Mix Concrete shall be as given below.

Grade of Concrete	Minimum Cement Content in Kg/Cu.m of concrete
M20	330
M25	365
M30	380
M35	400

The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The Contractor's quoted rates for concrete shall provide for the above eventually and nothing extra shall become payable to the Contractor in this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the Contractor.

D.7.7.2.1.3 It shall be Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to Engineer at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS : 516 shall comply with the requirements of IS : 456.

Grade of Concrete	Minimum Compressive Strength (N/Sq.mm at 7 days)	Specified Compressive strength (N/Sq.mm at 28 days)
M 20	13.5	20.0

M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

D.7.7.2.1.4 A range of slumps, which shall generally be used for various types of construction unless otherwise instructed by the Engineer is given below :

Structure / Member	Slump in millimeters	
	Maximum	Minimum
Reinforced foundation walls and footings	75	25
Plain footings, caissons and substructure walls	75	25
T.G. and massive compressor foundations	50	25
Slabs, beams and reinforced walls	100	25
Pumps and miscellaneous equipment foundations	75	25
Building columns	100	25
Pavements	50	25
Heavy mass construction	50	25

## **D.7.7.2.2 Batching and Mixing of Concrete**

D.7.7.2.2.1 Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

D.7.7.2.2.2 Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water cement ratio specified shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

D.7.7.2.2.3 Arrangement should be made by Contractor to have the cubes tested in an approved laboratory or in field at his own expense, with prior consent of Engineer. Sampling and testing of strength and workability of concrete shall be as per **IS : 1199, IS : 516 and IS : 456.**

## **D.7.7.3 Nominal Mix Concrete**

### **D.7.7.3.1 Mix Design and Testing**

D.7.7.3.1.1 Mix design and preliminary tests are not necessary for Nominal mix Concrete. However works tests shall be carried out as per IS : 456. Proportions for Nominal Mix Concrete and **water / cement ratio may** be adopted as per

Table 3 of IS : 456. However it will be Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

**D.7.7.3.2      Batching and Mixing Concrete**

D.7.7.3.2.1      Based on the adopted nominal mixes, aggregates and cement shall be measured by weight.

## **D.7.8 FORM WORK**

- D.7.8.1 Form work shall be all inclusive and shall consist of but not limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, falsework, wedges etc.
- D.7.8.2 The design and engineering of the formwork as well as its construction shall be the responsibility of Contractor. However, if so desired by Engineer the drawings and calculations for the design of the formwork shall be submitted to Engineer for approval.
- D.7.8.3 Formwork shall be designed to fulfill the following requirements :
- a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
  - b) Made of suitable materials.
  - c) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
  - d) Capable of withstanding without deflection the worst combination of self weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
  - e) Capable of easily striking without shock, disturbance or damage to the concrete.
  - f) Soffit forms capable of imparting a camber if required.
  - g) Soffit forms and supports capable of being left in position if required.
  - h) Capable of being cleaned and / or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.
- D.7.8.4 The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of Engineer. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, work holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.
- D.7.8.5 The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.
- D.7.8.6 Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly

scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of Engineer. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

- D.7.8.7 Permanent formwork shall be checked for its durability and capability with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.
- D.7.8.8 Wire ties passing through beams, columns and walls shall not be allowed. In their placed bolts passing through sleeves shall be used. Formwork spacers left in situ shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage or moisture.
- D.7.8.9 For liquid retaining structures sleeves shall not be provided for through bolts or shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.
- D.7.8.10 Where specified or shown on drawings, all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.
- D.7.8.11 Forms for substructure may be omitted when, in the opinion of Engineer, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be slightly larger, as directed by Engineer, than that required as per drawing to compensate for irregularities in excavation.
- D.7.8.12 The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.
- D.7.8.13 The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side limit the drop of concrete to 1.0 m or as directed by Engineer. The Contractor shall temporarily and securely fix items to be cast in (embedments / inserts) in a manner that will not hinder the striking of forms or permit loss of grout.
- D.7.8.14 Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty form work, shall be entirely removed and formwork corrected prior to placement of new concrete at the cost of the Contractor.
- D.7.8.15 The striking time for formwork shall be determined based on following requirements :
- a) Development of adequate concrete strength;
  - b) Permissible deflection at time of striking form work;

- c) Curing procedure employed – its efficiency and effectiveness;
- d) Subsequent surface treatment to be done;
- e) Prevention of thermal cracking at re-entrant angles;
- f) Ambient temperature; and
- g) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

D.7.8.16 Under normal circumstances (generally where temperatures are above 20 Deg. C) forms may be struck after expiry of the time period given in IS : 456, unless directed otherwise by Engineer. For portland pozzolona / slag cement the stripping time shall be suitably modified as directed by the Engineer. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

#### **D.7.9 Reinforcement Workmanship**

D.7.9.1 Reinforcing bars supplied bent or in coils shall be straightened cold without damage at no extra cost. No bending shall be done when ambient temperature is below 5 Deg. C. Local warming may be permitted if steel is kept below 100 Deg. C.

D.7.9.2 All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings / schedules or as directed by Engineer.

D.7.9.3 Re-bending or straightening incorrectly bent bars shall not be done without approval of Engineer.

D.7.9.4 Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by Engineer prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete cover.

D.7.9.5 Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

D.7.9.6 Substitution of reinforcement, laps / splices not shown on drawing shall be subject to Engineer's approval.

#### **D.7.10 TOLERANCES**

D.7.10.1 Tolerance for formed and concrete dimensions shall be as per IS : 456 unless specified otherwise.



D.7.10.2 Tolerances specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.

#### **D.7.11 PREPARATION PRIOR TO CONCRETE PLACEMENT**

D.7.11.1 Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets etc. provided.

D.7.11.2 All arrangements formwork, equipment and proposed procedure, shall be approved by Engineer. **The Contractor shall maintain separate Pour Card for each pour** and shall produce before commencement of concreting to Engineer-in-charge.

#### **D.7.12 TRANSPORTING, PLACING AND COMPACTING CONCRETE**

D.7.12.1 Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

D.7.12.2 In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms. The Contractor shall provide suitable drops and 'Elephant Trunks'. Concrete shall not be dropped from a height of more than 1.0 m as stipulated in clause D.7.8.13.

D.7.12.3 Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

D.7.12.4 While placing concrete the Contractor shall proceed as specified below and also ensure the following :

- a) Continuously between construction joints and predetermined abutments.
- b) Without disturbance to forms or reinforcement.
- c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.
- d) Without dropping in a manner that could cause segregation or shock.
- e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.
- f) Do not place if the workability is such that full compaction cannot be achieved.
- g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the lining progressively as concrete is placed.

- h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
  - i) Ensure that there is no damage or displacement to sheet membranes.
  - j) Record the time and location of placing structural concrete.
- D.7.12.5 Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over vibration shall be avoided.
- D.7.12.6 Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.
- D.7.12.7 Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as determined by Engineer. Concrete shall be protected against damage until final acceptance.
- D.7.13 MASS CONCRETE WORKS**
- D.7.13.1 Sequence of pouring for mass concrete works shall be as approved by Engineer. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.
- D.7.14 CURING**
- D.7.14.1 Curing and protection shall start immediately after the compaction of the concrete to protect it from :
- (a) premature drying out, particularly by solar radiation and wind;
  - (b) leaching out by rain and flowing water;
  - (c) rapid cooling during the first few days after placing;
  - (d) high internal thermal gradients;
  - (e) low temperature of frost;

- (f) vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

D.7.14.2 All concrete, unless directed otherwise by Engineer, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessian or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

D.7.14.3 Where a curing membrane is directed to be used by the Engineer, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be got approved from the Engineer before use and shall be applied with spraying equipment capable of a smooth, even textured coat.

D.7.14.4 Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

D.7.14.5 Extra precautions shall be exercised in curing concrete during cold and hot weather.

#### **D.7.15 CONSTRUCTION JOINTS AND KEYS**

D.7.15.1 Construction joints will be as shown on the drawing or as approved by Engineer. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approved of Engineer.

D.7.15.2 Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as directed by Engineer.

D.7.15.3 Before resuming concreting on a surface which has hardened all laitance and loose stone shall be thoroughly removed by wire brushing / hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and a 15 mm thick layer of cement sand mortar for horizontal layers, the ratio of cement and sand being the same as in the concrete mix.

D.7.15.4 When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

## **D.7.16 FOUNDATION BEDDING**

D.7.16.1 All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy area shall be cleaned out and back filled with either soil cement mixture, lean concrete or clean sand compacted as directed by Engineer. The surfaces of absorptive soils shall be moistened.

D.7.16.2 Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

## **D.7.17 FINISHES**

### **D.7.17.1 General**

D.7.17.1.1 The formwork for concrete works shall be such as to give the finish as specified. The Contractors shall make good as directed any unavoidable defects consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

### **D.7.17.2 Surface finish Type F1**

D.7.17.2.1 This type of finish shall be for non-exposed concrete surface against which back fill or concrete is to be placed. The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which could interfere with proper and effective application or waterproofing material specified for use.

### **D.7.17.3 Surface finish Type F2**

D.7.17.3.1 This type of finish shall be for all concrete work which will be exposed to view upon completion of the job. The appearance shall be that of a smooth dense, well-compacted concrete showing the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

### **D.7.17.4 Surface finish Type F3**

D.7.17.4.1 This type of finish shall be for concrete work which will be exposed to view but to give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discoloration, blemishes, arrises, air holes etc. Only lined or coated plywood with very tight joints shall be used to

achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by Contractor.

#### **D.7.17.5 Integral cement finish on concrete floor**

- D.7.17.5.1 In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screened off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the Engineer shall be supplied and used as recommended by the manufacturer.

#### **D.7.18 REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE**

- D.7.18.1 Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be brought to the notice of Engineer who may permit patching of the defective areas or reject the concrete work.
- D.7.18.2 All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.
- D.7.18.3 Rejected concrete shall be removed and replaced by Contractor at no additional cost to Client.
- D.7.18.4 For patching of defective areas all loose materials shall be removed and the surface shall be prepared as directed by the Engineer.
- D.7.18.5 Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the Engineer as to the method of repairs to be adopted shall be final and binding on the Contractor and no extra claim shall be entertained on this account. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as directed by Engineer.

#### **D.7.19 VACUUM DEWATERING OF SLABS**

- D.7.19.1 Where specified floor slabs, either on grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per equipment manufacturers recommendation. The equipment to be used shall be subject to Engineer's approval.

#### **D.7.20 HOT WEATHER REQUIREMENTS**

- D.7.20.1 Concreting during hot weathers shall be carried out as per IS : 7861 (Part – I)

- D.7.20.2 Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40 Deg. C at the time of placement of fresh concrete.
- D.7.20.3 Where directed by Engineer, Contractor shall spray non-wax based curing compound of unformed concrete surfaces at no extra costs.

## **D.7.21 COLD WEATHER REQUIREMENTS**

- D.7.21.1 Concreting during cold weather shall be carried out as per IS : 7861 (Part-II).
- D.7.21.2 The ambient temperature during placement and upto final set shall not fall below 5 Deg. C. Approved antifreeze / accelerating additives shall be used where directed.
- D.7.21.3 For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

## **D.7.22 LIQUID RETAINING STRUCTURES**

- D.7.22.1 The Contractor shall take special care of concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.
- D.7.22.2 The minimum level of surface finish for liquid retaining structures shall be type F2. All such structures shall be hydro-tested.
- D.7.22.3 The Contractor shall include in his price of hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipelines etc.
- D.7.22.4 Any temporary arrangements that may have to be made to ensure stability of the structures shall also be considered to have been taken into account while quoting the rates.
- D.7.22.5 Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement / epoxy pressure grouting, guniting or such other methods as may be approved by the Engineer. All such rectification of the Client / Engineer at no extra cost to the Client.

## **D.7.23 TESTING CONCRETE STRUCTURES FOR LEAKAGE**

- D.7.23.1 Hydro-static test for water tightness shall be done at full storage by Engineer, as described below :
  - D.7.23.1.1 In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.
  - D.7.23.1.2 In the case of structures whose external faces are submerged and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of

the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven day shall be taken as an indication of the water tightness of the structure. The Engineer shall decide on the actual permissible nature of this drop in the surface level, taking into account weather the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

D.7.23.1.3 Each compartment / segment of the structure shall be tested individually and then all together.

D.7.23.2 For structures such as pipes, tunnels etc. the hydro-static test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

#### **D.7.24 OPTIONAL TESTS**

D.7.24.1 If Engineer feels that the materials i.e. cement, sand coarse aggregates, reinforcement and water are not in accordance with the specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the Engineer, as per relevant IS Codes. Client shall pay only for the testing of material supplied by the Client, otherwise Contractor shall have to pay for the tests. Transporting of all material to the laboratory shall however be done by the Contractor at no extra cost to Client.

D.7.24.2 In the even of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, Engineer reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. All these tests shall be carried out by Contractor at no extra cost to the Client. Alternatively Engineer also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work at the cost of Contractor.

D.7.24.3 If the structure is certified by Engineer as having failed, the cost of the test and subsequent dismantling / reconstruction shall be borne by Contractor.

D.7.24.4 The quoted unit rates / prices of concrete shall be deemed to provide for all tests mentioned above.

#### **D.7.25 GROUTING**

D.7.25.1 Grout shall be provided as specified on the drawings. The proportion of standard Grout shall be such as to produce a flowable mixture consistent with



minimum water content and shrinkage. Surface to be grouted shall be thoroughly roughened and cleaned. All structural steel elements to be grouted, shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting water in all pockets shall be removed. Grouting once started shall be done quickly and continuously. Variation in grout mixes and procedures shall be permitted if approved by ENGINEER. The grout proportions shall be limited as follows :

	Use	Grout Thickness	Mix Proportions	W/C Ratio
a)	Fluid mix	Under 25 mm	One part Portland cement to one part sand.	0.44
b)	General Mix	25 mm and over but less than 50 mm	One part Portland cement to 2 part sand.	0.53
c)	Stiff mix	50 mm and over	One part Portland cement to 3 part sand.	0.53

#### **D.7.25.2 Non Shrink Grout**

D.7.25.2.1 Non-shrink grout where called for in the Schedule of Quantities or specified on the drawings shall be provided in strict accordance with the manufacturer's instructions/ specifications on the drawings.

#### **D.7.26 INSPECTION**

D.7.26.1 All materials, workmanship and finished construction shall be subject to continuous inspection and approval of Engineer. Materials rejected by Engineer shall be expressly removed from site and shall be replaced by Contractor immediately at no extra cost to Client.

#### **D.7.27 CLEAN-UP**

D.7.27.1 Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood etc. resulting from the work shall be removed and the premises left clean.

#### **D.7.28 ACCEPTANCE CRITERIA**

D.7.28.1 Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

- a) Properties of constituent materials;
- b) Characteristic compressive strength;
- c) Specified mix proportions;
- d) Minimum cement content;
- e) Maximum free-water / cement ratio;
- f) Workability;
- g) Temperature of fresh concrete;

- h) Density of fully compacted concrete;
- i) Cover to embedded steel;
- j) Curing;
- k) Tolerances in dimensions;
- l) Tolerances in levels;
- m) Durability;
- n) Surface finishes;
- o) Special requirements such as :
  - i) water tightness;
  - ii) resistance to aggressive chemicals
  - iii) resistance to freezing and thawing
  - iv) very high strength
  - v) improved fire resistance
  - vi) wear resistance
  - vii) resistance to early thermal cracking

D.7.28.2 The Engineer's decision as to the acceptability or otherwise of any concrete work shall be final and binding of the Contractor.

D.7.28.3 For work not accepted, the Engineer may review and decide whether remedial measures are feasible so as to render the work acceptable. The Engineer shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extra shall become payable to the Contractor. Nothing extra shall become payable to the Contractor by the Client for executing the remedial measures.

## **D.7.29 MODE OF MEASUREMENT AND PAYMENT**

D.7.29.1 The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items as leaving holes, embedding inserts, etc. shall be entertained unless separately provided for in the schedule of quantities. No extra claim shall also be entertained due to change in the number, position and / or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift, lead of scaffolding etc. All these factors should be take into consideration while quoting the unit rates. Unless provided for in the Schedule of Quantities the rates shall also include fixing insets in all concrete work, whenever required.

D.7.29.2 Payments for concrete will be made on the basis of unit rates quoted for the respective items in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 0.100 of a sq.m in areas where concrete is measured in sq.m and 0.010 cu.m where concrete is measured in cu.m. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets, etc. will not be made. Similarly the unit rates for concrete work shall be inclusive or exclusive of shuttering as provided for in the Schedule of Quantities.

- D.7.29.3 Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slab / beams.
- D.7.29.4 The unit rate for precast concrete members shall include formwork, mouldings, finishing, hoisting and setting in position including setting mortar, provision of lifting arrangement etc. complete. Reinforcement and inserts shall be measured and paid for separately under respective item rates.
- D.7.29.5 Where the formwork is paid for separately, it shall be very clearly understood that payment for formwork is inclusive of formwork, shuttering, shoring, propping scaffolding etc. complete. Only the net area of concrete formed (shuttered) shall be measured for payment. Unless otherwise stated clearly form work will not be paid separately and it is deemed to be included in the respective concrete item.

Under remarks indicate deviations from drawings & specifications congestion in reinforcement if any unusual occurrences such as failure of equipment sinking of supports / props, heavy rain affecting reasonable. Poor compaction improper curing other deficiencies observations etc.

#### **D.7.30 MATERIALS : STRUCTURAL STEEL**

All structural steel shall comply with the requirements of IS 226-1961 and structural steel work IS 1915-1962 specifications for structural steel appropriate for bridge work.

##### **D.7.30.1 Steel for Pins and Rollers**

Rolled steel pins and rollers, shall comply with requirements of the IS specifications appropriate for the work. Steel casting for cast steel pins shall conform to grade 1 or 3 of IS 1030-1956 specifications for steel casting (for general engineering purposes as appropriate).

##### **D.7.30.2 Bolts and Nuts**

Mild steel for bolts and nuts when tested shall comply with IS 1608-1960 and shall have tensile strength of not less than 2500 Kg/cm<sup>2</sup>. Plain washers shall be made of steel.

##### **D.7.30.3 Welding Electrode**

Mild steel electrodes shall comply with requirements of IS 814-1957 specification for covered electrodes for metal arc welding of mild steel.

##### **D.7.30.4 Workmanship**

All work shall be in accordance with the drawings and shall satisfy IS specification No. 1915-1961. Care shall be taken to ensure that all parts in

assembly fit accurately together. Notes or specifications on the drawings supplied by the Engineer-in-Charge/consulting Engineer, are to be constructed as superseding or cancelling any clause of this specifications with which they conflict. On all drawings dimensions shown in figures shall be acted in preference to measurement by scale.

**D.7.30.5 Straightening**

All structural steel members and parts shall have straight edges. All straightening shaping and levelling etc. shall be done by pressure only and not by hammering. All joggles and knees shall be formed by pressure and where practicable in making these, the metal shall not be cut and welded.

**D.7.30.6 Cutting**

All structural steel parts where required shall be sheared, cropped sawn or flame cut and ground accurately to the required dimensions and shape.

**D.7.30.7 Bolts Holes**

The diameter of bolts holes shall be 1.5 to 2.0 mm. larger than the nominal diameter of bolt. All holes for bolts shall be drilled unless permitted by Engineer-in-Charge for punching the holes. Care shall be taken, such as surrounding material is not deformed or damaged in case of punching the hole is allowed.

**D.7.30.8 Welding**

Welding of steel conforming to relevant IS specifications shall be in accordance with general requirements of metal arc welding. In addition to general requirement, the following care shall be taken :-

- (a) The welding shall be positioned for downward welding wherever practicable.
- (b) The welding current shall conform with respect of voltage and empear to the recommendations of the manufacturers of the electrode being used. The arc length, voltage and empear shall be suited to the thickness of material, type of groove and other circumstances of the work.
- (c) The surface to be welded and surrounding material for a distance of atleast 155 mm shall be free from scale, dirt, grease, paint, heavy rust or other surface deposit.
- (d) Members to be welded shall be held in correct position by holes, clamps, wedges, jigs or other suitable devices or by tack welding until welding has been completed, such fastening as may be used shall be adequate to ensure safety. Suitable allowance shall be made for warpage and shrinkage.
- (e) Tack welds located where the final welds will later be made shall be subject to the same quality requirements as final welds. Defective and broken tack welds shall be removed before final welding.

- (f) Fusion faces shall be made or cut by shearing, chipping, machining or by gas cutting.
- (g) Exposed faces of welds shall be made reasonably smooth and regular so as to conform as closely as practicable to design requirements and shall not be of less than the required cross section.
- (h) Finished welds and adjacent parts shall be protected with clean boiled linseed oil after all slag has been removed.

#### **D.7.30.9 Safety Precautions**

- D.7.30.9.1
  - (a) Operators of welding and cutting equipment shall be protected from the rays of the arc flame gloves and by helmet, hand shields, or goggles equipped with suitable filter lenses.
  - (b) Closed space shall be ventilated properly while welding is being gone therein.
  - (c) Welders should be provided with such staging as will enable them to perform the welding operation. For site welding shelter should be provided to protect welders and the parts to be welded from the weather.
- D.7.30.9.2 The Constructor shall employ a competent welding supervisor to ensure that the standard of workmanship and the quality of materials comply with requirements laid in these specification.
- D.7.30.9.3 The Constructor shall provide free access to the representative of Engineer-in-Charge/Consulting Engineer to the work being carried out at all reasonable times and facilities shall be provided so that during the course of welding he may be able to inspect any layer of weld metal. He shall be at liberty to reject any material that does not conform to the terms of the specifications and to require any defective welds to be cut out and welded. The representative of the Engineer-in-Charge/Consulting Engineer shall be notified in advance of any welding operations.
- D.7.30.9.4 Inspection and testing of welds shall be done as laid down in IS 822 and IS 11017.
- D.7.30.9.5 No welder shall be employed in any position expect those who are fully qualified to welding. Qualification for welders shall be as laid down in IS 812.

#### **D.7.30.10 Joints**

All steel work intended to be bolted together must be in contact over the whole surface. Joints which have to take compressive stress and the ends of all stiffeners shall meet truly over the whole of the butting surface.

#### **D.7.30.11 Assembling**

All member shall be so arranged that they can be accurately assembled, without being unduly packed, strained or forced into position and when built

shall be true and free from twist kinks, buckets or open joints between component pieces. Work shall be kept properly bolted together and no drifting shall be allowed except for the purpose of drawing assembled sections together in accuracy's in matching of holes may be corrected. But drifting to enlarge holes is prohibited. Failure in any of the above respect will involve the rejection of defective members.

**D.7.30.12 Mode of Measurement and Payment**

D.7.30.12.1 Measurement of this item shall be as per IS 1200(Part VIII) - 1974 or as per its latest revision so far as applicable.

D.7.30.12.2 The contract rate shall be suitable for unit of one metric tonne of structural steel.

**D.7.31 MATERIALS : REINFORCEMENT**

**D.7.31.1 Specification for TMT bars reinforcement (Fe-500)**

**D.7.31.1.1 Scope of work :**

The scope of work consists of providing and laying mild steel reinforcement and TMT reinforcement for RCC works of various components of the structure. This may be of **Tata, Sail, Vizag, Vinayak, Steffo** or any other approved make. This includes cuttings, bending, binding, placing, with all equipments and labour required for the work as directed by the Engineer-in-charge and all operations covered within the intent and purpose of the specification.

**D.7.31.1.2 Bending of Reinforcement :**

Reinforcing steel shall conform accurately to the dimensions shown on relevant drawings and conforming to the relevant IS codes (latest revision)

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-charge using a proper bar bender, operated by hand or power to attain proper radii of bends.

Bars shall not be bent or straightened in a manner that will cause injury to the material.

Bars bent during transport or handling shall be straightened before being used on work; they shall not be heated to facilitate bending.

The bending of the TMT bars shall be carried out as per the following :

Sr. No.	Operation	Size	TMT Fe-500
1	Bend	Upto 22 mm dia.	3d
		Over 22 mm dia.	4d
2	Rebend	Upto 10 mm dia.	4d
		Over 10 mm dia.	5d

#### **D.7.31.1.3 Placing of Reinforcement :**

All reinforcing bars shall be accurately placed in the exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm. in size and conforming to IS : 280 and by using stays blocks or metal chairs, spacer, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation over the work. All devices used for positioning shall be of noncorrodible material. Wooden and metal supports will not extend to the surface of concrete, except where shown on the drawings, Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing will not be allowed. Pieces of broken stone, brick or wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices.

Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed.

To protect reinforcement from corrosion, concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

In the case of columns and walls, vertical bars shall be kept in normal position with timber templates having slots accurately cut in for bar position. Such templates shall be removed after the concreting has progressed upto a level just below them.

Bars crossing each other, where required, shall be secured by binding wire (annealed) of size not less than 1 mm and conforming to IS : 280 in such a manner that they do not slip over each other at the time of fixing and concreting. As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the Engineer-in-charge. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm or 1 1/4 times the maximum size of the coarse aggregates whichever is greater, by concrete between them. Where this is not feasible, overlapping bars shall be bound with annealed steel wire, not less than 1mm thickness twisted tight in eight shape around the lapped bars. The overlaps shall be staggered for different bars and located at fixed locations only along the span where neither shear nor bending moment is maximum.

#### **D.7.31.1.4 Welding of Bars**

Welding of TMT bars can be permitted if specified on the drawings, joints of reinforcement bars shall be butt welded so as to transmit their full strength. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and

welds so staggered that at any one section, not more than 33 per cent of the rods are welded. No pre-warming or post heat treatment is necessary. Interpass temperature should be limited to 200°C with low heat input and equivalent strength low hydrogen type electrode. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work.

**Welded pieces of reinforcement shall be tested. Specimens shall be taken from the actual site and their number and frequency of tests shall be as directed by the Engineer-in-charge.**



## **D-8 : DOUBLE WALL CORRUGATED (DWC) HDPE PIPES**

### **SECTION - D: 8**

#### **D.8.1 DOUBLE WALL CORRUGATED (DWC) HDPE PIPES:**

##### **SCOPE**

This specification covers the requirements for successfully designing, manufacturing, supplying, laying, jointing and testing at works and site of double wall corrugated (DWC) High Density Polyethylene (HDPE) Pipes used for drainage and Sewerage.

#### **D.8.2 APPLICABLE CODES**

The manufacturing, testing, supplying and testing at work sites of HDPE-DWC pipes shall comply with IS 16098 Part-II: 2013 and 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 standards / Codes, this Specification shall govern:

<b>Code No.</b>	<b>Title/Specification</b>
IS 4905:1968	Methods for random sampling.
IS 5382:1985	Specification for rubber sealing rings for gas mains, water mains and sewers (first revision). Type-I & Type-VI
IS 12235	Methods of test for thermoplastics pipes & fittings.
(Part 1): 1986	Method of measurement of outside diameter.
(Part 5):1986	Reversion test
(Part 8):1986	Internal hydrostatic pressure test
IS 16098 Part-II:2013	Structured wall plastics pipes for non pressure drainage and sewerage- specifications.

Others Codes not specifically mentioned here but pertaining to the use of HDPE-DWC pipes form part of these Specifications.

#### **D.8.3 DESIGNATION**

Pipes shall be designated as per IS 16098:2013, according to the grade of material, followed by stiffness classes (SN) and Nominal diameters e.g. 200 mm SN-8.

#### **D.8.4 MATERIALS**

The material from which the pipe is produced shall consist substantially of polyethylene (PE), to which may be added only those additives that are needed to facilitate the manufacture of these pipes and fittings confirming to requirement of this standards as per table 1, 2, 3 & 4. A pipe of fittings with a smooth internal & profiled external surface forming a finished double walled profile shall come under this standard

When sealing rings are retained by means of retaining devices (rings or caps), the devices may be made from polymers, provided they conform to the same functional dimensions and test requirements as applied to sockets with either loose or fixed sealing rings.

The manufacturer's own rework material conforming to the requirements given in 3.25 of IS:16098 is permissible. No other rework material shall be used.

#### **D.8.5 DIMENSIONS**

Mean inside Diameter

The mean inside diameter, at any point and tolerances shall be as given in Table 5 of IS: 16098 and shall be measured according to the method given in IS 12358 (Part 8). Wall Thickness The nominal wall thickness,  $e$ , shall be in accordance with Table 5 of IS: 16098. Tolerances in inside diameters shall be those given in IS: 16098.

Length of pipe

Effective length of pipes ( $L_e$ ) with sockets shall be not less than that specified by the manufacturer when measured as shown figure to of IS: 16098 : 2013.

The lengths may be supplied as agreed to between the purchaser and the manufacturer. Dimensions of pipes & spigots of pipes & fittings. The nominal size and minimum mean inside diameter for DN-ID series are specified in Table-5. The outside diameters of the DN-ID series pipes and spigots intended to have jointing dimensions as pipes and /or fittings according to this standard shall comply with the outside diameters and tolerances as specified by the manufacturer. However, the guidelines for pipes, spigots and fittings not intended to have jointing dimensions as pipes and /or fittings according to this standard, the tolerances of the outside diameter of pipes and spigots fittings shall be  $+ 0.3\text{mm}/(-) 0.6\text{mm}$  of the nominal size of outside diameter.

#### **D.8.6 INSPECTION AND TESTING:**

The material will be inspected and tested by the Inspectors to be nominated by the Employer. The sampling procedure to be adopted and the criteria for conformity shall be as given in IS: 16098. The following tests shall

be conducted:

#### TYPE TESTS

Type tests are intended to prove the suitability and performance of a new technique or a new size of pipe. Type testing shall be in accordance with tables 15 to 18 as applicable of IS: 16098 2013. All tests are to be carried out either in an in-house laboratory or at an authorised third party laboratory.

### A) PHYSICAL CHARACTERISTICS: Appearance

The structured outer layer of finished pipes and fittings shall be uniformly corrugated. The inner layer shall be smooth and plain. Both layers shall be free from any visual defects such as cracks, blisters, foreign inclusions and any other visual irregularities which may cause harm to its construction integrities. The inner surface may reflect slight shallow undulations.

#### Colour of Finished Pipes

The inner and outer layer of pipes and fittings shall be coloured throughout. The outside layer of pipes and fittings should preferably be black, orange brown or grey. When tested in accordance with the test method specified in Table 6 and Table 7 using the indicated parameters, the pipes shall have physical characteristics conforming to the requirements given in Table 6 and Table 7. When tested in accordance with the test method specified in Table 8 and Table 9 using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements as given in Table 8 and Table 9.

### B) MECHANICAL CHARACTERISTICS

#### General

The pipes shall be designated in the following nominal ring stiffness classes (SN):

- a)  $DN \leq 500$  : SN 4, SN 8 or SN 16
- b)  $DN > 500$  : SN 2, SN 4, SN 8 or SN 16

For  $DN \leq 500$ , the manufacturer's guaranteed minimum stiffness between the SN values, of a component may be used for calculation purposes only. Such pipes shall be classified and marked as the next lower stiffness class. When tested in accordance with the test method specified in Table 10 using the indicated parameters, the pipe shall have mechanical characteristics conforming to the requirements given in Table 10.

#### Ring Flexibility

When tested in accordance with the test method described in Table 10 using the indicated parameters, and visually inspected without magnification,

requirements in (a) and (b) shall be satisfied during the test and requirements (c) to (d) shall be satisfied after the test.

- a) There shall be no decrease of the measured force;
- b) There shall be no cracking in any part of the wall structure;
- c) There shall be no wall delamination except possible delamination between the outside and inside wall of double wall pipes occurring in reduced welding zone in the ends of test piece. Process aiding profile of material other than the pipe material (see Fig. 1) is not subject to this requirement;
- d) There shall be no other types of rupture in the test piece; and
- e) Permanent buckling in any part of the structure of the pipe wall including depressions and craters, shall not occur in any direction.

## **D.8.7 MARKING**

### **General**

Marking shall be labelled, printed or formed directly on the pipe or fitting, in such a way that after storage, weathering and handling the legibility shall be maintained. Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipes or the fitting.

### **Minimum Required Marking**

#### **Pipes**

Each pipes shall be marked at intervals of maximum 3 m, at least once per pipe, with the following information:

- a) Manufacturer's name/Trade-mark;
- b) Diameter series, nominal size;
- c) Stiffness class;
- d) Material; and
- e) Lot number/batch number containing information regarding period of manufacture.

#### **Fittings**

Each fitting shall be marked with the following information:

- a) Manufacturer's name/Trade-mark;
- b) Diameter series, nominal size;
- c) Nominal angle;
- d) Stiffness class;
- e) Material; and
- f) Lot number/batch number containing information regarding period of manufacture.
- g) BIS Certification Marking each pipe or fittings may also be marked with the standard

Mark.

The use of the Standard mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

#### Requirement for the HDPE-DWC Pipe Supplier

The manufacturer of HDPE-DWC pipes from whom the pipes will be procured in the contract have current accreditation under ISO 9000 and should also possess BIS license for production of DWC pipes as per IS-16098:2013. He must have supplied at least 2.0 km of such pipes under one contract which should have been commissioned to the satisfaction of the client.

The bidder should submit the following data / certificates regarding HDPE-DWC pipes along with the Qualification bid:

Brand Name, Manufacturers capacity, previous supply details etc. Copy of valid ISO 9000 /14000 accreditation. (If any) Copy of valid BIS accreditation for manufacture of HDPE-DWC pipe as per IS 16098 2013. Manufacturer's recommendation and Pressure testing procedure.

#### Joints

Elastomeric sealing rings shall be free from substances that can have a detrimental effect on the pipes or fittings used in conjunction with pipes.

The design of the profile and dimensions of the sealing ring is left to the manufacturer, as long as the pipe with the sealing ring meets the requirements of this standard. Where the design of the socket is such that the ring is not firmly fixed in position, the housing for the ring shall be so designed as to minimize the possibility of the ring being dislodged during insertion of the pipe (or spigot or fitting) to complete the joint. Elastomeric sealing rings shall be in accordance with one of the type (Type 1 to Type 6) of IS 5382. The manufacturer should specify the type of sealing ring (namely Type 1, 2, 3, 4, 5 or 6) that is being offered.

NOTE — A test report or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382.

### **D.8.8 MATERIALS**

It is not unusual for corrugated polyethylene pipe to be connected to other types of pipe materials. Available options depend on the joint duality required throughout the system and the particular combination of pipe materials. In most storm sewer applications , the pipe can be jointed by heating the pipe

ends together, wrapping them with a geotextile, and pouring a concrete collar around them. Although such a connection is dependent on contractor expertise, it will generally limit soil intrusion but not provide a watertight joint. Watertight connections between different materials will require additional fittings and adapters. If those options are not acceptable, a Machinehole can be used to make the transition.

Pipe manufacturers are a valuable resource during the project planning stage since they are familiar with adapters that work well with their own products.

#### PLAIN END PIPE COUPLERS

1. Soil Tight Split Coupler – This is a clam Shell type coupler used in Non-Water Tight application. They are used on perforated or solid style CPP pipes at site where the native soil is stiff and cohesive enough to reduce the possibility of a loose soil infiltration into the pipe that could create a flow restriction.
2. Silt Tight Split Coupler – These are Calm Shell type coupler to which a gasket material has been added for the purpose of restricting Silt Infiltration into the pipe at a coupling joint. This non-water tight gasket material meets ASTM-D-1056, Grade 2A2 or ASTM-F-477. The installer should take care to remove all dirt and foreign matter from the pipe ends and gasket material to ensure a secure fit.

#### BELL & SPIGOT COUPLERS WITH “O” RING GASKETS

These couplers to impede or prevent the infiltration or infiltration of liquids in NON- PRESSURE application.

1. Bell & Spigot Couplers with “O” Ring Gaskets:- These couplers are produced on the pipe during the pipe extrusion process. Bell & Spigot pipes are available in 20-foot lengths, each coupler Spigot End comes with a non-pressure pipe water leak restriction gasket manufactured per ASTM-D-477. Should gravity flow pressure tests be required per ASTM-F-1417, one should not test until the pipes have been backfilled or restrained for safety.
2. Shear gasket gravity flow seal couplers: - These pliable couplers with stainless steel clamp- Grip Compression bands have been used for years connecting clay, concrete, steel and plastic pipes in all types of environments. They are impervious to normal. As with any coupler, before applying, insure that no foreign matter jeopardizes contact between the two surfaces.
3. Mastic Wrap Coupler:- Wrap around style mastic couplers have an outer layer of cross laminated polyethylene plastic and an under layer adhesive surface of rubberized mastic material. In between these two surface layers is a high strength shear and puncture resistant layer of woven polypropylene. This center third layer provides toughness against puncture as well as stretch resistance under earth load shifts or settlements. The Mastic

wrap coupler is mechanically sealed by stainless steel screw type hose clamp compression bands. These adjustable compression clamp bands are easily secured using simple tools such as screwdrivers, nut drivers, or socket wrenches. Proper tension on those bands will provide a seal against infiltration and exfiltration in gravity flow, non-pressure pipes. Each mastic coupler comes with three hose clamp compression bands or ties located within the coupler. There is one compression strap located in the heat joint corrugation pipe valley, and one strap in the first valley on each side of the heat joint. Proper compression tension on each strap (centered over a corrugation valley) will forcibly apply the mastic surface around the corrugation crests and walls to provide a seal. Enough tension should be applied to substantially sink the compression straps into the corrugation valleys below the corrugation crests in order to have a leak resistant seal. Prior to applying the mastic side to the pipe be sure to clean the pipe of soil/dust particles that could interfere with the mastic seal making contact with the pipe surface. Mastic couplers can also be used to couple corrugation pipes manufactured with different corrugation designs of the same pipe size as well as to couple pipes to other pipes made from a different raw material base.

#### **D.8.9 DELIVERY INSPECTIONS**

Contractor along with Project manager or his representative make every effort to ensure order accuracy and quality. As a final check, the AMC should conduct a personal inspection at delivery to verify that the correct product and the expected quantity is received. Pipe corrugations, gaskets, pipe ends, couplers or other joints, and any accessories should be visually inspected for damage that may have occurred during transportation

#### **D.8.10 PRODUCT IDENTIFICATION**

Product markings on Crumpler Plastic Pipe will include the following information to facilitate jobsite inspection.

- Nominal pipe size
- Manufacturer's name
- Date code
- Application standard(s)

#### **D.8.11 UNLOADING**

- a) The Contractor should set aside an area for products to be stored on site.
- b) This area should be flat, free of large rocks, rough surfaces and debris.
- c) It should also be out of the way of construction traffic.
- d) Pipe may be delivered either palletized or loose, depending on the type and quantity of product.
- e) Pallets may be unloaded with a backhoe, forklift or other piece of equipment and a nylon sling or cushioned cable.
- f) The sling should be wrapped around the pallet at the third points as it lifts the pallet onto the ground. As an alternative to using a sling to unload full

pallets, the pallet may be opened and lengths of pipe unloaded individually be carefully rolling single lengths of loose pipe from the delivery truck onto the front end loader, then onto the ground.

- g) Alternately, the pipe can also be lifted using a nylon sling or cushioned cable at the third points.
- h) End handling with a forklift **MUST NOT** be used as pipe damage will occur.
- i) Due to joint weight, larger diameter pipes should not be off loaded by hand.

#### **D.8.12 JOB SITE STORAGE**

- a) Reasonable care should be used in handling pipe.
- b) The pipe should not be dropped, dragged or bumped against other pipe or objects. c) Palletized pipe should remain in the pallet for jobsite storage.
- d) Non-palletized pipe can be stockpiled for temporary storage in a flat debris-free area out of the way of construction traffic.
- e) Begin the stockpile with secured timbers spaced the width of the proposed stockpile at a distance not exceeding the third points.
- f) For pipe with attached bells, a recommended stacking method is to alternate the direction of the pipe lengths so that the bells are not stacked on each other.
- g) As upto three pipes can be laid before alternating directions. Subsequent layers should follow the same pattern as the first but with fewer sticks of pipe in each row.
- h) For smooth interior pipe, storage space can be minimized by nesting smaller diameters into large diameter pipe.
- i) Factory installed gaskets on the spigot should be protected by positioning them between corrugations.

#### **D.8.13 STRINGING THE PIPE**

- a) Placing the pipe and accessories along the open trench, or “stringing” Can save handling time.
- b) Each pipe length should be laid on a level surface as near as possible to the trench on the side opposite the excavated trench material; allow some space between pipe to protect pipe ends.
- c) The pipe should be out of the way of any equipment in a location that will allow excavation to proceed uninterrupted.

#### **D.8.14 WORKMANSHIP / APPEARANCE**



Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe.

#### **D.8.15 LOWERING, LAYING OF PIPES**

- a) Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Project Manager shall be laid.
- b) While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. The bedding should be as per pipe trench drawing submitted.
- c) As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets
- d) During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.)
- e) For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.
- f) The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.
- g) The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.
- h) PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done

- i) When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.
- j) However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.
- k) Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

#### **D.8.16 JOINTING OF PIPES**

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as specified above shall be selected considering site and working condition, pressure and flow of liquids

#### **D.8.17 MEASUREMENT**

The net length of pipes as supplying, laid or fixed shall be measured in running meters correct to a cm.

## **D-9 : DUCTILE IRON PIPE AND FITTINGS**

### **SECTION - D: 9**

#### **D.9.1 DUCTILE IRON (DI) PIPES**

The hydrostatic site test pressures and hydraulic working pressures of each size of pipe shall be as per IS : 8329 : 2000.

#### **D.9.2 Applicable Codes**

Following IS code shall be applicable for :

1. The pipes shall conform to IS 8329-2000 with BIS certification markings on each pipe.
2. The rubber gaskets shall conform to IS : 5382 – 1969 or its latest edition.

#### **D.9.3 GENERAL TECHNICAL SPECIFICATIONS**

##### **Scope**

The items includes following operations.

- a) The pipe shall be manufactured for centrifugally cast (spun) ductile iron pipe for pressure pipes, manufactured in metal (lined or unlined) or sand moulds and their joints for construction of pipelines to convey water and to be installed underground and to be operated with pressure.
- b) Cement mortar lining shall be as per Annexure B of IS 8329 – 2000 and thickness, tolerances and maximum crack width shall be as per IS.

The lining shall be with Ordinary Portland Cement for water supply network and with SRC cement for Sewerage rising main.

- c) The pipes will be externally coated with bituminous coating as per Annexure – C of IS – 8329-2000 at store at site of work.

#### **D.9.4 Standards**

The ductile iron pipes to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance to and conforming to 8329-2000 or its latest revision.

#### **D.9.5 Scope of Item**

The scope of item shall include all cost for labour, materials and machinery etc. necessitated to be utilized for :-

- a) Proper manufacturing of the D. I. Pipes.

- b) All tests required to be undertaken at manufacturer's premises as per IS.
- c) Transportation of the pipes either by rail and or road services with all the covers duly appropriately insured by contractor.
- d) Delivery of pipes with proper loading, unloading, stacking at site of work as indicated by Engineer- in-charge.

#### **D.9.6 Marking**

The method of marking all the pipes to be delivered under scope of this item shall ensure that all the information will remain legible even after transportation, stacking on site etc. In general the legible and indelibly marking upon each pipe shall be indicate the followings.

- i) Manufacturer's brand name and / or trade mark.
- ii) The nominal diameter and class reference.
- iii) The lasts two digits of the year of manufacture.
- iv) BIS certification marking.
- v) Any other important matter, the manufacturer deems fit to be described.

All these marking shall be done :-

- (a) On the socket faces of pipe, centrifugally cast in metal mould and
- (b) On the outside of socket or on the barrel of pipe, centrifugally cast in sand mould.

#### **D.9.7 Workmanship**

All pipes shall be well finished and when visually inspected shall be free from defects such as cracks surface flaws, laminations etc.

Rubber gaskets used with push – on – joints shall conform IS:5382 shall be compatible with drinking water to be conveyed at the working pressure and temperature. Therefore, the **rubber gaskets shall not deteriorate the quality of water and shall not impart any bad taste or foul odour.**

#### **D.9.8 Sampling**

Sampling criteria for various tests shall be as laid down in IS : 11606.

The mechanical acceptance tests shall be carried out on samples of DI pipes as shown in Clause 9.2 of IS : 8329 – 2000.

#### **D.9.9 Mechanical Tests**

Mechanical tests shall be carried out during manufacturing of the pipes in the factory. The following tests are required to be carried out.

- (a) Tensile Test
- (b) Brinell Hardness Test

(c) Retest

#### **D.9.10 Hydraulic Test**

All the pipes shall be tested hydrostatically at a pressure specified in IS:8329 – 2000.

#### **D.9.11 Test Certificates**

- a. The contractor shall always provide manufacturers test certificate for the grade of material and tensile strength in accordance with every batch/lot of goods as manufactured and supplied.
- b. The contractor shall also produce in addition to manufacturer's test certificate as mentioned above test certificate from person / agency appointed by Ahmedabad Municipality for third party inspection.
- c. If the test reports of pipe are not satisfactory, the entire lot will be rejected.
- d. Each pipe and special shall be inspected and tested in factory and a special register of pipe testing shall be maintained and a copy of the same shall be submitted alongwith the delivery of pipes and specials every time.

#### **D.9.12 DETAILED TECHNICAL SPECIFICATION**

##### **Manufacture**

- a) The metal used for the manufacture of pipes shall be of good quality commensurate with the mechanical requirements laid down in IS-1387. It shall be manufactured by any method at the discretion of the manufacturer provided that the requirements defined in this standard are complied with.
- b) The pipes shall be stippled with all precautions to avoid warping or shrinkage defects, detrimental to their good quality. The pipes shall be sound and free from surface or other defects. Pipes showing small imperfections which result from the method of manufacture, and which do not affect service ability, shall not be rejected on that account alone. Minor defects arising out of manufacturing process may be rectified with the consent of the purchaser.
- c) Pipes centrifugally cast shall be heat treated in order to achieve the necessary mechanical properties and to relieve casting stresses caused due to the method of manufacture and repair work.
- d) If necessary the pipes may be subjected to reheat treatment to ensure that Brinell hardness does not exceed the specified value and the specified mechanical properties are achieved as specified.
- e) Pipes shall be delivered internally and externally coated.

**Internal lining :** Ordinary Portland Cement mortar lining as per Annexure – B of IS 8329 : 2000 for water supply line and Sulphate resistant cement for Sewerage rising main.

**External coating:** Bituminous coating as per Annexure – C of IS : 8329 : 2000

#### **D.9.13 Length of Pipes**

The standard working length of socket and spigot pipes shall be 4.0 meter, 5.0 meter, 5.5 meter and 6.0 meter and for flanged pipes shall be 4 meters, 5 meters and 5.5 meters.

#### **D.9.14 Tolerance on Thickness**

Tolerance on thickness, external diameter, length and ovality shall be as per IS 8329:2000 or its latest revision or amendment.

#### **D.9.15 Testing of Pipes**

The main test among others to be conducted shall be as per IS 8329-2000 or with its latest revision or amendments and the **test reports shall be submitted alongwith each delivery of pipes and / or specials.**

#### **D.9.16 Rubber Gaskets**

- A) Rubber gaskets for use with push-on-joints or mechanical joints shall conform to IS : 5382 – 1969 or its latest edition.
- B) Rubber gaskets for push-on, mechanical and flanged joints shall be compatible with the fluid to be conveyed for materials, pressure and temperature.
- C) Rubber gaskets for mechanical joints may be suitably protected so that the elastomer does not come in direct contact with the water.
- D) Rubber gaskets for use with flanged joints shall confirm to IS 638:1979.
- E) While conveying potable water, the gaskets should not deteriorate the quality of water or should not impart any bad taste or foul order.

#### **D.9.17 Stacking of Pipes**

On receipt the pipes shall be stacked on wooden/concrete sleepers to ensure that they do not come in contact with earth. The contractor shall take necessary precautions for safety of pipes; so that no damage occurs during stacking.

#### **D.9.18 Inspection**

Inspection of pipes and specials will be carried out by Engineer in Charge or his representative agency appointed by AMC. All the expenditure for inspection shall be borne by the Contractor except, inspection charges if any, in case of inspection agency appointed by AMC, shall be paid by AMC.

#### **D.9.19 Laying, Jointing and Anchoring**

Pipes shall at all times be handled with care in accordance with manufacturer's recommendations. Pipes shall be lowered into the trench with tackle suitable for the mass of the pipes. A mobile crane or a well designed set of shear legs shall be used and the positioning of the sling checked, when the pipe is just clear of the

ground to ensure a proper balance where lifting equipment is not available, small diameter pipes (normally DN 250 Mx) shall be lowered by hand using suitable ropes.

All persons shall vacate the section of the trench into which the pipe is being lowered.

All construction debris should be cleared from the inside of the pipe either before or just after a joint is made. This can be done by passing a pull through along the pipe or by hand, depending on a diameter of the pipe. When laying is not in progress, a temporary closure shall be filleted securely to the open end of the pipeline. This may make the pipes buoyant in the event of end trench becoming flooded in which case the pipes shall be held down either by partial re-filling of the trench or by temporary strutting.

Jointing procedures will vary according to the type of joint being used.

- (a) Clean lines of all parts
- (b) Correct location of components
- (c) Centralization of spigot within socket and
- (d) Strict compliance with the manufacturers jointing instructions.

The inside of sockets and the outside of spigots shall be cleaned for atleast the insertion depth for each joint.

Gaskets shall be wiped clean and inspected for damage. Where lifting gear has been used to support the pipe and assist in centralizing the spigot in the socket. Where the pipeline is suspected to be subject to movement due to ground settlement or temperature variation a suitable gap shall be left between the end of the spigot and the bottom of the socket. To ensure this two hand marks and made near the spigot end after jointing the end of the socket must end between these two bands.

The cutting of pipe for inserting valves, fittings etc. shall be done in a neat and workmanlike manner without damage to the pipe or lining so as to leave a smooth end at right angles to the axis of the pipe. The burr left after cutting shall be trimmed off by light grinding or by filing.

In case of short length requirement if DI pipe is required to be cut, contractor has to cut. Pipe by electric cutter and the cut end should be chamfered for to be suitable for push – on – joint. No extra payment shall be made for this.

### **Jointing pipes laid on gradients**

If pipes are laid on steep gradients where the soil/pipe friction is low, care shall be taken to ensure that no excessive spigot entry or withdrawal occurs. As soon as the joint assembly has been made. The pipe shall be held in place and the trench back filled over the barrel of the pipe.

Unless the gradient 1:2 or steeper, anchorage's are not normally necessary. However of these very steep gradients, restrained joints or anchor blocks at each socket are recommended.

### **Anchoring**

External anchorage shall be provided at blank ends, bends, tees, tapers and valves to resist the thrust arising from internal pressure and dynamic loading. Anchor and thrust blocks shall be designed to withstand the forces resulting from the internal pressure when the pipeline is under test, taking into account the safe bearing pressure of the surrounding soil. Considerations shall also be given to forces on the pipeline, when empty, and precautions taken against possible flotation. Wherever possible, concrete anchor blocks shall be of such a shape as to leave the joint area clear.

### **Hydrostatic Testing of the Pipeline**

- \* A test length shall not be more than 1000 m. on straight or curved line.
- \* All air shall be expelled from the test segment by marking air vents at the highest point of the test section.
- \* The first part of the testing shall be to stabilize the section at a lower pressure of 1-2 kg/sq/cm at the highest point for a duration of at least 4 hours. On satisfactory completion of this, joints shall be tested against leakage by increasing the test pressure to 1.5 times the maximum working pressure in the section or as specified and holding it for 15 minutes.
- \* If the pressure drop is less than 0.2 kg/sqcm over this period, the test shall be deemed satisfactory.
- \* For the purpose of the test, either power-driven or manual reciprocating pumps shall be used with clean water.
- \* The pressure gauges shall be in good condition and of suitable ranges such as 0.4 kg/sq.cm or 0.7 kg/sq.cm, as required.
- \* The air vent holes shall be properly plugged and sealed with M-Seal on completion of the test.

A pipe segment once tested shall not be used as a support to anchor the end blocks used for testing the next segment.

### **Cleaning**

Before a pipeline can be considered ready for service, it shall be cleaned internally as thoroughly as possible to ensure that no foreign matter remains inside the pipe. The first stage of the cleaning operation i.e. cleaning individual pipes during jointing, shall be performed. Pigs of suitable design e. g. polyurethane swabs, may be used provided that the pipeline has been constructed to allow the passage of such pigs. Here the pipeline is to be tested with water, the fillings and emptying of the pipeline may to some extent cleanse the line.



**The Scope for the item covers :**

- Cost required for jointing cleaning the site of all scrubs, bushes, and trees and dewatering where necessary.
- Cost of all materials like steel, cement, aggregate, bolts, nuts, washers, gasket etc. necessary for pipe lowering, laying & jointing.
- Labour for laying pipes in trenches to correct alignment at required depth with tools, including cutting of pipes and specials if required for laying of pipes including connecting pipes to specials and appurtenances.
- Cost of scaffolding, tools and plants, ropes etc.
- Protection of existing works from damage and cost of repair to the damages carried out of the existing structures, sewer line, telephone/electricity cables, gas pipe line, water supply / irrigation pipe line etc.
- Labour for making joints including jointing material for joints, tools as well as tests. Testing of pipes for leakage under water pressure and flushing the pipes after testing and construction work shall have to be arranged by the contractor at his own cost.

**D.9.20 Method of Measurement and Payment**

The measurement shall be made in running meter basis.

**D.9.21 Ductile Iron fitting**

**Specifications**

The fittings shall be tees, bends, reducers etc. Ductile iron fittings shall conform to IS – 9523 with the latest revision inclusive of Ordinary Portland internal cement mortar lining at the store or site of work including freight, loading, unloading stacking including all taxes, insurance etc. complete. The fittings shall be bitumen coating on the external surface of fittings.

**D.9.22 Method of Measurement and Payment**

Mode of payment will be as under :

On Supply of D.I. Pipe at Site	-	65%
On Lowering , laying and jointing of Pipe	-	25%
On Hydro Test	-	5%
On Commissioning	-	5%

- D.9.22.1 The Vendor list for DI pipe shall be Jindal Saw Ltd. / Rashmi Metaliks/ Electro Steel casting.

## **D-10 : SLUICE VALVES, AIR VALVE & ELECTRO MAGNETIC FLOW MEASURING SYSTEM**

### **SECTION - D: 10**

#### **D.10.1 GENERAL**

The contract shall be covering manufacturing, supplying, testing at factory and delivery of : Sluice valves IS as per 14846-2000 with body, length over flanges.

#### **D.10.2. STANDARDS**

The C. I. Sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications.

#### **D.10.3. TEMPERATURE VARIATIONS**

All sluice valves, manufactured, supplied, tested and delivered shall be subjected to drinking water under variable temperature conditions ranging from 4<sup>0</sup> to 45<sup>0</sup> C.

#### **D.10.4. MARKING**

The legible and indelible markings upon each valve shall indicate the following :  
Manufacturer's brand name and/or trade mark.

- (i) Size of valve and nominal pressure of valve
- (ii) Heat number of cast.
- (iii) Serial number in punch.
- (iv) Where a valve has been tested for only open end test, it should be marked "O" distinctly and permanently.
- (v) Any other important mater that the manufacturer deems fit to be inscribed / embossed.

#### **D.10.5. TEST CERTIFICATE**

- (1) The contractor shall always provide manufacturer's test certificate in accordance with every batch / lot of valves so manufactured and supplied.
- (2) The contractor shall also produce; in addition to manufacturer's test certificate as above, the inspection certificate issued by the authorised person of AMC.

#### **D.10.6. NOMINAL PRESSURE**

Each valve shall be subjected to hydrostatic tests as per IS: 14846-2000. The test pressure and test duration shall be as per table given below.

**Test Pressure for Sluice Valves**

<b>PN Rating</b>	<b>Test for Body / Seat</b>	<b>Test Pressure MPa (Gauge)</b>
PN 1.0	Body	1.5
	Seat	1.0

### Test Duration for Sluice Valves

Valve Size mm	Test for Body / Seat	Test Duration Min.
50 to 1200	Body	5
	Seat	2

#### D.10.7. MATERIAL OF CONSTRUCTION

The material for different component parts of Sluice valves shall conform to IS: 14846 – 2000. The material of construction shall be as per table given below.

Item	Description
Body	Ductile Iron DIN 1693-GG40 / Spheroidal Graphite Iron IS 1865 Gr 400/15
Wedge	Ductile Iron DIN 1693-GGG40 / Spheroidal Graphite Iron IS 1865 Gr 500/7 FOR SIZE UP TO 350 MM :-Rubberlined with EPDM FOR SIZE 400 MM & ABOVE- BODY & WEDGE SEAT RING OF LTB IS 318 GR –II
Spindle/Stem	SS : IS 6603 04 Cr 17Ni 12 M02 /AISI 316
Bonne Gasket	EPDM
Fastners	H.T.- GALVANISED
Nuts, Bolts & Washers for pipe flanges	High tensile steel Hot dip galvanized for valves in chambers, Stainless Steel SS 316 for buried valves
Coating	FOR SIZE UP TO 350 MM :-Internal and external with powder or liquid epoxy coating with minimum dry film thickness of 150 microns. FOR SIZE 400 MM & ABOVE- BLACK BITUMASTIC PAINT.

#### D.10.8. FLANGES

The flanges and their dimension of drilling shall be in accordance with part –IV and VI of IS:1538 (Part – I to XXII) 1976 (specification for cast iron fittings for pressure pipes for water, gas and sewage) or its latest revision.

#### D.10.9. VENDOR LIST

Sluice valves to be supplied shall be of following make, subject to condition that valve shall conform to the requirement of tender specification.

#### **D.10.9.1 Approved Make for Sluice Valves**

The Vendor list for valve shall be Kirloskar Brothers / VAG Vavles / Hawa Engineering Ltd. / Durga Valves / R&D Multiples

#### **D.10.10. TESTING**

Defects noted during test and operation of sluice valve shall be refitted by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

#### **D.10.11. INFORMATION REQUIRED**

Following documents / drawings shall be submitted by Bidder alongwith the quotation.

Preliminary outline dimensional drawings.

Typical cross section drawings.

Supplier's data sheet showing valve size, pressure rating, test pressures, list of tests to be conducted etc.

#### **D.10.12. SCOPE**

The rate of item for valves shall be inclusive of cost of supply of valves with pair off tail pieces. (Pair of tail pieces consist of One no flange socket and One no flange spigot) The cost shall also include all taxes, duties, insurance etc. complete.

Tail pieces shall conform specifications as below:

1. Tail piece shall conform to the latest version of IS : 1535 / 1993.
2. The materials of tail pieces shall be of good quality grey cast iron conforming to IS : 21.
3. Pair of tail piece shall be supplied with each Sluice Valve. One socketed & other spigot ended with flange shall be provided.
4. Flange shall be drilled as per IS : 1538 / 1993.
5. Testing as per IS 1536 / IS 1538 – 1993 of tail pieces will be witnessed by the purchaser before dispatch.

#### **D.10.13. PAYMENT**

The payment will be made on No. basis.

#### **D.10.14. TAMPER PROOF DOUBLE ACTING KINETIC AIR VALVES**

Tamper proof double acting Kinetic Air Valves are to be supplied which shall be designed as per AWWA C512-92 standards.

##### **GENERAL**

The double air valves shall have two ball chambers, having one outlet of large capacity for admission and release of bulk volume of air during emptying and filling of the main and another having small outlet for escape of smaller quantities of entrapped air. This type of air valves shall be of flanged type with full conformation with IS:1538.

The ball sealed orifice always remains open while air is exhausting and is immediately closed when water rises in the chamber, lift the ball and seals the orifice. It shall also ensure that there are no recesses or pockets, sheltering, escaping air for the large orifice (low pressure) valve to drop into when the valve is open. Turbulent air at the time of filling of pipe shall not circulate in such cavities and cause the ball to be blown into when the valve is open. Turbulent air at the time of filling of pipe shall not circulate in such cavities and cause the ball to be blown into the discharging air streams, blowing the valve shut prematurely.

The cone angle of the lower pressure chamber shall be such that even at the critical velocity of air escape at 300 m/sec. The total impact force on the ebonite covered ball is less than the suction force on the angular area between the ball and the cone. The design of the valve should be such as to allow maximum free air discharge at various pressure differentials. The tenderer shall submit with the tender full set of curves showing discharge of free set of curves showing discharge of free air valves pressure differential for all sizes of valves offered by him.

Under no circumstances shall the large orifice ball blow shut prematurely.

The low pressure cover shall be massive and designed to withstand full operating thrust in working conditions.

Air valve shall be design to prevent premature closure prior to all air having been discharge from the line. The orifice shall be positively sealed in the close position but float ( Ball) shall only be raised by the liquid and not by mixer of air and liquid. The sealing shall be design to prevent the floats sticking after long period in the close position.

All branched outlets including outlets for Air valves will be with compensation pads (Dia of Main / For branch Dia ratio greater than 3). Diameter of compensation pad will not be less than 1.75 times the O.D. of the branched outlet. Plate thickness for pads will be same that of the main.

For outlets with above ratio less than three, then the joints will be of plate reinforcement type.

All branched outlets including air valve tee's will be provided with one ½" BSP coupling duly plugged for measurement of pressure in due course. The closing plug will be in Stainless Steel (AISI 304 or equivalent) with Hex. Head and will be provided with copper washer for sealing.

The neoprene seat ring shall be held securely in place under the low pressure cover by a joint support ring to prevent it from sagging when the ball is not sealing the orifice.

The valve body, the orifice cover, cowl of the air valves shall be made of cast iron of grade 2 of IS:210.

Where tenderer considers necessary a suitable drain plug shall be provided.

### **HIGH PRESSURE ORIFICE**

The high pressure orifice and the high pressure chamber shall be so designed that the orifice is effectively sealed in working conditions by "EPDM" coated float.

The material of the orifice shall be gunmetal. The orifice shall be of size not less than 3 mm and tapering to 100 mm suitable to release accumulated air within the pipe. The profile of the orifice shall be carefully chosen to avoid damage to the float surface. The orifice shall be protected by a suitable plug of stainless steel.

### **VALVE FLANGES**

All valves flanges shall be designed to withstand the stresses to which they would be subjected under hydraulic tests. Flanges shall be machined flat. The flanges shall be drilled in accordance with IS:1538 (part – I to XXII) – 1976 (specifications for C. I. Fittings for pressure pipes for water etc.)

### **COATING**

The casting shall be such that it shall not impart any taste or smell to water. The coating shall be smooth, glossy and tenacious, sufficiently hard so as not to flow when posed to a temperature of 770 C and not so brittle at a temperature of 150 C as to chip off when scratched lightly with the point of penknife.

Alternatively, two coats of black Japan conforming to type 8 of IS 341-1971 (Or latest edition) or paint conforming to type – 2 of IS 158-1969 (OR latest edition) shall be applied.

### **TAMPER PROOF AIR RELEASE VALVES**

The bidder has to supply tamper proof Air Release Valves.

The valves shall be

- (i) 100% tamper proof
- (ii) Zero water leakage
- (iii) Unaffected by strong air flow
- (iv) Maintenance free

The tamper proof air release valve shall have following:

- (i) Double orifice & double float.
- (ii) Stainless steel large & small float.
- (iii) Stainless steel guiding stem for large float shall give 100% perfect closing.
- (iv) Aerodynamic bucket design for maximum airflow & which should restrict entry of foreign material.
- (v) Integral vent welded to inverted cap made of MS should restrict tampering of Air Release Valve large orifice.
- (vi) Small orifice automatic valve vertically assembled should discharge small quantity of dissolved air / air pockets automatically.
- (vii) Design shall be as per AWWA C512-92 standards.
- (viii) Air Release Tamper Proof Valves shall be tested as per IS 14845 – 2000.

#### **MATERIAL OF CONSTRUCTION OF KINETIC AIR VALVES**

<b>Sr. No.</b>	<b>Kinetic Air Valves</b>	<b>Material Description PN 10</b>
1	Body	Cast Iron IS 210 GR FG 260
2	Float (Large)	Stainless Steel : ISI – 304 / 316 / 316L
3	Nozzle	Gun Metal : IS 318 LB2 / GM + Neoprene Rubber
4	Gasket	Rubber : Neoprene
5	Cover	Carbon Steel : Plate
6	Fasteners	Carbon Steel : IS 1363

#### **TESTING**

The air valves shall be tested as per IS 14845 – 2000. The air valves shall withstand 1.5 times the working pressure. The joints and air valve shall be water tight. During test if the joints of air valve are found leaking or the air valve is found not functioning properly then the same shall be got rectified or replaced by the contractor to the satisfaction of Engineer-in-charge.

#### **APPROVED MAKE FOR KINETIC AIR VALVE – TAMPER PROOF**

The Vendor list for valve shall be Kirloskar Brothers / VAG Vavles / Hawa Engineering Ltd. / Durga Valves / R&D Multiples

#### **MODE OF PAYMENT**

The payment will be made on No. basis.

## **D-11 : PVC SWR PIPE**

### **SECTION - D: 11**

#### **D.11.1 SCOPE**

This standard covers requirements for plain and socket end unplasticized polyvinyl chloride (PVC-U) pipes with nominal outside diameters 40 mm to 315 mm for use for soil and waste discharge system inside and outside buildings including ventilation, rain water and rain water harvesting applications.

#### **REFERENCES**

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

<b>IS No.</b>	<b>Title</b>
4669 : 1968	Methods of test for polyvinyl chloride resins
4905 : 1968	Methods for random sampling
4985 : 2000	Unplasticized PVC pipes for potable water supplies — Specification
12235	Thermoplastics pipes and fittings — Methods of test:
(Part 1) : 2004	Measurement of dimensions
(Part 2) : 2004	Determination of vicat softening temperature
(Part 5) : 2004	Longitudinal reversion
(Part 6) : 2004	Stress relief test
(Part 7) : 2004	Resistance to sulphuric acid
(Part 8) : 2004	Resistance to internal hydrostatic pressure
(Part 9) : 2004	Resistance to external blows (impact resistance) at 0°C (round- the-clock method)
(Part 11) : 2004	Resistance to dichloromethane at specified temperature
(Part 13) : 2004	Determination of tensile strength and elongation
14182 : 2004	Solvent cement for use with polyvinyl chloride pipes and fittings

#### **TYPES OF PIPES**

Type B - for use in soil and waste discharge systems.

#### **SIZE DESIGNATION**

Pipes shall be designated by the nominal outside diameter DN, in mm as 110 mm.



## **COLOUR OF PIPE**

Surface colour of the pipes shall be dark shade of grey.

## **MATERIALS**

The material from which the pipes are produced shall consist essentially of polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of sound and durable pipes of good surface finish, mechanical strength, and opacity under condition of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard, impair the fabrication, welding, chemical and physical properties of the pipes. The material should also consist of sufficient quantity of stabilizer to help the pipe withstand thermal ageing and exposure to ultra-violet light.

The addition of the manufacturer's own rework material is permissible. The quantity of the rework material used is to be declared by the manufacturer. No other rework material shall be used.

The composition shall be based on PVC resin having a K-value of 64 or greater when tested in accordance with IS 4669.

## **DIMENSIONS**

### **Diameter and Wall Thickness**

Mean outside diameter, outside diameter at any point and wall thickness for Type B pipes manufactured plain or with socket shall be as given in Table 1. Dimensions shall be measured according to the method given in IS 12235 (Part 1).

### **Length of Pipe**

Pipes shall be supplied in nominal lengths of 2, 3, 4 or 6 metres either plain or with socket for solvent cementing/grooved socket. Tolerances on specified length shall be + 10 mm and – 0 mm.

**NOTE - The pipes may be supplied in other lengths where so agreed to between the manufacturer and the purchaser**

The nominal length of the pipe with socket for solvent cementing/grooved socket shall be as given in Fig. 1 in IS : 13592.

### **Socket of Pipe**

Minimum wall thickness of socket on pipes shall be as given in Table 2 read with Fig. 2 and Fig. 3 in IS : 13592

Dimensions of sockets for solvent cementing and grooved sockets of pipes shall be as given in Tables 3 and 4 respectively, read with Fig. 2 and 3 in IS : 13592.

**Table 1 Dimension of Pipes**

(Clause 7.1)

All dimensions in millimetres

Sl. No.	Nominal Outside Diameter DN	Mean Outside Diameter		Outside Diameter at any point		Wall Thickness, S Type B	
		Min	Max.	Min	Max.	Min	Max.
1	2	3	4	5	6	7	8
i)	40	40.0	40.3	39.5	40.5	3.2	3.8
ii)	50	50.0	50.3	49.4	50.6	3.2	3.8
iii)	63	63.0	63.3	62.2	63.8	3.2	3.8
iv)	75	75.0	75.3	74.1	75.9	3.2	3.8
v)	90	90.0	90.3	88.9	91.2	3.2	3.8
vi)	110	110.0	110.4	108.6	111.4	3.2	3.8
vii)	125	125.0	125.4	123.5	126.5	3.2	3.8
viii)	140	140.0	140.5	138.3	141.7	3.6	4.2
ix)	160	160.0	160.5	158.0	162.0	4.0	4.6
x)	180	180.0	180.6	177.8	182.2	4.6	5.5
xi)	200	200.0	200.6	197.6	202.4	4.9	5.6
xii)	250	250.0	250.8	247.0	253.0	6.2	7.1
xiii)	315	315.0	316.0	311.2	318.8	7.7	8.7

**Table 2 Minimum Wall Thickness of Sockets on Pipes**

(Clause 7.3.1)

All dimensions in millimetres

Sl. No.	Nominal Outside Diameter DN	S2 Min. Type B	S3 Min. Type B
1	2	3	4
i)	40	2.9	2.4
ii)	50	2.9	2.4
iii)	63	2.9	2.4
iv)	75	2.9	2.4
v)	90	2.9	2.4
vi)	110	2.9	2.4
vii)	125	2.9	2.4
viii)	140	3.2	2.7
ix)	160	3.6	3.0
x)	180	4.1	3.4
xi)	200	4.4	3.7
xii)	250	5.5	4.7
xiii)	315	6.9	5.8

**Table 3 Dimensions for Sockets for Solvent Cementing**

(Clause 7.3.2)

All dimensions in millimetres

Sl. No.	Nominal Outside Diameter DN	Socket Depth C	Mean Inside Diameter of Socket at Midpoint, D1	
		Min.	Min.	Max.
1	2	3	4	5
i)	40	26.0	40.1	40.3
ii)	50	30.0	50.1	50.3
iii)	63	36.0	63.1	63.3
iv)	75	40.0	75.1	75.3
v)	90	46.0	90.1	90.3
vi)	110	48.0	110.1	110.4
vii)	125	51.0	125.1	125.4
viii)	140	54.0	140.2	140.5
ix)	160	58.0	160.2	160.5
x)	180	60.0	180.2	180.5
xi)	200	60.0	200.3	200.6
xii)	250	60.0	250.4	250.8
xiii)	315	60.0	315.4	316.0

**PHYSICAL TEST REQUIREMENTS****Visual Appearance**

The internal and external surface of the pipes shall be smooth and clean, and free from grooving and other defects. The end shall be clearly cut and shall be square with the axis of the pipe. The end may be chamfered on the plain side. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided the wall thickness remains within the permissible limits.

**Reversion Test**

When tested by the method described in IS 12235 (Part 5), a length of pipe sample of  $200 \pm 20$  mm shall not alter in length by more than 5 percent. In the case of socket ended pipes, this test shall be carried out on the plain portion of pipe taken at least 100 mm away from the root of the socket.

**Stress Relief Test**

This test shall be carried out for socket end pipes only. When tested by the method described in IS 12235 (Part 6), the test specimens shall not show blisters, excessive delamination or cracking or signs of weld line splitting. The weld line or lines may become pronounced during the test, but this shall not be deemed to constitute failure.

### Vicat Softening Temperature

When determined in accordance with IS 12235 (Part 2), the vicat softening temperature of the specimen shall not be less than 79°C.

### Effect of Sunlight

Two samples each 300 mm long from different length of pipes shall be prepared. One sample shall be kept covered in thick paper and kept in shade as control sample and the other exposed to sun for not less than 1 600 h at ambient temperature. After the required period of exposure, the tensile strengths of two samples when tested as per IS 12235 (Part 13) shall not show difference of more than 20 percent of their initial tensile strengths.

**NOTE — Alternatively, effect of sunlight on the pipe may tested using weatherometer for an equivalent exposure time. Relationship, however, shall be established to the satisfaction of purchaser/inspection agency that duration of the exposure required using weatherometer is comparable with stipulated exposure to the sun for 1 600 h.**

### RESISTANCE TO SULPHURIC ACID

When tested by the method described in IS 12235 (Part 7), the mass of specimen shall neither increase by more than 0.32 g nor decrease by more than 0.13 g. The effect of the acid on the surface appearance of the specimen (roughening, bleaching, or blacking) shall be ignored.

### MECHANICAL PROPERTIES

#### Resistance to External Blows at 0°C (Impact Test)

When tested by method prescribed in IS 12235 (Part 9), the pipe shall have a true impact rate of not more than 10 percent. Mass of striker and height of fall shall be as per Annex A of IS- 13592.

In case of socket end pipes, this test shall be carried out on the plain portion of the pipes taken at least 100 mm away from the root of the socket.

#### Tensile Strength

When determined in accordance with the method described in IS 12235 (Part 13), the tensile strength at break shall not be less than 45 MPa.

#### Axial Shrinkage (for Type B Pipes Only)

The axial shrinkage shall not exceed 2 percent when determined in accordance with Annex B of IS : 13592

## **WATER TIGHTNESS OF JOINT**

The assembly of pipe and fitting shall be tested for water tightness in apparatus, which consist of two end sealing devices for the open ends of the fittings, one end connected to a hydraulic pressure source shall be capable of allowing the system to be bled and the other end blanked.

Assemble the systems with the sealing devices [(a) in the case of socket for solvent cementing, the joint has to be achieved by using solvent cement, and (b) in the case of grooved socket, the joint has to be achieved by fitting the rubber sealing ring in the groove], fill with water ensuring all air is removed. Jointing of solvent cementing joints is to be carried out using solvent conforming to IS 14182.

Apply a pressure of 0.05 MPa for a period of 15 min and there should be no leakage at any joint.

## **RESISTANCE TO DICHLOROMETHANE AT SPECIFIED TEMPERATURE**

When tested in accordance with the method described in IS 12235 (Part 11), there shall be no attack observed on any part of the surface of the test piece.

## **SAMPLING AND CRITERIA FOR CONFORMITY**

### **Acceptance Test**

The scale of sampling and criteria for conformity as a lot for acceptance tests specified in Table 5 shall be as given in Annex C of . IS : 13592

### **Type Tests**

Type test given in Table 5 shall be conducted whenever a change is made in the material composition; method of manufacture or a new size of pipe is to be introduced. However, if no change is envisaged, at least one sample from each size and type produced during the period shall be subjected to type tests once in six months.

## **MARKING**

Each pipe shall be clearly and indelibly marked with the following information at intervals not more than 3 m.

- a) Manufacturer's name or trade-mark;
- b) Nominal outside diameter of pipe;
- c) Type A or Type B, as appropriate; and d) Batch No.

Class of Pipe	Colour
Type A	Blue
Type B	White

## BIS Certification Marking

Each pipe may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. Details of conditions under which a licence for the use of the Standard Mark may be granted to the manufacturer or producer may be obtained from the Bureau of Indian Standards.

**Table 5 Acceptance and Type Tests**  
(Clause 13.1 and 13.2)

Sl. No.	Test	Clause	Acceptance Test	Type Test
1	2	3	4	5
i)	Colour	5	✓	
ii)	Dimensional	7.1	✓	
		7.2		
		7.3		
iii)	Visual	8.1	✓	
iv)	Reversion	8.2	✓	
v)	Stress relief test	8.3	✓	
vi)	Impact strength	10.1	✓	
vii)	Tensile strength	10.2	✓	
viii)	Axial shrinkage	10.3	✓	
ix)	Water tightness of joint	11	✓	
x)	Vicat softening temperature	8.4		✓
xi)	Effect of sunlight	8.5		✓
xii)	Resistance to H <sub>2</sub> SO <sub>4</sub>	9		✓
xiii)	Resistance to dichloromethane at specified temperature	12	✓	

This item also includes Providing , laying and jointing in true line and level 110 diameter U.P.V.C. (Type B) conforming to IS 13592-1992 with one end plain and other end socketed with rubber ring & fittings conforming to ISI 14735-1999 of approved make for drainage system pipeline, pipe shall be jointed with each other with rubber lubricant as directed including necessary fittings such as bends, shoes etc. including testing of pipes and joints and jointed with adhesive solvent cement including cost of all materials.

The measurement and payment will be given on Rmt. Basis on completed item.

## **D-12 : ROAD**

### **SECTION - D: 12**

#### **D.12.1 Scope:**

This work shall consist of the preparation of base by necessary excavation, Loosening & Recompacting Ground (below crust 200 mm) with required rolling and watering for preparation of base, construction of DLC as per MoRTH Specification Clause 601 and P.Q.C. in M - 35 as per MoRTH Specification Clause 602 and preparing shoulder with hard murrum as per MoRTH clause 305.

Item shall be measured in Sqm of C.C. Pavement.

The Contract unit rate shall be paid in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work. These will also include excavation and backfilling where necessary to the required compaction.

## **D-13: MDPE PIPE & HOUSE CONNECTION**

### **SECTION : D-13**

- D.13.1**      **Providing, supplying, lowering, laying, jointing of MDPE pipe conforming to ISO - 4427 including compression fitting conforming to ISO/DIS 14236 such as female adopter, elbow, bend, reducer, Tee required for house service connection inclusive of all taxes, insurance, transportation, freight charge, inspection charges, hydro testing etc. complete. The item also includes dismantling of asphalt / metal road, excavation, refilling, watering, ramming, consolidating and restoration of road etc. complete.**

MDPE pipe PE-80 shall conform to ISO-4427. Bidder shall supply the required diameter and length of pipe ISI marks at his cost. The pipe end shall be cut at right angle to the pipe axis. The each pipe shall clearly and indelibly marked. The rate shall be inclusive transportation at site.

**D.13.2      Raw Material**

Raw material used to Manufacture MDPE Blue Pipes shall be Virgin Natural Resin PE 80 containing those anti – oxidants, UV Stabilisers & Pigments necessary for Manufacturing of pipes. The Density of Pipes shall be in the Range 0.926 to 0.940 g/cm<sup>3</sup> confirming to ISO 4427 Standard. The PE 80 Resin shall have MRS of 8 Mpa.

**D.13.3      Effects on Water Quality :**

The MDPE PE 80 Blue Pipes shall confirm to clause 3.5 of ISO 4427 for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW/KIWA/SPGN/WRC-NSF and certificate of compliance to be produced for the following parameters

- a.      Odour & Flavour of Water
- b.      Appearance of Water
- c.      Growth of Micro Organism
- d.      Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e.      Extraction of Metals

**D.13.4      Pressure Rating:**

The Pressure rating of MDPE Blue PE 80 Pipes shall be confirming to Clause 4.1 of ISO 4427 : 1996.

**D.13.5      Colour of Pipes:**

The Colour of MDPE PE 80 Pipes shall be BLUE confirming to Clause 3.2 of ISO 4427 : 1996.



#### **D.13.6 Dimensions:**

The pipe dimensions shall be as per latest revisions of Clause 4.1 of ISO 4427 : 1996 and pipes upto diameters 32 mm shall be supplied in Coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427:1996. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE 80 Pipes shall be as per ISO 4427.

The dimension tolerances shall be as per ISO 4427 clause 4.1.3

#### **D.13.7 Performance requirements**

The Pipe supplied should have passed the acceptance test as per ISO 4427. The manufacturer should provide the test certificates for the following tests.

1. Melt Flow Rate
2. Density,
3. Oxidation and Induction test,
4. Hydrostatic Test ,
5. Pigment dispersion Test,
6. Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer In charge.

#### **D.13.8 TECHNICAL SPECIFICATIONS FOR COMPRESSION FITTINGS**

##### **90 DEG COMPRESSION ELBOW WITH METAL INSERT**

One end of the Metal threaded compression Elbow will be with Taper male threads & other end will have compression fitting suitable to connect to PE pipe. The Taper male threads will be pressure tight. Pressure rating will be PN16.

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in colour, Nut blue in colour. Lip gaskets in Food safe Rubber (NBR) black colour must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamp ring material will be Polyacetal (POM) white colored and shall not be connected to thrust ring. Male threaded part will be made of SS 304.

The product will be tested as per below

Type test	Standard
Dimensions of the threads	ISO 7/1
Tightness of the joints	ISO 3458
Tightness of the joints when subjected to bending	ISO 3503
Resistance to pull-out	ISO 3501
Internal under-pressure test	ISO 3459
Long term pressure test	ISO/DIS 14236

#### **90 DEG COMP ELBOW with COMPRESSION JOINT BOTH ENDS**

The Compression Elbows will have compression ends in both sides, so that PE pipes can be connected at both ends. Pressure rating will be PN 16.

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in colour, Nut blue in color.. Lip gaskets in Food safe Rubber (NBR) black colour must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamp ring material will be Polyacetal (POM) white colored and shall not be connected to thrust ring.

The product will be tested as  
per below

Type test	Standard
Dimensions of the threads	ISO 7/1
Tightness of the joints	ISO 3458
Tightness of the joints when subjected to bending	ISO 3503
Resistance to pull-out	ISO 3501
Internal under-pressure test	ISO 3459
Long term pressure test	ISO/DIS 14236

#### **FEMALE THREADED ADAPTER with METAL OFFTAKE**

**D.13.9 One end of the Female adaptor with metal off take will be with female threads & other end will have compression fitting suitable to connect to PE pipe. The Taper male threads will be pressure tight. Pressure rating will be PN16.**

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in color, Nut blue in color. Lip gaskets in Food safe Rubber (NBR) black color must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamp ring material will be Polyacetal (POM) white colored and shall not be connected to thrust ring. Female threaded part will be made of SS 304.

The product will be tested as per below

Type test	Standard
Dimensions of the threads	ISO 7/1
Tightness of the joints	ISO 3458
Tightness of the joints when subjected to bending	ISO 3503
Resistance to pull-out	ISO 3501
Internal under-pressure test	ISO 3459
Long term pressure test	ISO/DIS 14236

The pipe and fitting shall be lowered, laid and joint using electro-fusion process and hydraulic testing shall be done as specified above in electro-fusion fitting.

**Or**

Compression fittings used for House service connection comply as per ISO 14236

Material of Construction

Compression fittings material shall confirm to ISO14236.Clause -5.

- A .Body-Polypropylene
- b. Nut / Cap –Polypropylene.
- c. Clip Ring-POM (Acetylic resin )
- d. Packing bush- Polypropylene
- e. “O” ring – NBR
- f. Threaded metal inserts –SS 304 with BSP Threads

Pressure testing

The pressure rating of compression fittings as per clause 8 of ISO 14236 which shall be PN16

Dimensions:

The Dimension of compression fittings shall be as per clause 7.1 of ISO 14236

Performance requirements

The compression fittings shall be tested as per ISO 14236. Following Test methods shall be performed.

- Clause 8.2.1 -Leak tightness under internal pressure.
- Clause 8.2.2 -Resistance to Pull out.
- Clause 8.2.3 -Leak tightness under Internal Vacuum.
- Clause 8.2.4 -Long term Pressure Test for Leak tightness for assembled joint
- Clause 8.3.2.1 -MRS Value as per ISO 9080
- Clause 8.3.3.1 -Resistance to Internal pressure.

Effects on Quality of Water

The Compression fittings for intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW / KIWA / SPGN / WRc –NSF and certificate of compliance to be produced for the following parameters :

- a. Odour & Flavour of Water.
- b. Appearance of Water.
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (Cytotoxicity)
- e. Extraction of Metals.

For clear identification of the water services, the nuts of the fittings should be coloured blue while the body to be black. All fittings with threaded ends should be with BSP threads.

#### Excavation

##### General

Any soil which generally yields to the application of pickaxes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel, silt and turf loam, clay, peat etc. fall under this category.

##### Clearing the site

The site on which the structure is to be built shall be cleared, and all obstructions, loose stone, materials and rubbish of all kind, bush, wood and trees shall be removed as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50 m. lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt.

The rate of side clearance is deemed to be included in the rate of earthwork for which no extra will be paid.

##### Setting out

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

##### Excavation

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed.

The contractor shall do the necessary showing and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transferely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level, if by mistake or any other reason excavations is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation upto 1.5 m. depth shall be measured under this item.

#### Disposal of the excavated stuff

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

The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead upto 50 m. and all lift.

#### Dismalting of asphalt / metal road

Under this item contractor shall demolish existing asphalt or WBM / CC pavement met with during laying pipe.

Only area of pavement intercepted in pipe laying shall be demolished. If excess area is demolished same shall be reinstated by the contractor.

Demolished material like asphalt pavement lump and metal shall be stacked separately as directed by the Engineer in charge.

Work done to the extent of requirement for laying of drain and as per specifications shall be measured in sq.m. and paid at the tender rate.

#### Mode of measurements and payment

The description of each item shall, unless otherwise stated, be held to include where necessary, conveyance, and delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting in position, straight, cutting and waste, return of packings etc.

The length shall be measured on running metre basis of finished work. The length shall be taken along the centre line of the pipe and fittings. The pipes fixed to walls, ceiling, floors etc. shall be measured and paid under this item.

All the work shall be measured in decimal system as fixed in its place,

subject to tolerance given below unless otherwise stated.

- (i) Dimensions shall be measured to the nearest 0.01 metre.
- (ii) Area shall be worked out to the nearest 0.01 sq.metre.  
All measurements of cutting shall unless otherwise stated be held to include the consequent waste.

In case of fitting of unequal bore, the largest bore shall be measured for the test.

Testing of pipe lines, fittings and joints include for providing all plant and appliances necessary for obtaining access to the work to be tested and carrying out the tests.

The rate includes all the electro-fusion fittings such as female adopter, elbow, bend, reducer, coupling etc. required for the water meter connection.

The rate shall be for a unit of one running metre.

**D.13.10 Providing, supplying and fixing Ductile Iron strap saddle inclusive of of all taxes, insurance, transportation, freight charge, inspection charges etc. complete as per the detailed specification.**

DI Strap Saddle required for providing house service connections on DI/CI mains.

General specification:

Strap saddles shall be suitable for CI/DI pipes of nominal size 60 mm to 300 mm with nominal outlet connection size from ½", ¾" & 1" BSP female thread.

The body shall be **Resicoat® epoxy** coated with thickness >250 micron as per GSK standard & EN14901. The saddles shall be single type upto pipe sizes of NB 300 and service outlet of ½", ¾" and 1" BSP female thread.

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size 1/2" (M12) shall be used.

Saddle strap shall be with NBR protection rubber.

The sealing between the saddle and mains shall be obtained by using a profiled elastomeric seal matching to the curvature of the pipe. The seal shall be of NBR elastomeric type, suitable for all potable water applications.

The clamp saddles shall be suitable for online tapping with spatula & drilling tool, maximum working pressures upto **16** bars.

## Material and Design Specifications

**Saddle body: DI GGG40 with Resicoat® epoxy** (for corrosion protection of fittings) coating with length 172 mm, width 75 mm, height 67 mm & thread depth 24.5mm. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealing shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.

**Saddle strap:** Saddle straps shall be made of stainless **steel 304 grade, gauge 16 & width 40mm** to prevent corrosion over the long service life & should be with no weld joint to avoid inconsistency of strength.

**Strap Protection Rubber:** NBR UV protected Elastomeric (rubber) shall be such that none of the Stainless Steel Strap is in direct contact with the pipe. It shall ensure a firm non slip grip mounting on the pipe due to external loading.

**Saddle seal:** It shall be virgin rubber NBR Class 70 complying with EN 682-2002. It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be, with the outlet section having o-ring contacting the saddle body.

**Nuts – Bolts- Washer:** Stainless Steel Type 304, NC rolled thread, Tightening torque for ½” (M12) nut-bolt: 14-15 kg m.

**OR**

### **D.13.11 Specifications for Clamp Saddle for Service Connections**

General Specifications :

Clamp saddles for service connection from water distribution mains shall be of wrap around design, wide skirt and wide straps support, which shall reinforce the pipe while providing excellent stability to the saddle.

Clamp Saddles for service connections shall be of fastened strap type with threaded outlet for service connection.

The service connection threading sizes shall be conforming to IS: 554

Clamp saddles shall be suitable for DI pipes of nominal size 3” (NB 80) to 12” (NB 300) with nominal service connection size from ½” (NB 15), ¾” (NB 20), 1” (NB 25), 1 ¼” (NB 32), 1 ½” (NB 40) and 2” (NB 50).

The straps shall be elastomer coated (insulated) type for firm grip on pipe as well as to protect the coating on the pipe and to insulate the un-identical metals. The saddles shall be single strap type upto pipe sizes of NB 600 and

service outlet of ½”, ¾” and 1”.

The saddles shall be double strap type for pipe sizes above NB 600 or when the service outlet is 1 ¼”, 1 ½” or 2”.

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size ½” (M12) shall be used for saddles of size up to 4” (NB 100) and Nut-bolts of size 5/8” (M16) shall be used for saddles of size 6” (NB 150) and above.

The sealing between the saddle and mains shall be obtained by using a profiled elastomer seal matching to the curvature of the pipe.

The seal shall be of elastomer type, suitable for all potable water applications.

The Material of construction of the body, straps, fasteners etc. shall be of a non corrosive material such as engineering plastic (PE/PP) or stainless steel or a combination of both.

The design of the saddle body should be such that, the service connection outlet metal insert shall project out towards pipe side and align with the hole drilled on the pipe to ensure positive locking against rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

The clamp saddles shall be suitable for maximum working pressures upto 10 bars.

#### **D.13.12 Material and Design Specifications:**

**Saddle Body:** Non corrosive Engineering Plastic body moulded with Stainless steel threaded metal insert for tapping outlet. Also, the stirrup metal plate shall be duly embedded in the plastic body, except at the place of nut-bolt lugs. Threading size and dimensions shall conform to IS: 554. The body shall have retaining cavity housing for internal and external retention of the elasomeric seal. Sealing shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.

**Saddle Strap:** Saddle straps shall be made of stainless steel 304 grade to prevent corrosion over the long service life.

**Strap Insulation:** Elasomeric (rubber) insulation / lining shall be such that none of the Stainless Steel Strap is in direct contact with the pipe. It shall ensure a firm non slip grip mounting on the pipe to prevent the saddle from rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

**Saddle Seal:** It shall be virgin rubber SBR Grade 30 / NBR (NSF 61 approved). It



shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be gridded mat, with tapered ends, with the outlet section having oring contacting the saddle body multiple o-rings contacting the pipe, preferably with a Stainless steel reinforcing ring insert moulded to prevent expansion under pressure.

**Nuts-Bolts- washer:** Stainless Steel Type 304, NC rolled thread, Tightening torque for ½” (M12) nut-bolt: 14-15 kg.m and for 5/8” (M 16) nut-bolt: 21-23 kg.m

The payment shall be made as per number basis.

**D.13.13 Providing and fixing brass ferrule of approved make of following sizes inclusive of all taxes, insurance, transportation etc. complete.**

The brass ferrule shall be best quality and make as approved by Engineer-in-charge.

The work shall be carried out in good workmanship manner as directed by the Engineer-in-charge with proper fixing of ferrule as required.

The payment shall be made as per number basis.

**D.13.14 Providing, supplying and fixing U PVC ball Valves with compression end on one side to connect PE Pipes and female threading on the other side for connecting BSP threaded fittings or pipes. The product shall confirm to ISO 4422-4 Standards. The rate shall be inclusive of all taxes, insurance, transportation etc. complete.**

The U PVC ball Valves will have Compression end on one side to connect PE Pipes and female threading on the other side for connecting BSP threaded fittings or pipes. The product shall confirm to ISO 4422-4 Standards and pressure rating will be PN 16. The product should be suitable for use in drinking water for human consumption.

Body, Nut and Thrust Ring will be injection molded from Polypropylene and UV stabilized body & thrust ring black in color, Nut blue in color Lip gaskets / O Ring in Food safe Rubber (NBR) black color must have a conical shape on inside of gasket for easy insertion of pipe & with two lips on bottom to guarantee good sealing. Use of O ring not permitted. Clamp ring material will be Poly acetal (POM) white colored and shall not be connected to thrust ring.

The Compression Fittings & U PVC Ball Valves for drinking water applications should have undergone type test by WRc-NSF, U.K. according to BS 6920 and a certificate from either WRc-NSF or WRAS (Water Regulations Advisory Scheme) should be available evidencing this fact.

The payment shall be made as per number basis.

## **D-14 : REINFORCED CEMENT CONCRETE PIPES SOCKET & SPIGOT**

### **SECTION - D: 14**

#### **D.14.0 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 and gravity, sewers and storm water drains. Laying of pipes and fittings/specials are covered in Technical Specifications: Section-D6. The two parts are complementary and are to be read together for a correct interpretation of the provisions of this specification.

#### **D.14.1 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.

#### **D.14.2 MATERIALS**

- (a) IS: 458- Specification for precast concrete pipes (with and without reinf.)-2021
- (b) IS: 3597 -Method of tests for concrete pipes.
- (c) IS: 5382 -Specification for rubber sealing rings for gas mains, water mains and sewers.
- (d) IS: 516 -Method of test for strength of concrete.

#### **D.14.3 CODE OF PRACTICE**

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

#### **D.14.4 DESIGN**

Design of RCC pipes including reinforcement details and the ends of pipes shall be in accordance with the relevant clauses of IS: 458-2021.

## **D.14.5 MANUFACTURING**

### **GENERAL :**

**Pipe should be with ISI mark confirming to IS-458-2021. Pipe can be manufactured by spinning process or by vibrated casting process.**

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 clause of 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. The ends of the pipes shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.

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

Owner/Engineer shall at all reasonable times have free access to the place 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 the supplier/contractor at his own cost and in presence of Owner/Engineer if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to Owner/Engineer.

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

## **D.14.6 MATERIALS**

### **Cement**

Cement used for the manufacture of RCC pipes should be SRC and shall confirm to relevant IS codes.

### **Aggregates**

Aggregates used for the manufacture of RCC pipes 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 and Curing Water**

Water shall be clean, colorless 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 shall be mild steel Grade I or medium tensile steel bars conforming to IS: 432 (Part-I) or hard-drawn steel wire conforming to IS: 421 (Part-2). Reinforcement cages for pipes shall be as per relevant requirements of IS: 458.

### **Concrete**

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

### **Rubber Ring**

Rubber ring chords used in pipe joints shall be EPDM rubbering as per IS 5382 : 1985.

## **D.14.7 CURING**

Pipes manufactured in compliance with IS:458 (Latest Edition) shall be either water cured or steam cured for minimum stipulated curing period in accordance with relevant requirements of the latest revised IS:458 (Latest Edition).

## **D.14.8 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 classes of pipes.

**Table – 3 of IS-458-2021**

**Design and Strength Test Requirements of Concrete Pipes of Class NP3  
Reinforced Concrete, Medium Duty, Non-Pressure Pipes made by spinning process**

(Clauses 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 and 8.1 and Table 20)

Internal Diameter of Pipes in mm	Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Draws Steel	Load to Produce 0.25 mm Crack kN/linear metre	Ultimate Load
		Minimum number	Kg/linear metre	Kg/linear metre		kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300	40	8	0.78	1.53	15.50	23.25
400	75	8	0.78	1.6	19.16	28.74
450	75	8	0.78	1.9	21.56	32.34
600	85	8 or 6+6	1.18	2.82	28.74	43.11
800	95	8 or 6+6	2.66	6.87	38.32	57.48
900	100	6 + 6	2.66	11.55	43.11	64.67
1000	115	6 + 6	2.66	15.70	47.90	71.85
1200	120	8 + 8	3.55	24.74	57.48	86.22
1400	135	8 + 8	3.55	46.21	67.06	100.60
1600	140	8 + 8	3.55	65.40	76.64	114.96
1800	150	12 + 12	9.36	87.10	86.22	129.33
2000	170	12 + 12	9.36	97.90	95.80	143.70
2200	185	12 + 12	9.36	133.30	105.38	158.07

**Note :**

1. If mild steel is used for spiral reinforcement, the weight specified under col.5 shall be increased to 140/125.
2. The longitudinal reinforcement given in this table is valid for pipes upto 2.5 m. effective length for internal diameter of pipe upto 250 mm and upto 3 m. effective length for higher diameter pipes.
3. Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col.4 by the length of the pipe and then deducting for the cover length provided at the two ends.
4. Concrete for pipes shall have a minimum compressive strength of 35 N/mm<sup>2</sup> at 28 days.

**Table – 5 of IS- 458-2021**

**Design and Strength Test Requirements of Concrete Pipes of Class NP3  
Reinforced Concrete, Medium Duty, Non-Pressure Pipes Made by Vibrated Casting  
Process**

(Clauses 5.5.1, 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 and 8.1 ; and Table 20)

Internal Diameter of Pipes in mm	Minimum Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Draws Steel	Load to Produce 0.25 mm Crack kN/linear metre	Ultimate Load kN/linear metre
		Minimum number	Kg/linear metre	Kg/linear metre		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300	50	8	0.78	1.53	15.5	23.25
400	60	8	0.78	1.6	19.16	28.74
450	65	8	0.78	1.9	21.56	32.34
600	75	8 or 6 +6	1.18	2.2	28.74	43.11
800	95	8 or 6 +6	2.66	6.87	38.32	57.48
900	100	6 + 6	2.66	11.55	43.11	64.67
1000	115	6 + 6	2.66	15.7	47.9	71.85
1200	125	8 + 8	3.55	21.25	57.48	86.22
1400	140	8 + 8	3.55	30	67.06	100.6
1600	165	8 + 8	3.55	50.63	76.64	114.96
1800	180	12 + 12	9.36	64.19	86.22	129.33
2000	190	12 + 12	9.36	83.12	95.8	143.7
2200	210	12 + 12	9.36	105.53	105.4	158.07

**Note :** Concrete for pipes shall have a minimum compressive strength of 35 N/mm<sup>2</sup> at 28 days

**Table – 6 of IS-458-2021**

**Design and Strength Test Requirements of Concrete Pipes of Class NP4  
Reinforced Concrete, Heavy Duty, Non-Pressure Pipes**

(Clauses 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 and 8.1 ; and Table 20)

Internal Diameter of Pipes in mm	Minimum Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Draws Steel	Load to Produce 0.25 mm Crack kN/linear metre	Ultimate Load kN/linear metre
		Minimum number	Kg/linear metre	Kg/linear metre		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300	40	8	0.78	1.53	26.4	39.6
400	75	8	0.78	1.97	33.9	50.9
450	75	8	0.78	3.36	36.9	55.3
600	85	8 or 6 + 6	2.34	8.5	46.3	69.4
800	95	8 or 6 + 6	3.44	16.72	59.3	89.1
900	100	6 + 6	3.44	20.92	66.3	99.4
1000	115	8 + 8	6.04	26.7	72.6	108.9
1200	120	8 + 8	6.04	46.25	88.3	132.4
1400	135	8 + 8	9.36	59.2	99.1	148.65
1600	140	12 + 12	9.36	86.6	109.90	164.85
1800	150	12 + 12	14.88	103.3	120.7	181.05
2000	170	12 + 12	14.88	125.28	131.5	197.25
2200	185	12 + 12	14.88	154.94	142.2	213.3

- Note :**
1. If mild steel is used for spiral reinforcement, the weight specified under col.5 shall be increased to 140/125.
  2. The longitudinal reinforcement given in this table is valid for pipes upto 2.5 m. effective length for internal diameter of pipe upto 250 mm and 3 m. effective length for higher diameter pipes.
  3. Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col.4 by the length of the pipe and then deducting for the cover length provided at the two ends.
  4. Concrete for pipes shall have a minimum compressive strength of 35 N/mm<sup>2</sup> at 28 days.

**Table – 8 of IS-458-2021**

**Design and Strength Test Requirements of Concrete Pipes of Class NP4  
Reinforced Concrete, Heavy Duty, Non-Pressure Pipes  
made by Vibrated casting process**

(Clauses 5.5.1, 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 and 8.1 ; and Table 20)

Internal Diameter of Pipes in mm	Minimum Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Draws Steel	Load to Produce 0.25 mm Crack kN/linear metre	Ultimate Load kN/linear metre
		Minimum number	Kg/linear metre	Kg/linear metre		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300	50	8	0.78	1.53	26.4	38.6
400	60	8	0.78	1.97	33.9	50.9
450	65	8	0.78	3.36	36.9	55.3
600	75	8 or 6 + 6	2.34	8.50	46.3	69.4
800	95	8 or 6 + 6	3.44	16.72	59.3	89.1
900	100	6 + 6	3.44	20.92	66.3	99.4
1000	115	8 + 8	6.04	26.70	72.6	108.9
1200	125	8 + 8	6.04	42.42	88.3	132.4
1400	140	8 + 8	9.36	51.39	99.10	148.65
1600	165	12 + 12	9.36	61.81	109.9	164.85
1800	180	12 + 12	14.88	78.03	120.70	181.05
2000	190	12 + 12	14.88	103.5	131.5	197.25

**Note :** Concrete for pipes shall have a minimum compressive strength of 35 N/mm<sup>2</sup> at 28 days.

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

#### **D.14.9 WORKMANSHIP AND FINISH**

Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter.

The outside and inside surfaces of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between Owner/Engineer and the manufacturer or supplier.



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 3 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

The deviation from straight in any pipe 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 diameters 3 mm forever meter run.

#### **D.14.10 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 (Latest Edition).

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 the results of compressive tests of concrete cubes and split tensile tests of concrete cylinders made from the concrete used for the pipes. The manufacturer shall supply cylinders or cubes for test purposes required by the Owner/Engineer and such cylinders or cubes shall withstand the tests prescribed by the manufacturer for the hydrostatic test pressure. For non-pressure pipes, 2 percent of the pipes shall be tested for hydrostatic test pressure.

The specimen of pipes for the following tests shall be selected in accordance with relevant Clause of IS:458 (Latest Edition) and tests in accordance with the methods described in IS:3597.

- i) Hydrostatic test
- ii) Three edge bearing test
- iii) Absorption test

Note: Three edge bearing strength to produce 0.25 mm crack in case of special design of pipes shall be as per IS:458:2003.

For Inspection at manufacturing site 24 hrs. access shall be provided to AMC Engineers as well as engineer appointed by PMC/TPI agency. Apart from this AMC will establish its own pipe testing facility where pipes will be randomly tested. The cost of transporting the pipe to the testing facility & testing charges shall be borne by the contractor.

#### **D.14.11 SAMPLING AND 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 for testing shall be in accordance with Table 15 of IS:458 (Latest Edition).

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 'n'th pipe be selected till the requisite number is obtained, n being the integral part of  $N/n$ , where N is the lot size and n is the sample size.

All pipes selected as per IS : 458 shall be inspected for dimensional requirements, finish and deviation from straight. A pipe failing to satisfy one or more of these requirements shall be considered as defective.

The number of pipes to be tested for tests under IS : 458 shall be in accordance with column 4 of Table 15 of IS:458 (Latest Edition). These pipes shall be selected from pipes that have satisfied the requirements mentioned in Clause above.

A lot shall be considered as conforming to the requirements of IS:458 (Latest Edition) if the following conditions are satisfied.

The number of defective pipes shall not be more than the permissible number given in column 3 of Table 15 of IS:458 (Latest Edition).

All the pipes tested for various tests as per IS-458 shall satisfy corresponding requirements of the tests.

In case the number of pipes not satisfying requirements of any one or more tests, one or two further samples 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.

#### **D.14.12 MARKING**

The following information shall be clearly marked on each pipe :

- a) For AMC USE
- b) Internal diameter of pipe
- c) Class of pipe
- d) Date of manufacture, and
- e) Name of manufacturer or his registered trademark or both.

#### **D.14.13 LAYING OF PIPES**

The laying of RCC pipes shall conform to Technical Specifications: Section-D-6.

#### **D.14.14 JOINTING**

##### **GENERAL**

Jointing of RCC pipes shall be done with SRC cement only and as per the requirements of following specifications and as per the relevant IS. The type of joints shall be as below. After jointing, extraneous material, if any, shall be removed from the inside of the pipe and the newly made joints shall be thoroughly cured. In case, rubber-sealing rings are used for jointing, these shall conform to IS 5382 and shall be of such type as mentioned in IS-458:2003.

#### **D.14.15 FLUSH JOINT (INTERNAL)**

This joint shall be generally used for culvert pipes of 900-mm diameter and over. The ends of the pipes are specially shaped to form a self-centering joint with an internal jointing space 13-mm 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 IS-458-2003, mixed sufficiently dry to remain in position when forced with a trowel or rammed.

##### **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 IS-458-2003, 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.

##### **SPIGOT AND 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 pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The RCC pipes shall be of spigot and socket type and rubber rings as specified in IS-458-2003, shall be used, and the manufacturers 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.

Socket & Spigot NP3 & NP4 pipe with rubber ring roll on joint for diameter upto 900 mm should be provided as per table 14 pf IS 458 : 2003.

Socket & spigot NP3 & NP4 pipe with rubber ring confined joint for diameter 1000 mm to 2200 mm should be provided as per Table -17 of IS 458:2003.

#### **D.14.16 CLEANING OF PIPES**

As soon as a stretch of RCC pipes has been laid complete from Machinehole to Machinehole or for a stretch as directed by Owner/Engineer, 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 the incomplete stretch of pipeline shall be securely closed as may be directed by Owner/Engineer to prevent entry of mud or silt etc.

If as a result of the removal of any obstructions Owner/Engineer 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 are required by Owner/Engineer.

It shall also be ascertained by contractor that each stretch from Machinehole to Machinehole or the stretch as directed by Engineer is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

#### **D.14.17 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. All equipment for testing at work site shall be supplied and erected by contractor. Water for testing of pipes shall be arranged by him. Damage during testing shall be contractor's responsibility and shall be rectified by him to the full satisfaction of Owner/Engineer. Water used for test shall be removed from pipes and not released to the excavated trenches.

After the joints have thoroughly set and have been checked by Owner/Engineer and before backfilling the trenches, the entire section of the sewer or storm water drain shall be proved by contractor to be water tight by filling in pipes with water to the level of 1.50 m above the top of the highest pipe in the stretch and heading the water up for the period of one hour. The apparatus used for the purpose of testing shall be approved by Owner/Engineer. Contractor if required by Owner/Engineer shall dewater the excavated pit and keep it dry during the period of testing. The loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular 10 minutes intervals and noting the quantity required to maintain the original water level. For the approval of this test the average quantity added should not exceed 1 litre/hour/100 linear metres/10 mm of nominal internal diameter. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good.

In case of pressure pipeline the completed stretch of pipeline shall be tested for site test pressure as specified in IS-458-2003. The site test pressure should not be less than the maximum operating pressure plus the calculated surge pressure, but in no case should it exceed the hydrostatic test pressure as specified in IS:458 (Latest Edition).

#### **D.14.18 MEASUREMENT**

All RCC pipes shall be measured according 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 meter 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 rubber rings, jointing material, testing and extra excavation required for ordinary bedding of pipes and also for pipe sockets, if any.

#### **D.14.19 NOTES**

- (i) 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 Engineer.
- (ii) Water for testing of pipeline shall be arranged by Contractor at his own cost.
- (iii) Pipes shall be brought on site proportionate to the required progress for Thirty days only.

## **D-15 : GENERAL BUILDING WORKS**

### **SECTION : D-15**

#### **D.15.1 SCOPE**

- D.15.1.1 This specification covers the general requirement for brick and stone masonry, plastering, flooring, doors, windows, ventilators, wood work, water proofing, false ceiling, painting and such other related works forming a part of this job, which may be required to be carried out though not specifically mentioned above. The work under this specifications shall consist of furnishing of all tools, plants, labour, materials, any and everything necessary for carrying out the work.

#### **D.15.2 APPLICABLE CODES AND SPECIFICATIONS**

- D.15.2.1 The following codes, standards and specifications are made a part of this specifications. All standards, tentative specification, specification, codes of practices referred to herein shall be latest edition including all applicable official amendments and revisions.

- D.15.2.2 In case of discrepancy between this specification and those referred to herein, these specifications shall govern.

- IS : 1077 - Common burnt clay bricks
- IS : 3102 - Classification of burnt clay bricks
- IS : 2180 - Burnt clay building bricks, heavy duty
- IS : 3495 - Method of sampling and testing clay building bricks
- IS : 2691 - Burnt clay facing bricks
- IS : 2212 - Code of practice for brick work
- IS : 2185 - Load bearing hollow concrete blocks
- IS : 5498 - Lime-Cement-Cinder hollow concrete blocks
- IS : 3115 - Lime-Cement-Cinder soil blocks
- IS : 1597 - Code of practice for construction of stone masonry (Part-I)
- IS : 2394 - Code of practice for application of lime plaster finish
- IS : 2645 - Integral cement water proofing compounds
- IS : 1443 - Code of practice for laying and finishing of cement concrete flooring tiles
- IS : 2114 - Code of practice for laying in situ terrazzo floor finish
- IS : 777 - Glazed Earthenware tiles
- IS : 4021 - Timber door, window and ventilator frames
- IS : 2202 - Wooden flush door shutters (Solid Core Type) (Part-I)
- IS : 1003 - Timber panelled and glazed shutters (Parts – I and II)
- IS : 4020 - Methods of tests for wooden flush doors : Type tests
- IS : 1761 - Transparent sheet glass for glazing and framing purposes
- IS : 4351 - Steel door frames
- IS : 1038 - Steel doors, windows and ventilators
- IS : 1081 - Codes of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators

- IS : 5807 - Method of test for clear finishes for wooden furniture (Part-I to III).
- IS : 1477 (Part-I & II) - Code of practice for painting of ferrous metals in buildings and allied finishes.
- IS : 2338 (Part-I) - Code of practice for finishing of wood and wood-based materials
- IS : 437 - Distemper, dry, colour as required
- IS : 428 - Distemper, oil emulsion, colour as required
- IS : 2395 - Code of practice for painting concrete, masonry and plaster surfaces
- IS : 3384 - Bituminous primer for use in water proofing and damp proofing
- IS : 1580 - Bituminous compound for water proofing and caulking purpose
- IS : 1322 - Bitumen felts for water proofing and damp proofing
- IS : 1346 - Code of practice for water proofing of roofs with bitumen felts

### **D.15.3 BRICK WORK**

D.15.3.1 Bricks used in works shall conform to the relevant Indian Standards. They shall be sound, hard, homogenous in texture, well bunt in kiln without being vitrified, table moulded, deep red, cherry or copper coloured, of regulator shape and size and shall have sharp and square edges and parallel faces. The bricks shall be free from pores, chips, flaws or humps or any kind. Bricks containing unground particles and / or which absorb water more than  $1/6^{\text{th}}$  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 35 Kg/sq. cm. Unless otherwise noted in drawings. The classes and quality requirements of bricks shall be as laid down in IS : 3102.

D.15.3.2 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. However, bricks conforming in size to IS : 1077 could be used. Bricks shall be provided with frogs. Only full size bricks shall be used for masonry work. Brick bats shall be used only with the permission of the Engineer to make up required wall length or for bonding. Sample bricks shall be submitted to the Engineer for approval and bricks supplied shall conform to approved samples. If demanded by Engineer, brick sample shall be got tested as per IS : 3495 by Contractor at no extra cost to Client. Bricks rejected by Engineer shall be removed from the site of works within 24 hours.

#### **D.15.3.3 Mortar**

D.15.3.3.1 Mortar for brick masonry shall be prepared as per IS : 2250 Mix for cement mortar shall be specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one completed bag of cement containing

50 kg of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer, sand shall be thoroughly washed till it is free of any contamination.

D.15.3.3.2 For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, though hand mixing in a thorough manner may be allowed. The mortar so mixed shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

D.15.3.3.3 The Contractor shall arrange for test on mortar samples if so directed by the Engineer. Re-tempering of mortar shall not be permitted.

#### **D.15.3.4 Workmanship**

D.15.3.4.1 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 shall be as specified in the respective item of work. Brick work 230 mm thick and over shall be laid English Bond unless otherwise specified. 115 mm thick 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.

D.15.3.4.2 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 course 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 so portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be racked back according to bond (and not saw toothed) at an angle not exceeding 45 degree. But in no case the level difference between adjoining walls shall exceed 1.25 m. Workmanship shall conform to IS : 2212.

D.15.3.4.3 Bricks 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 10/15 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 brick work 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 the mortar in the lower course has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.



- D.15.3.4.4 All brick work shall be built tightly against columns, floor slabs or other structural members.
- D.15.3.4.5 Where drawings indicate that structural steel columns are to be fireproofed with brickwork, the brick shall be built closely against all flanges and webs with all spaces between the steel and brickwork filled with mortar. Steel members partly embedded in brickwork and not indicated to be fireproofed with concrete, shall be covered with not less than 12 mm thick mortar unless directed otherwise by Engineer.
- D.15.3.5 Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural steel, steel inlets etc. shall be installed by the Contractor at no extra cost to the Owner. Furnishing of any of these inserts by the Contractor, will be paid for separately. Openings, arches etc. shall be provided as shown on the drawings. Chases, pockets etc. shall be provided as shown on the drawings to receive windows, louvers, doors frames etc. Wall ties and flashings shall be built into the brickwork in accordance with the drawings and specifications. It shall be clearly understood that the rates quoted by the Contractor include for fixing of inserts, leaving openings, cutting chases in brickwork for various trades etc.
- D.15.3.6 Facing Brickwork**
- D.15.3.6.1 Facing bricks of the type specified shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks. No facing brickwork shall at any time be more than 600 mm above the backing brickwork.
- D.15.3.6.2 All facing brickwork shall be pointed as the work proceeds and internal faces of the brickwork shall be pointed with neat flush joint to give a fair face.
- D.15.3.6.3 Faced work shall be kept clean and free from damage, discoloration etc. at all times. The Contractor shall fill carefully all holes with bricks similar to the surrounding brickwork, point brickwork as required.
- D.15.3.6.4 For facing brickwork, double scaffolding shall be used no holes in brickwork for scaffolding shall be permitted.
- D.15.3.7 The green work shall be protected from rain by suitable covering bricks shall be kept constantly moist on all faces for a minimum period of ten days. Brickwork shall not be raised more than one metre per day.
- D.15.3.8 The rates quoted by the Contractor are exclusive of transoms and mullions. Contractor shall provide the same as shown or indicated on the drawings. These shall be generally provided only in half and full brick walls. Dimensions of the transoms and mullions shall conform to the thickness of the wall. Concrete work for transoms and mullions shall conform to the specifications for concrete and shall be of grade M200.

D.15.3.9 Where shown on the structural drawings, bricks for partitions walls shall be stacked adjacent to the structural member to pre deflect the structural member before the wall is built.

**D.15.3.10 Measurement**

D.15.3.10.1 Brick work of thickness one brick i.e. 230 mm and above shall, unless otherwise stated in the Schedule of Quantities, be paid in units of cu.m. or part thereof. Brickwork of thickness less one brick i.e. less than 230 mm thick shall be measured and paid on the basis of rates quoted per sq.m. of part thereof in all cases, the quantities measured and paid for shall be those actually executed after making necessary deductions for openings etc. Brick masonry for steps and such other mass works and encasement shall be paid on the basis of rates quoted per cu.m. or part thereof.

**D.15.4 CONCRETE BLOCK MASONRY**

D.15.4.1 Concrete blocks (hollow or solid) shall generally conform to IS : 2185. Blocks shall be regular size and shape and shall be of specified strength. Blocks shall be properly cured before they are brought to site. Half of three quarter size blocks are to be used wherever required to make up length of wall and broken blocks shall not be used. The texture of the blocks shall be such that plaster will adhere to it. The Contractors shall supply samples for approval. Blocks supplied shall conform to approved samples.

**D.15.4.2 Mortar**

Mortar shall be similar to mortar in brickwork as given Clause D.15.3.3 herein before.

D.15.4.3 All block work shall be plumb, square and properly bonded. The joints shall be broken. The thickness of the courses shall be uniform with courses horizontal. All connected work shall be carried out at nearly one level and no portion of the work shall be left more than one course lower than the adjacent work.

D.15.4.4 Blocks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and nor more than 8 mm. The face joints shall be raked to a minimum depth of 10 mm by raking tools daily during the progress of work when the mortar is still green, so as to provided a proper key for the plaster or pointing. When plastering or pointing is not required, the joints shall be struck flush. For pointed masonry or for masonry without plaster, smooth textured concrete shall be use. The face of block work shall be kept clean at all times.

D.15.4.5 Where blocks are to be used for load bearing walls, the uppermost layer of blocks supporting slab or other structural members, shall be solid of treated as directed by the Engineer.

D.15.4.6 Precast concrete screen blocks or 'jali' work may be used for decorative purpose. The Contractor shall furnish samples for approval.

**D.15.4.7 Measurement**

D.15.4.7.1 Block work of specified thickness shall be paid in units of sq.m. or parts thereof. If reinforcing bars are specified in horizontal courses, it shall measured and paid for separately at quoted rate for reinforcement. In all cases, the quantities measured and paid for, shall be those actually executed after making necessary deductions for openings etc.

D.15.4.7.2 Miscellaneous inserts e.g sleeves, ties, anchors, conduits etc. in block masonry shall be installed by Contractor, at no extra cost to Owner. Furnishing of any of these inserts by Contractor will be paid for separately.

**D.15.5 RANDOM RUBBLE MASONRY, UNCOURSED IN FOUNDATION, PLINTH AND SUPERSTRUCTURE**

D.15.5.1 Stones for this work shall be hard, durable rock, close or fine grained and uniform in colour, free from veing, flaws and other defects and shall conform to IS : 1597 (Part-I). The stones shall be laid in mortar proportions specified for the particular item of work. Stones shall be got approved, if desired by Engineer.

D.15.5.2 For all work below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for hearting and faced with selected quarry dressed stones.

D.15.5.3 For all work above ground level and in superstructure the masonry shall random rubble, well bonded, faced with hammer dressed stones with squared quoins at joints and corners.

D.15.5.4 No stones shall tail into the wall, either with a point or to length less than 1.5 times its height. The thickness of the joint shall not exceed 12 mm.

D.15.5.5 Spawls and pinnings shall not be allowed to show on the face of the wall. Two bond stones each of minimum area of 500 sq.cm. for every 1.0 sq.m. of each wall face shall be provided. These shall be through stones in walls 600 mm thick and under. In walls thicker than 600 mm, the length of bond stones shall be 2/3 times the thickness of walls. The stones for hearting of the wall shall not be less than 150 mm in any direction. Chips and Spawls shall be wedged in to avoid thick mortar beds and joints. The quoins shall be of selected stones neatly dressed with chisel to form the required angles and laid harder and stretcher alternately.

D.15.5.6 The exposed face of the work shall be carefully and neatly pointed with mortar in all joints. On the other sides, the joints shall be neatly struck with trowel while the mortar is fresh.

**D.15.5.7 Mortar**

The mortar for the work shall be as specified in the respective items of work and shall be prepared as per Clause D.15.3.3.

D.15.5.8 Curing of masonry shall continue for a minimum of ten days.

**D.15.5.9 Measurement**

The unit of measurement shall be cu.m. or part thereof. Actual quantity of masonry shall be calculated from dimensions shown on the drawings less opening and shall be paid for.

**D.15.6 COURSED RUBBLE MASONRY (FIRST SORT) FOR SUPERSTRUCTURE**

D.15.6.1 The stones used shall be hard, durable, rock free from veins, flaws and other defects and shall conform to IS : 1597 (part-I). Height of each course in the masonry shall not be less than 150 mm. The stones in each course shall be of equal height. All courses shall be of the same height unless otherwise specified. All stones shall be set in full cement mortar of proportion specified for the respective items of works. Stones shall be got approved, if desired by Engineer.

D.15.6.2 The free stones shall be squared on all joints and beds. The beds being hammer or chisel dressed true and square for at least 75 mm from the face and the joints for at least 40 mm. The face of the stone shall be hammer dressed so that bushings shall not project more than 40 mm.

D.15.6.3 No spalls or pinnings shall be allowed in the face. All bed joint shall be horizontal and side joints vertical and no joints shall be more than 10 mm thickness.

D.15.6.4 No face stone shall be less in breadth than in height or shall tail into the work to a length less than the height and at least  $\frac{1}{3}$ <sup>rd</sup> the number of stone shall tail into the work to at least twice their or in walls over 600 mm in thickness 3 times their height.

D.15.6.5 Through stones shall be inserted every 1.5 metres to 1.8 metres apart in every course and shall run right when the wall is not more than 600 mm thick. When the wall is more than 600 mm thick a line of two or more headers be laid from the face to face which shall overlap each other by at least 150 mm. A header shall have a length of at least thrice its height.

D.15.6.6 Stones shall break joint at least half the height of the courses. Quoins shall be formed of stones at least 45 cm. Long, laid stretcher and header alternately. They shall be laid square in their beds, which shall be fair dressed to a depth of at least 100 mm. The corner shall be chisel dressed for a width of 25 mm.

D.15.6.7 The work on the interior face shall be precisely the same as on the exterior face unless the work is to be plastered in which case the side joints need not be truly vertical.

D.15.6.8 Hearting shall consist of flat bedded stone carefully laid on their proper beds and solidly bedded in mortar, chips and spalls of stone being wedged in wherever so as to avoid thick beds or joints of mortar. Care shall be taken so that no dry work or hollow spaces shall be left anywhere in the masonry. The face and backing shall be brought up evenly but the backing should not be levelled up at each course by the use of chips.

**D.15.6.9 Mortar**

The mortar for the work shall be as specified in the respective items of work and shall be prepared as of Clause D.15.3.3.

D.15.6.10 Curing of masonry shall continue for a minimum of ten days.

**D.15.6.11 Measurement**

The unit of measurement shall be cu.m. of part thereof. Actual quantity of masonry shall be calculated from dimensions shown on drawings less openings and shall be paid for.

**D.15.7 INSERTS, BOLTS ETC.**

D.15.7.1 Inserts, bolts etc. shall be provided in masonry and concrete works as indicated on the drawings. It is imperative that all inserts, bolts, fixtures and fittings shall be provided in their position very accurately. If the Engineer directs that such inserts and bolts be fixed by use of templates, the Contractor shall make arrangements for providing such templates. If as a consequence of negligence on the part of the Contractor, the inserts, bolts, fixtures, fittings etc. are out of alignment, the Contractor shall make arrangement to have the inserts and bolts removed and refixed in their proper position as directed by the Engineer, at no cost to the Owner.

**D.15.7.2 Measurement**

Inserts, bolts etc. shall be measured and paid for as indicated in Schedule of Quantities.

**D.15.8 RUBBLE PACKING**

D.15.8.1 Rubble used for packing under floors, foundations etc. shall be hard, durable rock free from veins, flaws and other defects. The quality and size of the rubble shall be subject to the approval of the Engineer.

D.15.8.2 Rubble shall be hand packed as directed by Engineer. This shall be laid closely in position on the sub-grade. All interstices between the stones shall

be wedged in with smaller stones of suitable size well driven to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of rubble stones and shall not lag behind.

- D.15.8.3 Small interstices shall be filled with hard clean sand and well watered and rammed.

**D.15.8.4 Measurement**

- D.15.8.4.1 The unit of measurement shall be sq.m. for the specified thickness of rubble packing.

**D.15.9 CEMENT POINTING**

- D.15.9.1 The joints of masonry shall be raked atleast 12 mm deep. 3 or 4 days after the courses are laid if not done earlier. The dust shall then be brushed out of the joints and the wall, washing with water.

- D.15.9.2 The mortar shall consist of one part of cement to one part of fine sand. Mortar shall filled into joints and well pressed with special steel trowels. The joints shall not be touched again after it has once begun to set.

- D.15.9.3 The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk of 'V' as may be directed. No false joints shall be allowed.

- D.15.9.4 The work shall be kept we for a after the pointing is complete. Whenever coloured pointing has to be done, the colouring pigment of the colour requirement shall be added to cement in such proportion as recommended by the manufactures and as approved by the Engineer.

**D.15.9.5 Measurement**

- D.15.9.5.1 The area pointed shall be calculated in sq.m. from dimensions shown on drawings less opening and shall be paid for.

**D.15.10 CEMENT PLASTER WORK**

- D.15.10.1 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 plastering work is commended. Concrete surfaces to be rendered will however be kept dry. The wall should not 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. Cement shall be sulphate resistance cement confirming to IS 12330 for underground work and in OPC for the work above ground level.

- D.15.10.2 The proportion of the mortar shall be as specified under the respective items of work. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per IS : Standards. 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. Cement be sulfate resistant cement conformity to IS : 12330 for under ground work at OPC for the work above ground low.
- D.15.10.3 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 has hardened, will be given by the Engineer. Curing shall be done by continuous applying water in a spray and shall be carried out for at least 7 days.
- D.15.10.4 Whenever the specifications or the item of work calls for water proofing, the Contractor shall provide the percentage of water proofing compound as specified in the items of work.
- D.15.10.5 Where lath plaster is specified, it shall be paid for at the same rate as for plasterwork without metal lath except that separate payment for metal lath will be made.
- D.15.10.6 Ceiling plaster shall be done before wall plaster and wall plaster shall commence at top and work downwards.
- D.15.10.7 **Interior plaster** - This plaster shall be laid in a two coats of 12 and 8 mm for 20 mm and single coat for 15 mm & 10 mm thickness. The mortar shall be dashed on the prepared surface with a trowel and finished smooth by trowelling on the surface with neeru (lime cream). Neeru shall be properly slaked fat lime. The standard of finish expected is high and shall conform to IS : 2394. Interior plaster shall be carried out on jambs, lintel and sill faces, top and undersides etc. as shown in the drawing or as directed by the Engineer. Rate quoted for plasterwork shall be deemed to include plastering of all those surfaces. However, if the item of work includes plaster finish, no separate payment would be made under 'plastering work'.
- D.15.10.8.1 **Exterior Plaster** – Exterior plasterwork shall be carried out in 2 layers. The first layer being 12 mm thick and the second layer being 8 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise directed by the Engineer.
- D.15.10.8.2 **Exterior Sand Faced Plaster** – The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 12 mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the

finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item of work. The scratch coat shall be cured for atleast 7 days and then allowed to dry.

- D.15.10.8.3 The second coat shall be 8 mm thick and it shall not be applied until atleast 10 days have elapsed after the application of the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation and without joints, finish shall be straight, true and even. The mortar proportions of this coat shall be as specified under the respective item of work. Only approved white sand shall be used for the second coat and for finishing work. Sand for finish shall be used for the second coat and for finishing work. Sand for finish shall be even coarse size and shall be dashed on the surface and sponged.
- D.15.10.8.4 Wherever 32 mm thick plaster has been specified, this is intended for purpose of providing beading, bands etc. This work should be carried out in two or three layers and as directed by the Engineer.
- D.15.10.8.5 In the case of pebble face finished plaster, pebbles of approved size and quality shall be dashed against the final surface to obtain as far as possible uniform pattern. In all cases, workmanship shall conform to IS : 1661.

#### **D.15.10.9 Measurement**

- D.15.10.9.1 The quantity of work to be paid for under this item shall be calculated by taking the projected surface of the area plastered after making necessary deductions for opening, doors, windows, fan openings etc. The actual plasterwork carried out on jambs of doors, windows openings etc. shall be measured and added. However, for purposes of payment under this item, plaster work carried on surface of items of work, which include plaster finished, shall not be taken into account.

#### **D.15.11 WATERPROOFING ADMIXTURES**

- D.15.11.1 If directed by the Engineer, the Contractor shall use approved waterproofing admixtures made by reputed manufacturer in the mortar for plasterwork. The quantity to be used etc. shall be in accordance with the manufacturer's instructions subject however to the approval of the Engineer. These admixtures shall not contain calcium chloride unless specifically allowed by Engineer and shall conform to IS : 2645 with property of strong hydro phober and corrosion inhibitor. Dosage – 2% by weight of cement i.e. 1 kg per 50 kg bag of cement. Manufacturer must comply ISO – 9002 specifications. Payment shall be made for actual quantity of such admixture used unless it is already covered in the rates for the work concerned.



**D.15.12 MOSAIC, TERRAZZO AND PLAIN CEMENT TILING WORK IN FLOORING**

- D.15.12.1 The type, quantity, size, thickness, colour etc. of the tiles for flooring and skirting work shall be of best quality approved by the Engineer. For this purpose, the Contractor shall provide the Engineer with necessary samples for his selection.
- D.15.12.2 Before the tiling work of commenced, the sub-surface shall be thoroughly cleaned and washed of all loose materials, dirt and scum or laitance and then well wetted without forming water pools on the surface.
- D.15.12.3 The tiles shall be laid on cement mortar bedding of about 20 to 25 mm thick. The proportion of mortar shall be one part of cement, 6 parts of sand. The mortar shall be evenly spread on the sub-floor. The tiles shall be fixed on this bed one after another, each tiles being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be perfectly straight and uniform in thickness. The tiles shall be laid perfectly in level unless otherwise specified or required or desired by the Engineer. After laying the tiles the joints shall be finished with white cement or cement of approved colour.
- D.15.12.4 Floor tiles laid adjoining the wall shall project 12 mm under the plaster, starting or dado as may be required by the Engineer. Half tiles and pieces shall not be avoided as far as possible. After laying, the flooring shall be allowed to cure undisturbed for seven days. Design traffic shall not be allowed on the floor for atleast 14 days after laying the tiles.
- D.15.12.5 About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles alongwith any other cracked or broken tiles shall be removed and replaced with a new tile proper line and level. The same procedure shall be followed again after the tiles are finally polished. For the purpose of ensuring that such replaced tiles match with those earlier laid, it is necessary that the Contractor order enough extra tiles from the factory to meet this contingency. The tiles shall finally be cleaned and polished by using dilute oxalic acid or any other method recommended by the manufacturer and approved by the Engineer.
- D.15.12.6 After the joints have developed sufficient strength, the floors shall be machine polished to the desired finish as approved by the Engineer. Sufficient quantity of water shall always be used during polishing to prevent scratching.
- D.15.12.7 For dado and skirting work, the vertical surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with about 12 mm thick 1:2 cement mortar. For this work the tiles as obtained from the factory shall be of the size required and practically fully polished. The back of each tile to be fixed shall be covered with a thin layer of near cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. This shall be done from the bottom off the surface upwards. The joints shall be as close as possible and the work shall be truly vertical and flush. After the work has set, hand polishing with carborandum stones shall be done so that the surface attains a high glossy finish. Corners and junctions shall be finished true. The workmanship shall conform to IS : 1443.

D.15.12.8 The work is subject to the approval of the Engineer. If the Engineer rejects any portion of the work, the same shall be removed and redone by the Contractor to the satisfaction of the Engineer at no extra cost to the Owner.

D.15.12.9 The procedure for laying and finishing cement tiles in floor and dado shall be as for mosaic tiles except that in this case the tiles shall be cement tiles instead of mosaic / terrazzo tiles.

**D.15.12.10 Measurement**

D.15.12.10.1 Unit of measurement for floor tiling, and dado shall be sq.m. or part thereof of the superficial area. Actual quantity of tiling work carried out will be measured and paid for after making deductions for openings etc. For skirting, unit of measurement shall be running metre for the specified width.

**D.15.13 IN-SITU TERRAZZO / MOSAIC FLOORING**

D.15.13.1 The marble chips shall be of approved size, colour and shade. The cement used may be white coloured cement or cement mixed with colouring pigments as directed by the Engineer. The proportion of marble chips to cement shall be as directed by the Engineer but in no case it shall be less than 2.5:1.

D.15.13.2 Samples of terrazzo / mosaic work shall be prepared for approval of the Engineer. The entire work shall be conform to the approved samples. For in-situ mosaic on stair treads, floors at building entrances etc. the Contractor shall provide a chequered non-slippery finish at no extra cost.

D.15.13.3 The terrazzo chips shall be laid after placing the base. The base shall consist of a layer of cement mortar 15 mm thick spread and levelled. Chips shall be thoroughly mixed dry and then white cement or cement of approved colour shall be added in specified proportion. Chips and cement shall be thoroughly mixed and evenly spread on the platform and not heaped. Water shall then be added to obtain a plastic mix of suitable consistency as directed by the Engineer.

D.15.13.4 Terrazzo layer shall be placed as soon as the screed coat has set sufficiently but in no case than the day thereafter. The thickness of terrazzo topping shall not be less than 10 mm. The surface shall be rammed to obtain the consolidation and a level surface. Additional chips shall be sprinkled on the surface and rammed in until surplus cement is worked out and chips forced together so that the finished floor will show not less than 70% aggregate. The surface is finally trowelled lightly.

D.15.13.5 The Contractor shall keep the floor moist for not less than six days. Their surface shall then be machine polished. Voids shall be filled with neat grouting of same kind and colour as matrix, this grouting shall remain atleast 72 hours before being removed for final cleaning. The floor shall be

refinished wherever necessary to leave the work in first class condition. The workmanship shall conform to IS : 2114.

- D.15.13.6 While the underbed is still plastic, metal dividing strips of brass or aluminium, about 35 mm wide and 1.25 mm thick, shall be inserted in mortar bed according to the design of the floor, care being taken to see that no section exceeds 1.5 sq.m in area. The top of strips shall be 10 mm above the surface of the underbed and shall conform to the finished level of the floor.

**D.15.13.7 Measurement**

- D.15.13.7.1 Measurement and payment shall be as per Clause D.15.12.11.

**D.15.14 GLAZED TILE WORK**

- D.15.14.1 The glazed tiles in paving and dado shall be of the best available first class quality approved by the Engineer and they should be laid on a base of 12 mm thick cement mortar for flooring and 15 mm thick cement mortar for skirting. The proportion of C.M. will be (1:3). The tiles shall be of standard size without warp and with straight edges true and even in shape and size and of uniform colour. They shall be laid truly vertical on walls and truly horizontal on floors or to slopes as directed. The joints shall be very thin, uniform and perfectly straight. The joint shall be floated with white cement as approved by the Engineer. The rate quoted for paving and dado work shall be inclusive of angles, corner piece and approved colour border on top. Glazed tiles shall conform to IS. 777.

**D.15.15 SHAHBAD/TANDUR/KOTA STONE FLOORING.**

- D.15.15.1 Stones, should be of approved quality, hard, durable and uniform thickness. Edges shall be chisel dressed and the top surface shall be machine polished with joints running true and parallel from side to side. Stones should be laid on a bed of cement mortar. Thickness of mortar bedding should not be less than 12 mm and not more than 25 mm. The proportion of C.M. will be (1:6). For skirting base should be 12 mm thick and C.M. proportion will be (1:3). Before laying, the stone slabs should be thoroughly wetted with clean water. Neat cement should be spread over the mortar bed over as much area as could be covered with the slabs within half an hour. The slabs are then laid and gently tapped with wooden mallet till it is firmly and properly bedded. There should be no hollows left. The joints should not be more than 2 mm thick. The joints should be struck smooth. The floor should be kept covered with damp sand or water for a week. Slabs should meet all the required properties and test requirements as stipulated in IS Code 1124.

**D.15.16 INTEGRAL CEMENT FINISH ON CONCRETE FLOOR**

- D.15.16.1 In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be

forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the Engineer shall be supplied and used as recommended by the manufacturer.

**D.15.17      WOODWORK IN DOORS, WINDOW, PARTITIONS, LOUVERS, RAILINGS ETC.**

- D.15.17.1      Wood used for all work shall be the best of the respective class specified, and properly seasoned by at least 6 months air drying, suitable for joiner's work, should be of natural growth, uniform in texture, straight grained, free from sapwood, deal knots, opens shakes, boreholes, rot, decay and any and all other defects and blemishes.
- D.15.17.2      The thickness specified for joiner's wrought timbers are, unless otherwise specified, prior to planning and 3 mm will be allowed from the thickness started for each wrought face.
- D.15.17.3      All joining shall be wrought on all faces and finished off by hand with sandpaper, with slightly rounded arises.
- D.15.17.4      The joints shall be pinned with hard wood pins and put together with white lead. Jointing shall be by means of mortice and tennon or dovetailed joints as approved.
- D.15.17.5      Any joiner's work which shall split, fracture, shrink, or show flaws or other defects due to unsoundness, inadequate seasoning or bad workmanship, shall be removed and replaced with sound material at the Contractor's expense.
- D.15.17.6      Doors, windows and ventilator frames, transoms and mullions shall be rebated. All dimensions shall be as per drawings. The top framing member of doors and top and bottom framing of windows and ventilators shall project about 10 mm below finished floor. Surface coming in contact with brickwork shall be painted with bitumen as directed by the Engineer. Each of the door and window frames shall be provided with 3 Nos. M. S. 25 X 25 X 6 flat split hold fasts on each side. These hold fasts shall be embedded in masonry or concrete work. The work shall conform to IS-4021.
- D.15.17.7      The doors shall be paneled or solid flush doors as described in the item of work. All flush doors shall be supplied with approved fittings such as hinges, mortice lock of approved make with handles on both sides, oxidised brass lower bolts and latch arrangements, door stops etc. and as shown in drawings but exclusive of door closers. Door closers, where separately specified shall be of heavy duty hydraulic type to be approved by Engineer. Panelled doors shall have the same fittings except in place of union lock, an aldrops shall be provided. Each door leaf shall have two 250 mm tower bolts, two aluminium or oxidised brass handles, and one door stopper be made of weatherproof plywood. Flush doors shall conform to IS:2202 (Part – 1).

- D.15.17.8 Doors will generally have no sills but if a few have to be provided, the Contractor shall do so at no extra cost to the Client.
- D.15.17.9 The type of window shall be as specified. Each shutter shall have one pair of hinges, two lower bolts (one 225 mm long and another 150 mm long), one handle and one hook with tyee and pegstay. Ventilators shall have two M. S. hold fasts and hinges, one handle and one hook and eye at each and one small tower bolt in the centre. Where so directed by the Engineer, the doors and windows shall be provided with parliamentary type hinges at no extra cost.
- D.15.17.10 The workmanship of all door and window shutters shall conform to the requirements of IS : 1003 (Part – I & II) and IS:2202(Part-I). If required, flush door panels shall be got testest as per IS:4020.
- D.15.17.11 Cupboards, almirahs and shelves shall be provided as shown in drawings. The doors could be of either hinged type or sliding type as approved by the Engineer. All dimensions as furnished in the drawings shall be followed. Fixtures and fittings as shown on drawings or as directed by Engineer shall be used.
- D.15.17.12 Railings and architraves shall conform to the shape shown on drawings or as approved and fixed by means of screws (counter sunk or otherwise) or bolts.
- D.15.17.13 The finish expected is of a very high order and the work shall be all inclusive weather or not all detailed specifications have been splot out and the work shall be free from blemish.
- D.15.17.14 No iron bars or grills are proposed to be provided in the windows or ventilators. Glass louvred ventilators where specified shall be provided.
- D.15.17.15 Glazed windows, louvres, ventilators and doors shall be provided with either clear or pinheaded glass 5 mm thick which shall be free from all blemishes and shall conform to IS : 1761. It should be clearly understood that glass which does not have uniform refractive index or which is wavy, will be rejected.
- D.15.17.16 Woodwork shall not be painted, oiled or otherwise treated before it has been approved by the Engineer.
- D.15.17.17 Measurement**
- D.15.17.17.1 All doors, windows, ventilators, louvers, will be measured in sq. m. The measurement will be taken to the outside of frame work exclusive of horns, projections, etc. The rate quoted shall be all inclusive such as nails, screws, glazing, fixtures, fittings, providing peep holes, locking device, handles, door stops etc. The rate shall also be inclusive of polishing / painting with 2 coats of approved paint over primer coat.

## **D.15.18 STEEL DOORS, WINDOWS AND FITTINGS.**

D.15.18.1 The steel doors, windows, ventilators shall conform to IS : 4351 and 1038. All steel doors, windows, ventilators, louvers etc. shall be of sizes as specified and conform to the description in the respective item of work. Whether or not specifically mentioned, all fixtures and fittings necessary for the satisfactory operation of the doors and windows shall be provided. Doors, windows and ventilators shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained before hand. Sample shall also be got approved before further manufacture starts, unless this is waived in writing by the Engineer. All steel doors shall be of pressed steel (18 gauge) flush type with or without removable transoms. All doors shall be provided with a three way bolting device and locking arrangement with duplicate keys and handles on both sides and operable from either side. The Contractor shall obtain windows with friction hinges in place of windows with pegstays if so directed by the Engineer. For center hung and top hung ventilators suitable spring catch/pulley and chord arrangement shall be provided for facility of opening. Whenever fly mesh over windows have been called for, they shall be fixed on the window and suitable lever type or roto type arrangement shall be provided for opening or closing of the glazed panels from inside. Prior approval of Engineer shall be taken before order is placed with the manufacturer.

D.15.18.2 Where specified, steel doors supplied shall be airtight. For this purpose, the Contractor shall provide necessary padding material such as rubber, felt or any other approved material.

### **D.15.18.3 Measurement**

D.15.18.3.1 Doors, windows shall be measured in sq.m. of the actual size measured to the outside of the steel framework.

D.15.18.3.2 The rate quoted shall be inclusive of glazing with 5.0 mm thick glass free from all blemishes. The workmanship shall conform to IS:1081. The rate quoted shall also be inclusive of fixing doors, windows, ventilators, louvres etc. in brick work, steel framing etc. by making holes/drilling holes in steel work where required complete.

D.15.18.3.3 The rate shall also include cost of painting two coats of approved enamel. Paint over one coat of approved zinc rich primer.

## **D.15.19 ROLLING SHUTTERS**

D.15.19.1 The rolling shutters shall conform to the size indicated in drawings and shall be of quality specified in the Schedule of Quantities. The rolling slats shall be in one piece and be made of heavy gauge steel sheets minimum 18 Swg in thickness. A cylindrical hood shall be provided on the top to enclose the shutter when it is open. The rolling shutters shall be provided with suitable locking arrangements and deep channel guides. In case galvanised rolling

shutters are specified the rolling shutter shall be made of hot dip galvanised slats, hood, deep channel guides all preferably in one piece.

- D.15.19.2 In case of hand operated pull and push type rolling shutters of sizes larger than 10 sq. m. in area and in case of very large gear operated and/or as directed by the Engineer, rolling shutters shall be provided with ball bearings for smooth and efficient operation. In case of large rolling shutters and depending upon local wind conditions, the rolling shutters should be provided with special locking type of wider channel guides or it shall be provided with central moveable channel supports to take up the design wind pressures in the area.
- D.15.19.3 The rates quoted shall be inclusive of providing three coats of approved paint over one coat of approved primer coat where not galvanised. Rates quoted shall also inclusive cost of lever lock and erection. Fixing lugs to be provided to guide channel to suit actual site conditions or as directed by the Engineer at no extra cost.
- D.15.19.4 The payment will be made on Sq.m. basis.

#### **D.15.20 POLISHING / PAINTING FOR WOOD WORK & IRON WORK**

- D.15.20.1 Paint/Polish to be used for various item of work shall be of best quality and shall be obtained ready mixed in sealed containers from approved manufacturer. The Contractor shall obtain the Engineer's approval for the make and colour of the paint he proposes to use. If required, polish for woodwork shall be tested as per IS:5807 (Parts-I & III)
- D.15.20.2 All surfaces shall be thoroughly cleaned of all dirt, loose particles and rust and approved prior to application of paint. For wood surfaces, a priming coat without colouring matter shall be first applied after and all knots properly killed with quick-lime. Workmanship shall conform to IS:1477 (Part-I & II) and 2338 (Part-I).
- D.15.20.3 Specified number of coats shall be applied and at least 24 hours shall elapse between the application of successive coats. No painting shall be carried out on exterior work in wet weather or on surfaces which are not entirely dry.
- D.15.20.4 Polishing / painting rate shall include all necessary scaffolding, cradles and plant. Measurements will be on the basis of sq. m. for doors and windows, only the projected area will be measured. If such painting/polishing is not already a part of the item, without deducting for the glazed portions though not painted. The Contractor's rate should take this into account.

**D.15.21 DISTERMPERING, WHITE/COLOUR WASHING AND PAINTING OF WALLS**

**D.15.21.1 Distemperring**

D.15.21.1.1 The surface to be treated shall be thoroughly cleaned of all dirt and loose particles etc. Inequalities and holes shall be filled with gypsum, which would be allowed to set hard before distemper is applied.

D.15.21.1.2 Distemper shall be of well-known brands of approved make. It shall be applied by a board stiff brush in two coats over a coat of primer. The first and second coat shall be applied only after the primer has thoroughly dried. The first coat shall be of a lighter tint. The shade of the distemper shall be got approved by Engineer. Water bound and oil bound distemper shall conform to the requirements of IS : 427 and 428 respectively.

**D.15.21.2 White Wash**

D.15.21.2.1 Walls to be thoroughly cleaned before white wash is applied. White wash shall be of ordinary fat lime and of good quality. It shall be slaked with an excess of water to the consistency of a cream and allowed to remain under water for 2 days. It shall then be strained through a cloth and 2 kg of clean gum added for every cubic metre of like ready for white washing.

D.15.21.2.2 Each coat is to be applied with a brush. It shall be laid with a stroke of the brush from the top downwards, another from bottom upward over the first stroke and similarly, one stroke from the right and another from the left over the first brush before it dries. Three such coats shall be applied.

**D.15.21.3 Colour Wash**

D.15.21.3.1 Colour wash shall be applied the same way as white wash. Necessary and approved colouring matter shall be added to the white wash, which has been strained. Only wash sufficient for the day's work shall be prepared each morning. If the finished surface is powdery and comes off easily or the general appearance is streaky, the work shall be rejected.

**D.15.21.4 Painting**

D.15.21.4.1 Paint to be used for the various items of work should be of approved make and colour. It is imperative that the Contractor should obtain Engineer's permission in regard to the make and colour of paint that he proposes to use for the various items of work. The painting work shall be carried out as directed by Engineer keeping, however, in view the recommendation of the manufacturer.

D.15.21.4.2 Where painting with plastic emulsion is specified, all uneven surfaces shall be made up by use of putty of appropriate quality, after the surface has been thoroughly cleaned of all dust, dirt and sand prepared. One primer coat and



two coats of emulsion paint shall be applied. Workmanship shall conform to the requirements of IS : 2395.

**D.15.21.5 Measurement**

The actual quantity of work carried out will be measured in sq.m. after making deduction for openings etc. and shall be paid for.

**D.15.22 EXPANSION JOINTS, WATER STOPS, PREMOULDED JOINT FILTERS, FLASHINGS**

**D.15.22.1 Expansion Joints**

D.15.22.1.1 Expansion joints shall be provided galvanised strips of 250 mm width at locations shown on drawings or as approved by Engineer. The strips shall be bent to the shape indicated of the drawing and embedded properly in masonry. The joint width shall be uniform throughout and special care shall be taken to ensure proper bonding at expansion joints. Expansion joints shall be continuous and where two or more strips meet, they shall be lapped to the extent of 75 mm and joints properly soldered. The expansion joints shall be filled with premoulded joint fillers and sealed with mastic compound. For purposes of measurement, the laps provided will be neglected. Wherever an expansion joint between the existing part and new part is proposed the rate quoted shall be inclusive of making necessary connections with existing part.

**D.15.22.2 Water Stops**

D.15.22.2.1 Water stops shall be of rubber or PVC Bars of approved make. These shall be provided at locations indicated on drawings. Water stops shall be lapped 100 mm and that sealed to obtain continuity. Water stops shall be cleaned thoroughly of all concrete and mortar coating as directed before resuming concrete work. Water stops shall be in long lengths to avoid joints as far as possible.

**D.15.22.3 Joint Filler**

D.15.22.3.1 Pre-moulded joint fillers shall be of a non-deteriorating and resilient type. A sample of material shall be approved by the Engineer before being brought on site. Installation shall be carried out properly and as directed.

**D.15.22.4 Flashings**

D.15.22.4.1 Metal or tar felt flashings shall be fixed as directed by the Engineer. Metal flashings where provided shall be welded / soldered to obtain continuity. Tar felt flashings shall be lapped for a minimum length of 150 mm.

D.15.22.4.2 Flashings shall be measured and paid for in linear metres for the specified width disregarding laps or joints.

### **D.15.23 WATER PROOFING WORK**

D.15.23.1 All surfaces to be water proofed shall be dry, clean, smooth and free from dust and loose particles.

#### **D.15.23.2 Tar felt Type**

D.15.23.2.1 For a five layer treatment, bitumen primer conforming to IS : 3384 shall be applied. Over this primer coat, hot bitumen conforming to IS : 1580 shall be applied at the rate of 1.2 kg/sq.m. Hessian based felt type 3 grade 2 conforming to IS : 1322 shall be spread and embedded in the previously laid bitumen while hot. Hot bitumen will again be applied over the felt at the rate of 1.2 kg/m. Pea size gravel or grit shall be uniformly spread at the rate of 0.008 cu.m./sq.m. The end and side laps of each sheet shall not be less than 100 and 175 mm respectively and shall be firmly bonded with bitumen. The extreme ends shall be taken up about 100 – 150 mm along parapet wall and embedded in chases made in the wall and brick masonry and made good in plaster. The standard of water proofing shall comply with IS : 1346. For seven layer treatment, one additional layer of bitumen shall be laid before gravel layer in a manner described above for five layer treatment.

#### **D.15.23.3 Brickbat Coba China Mosaic type**

D.15.23.3.1 In case of works where brick bat coba and china mosaic are specified, brick bat coba of average thickness specified in the item of work shall be laid to the required slopes as shown on the drawing. Proportion of brick bat shall be 2 parts of brick bat to one part of lime mortar (one part of lime to 2 parts of sand). The brick bats shall be hard, well brunt and of size varying from 12 mm to 25 mm. Lime shall be of best quality of hydraulic lime double ground. While preparing brick bat concrete, jaggery in proportion indicated by the Engineer shall be added. The brick bat coba shall then be laid to slopes, providing necessary wattas and beaten atleast for 48 hours after laying. Over the brick bat coba a bedding of 1:2 lime mortar 20 mm to 25 mm thick, shall be provided. A layer of neat cement grout, about 10 mm thick shall then be laid. Immediately on application of cement grout, assorted pieces of coloured china, previously soaked in water shall be set closely on the fresh surface and properly tamped to the required grade. The cement grout freshly laid shall work its way to the top surface. The surface after completion of work shall be finally cleaned with saw dust and waste and if so directed by the Engineer with dilute acid. China mosaic shall be cured for atleast 10 days. If so directed by the Engineer, a border of colour of white mosaic shall be provided.

D.15.23.3.2 Brickbat coba and china mosaic shall be taken up the parapet walls to a height of 125 mm to 150 mm. Necessary wattas shall be provided towards drain pipes as shown on drawings or as directed by the Engineer.

D.15.23.3.3 On prior approval from the Engineer, cement based proprietary type of waterproofing may be allowed to be done by a Specialist.

- D.15.23.3.4 The Contractor shall give a guarantee for any / all types of waterproofing for a minimum period of 7 years against bad or faulty material and construction and shall rectify the work at his own cost during the guarantee period.

**D.15.23.4 Measurement**

Payment for work executed would be made for projected area only between the inside of plastered walls. No payment would be made for rounding off at corners or for work carried in vertical faces of walls, slabs, parapet walls or column projection.

**D.15.24 EPOXY PAINTING WORK**

**D.15.24.1 Material**

- D.15.24.1.1 The epoxy material shall be non-sag, high build, solvent free, epoxy base coating, manufacturer must comply with ISO – 9002 specification.

**D.15.24.2 Chemical Resistance**

- D.15.24.2.1 Formaldehyde 40% solution, Acetic Anhydride, alcohol, Alum, of compounded of Aluminium, Ammonia, Acetone, Beer, Boric acid, Citric acid, Fatty acid, Glycerin, Sodium hydroxide 50% solution, sulphuric acid 50% solution, Hydrochloric acid 50% solution, Nitric acid 10% solution, Acetic acid 50% solution, Sea water, Lactic acid 50% solution, Styrene, Stearic acid, Petrol, Oxalic acid etc.

**D.15.24.3 Surface preparation**

- D.15.24.3.1 The surface should be free from excessive laitance, dust, grease, oil curing compound, chemicals, standing water etc. Ensure that the concrete, surface must be sound, cutting back where necessary and repair good using suitable cementitious or epoxy repair system. Ensure also that all blow holes and surface imperfection are made good prior to application. Mortars and concrete should be fully cured i.e. atleast 21 days at 25°C.

**D.15.24.4 Mixing**

- D.15.24.4.1 Before mixing hardner and base each container should be thoroughly stirred to homogenous consistency for 3 to 5 minutes. The mixing should continued for 3 minutes. Hydrophobic compound and corrosion inhibitor in water proofing compound.

**D.15.24.5 Application**

- D.15.24.5.1 First primer coat should be applied after cleaning the concrete surface. After application of primer coat 2 coats of epoxy paint should be applied as per directed by Engineer-in-charge.

**D.15.24.6 Technical Data**

Mixing Ratio	:	Hardner : Base : 1 by weight
Service Temperature	:	5°C – 45°C
Relative Density	:	1.25 ± 0.02
Pot Life	:	50 ± 10 minutes
DFT per coat	:	150 to 200 microns
Coverage	:	3 to 5 sq.m/kg/coat for the mixed material depending upon surface texture and porosity
Tack Free Time	:	4 ± 1 hours
Initial Cure	:	6 ± 2 hours
Full Cure	:	5 to 7 days
Minimum Re-coating time	:	3 to 5 hours
Maximum Re-coating time	:	8 to 9 hours
Bond Strength	:	> 180 kg/cm <sup>2</sup>
Compressive Strength	:	> 700 kg/cm <sup>2</sup>
Flexural Strength	:	> 300 kg/cm <sup>2</sup>
Amount of Shrinkage	:	< 0.0030 cm

**D.15.24.7 Measurement and payment**

D.15.24.7.1 Measurement shall be made square meter basis.

## **D-16 : ADDITIONAL SPECIFICATIONS FOR BUILDING AND ALLIED WORKS**

### **SECTION : D-16**

#### **D.16.1 PVC (VINYL) ASBESTOS TILE FLOORING**

- D.16.1.1 PVC (Vinyl) asbestos floor tiles shall have smooth surface and shall be homogenous. The tiles shall be of best quality and of approved make and shall conform to IS:3461. The tiles shall be plain or mottled. The colour, finish and mottling shall match as per the sample approved by Engineer. Plain tiles shall have the colour uniformity distributed through the tile. Mottled tiles shall have the colours distributed at random throughout the thickness of the tile. The material shall not develop any toxic effect in service and shall not give disagreeable odour. The type, thickness and size of tiles shall be as specified in the item of work. The PVC (Vinyl) asbestos floor tiles when tested in accordance with the methods given in IS : 3464 shall conform to the requirements specified in Table 1 of IS : 3461. The Contractor shall send test results along with the sample for approval. The tiles used shall be of Marbles or approved equivalent and shall be fixed on floor/walls as per the manufacturer's specification.

#### **D.16.2 WATERPROOFING OF TERRACE AND STAIRCASE ROOF SLAB**

- D.16.2.1 In case of works where brick bat coba and Indian Parent stone are specified, brick bat coba of average thickness specified, in the item of work shall be laid to required slope as shown on the drawing. Proportion of brickbat shall be 2 parts of brick bat to one part of the lime mortar (one part of lime to 2 parts of sand). The brick bats shall be hard, well brunt and of size varying from 12mm to 25mm. Lime shall be of best quality of hydraulic lime double ground. While preparing brick bat concrete, jaggery in proportion indicated by the Engineer shall be added. The brick bat coba shall then be laid to slopes, providing necessary vattas, and beaten and thoroughly soaked at least for 48 hours after laying and properly consolidated. The surface of brickbat coba shall be grouted with neat cement slurry. Indian patent stone flooring shall be laid in two layers, an under bed of 34 mm thick and topping of 6 mm thick. Before placing the under bed any excess standing water shall be mopped out. The under bed shall consist of cement concrete with 10 mm down clean well graded, hard, approved stone chips and clean, sharp, coarse sand. The proportions of the mix shall be 1 part cement 1.5 parts sand and 3 parts stone chips by volume. Water proofing compound of approved make shall be added as per manufacturer's specifications. Water content shall be minimum, just sufficient to give a workable consistency, which will allow a smooth finish to be obtained without excessive trowelling. Generally a water cement ratio of 0.4 should suffice. The floor shall be cast to required slope, in panels in a chequer board sequence so that no two adjacent panels one has before the contraction of the previous one has taken place. At least 48 hours shall be allowed to pass after casting a panel before the adjacent panel shall not exceed

5 sq.metres in area and shall not have sides exceeding 2.5 meters. Edges of individual panels shall be supported by flat bars of steel or wood well oiled to prevent sticking. These bars shall be removed before concreting the adjoining panels. The concrete of the new panel shall be well compacted against the edges of the previous panel. After laying, the under bed shall be levelled and compacted and brought to proper grade with a wooden screed of float.

- D.16.2.2 A topping of 6 mm thickness of the same mix as the under bed shall be laid when the latter is still green, and shall be trowelled smooth with a mixture of cement and sand in the proportion of 1:1 by volume. The under bed and topping shall be completed in one operation. The topping shall be trowelled smooth Engineer's satisfaction and all trowel marks mopped with a soft cloth to present a clean, even and smooth surface. Care shall be taken to see that no foot prints etc. are formed on the green topping surface during its laying, finishing and curing. The finished flooring shall be cured by ponding with water for a period of 7 days. The top surface shall be cleared of all dust and loose material and the joints shall be filled with bitumen as directed by Engineer.

#### **D.16.3 HEAVY DUTY TOPPING FLOOR**

- D.16.3.1 Heavy duty topping floor layer consisting of one part of floor hardner, two parts of sand and four parts of cement, shall be laid over 30mm thick cement, concrete 1:2:3 using 12 mm size chips. For one square meter surface area of 20 mm thick to be covered minimum 2.25 Kg. Of floor hardner of approved make shall be used as per manufacturer's instructions. The contractor shall take prior approval of the manufacturer's specification from the Engineer before starting the work. The top layer shall be laid while the under bed is still very green within about 3 hours of laying the latter. The finish shall be uniform, smooth and without any trowel marks, pin holes etc. Cutting shall start on the next 7 days after finishing and shall be continued for 7 days.

#### **D.16.4 CHEQUERED PLATING AND KERBING**

- D.16.4.1 Chequered plating complete with cut-outs and in sizes suitable for removal by hand shall be of mild steel and of sufficient thickness to carry minimum live load of 500 Kilograms per square metre but never less than 7 millimeters thick. This shall be measured excluding the pattern which shall be of non-slope type.
- D.16.4.2 Each length shall have two tapped holes for screwing in lifting hooks. Two pairs of lifting hooks shall be supplied for every 5 sq. m. of plating. Where a single area is covered by several pieces of plating, the direction of patterning of all plates shall be the same.
- D.16.4.3 Kerbing shall be built in so as not to reduce the width of the opening and it shall provide at least 25 mm bearing for the chequered plating. It shall be supplied with fixing lugs at suitable centers, not exceeding 1 m. Care shall be taken to ensure that the kerbing and chequered plating is set flush with the

surrounding finished floor level. Chequered plate, kerbing and supports shall be galvanised after fabrication.

D.16.4.4 Unless otherwise specified, chequer plating shall be screwed to its kerbing by countersunk screws of galvanised mild steel.

D.16.4.5 The contractor shall be responsible for the detailing, supply and installation of chequer plate, kerbing and supports as specified herein.

#### **D.16.5 OPEN TYPE FLOORING : (M.S.GRATING)**

D.16.5.1 Open type flooring shall be capable of carrying a minimum live load of 500 Kilograms per square meter per the spans indicated in the drawings. It shall be free from sharp edges and ragged welds and shall be delivered to site complete and cut to size to accommodate plant, pipes, ducts and the like.

D.16.5.2 Before fabrication of the open type flooring, the Contractor shall supply to the Engineer a copy of the manufacturer's working drawings for approval.

D.16.5.3 Kerbing to open type flooring shall be raised at least 50 mm from the top of the flooring and shall be adequately fastened to it.

D.16.5.4 M.S. kerbing and flooring shall be hot-dip galvanised.

#### **D.16.6 ACCESS LADDERS**

D.16.6.1 Access ladders shall be of mild steel shall be 60 cm wide with angle of 75 x 75 x 6 mm as support and rungs shall be 25 mm diameter at 200 mm centres.

D.16.6.2 Ladders shall be fixed at the top and the bottom and at intervals not exceeding 2 m by brackets of 50 mm x 10 mm flat, of such length that the rungs are not less than 200 mm from wall, secured by galvanised ragbolts of an approved type Brackets shall be fixed to the ladders by one 16 mm diameter bolt thorough each stringer. Ladders may also be fixed at the bottom by bending the stringers and bolting to the floor. Ladders shall be painted with two coats of approved paint over one coats of primer.

#### **D.16.7 HAND RAILING**

D.16.7.1 Hand railing and vertical posts shall be made from galvanised mild steel pipes and fittings. The design of the railing shall be approved by the Engineer to whom the Contractor shall submit manufacturer's drawings showing positions of vertical posts, joints, expansion joints and joint details and all fixing details. Fabrication shall not start until these drawings have approved by the Engineer.

D.16.7.2 Hand railing and vertical posts fabricated from galvaniseed mild steel pipes and fittings shall conform to the following requirements :-

- D.16.7.2.1 The height of the top railing shall be 1067 mm above finished floor level unless otherwise shown. The lower railing shall 533 mm above finished floor. Subject to the Engineer's approval these and other leading dimensions may be varied slightly to suit manufacturer's standard products.
- D.16.7.2.2 Unless otherwise shown, handrails and vertical posts shall be made of galvanised mild steel tubes (light class) of 40 mm nominal bore and fittings such as Tees, Bends, Crossed etc. of heavy class conforming to IS : 1239.
- D.16.7.2.3 In general the vertical posts shall be spaced at 1.5 metre c/c and shall be built into the concrete or bolted to the M.S. plate embedded in concrete as shown on detailed drawing.
- D.16.7.2.4 Hand railing and vertical posts shall be painted with 3 coats of approved paint.

## **D.16.8 GLAZING AND METAL WORK.**

### **D.16.8.1 Glass general**

- D.16.8.1.1 Glass shall conform to the requirements of IS : 1761. And shall be free from bubble, smoke wanes, air holes, scratches and other defects and shall be cut to fit the rebates with due allowance for expansion.

### **D.16.8.2 Sheet glass**

- D.16.8.2.1 Sheet glass shall be ordinary glazing quality of required thickness as mentioned in respective item of work.

### **D.16.8.3 Wired glass**

- D.16.8.3.1 All wired glass shall be 6 mm thick polished Georgian or equivalent wired glass with both faces ground and polished. The glass conform to IS:5437.

### **D.16.8.4 Plate glass**

- D.16.8.4.1 Generally where specified, windows shall be glazed in polished plate or float glass of glazing glass quality (G.G) of 6 mm or 10 mm thickness as specified in the item.

### **D.16.8.5 Glazing**

- D.16.8.5.1 Putty for glazing to wood shall be prepared in accordance with IS:1635. Compound for glazing to metal is to be an approved special compound manufactured for the purpose.

## **D.16.9 SYNTHETIC GRADE RUBBER WATER STOPS.**

- D.16.9.1 The specification of the synthetic grade rubber water stop shall be as follows :

i)	Tensile strength	110 Kgf/sq.cm.
ii)	Elongation at break	350 %



iii)	Modulus at 300% elongation	51 Kgf/sq.cm.
iv)	Specific gravity	1.12
v)	Compression set (constant deflection) Percent of original deflection at 70 deg. C for 22 hours)	24 %
vi)	Change in weight water immersion (2 days at 70 deg. C)	1.6 % Max.
vii)	Tensile strength and elongation at break as % of original, after oxygen pressure test, 48 hours, 70 deg. C. 21.1 Kgf/sq.m. before ageing. a) Tensile strength b) Elongation at break	85 % min. 83 % min.

D.16.9.2 The water stop shall be synthetic grade corrugated ‘**Caparstops**’ with centre bulb and with end grips type C1/C2 or equivalent of specified width and thickness mentioned in Schedule of Quantities.

D.16.9.3 The Contractor shall obtain prior approval from Engineer before procurement of waterstops and shall submit sample of water stops that he proposes to procure for this contract and test results for the same Engineer for his approval.

D.16.9.4 The storage, fixing in position, splicing of water stops shall be as per manufacturers’ instructions.

#### **D.16.10 CHAIN LINK FENCING**

D.16.10.1 Chain link fencing shall be of required height as shown on drawings, made of G.I. 75 mm mesh size and 10 gauge wires and shall be fixed with suitable G.I. wire nails and 10 mm dia. M.S. bars on angle posts of 65 mm x 65 mm x 6 mm thick. These angles shall be anchored in 1:3:6 PCC blocks of size 300 mm x 300 mm x 600mm deep and shall be spaced at maximum distance of 2 metres including corners. Every fifth bay shall be braced with angle of 75 mm x 75 mm x 6 mm size diagonal tracing and with angle of 50 mm x 50 mm x 6 mm size at top and bottom runner throughout the length. 3 coats of Aluminium paint shall be provided over & coat of primer on exposed steelwork. The measurement shall be done on square metre basis of the exposed chain link area and paid accordingly.

#### **D.16.11 BARBED WIRE FENCING**

D.16.11.1 Barbed wire fencing of required height shall be constructed of 14 gauge galvanised barbed wire and M.S. angles of 75 mm x 75 mm x 6 mm thick. The angles shall be anchored in 1:3:6 PCC and shall be spaced at minimum distance of 2.5 metres. The galvanised barbed wires shall be fixed at 150mm c/c and with necessary cross wires. The exposed steelwork shall be painted with 3 coats of Aluminium paint over a coat of primer. The measurement shall be done with item of compound wall on running meter basis.

**D.16.12 IPS FLOORING**

- D.16.12.1 Concrete (1:2:4) with water cement ratio of 0.5 shall be laid in bays of suitable sizes but not exceeding 6 sq.m. each, and to required slope in a chess board alternate panel fashion and neatly finished smooth in red colour with lines drawn as directed. Concrete shall be laid in two layers. Bottom layer shall be 25 mm thick with 10 mm to 6mm graded stone aggregates and shall be finished rough. Top layer shall be 15 mm thick with 6 mm and down size aggregates. This layer shall be thoroughly tamped, spread, trowelled and finished smooth with a floating coat of neat cement. The concrete shall be coast against teakwood stop-off boards, which shall be removed only after the concrete is set. No dry cement shall be allowed to be used for finishing the surface. Mechanical mixing of concrete may be resorted to. The surface shall be kept well watered after it is dry for a period of 8 days. Where specified a floor hardner (ironite powder) of approved quality shall be supplied and used as recommended by the manufacturer.

**D.16.13 CATTLE TRAP**

- D.16.13.1 This item includes of necessary excavation PCC 1:3:6 in foundation 1:6 brick masonry wall and fixing of 32 mm pipes over channel section size 350mm x 75mm supporting over 35 mm thick brick wall. The brick wall shall be plastered with C.M. (1:3). The item rate shall be in the unit of one No.

**D.16.14 GLASS COPING**

- D.16.14.1 The glass pieces for glass coping shall be of best quality, multi coloured, having non-Uniform dimensions with sharp edges and should be placed in plain cement concrete. In scattered manner with centre to centre distance not more than 3 cm. It should be placed in such a way that 2 cm of each piece should be above the PCC. The curing should be done properly to ensure that the glass pieces get embedded firmly. The payment for glass coping shall be made on a running metre basis. In case of any discrepancy, the Engineer-in-Charge should be consulted.

**D.16.15 M.S. FAN CLAMPS**

- D.16.15.1 The fan clamps shall be made of tor. Steel bar of size not less than 6 mm. The M.S. fan clamp shall be of the size of the corresponding reinforcement and should be strong enough to sustain the weight of the fan attached. The fan clamp should be properly embedded in concrete and proper anchorage shall be provided by binding it with the slab reinforcement. The size of clear opening shall be enough for the fittings of the fan.

**D.16.16 BIRD SCREEN**

- D.16.16.1 Bird screen shall be of precast RCC of the appropriate size to prevent the entry of the birds and shall be approved by Engineer-in-Charge.

**D.16.17 PROVIDING, SUPPLYING AND LAYING RUBBLE AT OVERFLOW STRUCTURE**

**D.16.17.1 Supplying of Rubble**

The Rubble to be used for pitching shall be obtained from quarries approved by Engineer-in-charge. It shall be hard, durable, and tough and of regular shape and shall be free from dust clay and other impurities for use in Rubble filling approx. weighing minimum 20 Kg. to 50 Kg. Any one side of which shall not be less than 23 cm. It shall be stacked at site of work as directed by Engineer in charge.

**D.16.17.2 Rubble**

The Rubble for Rubble filling shall be from standard quarry approved by the Engineer in charge and shall be hard, durable, tough and free from dust, clay and other impurities. The Rubble shall be large, flat and of minimum weight 20 Kg to 50 Kg size of Rubble shall not be less than 23 cm in any one directions and in other direction the size of Rubble shall be greater to account for the minimum weight of 20 Kg to 50 Kg.

**D.16.17.3 Laying**

The Rubble should be laid to the correct line and level and to the slopes and shape as shown in the drawing and as directed by the Engineer in charge. The intercrises between the Rubble should be filled with spouls, kapchas etc. free from rubbish and foreign materials and should be packed close tight as directed by the Engineer in charge.

**D.16.17.4 Payment**

Payment for this item of Rubble filling shall be made on cu.m. basis of finished section.

**D.16.18 DEMOLITION OF PCC, RCC WORK AND BRICK MASONARY WORK**

D.16.18.1 The exiting PCC, RCC work and Brick masonry work is to be demolished step by step as per direction of site in charge. All serviceable and unserviceable materials recovered from demolished PCC, RCC Work, brick etc. should be stacked properly as per direction of site in charge. All the above demolished material will be property of AMC.

All unserviceable materials like broken limbs of PCC, RCC and Brick masonry should be carted at dumping site.

**D.16.18.2 Measurement :**

All demolition of PCC, RCC work and B.K. masonry work will be paid on actual work done as per measurement on site on cmt. basis. No separate payment will be made for stacking and carting serviceable material to AMC store. No separate payment for cutting reinforcement steel of demolished RCC work will be paid separately and the same should be stacked and Carted to AMC store at No cost.

All unserviceable material to be carted on dumping site will be paid under the item of earth carting. The payment will be on quantity of demolition work not on truck measurement.

## **D-17 : PLUMBING SYSTEM**

### **SECTION : D-17**

#### **D.17.1 SCOPE**

- D.17.1.1 This specification covers the general requirements for execution of plumbing system comprising of water supply and distribution pipes, fittings, sanitary appliances, traps, soil, waste, vent and rain water pipes, building drains and sewers including their respective connections, devices and appurtenances within or adjacent to any building.

#### **D.17.2 APPLICABLE CODES**

- D.17.2.1 The following specifications and codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the specifications and codes shall be referred to. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

##### **D.17.2.2 Codes of Practice**

- 1) IS : 1172 - Basic requirements for water supply, drainage and sanitation.
- 2) IC : 2065 - Water Supply in buildings.
- 3) IS : 1742 - Building drainage.
- 4) IS : 5329 - Sanitary pipe work above ground for buildings.
- 5) IS : 2064 - Selection, installation and maintenance of sanitary appliances
- 6) IS : 4127 - Laying of glazed stoneware pipes.
- 7) IS : 2527 - Fixing rainwater gutters and down-pipes for roof drainage.

##### **D.17.2.3 Specifications for Materials**

- 1) IS : 3989 - Centrifugally cast (spun) iron spigot and socket soil, waster and ventilating pipes, fittings and accessories.
- 2) IS : 1729 - Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
- 3) IS : 1230 - Cast iron rainwater pipes and fittings.

- |     |                           |   |
|-----|---------------------------|---|
| 4)  | IS : 1239 STEEL           | - Mild steel tubes, tubular and other wrought fittings : Part I<br>- Mild Steel tubular and other rough steel pipe fittings : Part – II |
| 5)  | IS : 404                  | - Lead pipes  |
| 6)  | IS : 1626                 | - Asbestos cement building pipes, and fittings. (spigot and socket type.)   |
| 7)  | IS : 651                  | - Salt-glazed stoneware pipes and fittings.   |
| 8)  | IS : 778                  | - Gunmetal gate, globe and check valves for general purposes.   |
| 9)  | IS : 781                  | - Cast copper alloy screw-down bib taps and stop valves for water services.   |
| 10) | IS : 1795                 | - Pillar taps for water supply purpose.   |
| 11) | IS : 1703                 | - Ball valves (horizontal plunger type ) including floats for water supply purpose.   |
| 12) | IS : 774                  | - Flushing cisterns for water closets and urinals (Valve less siphon type).   |
| 13) | IS : 2326                 | - Automatic flushing cistern for urinals.   |
| 14) | IS : 771                  | - Glazed earthenware sanitary appliances.   |
| 15) | IS : 2526<br>Part-I to XV | - Vitreous sanitary appliances (Vitreous china)   |
| 16) | IS : 1726                 | - Cast iron manhole covers and frames intended for use in drainage works.   |
| 17) | IS : 5455                 | - Cast from steps for manholes.   |

### **D.17.3 GENERAL**

- D.17.3.1 The plumbing work shall be carried out through licensed plumber and shall comply in all respects with the requirements of these specifications.
- D.17.3.2 All sanitary appliances including sanitary fitting fixtures shall be as specified in the item of work and as per the sample approved by Engineer.
- D.17.3.3 Any openings made in wall/slab for providing pipes etc. should be made good by Contractor. Also any scaffolding / temporary supports required for execution of wall shall be provided by Contractor at no extra cost to Owner.
- D.17.3.4 All the tests certificates required for sanitary fixtures are to be made available by contractor and the testing of water supply and drainage system to be done as per the specifications at no extra cost to Owner.
- D.17.3.5 The location of plumbing fixtures. Fittings and related ancillary works shall be shown on relevant drawing.
- D.17.3.6 However, detailed drawing, if required shall be prepared by Contractor and got approved from Owner / Engineer before commencing the plumbing work.

## **D.17.4 WATER SUPPLY SYSTEM**

### **D.17.4.1 Storage Tanks**

#### **D.17.4.1.1 Underground Storage Tanks**

In case of underground storage for domestic purpose, the following requirements shall be complied with :

- a) The tank shall project at least 30 cm above the highest flood level. Where this is not possible the manhole cover shall be raised 30 cm above the highest flood level of the locality or ground level whichever is higher.
- b) The tank shall be such as to provide for the drawing of the tank when necessary and water shall not be allowed to collect round about the tank.
- c) The tank shall be perfectly watertight.
- d) The inner surface of the tank shall be rendered smooth as far as possible.
- e) The top of tank shall be so leveled as to prevent accumulation of water thereon.
- f) The tank shall have a complete concrete cover leaving a manhole opening provided with a properly fitting fibre reinforcement cover. Where tank is of large size, adequate number of manholes shall be provided as per detailed drawing.
- g) No gap shall be allowed to remain found the suction pipe and arrangements shall be provided for proper discharge of spill water from the electric pump by connecting the pump cabin to the water drain or by providing a small hole which will enable the water to flow out.
- h) The overflow pipes or vent shafts if provided shall have a wire gauge cover of 1.5 mm mesh properly screwed tightly to the opening. The underground storage tank shall be of such type and size as mentioned in respective item of work.

#### **D.17.4.1.2 Overhead Storage Tanks**

D.17.4.1.2.1 The overhead storage tanks shall be of such type and size as specified in the item of work. The general requirements shall be as follow :

D.17.4.1.2.2 The tanks shall be watertight and properly covered with a closed fitting mosquito-proof lid fitted with a locking arrangement and shall be provided with a sound and suitable ball valve and float conforming to IS : 1703 securely fixed to the tank and set in such a position that the body of the ball valve can not become submerged when the tank is full up to the water line. Ball valve shall be so adjusted as to limit the level of water in the tank to 25 mm below the lip of the warning or overflow pipe. A stop valve / gate valve shall be provided as near the tank as practicable on every outlet pipe from the storage tank, excepting the warning pipe. The outlet pipe from the storage tank, excepting the warning pipe. The outlet pipes shall be fixed 50 to 75 mm above the bottom of the tank and provided preferable with copper gauge strainers. The washout or draining pipe shall be made flush at the bottom of the tank at its lowest point. The floor of the tank shall be erected so as to give

a slight fall to the washout pipe for cleaning purpose. All the tanks shall be perfectly watertight. In case of M. S. tank these shall be painted with one coat of red oxide primer both internally and externally. On the inside two coats of bitumastic paint shall be applied and on the exterior two coats of paint of approved make and tint shall be applied.

#### **D.17.4.2 Water Supply Pipes and Fittings**

##### **D.17.4.2.1 G. I. Pipes and Fittings**

D.17.4.2.1.1 Pipes shall be galvanised mild steel butt welded and seamless, screwed, socketed and plain and tubes (Commonly known as G.I. Pipes) conforming to IS:1239 Part-I. The fittings shall be galvanised wrought steel welded and seamless conforming to IS : 1239 Part-II. The pipes and fittings shall be of such class and diameter (nominal bore) as specified in the respective items or work. These shall be cleanly finished and reasonable free from scale, surface flaws, lamination and other defects. The screw threads of pipes, sockets and fittings shall be clean and well cut the ends shall be cut cleanly and square with the axis of the pipe unless otherwise specified. Galvanizing of pipes and fittings shall be in accordance with IS : 4736. Pipes laid below ground shall be of heavy class and shall be coated with bitumastic paint and enwrapped with Hussein cloth. Pipes used above ground shall be of medium class. The pipes shall be cleaned and cleared of all foreign matter before being laid / fixed. In jointing the pipes the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped around the screwed end of the pipe. The end shall then be screwed in the socket, tee etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water Soil or any other foreign matter. All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to wall with standard pattern holder but clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts. All pipes inside the shaft shall remain clear off wall by at least 12 mm. All exposed G. I. pipes and fittings shall be painted with one coat of red oxide primer and two coats of oil paint of approved make and colour as directed by Engineer. Where concealed, piping is required to be done as per item of work, pipes and fitting after jointing shall first be coated with bitumatic paint and enwrapped with Hussein cloth and then embedded in a chase of required size cut in internal wall. The chase shall be filled with cement mortar (1:3) as directed by Engineer. The length of piping required to be concealed shall be measured and paid separately.

#### **D.17.4.3 Water Supply Fittings and Appliances**



#### **D.17.4.3.1 General Requirements**

- D.17.4.3.1.1 All cast fittings shall be sound and free from laps, blowholes and pitting; and both external and internal surfaces shall be clean, smooth and free from sand. Burning, plugging or patching of the casting shall not be permissible. The bodies, bonnets, spindle and other parts shall be machined so that when assembled the parts shall be axial, parallel and cylindrical, with surfaces smoothly finished. The fittings shall be fully examined and cleaned of all foreign matter before being fixed. The fittings shall be fixed in the pipeline in workman like manner. The joints between fittings and pipes shall be made watertight.

#### **D.17.4.3.2 Gate, Globe and Check Valves**

- D.17.4.3.2.1 The gunmetal gate, globe and check valve shall conform to IS : 778 and shall be of such class (1/2), type (screwed / flanged) and size (nominal bore) as mentioned in respective item of work.

#### **D.17.4.3.3 Bib Taps and Stop Valves**

- D.17.4.3.3.1 Screwed down bib taps and stop valves shall conform to IS : 781 whereas pillar taps shall conform to IS : 1795. In case of chromium plated (CP) fittings the thickness of plating shall not be less than service grade No. 2 of IS : 4827. The plating shall be capable of taking high polish and shall not easily tarnish or scale. The standard size of fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached.

#### **D.17.4.3.4 Self Closing Taps**

- D.17.4.3.4.1 Self-closing taps shall be of non-concussion type and shall comply with IS : 1711. In case other special fittings are required to be used for water supply system, these shall be of such size, shape and of approved make as per the requirements of competent authority.

#### **D.17.4.3.5 Shower Rose**

- D.17.4.3.5.1 The shower rose shall be of chromium plated brass of specified diameter. It shall have uniform perforations. The inlet size shall be 15 mm or 20 mm as specified. In case of shower rose vitreous china, this shall conform to IS : 2556 (Part-XI).

#### **D.17.4.3.6 Flushing Cisterns**

- D.17.4.3.6.1 The flushing cisterns shall be automatic or manually operated, high level or low level and of such capacity as specified in item of work for urinals and water closets. Valve-less siphonic type flushing cistern shall be of cast iron, glazed earthenware, vitreous china or pressed. Steel complying with the requirements of relevant I. S. codes and shall be provided as mentioned in respective item of work. A high level cistern is intended to operator with

minimum height of 125 cm and a low level cistern with a maximum height of 30 cm between the top of pan and the underside of the outlet shall be of 32 mm nominal bore and in the case of low level cisterns, the outlet shall be of 40 mm nominal bore. Ball valve shall be of screwed type 15 mm in diameter and shall conform to IS : 1703. The chain of cistern shall be galvanised steel wire and shall be of such strength as to sustain a dead load of 50 Kg. without any apparent or permanent deformation of shape of the link. The chain shall terminate in a suitable handle or 'Pull' which shall be of galvanised iron or non-ferrous metal, or a moulding in any heat resisting and non-absorbent plastic. The finish shall be smooth and free from burrs. In case of low level flushing cisterns the handle shall be chromium plated. The overflow pipe for cistern shall be of not less than 20 mm nominal bore with mosquit-proof device. The cast iron cistern shall be painted with two coats of black bitumastic paint on the inside and one coat of grey paint or a coat of emulsion on the outside. The cisterns shall be supported on two R. S. cast iron or mild steel brackets of size as approved by Engineer. The discharge rate of the cistern shall be about 5 liters in 3 seconds when connected to an appropriate flush pipe and there shall be no appreciable change in the force of flush during the period of discharge. The cistern shall have discharge capacity of 5, 10 or 12.5 liters as specified in item of work with a tolerance of (+/-) 0.5 liter or of 15 liters with a tolerance of (+/-) 1 liter.

## **D.17.5 SANITARY APPLIANCES**

### **D.17.5.1 General Requirements**

- D.17.5.1.1 All sanitary appliances and their components shall be durable. Impervious, corrosion resisting and have a smooth surface, which can be easily cleaned. These shall conform to relevant Indian Standards where it exists. In other cases these shall be of the best quality, workmanship and approved make. In general all glazed earthenware sanitary appliance shall (vitreous china) shall conform to IS : 2556 (Part-I to XV). Utmost care shall be taken to avoid any damage to sanitary appliances during transport, handing and fixing etc.

### **D.17.5.2 Wash Basins**

- D.17.5.2.1 Wash basins shall conform to the requirements given in IS : 771 or IS : 2556 (Part-IV) as mentioned in item of work. The wash basin shall be made in one piece and shall include a combined overflow and shall be such so as to facilitate cleaning. Where the wash basins are fixed in ranges, it is desirable that they shall be placed at centre to centre of at least 75 cm to ensure comfort when basins are in use; the centre line of the last basin shall be kept at least 40 cm away from the adjacent wall. The overflow shall be an open-weir type with removable grating of a slot type. The basin shall be such as to prevent slopping. Soap traps or sinkings shall be provided to drain into the basin. Tap holes shall be square or round to suit pillar tap conforming to IS : 1795 and shall be leveled around the opening to enable fixing of pillar taps perpendicular to wash basins. The waste outlet shall be bevelled or rebated to receive a waste fitting. Where there is no other means of fixing, a hole shall

be provided for the setting of the plug of the chain. Cast iron brackets and supports for wash basins and sinks shall conform to IS : 775. Brackets for screwing to walls are provided with ear holes for fixing screw, which should be screwed into suitable wall plug. In the case of this partition walls especially where this appliances are heavy, suitable from of floor support may be used, if however (as in the case of light appliances), wall fittings are used, they should be bolted through the wall, using back plates on the remote side.

### **D.17.5.3 Sinks**

- D.17.5.3.1 Sinks for kitchen use shall conform to IS : 771. Sinks for laboratory use shall conform to IS : 771 or IS : 2556 (Part-V). Hot and cold water supplies shall be provided as specified, the tap being mounted above the sink. The sinks shall be of one-piece construction, including a combined overflow. The floor of the sink shall gently slope towards the outlet. The outlet shall in all cases be suitable for waste fittings having flanges of 38 mm diameter of 65 mm at the bottom to suit the waste fittings. The waste hole shall be either rebated or bevelled having a depth of 10 mm. Sink shall be provided with a non-ferrous 50 mm dia waste fitting. The sink shall have overflow of the weir type and the invest shall be 30 mm below of the edge. Sink shall be provided with a waste plug, of suitable dia, chain and stay. The general requirements of fixing the sinks shall be same as mentioned for wash basins.

### **D.17.5.4 Urinals**

- D.17.5.4.1 Urinals shall conform to the requirements given in IS : 771 or IS : 2556 (Part-VI). The type, size and shape of urinals shall be as per respective item of work. The urinals shall be durable non-corrodable and shall have a hard glazed surface and these shall be manufactured in one piece without crack, joint or recess. The sidewall and back of urinals shall be made of hard, durable, impervious material. It shall be provided with a drain ending with a trap and provision for cleaning the floor. Urinals shall be provided such that a minimum clear width of 60 cm between the partitions is kept. Top of bowl shall be about 60 cm from the floor level. A drain of such width as shown on drawing shall be provided at the bottom of stall urinals so that other places are not fouled in usage. In case of open drain, it shall be of glazed type. Half-round channels for urinals shall conform to IS : 771 or IS : 2556 (Part-VIII). Urinals shall be provided with flushing cistern (manually operated / automatic) discharging through flush pipes and spreaders as mentioned in respective item of work. Urinal outlet shall be provided with dome shaped removable grating.

### **D.17.5.5 Water Closets**

#### **D.17.5.5.1 Squatting Pans (European Type W.C.)**

- D.17.5.5.1.1 Water closes shall be either of white glazed earthenware, white grazed vitreous china or white glazed fire clay as specified and shall be of "Siphonic Wash down type" conforming to IS : 2556 (Part VIII). The closets shall be of one piece construction with approved plastic / bakelite seat and cover. Each

water closet shall have 4 fixing holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type. It shall also have an inlet of supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self-draining type. The water closet shall have a weephole at the flushing inlet. Each water closet shall have an integral trap with either “S” or “P” outlet with at least 50 mm water seal. The water closets shall have an antisiphonage 50 mm dia. vent born on the outlet side of the trap. The inside of water closets and traps shall be uniform and smooth in order to ensure in efficient flush. The serrated part of the outlet shall not be glazed externally. The water closet when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 10 litres of water between the normal water level and the highest possible water level of the water closet installed.

## **D.17.6 WASTE WATER SYSTEM**

### **D.17.6.1 Cast Iron Soil, Waste and Vent Pipes and Rain Water Pipe and Fittings**

D.17.6.1.1 Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories shall conform to IS : 1729 of IS : 3989. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surfaces being as nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks, laps, pin holes or other imperfection and shall be neatly dressed and carefully reasonably square to their axis. The cast iron pipes and fittings shall be of such nominal diameter as mentioned in the respective item of work and the pipes shall be of longest length available unless shorter lengths are either specified or required at the junctions etc. The pipes and fittings shall be supplied without ear unless specified or directed otherwise. All pipes and fittings shall ring clearly when struck over with a light hand hammer and shall be capable of being easily worked with a drill or file. All soil, wastes and ventilating pipes shall be carried up above the roof, if required to such height as specified or directed and shall be provided with C. I. cowl. The minimum diameter of soil and rain water, waste water and vent pipes shall be 100 mm, 75 mm and 50 mm respectively. All pipes and fittings shall be properly cleared or foreign material and shall be perfectly dry before jointing. The spigot shall be centered in the socket by tightly caulking in sufficient turns of tarred gasket or hemp yarn to leave unfilled half the depth of socket for lead. A jointing ring shall then be placed round the barrel and against the faces of the socket. Molten pig lead shall then be poured into fill the remainder of the socket. The lead shall then be solidly caulked with suitable tools and hammer of not less than 3 Kg. Weight right round the joint to make up for the shrinkage of the molten metal on colling and shall be perfectly finished 3 mm behind the socket face. Lead for caulking shall conform to IS : 782. In case the cement mortar joint is specified in the item of work, the following procedure shall be adopted. The joint is first yarned with hemp yarn dipped in the cement slurry. The yarn is first inserted to slight depth and well pressed in the same manner as for lead jointing. Then cement mortar (1:1) with a water cement ratio not exceeding (1:5) shall be rammed into the joint by caulking tools and the joint completely filled. The joint shall

be kept wet for 24 hours after making. The pipes and fittings shall be fixed to the walls on wooden cleats fixed to the stone and or brick walls by means of special W.I. clamps and round headed nails so as to keep clear of the surface of the walls unless projecting ears with fixing holes are provided at socket end of pipes or by approved inserts well fastened to the walls. The access door fittings shall be such as to avoid dead spaces in which filth may accumulate. Doors shall be provided with 3 mm rubber insertion packing and when closed and bolted, these shall be air and watertight. The floor traps, nahani traps etc. shall conform to IS : 3989. All exposed cast iron pipes and fittings shall be painted with one coat of red oxide primer and two coats of zinc based paint of approved make and shade.

#### **D.17.6.2 Lead Pipes**

D.17.6.2.1 Lead pipes shall conform to IS : 404. The pipes shall be sound and free from lamination, flaws, pronounced extrusion marks or other imperfections and shall be as far as possible, be circular in cross section, smooth and of uniform wall thickness throughout. The chemical composition, wall thickness, weights and other specifications of lead pipes shall be as per relevant tables depending on different types of uses as specified in IS : 404. Lead pipes when not supported on bearers, shall be supported by strong lead-tacks at least 40 mm wide soldered on to the pipes at suitable intervals. All joints for lead pipes shall be of wiped solder joints. The pipe ends to be jointed shall be cleaned with wire brush and shall be free from oxide if any. Chalk shall be brushed and shall be free from greasy nature of lead. After this, plumber's black shall be applied. Suitable length of joint (approximately 60 mm to 90 mm) shall be marked on the pipe. A fine shaving of lead shall be removed from this length with shave hook. Tallow shall then be smeared over the prepared surface. The molten solder, an alloy composed of 3 parts of tin and 7 parts of lead, shall be poured in a thin stream from a ladle moved in elliptical direction over the joint position, when sufficient solder has been poured, the joint shall be wiped with a pad of wiped cloth with long continuous movements in one direction only so as to leave a neatly formed elliptical shaped bead. The bead shall be removed with a tool called "draw off". The joint shall be air and water tight and free from tears, burrs, strings, ribbons or dropping. The jointing of lead pipes with C. I. or stone ware pipes shall be as follows :

D.17.6.2.2 One end of the brass ferrule or thimble shall be slipped into or over the lead pipe and jointed to it by means of a wiped solder joint. The other end of the ferrule shall then be inserted into the socket of the cast iron or stone ware pipe. In the case of the former, the joints shall be made with molten lead and in the case of the latter with cement mortar. Brass screwed cleaning access shall be provided on lead pipes wherever necessary. Lead pipes shall be painted as directed by Engineer.

#### **D.17.6.3 Asbestos Cement Soil, Waste, Vent Pipes and Fittings**

D.17.6.3.1 Asbestos cement soil, waste and pipes and fittings shall conform to IS : 1626. The pipes and fittings shall be of spigot and socket ends and shall be of such

nominal diameter as mentioned in the respective item of work. The pipes shall be straight and the ends of the pipes and fittings shall be finished square to their axes. The finished pipes and fittings shall be true and smooth, their inner and outer surfaces being as nearly as concentric. They shall be in all respects sound, homogeneous and free from impurities or other imperfections. The joints for pipes and fittings shall be in cement mortar (1:1) as mentioned in detail for C. I. pipes. The general requirements for fixing A. C. pipes and fittings on wall etc. shall be as described for C. I. soil waste and vent pipes and fittings. All exposed A. C. pipes and fittings shall be painted with two coats of paint approved type, make and colour as specified and directed by Engineer.

#### **D.17.6.4 Salt-Glazed Stoneware Pipes and Fittings**

D.17.6.4.1 Salt-glazed stoneware pipes and fittings shall conform to IS : 651. The pipes and fittings shall be of spigot and socket ends and shall be of such grade (A/AA) and internal diameter as mentioned in respective items of work. These shall be sound, free from invisible defects such as fire crack or hair cracks. The glaze of the pipes and fittings shall be free from crazing. The pipes shall give a sharp clear note when struck with a light hammer. There shall be no broken blisters. The length of pipes shall be 60 cm exclusive of the internal depth of socket unless otherwise specified. The pipes and fittings shall be handled with sufficient care to avoid damage to them. In general, laying, jointing and testing of salt-glazed stoneware pipes shall be as per IS : 4127. The pipes shall be laid to the required alignment. Levels and gradient as per the relevant drawings. The socket ends shall face the upstream. The bottom of the trench shall be well compacted before the pipes are laid. Where the pipes are laid on a soft soil, with the minimum water table level lying as the invert level of the pipe or where the pipe line is crossing the road, the pipes shall be bedded in concrete or shall be fully encased as directed or specified in the item of work. The pipes shall be jointed by following procedure:

D.17.6.4.2 In each joint spun yarn soaked in neat cement slurry or tarred gasket shall be placed round the joint and inserted in it by means of a caulking tool. More skeins of yarn or gasket shall be added if necessary and shall be well caulked. Yarn or gasket so rammed shall not occupy more than fourth of the depth of socket. Cement mortar (1:1) (one part of cement to one part of sand) shall be slightly moistened and carefully inserted by hand into the remaining space of the joint after caulking of yarn or gasket. The mortar shall then be caulked into the joint with a caulking tool. More cement shall be added until the space of joint has been completely filled with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degrees. The cement mortar joint shall be cured at least for seven days before testing. The backfilling of trenches shall not be undertaken until the joints of the pipes are thoroughly set and have been inspected, tested and approved by Engineer. The backfilling from the bottom of pipe upto 300 mm above the top of pipe shall be done by selected earth free of any hard material. Care shall be taken not to disturb the joints during backfilling.

### **D.17.6.5 Gully Trap**

- D.17.6.5.1 In case gully trap is required to be provided before the wastewater pipe is connected to inspection chamber, this shall be of salt-glazed stoneware with square mouth and with 'P' or 'S' trap and shall conform to IS : 651. The size of gully trap as well as the brick masonry chamber in which it is fixed shall be as per the respective item of work. Gully trap shall have one C. I. grating of square size. Corresponding to the dimensions of inlet of gully trap. It will also have watertight C. I. cover and frame with inside clear dimensions of 300 mm x 300 mm, the cover weighting not less 5 Kg. And the frame not less than 3 Kg. The grating, cover and frame shall be off sound and good casting and shall have truly square machined seating face. The cover for Gully Trap may be of precast concrete if specified in the item. The gully trap shall be fixed on cement concrete M-100 foundation, 680 mm square and 150 mm thick. The jointing of gully trap outlet to the branch drain shall be done similar to jointing of glazed stoneware pipes. After fixing and testing gully and branch drain, a brick masonry (1:5) shall be built with 115 mm thick brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the trap shall be filled in with cement concrete M-100. The space between the chamber walls and the trap shall be filled in with cement concrete M-100. The upper portion of the chamber i.e. above the top level of the trap and inside face of chamber shall be cement plastered 12 mm thick in C. M. (1:3) finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating. C. I. cover with frame 300 mm x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete M150 and rendered smooth. The finished top of cover shall be left about 40 mm above the adjoining ground level so as to exclude the surface water from entering the gully trap. The item shall be executed as per the detailed drawing and as directed by Engineer.

### **D.17.6.6 Inspection Chamber**

- D.17.6.6.1 Inspection Chamber shall be provided at every change of alignment, gradient or diameter of sewer/storm water drains, bends and junctions in the sewer / drain shall be grouped together in inspection chamber as far as possible. The maximum distance between inspection chambers shall be about 25 meters. Where the diameter of sewer/drain is increased, the soffit of the pipe shall be fixed at the same level and necessary slope given to the channel of inspection chamber. The minimum internal sizes of inspection chamber shall be as per the respective item of work. The inspection chamber shall be constructed as per the detailed drawings and as directed by Engineer. The bed concrete BBCC (1:5:10) and for channel CC (1:2:4) and the brick masonry shall be constructed of such thickness as shown on drawing. The brick masonry shall be constructed in C. M. (1:5), plastered on both faces with 15 mm cement plaster in C. M. (1:3). The channel shall be semicircular in the bottom half and of diameter equal to the sewer/drain. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitable rounded off. The branch

channels shall also be similarly constructed with respect to the benching out at their junction with the main channel as appropriate fall suitable rounded off in the direction of flow in the main channel shall be given. The channel at the bottom of inspection chamber shall be plastered with C. M. (1:1) and finished smooth. Rungs shall be provided in all inspection chambers over 0.6 m in depth and shall be of cast iron conforming to IS : 5455. These rungs shall be fixed staggered in two vertical runs, 300 mm apart horizontally and 300 mm c/c vertically. The top rung shall be 450 mm below the inspection chamber over and the lowest not more than 300 mm above / the benching. The inspection chamber frame and cover and the lowest not more than 300 mm above the benching. The inspection chamber frame and cover shall be of cast iron of specified weight and shall conform to the requirements given in IS : 1726. The covers and frames shall be cleanly cast and they shall be neatly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage, gas inclusion or other causes. Covers shall have a raised chequered design on the top surface to provide an adequate nonslip grip. Cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner. The cover shall be gas tight and water tight. The size of covers specified shall be considered as the clear internal dimensions of the frame. Covers and frames shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. The frame of inspection chamber cover shall be firmly embedded to correct alignment and level in cement concrete on the top of the masonry. The item shall be executed as per the detailed drawing as directed by Engineer. Light duty CI seat and cover of required size shall be provided.

#### **D.17.6.7 Intercepting Trap**

- D.17.6.7.1 Intercepting trap shall be salt glazed earthenware and shall conform to IS : 651. This trap shall be provided in the last manhole/ inspection chamber of building properly before the sewer is connected to street manhole/septic tank as directed and specified in the item of work. This item shall, however, be provided as per the requirements of local authority. The connection to street manhole/septic tank shall be done in good workmanship manner and as per the requirements of local authority.

### **D.17.7 STORM WATER DRAINAGE SYSTEM**

#### **D.17.7.1 Rain Water Pipes and Fittings**

Cast iron rain water pipes and fittings shall conform to IS : 1230 whereas those of asbestos cement shall conform to IS : 1626. The general requirements of C. I. and A. C. rain water pipes and fittings, their fixing and jointing procedure, painting, etc., shall be as per the details described for respective type of pipes and fittings under the items for drainage work. The rain water pipe shall discharge directly or by means of a channel into or over an inlet to a surface drain or shall discharge freely in compound, drained to surface drain as directed by Engineer. In case the rain water pipe is to be connected to street drain this shall invariably be connected through gully trap. A rainwater pipe



shall not discharge into or connect with any soil, waste or ventilating pipe nor shall discharge into a sewer unless specifically permitted to do so by the local authority in which case such discharge into a sewer shall be intercepted by means of gully trap. The diameter, spacing and type of rainwater pipe shall be as per the detailed drawing and respective item of work. A bell mouth inlet at the roof surface be provided with suitable grating. Generally, minimum diameter of rainwater pipe shall be 100 mm unless otherwise specified. Fixing of rain water gutters and down pipes for roof drainage shall conform to the requirements of IS: 2527.

## **D.17.8 MISCELLANEOUS ITEMS**

- D.17.8.1 Miscellaneous items such as special types of plumbing fixtures and fittings not covered in this specification but which are required to be provided as per the items of work shall be of best quality and of approved make. Other items which are invariably provided in sanitary units such as C. P. towel rail, liquid soap holder, mirror, etc., shall be of such size and type as mentioned in respective item of work and shall be of best quality and as approved by Engineer.

## **D.17.9 TESTING OF PLUMBING SYSTEMS**

- D.17.9.1 All pipes, fittings and appliances shall be stated as per the requirements of relevant I.S.S. and/local authority and necessary test certificates shall be submitted by Contractor whenever called for by Engineer at no extra cost to Owner / Engineer.
- D.17.9.2 When water supply system is completed, it shall be slowly and carefully charged with water, allowing all air to escape and avoiding all shock or water hammer. The system shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight.
- D.17.9.3 Comprehensive tests of all sanitary appliances shall be made by simulating conditions of use. Overflows shall also be examined for obstructions.
- D.17.9.4 All soil, waste, vent pipes, fittings and their joints above ground shall be proved perfectly gas-tight by conducting a smoke test under a pressure 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke shall be produced by burning oil waste or tar paper or similar material in the combustion chamber of smoke machine. Contractor shall also perform water tests if required by Engineer before the appliances are connected. This test may be carried out in sections so as to limit the state head to 4.5 m. All the openings affected by the test shall be sealed and provided with supports to the plugs, which are used as stoppers during the test. All the pipes, fittings and their joints shall be proved water-tight.

- D.17.9.5 Discharge test shall be performed from all the sanitary appliances, singly and collectively. Obstruction in any of the pipe lines shall be traced and the whole system examined for proper hydraulic performance, including the retention of an adequate water seal in each trap.
- D.17.9.6 After laying and jointing salt glazed stoneware pipes, R.C.C. pipes suitable stretches of pipes inclusive of manhole/chambers shall be subjected to a test pressure of at least 1.5 meters head of water at the highest point of section water test. The tolerances figure of two liters per centimeter of diameter per kilometer shall be allowed during a period of ten minutes.
- D.17.9.7 Rain water pipes and fittings shall be tested to a height of water equivalent to the height of the building plus 3 meters to ensure no leakage in case of choking the pipe, by first installing test plugs in all openings, erecting 3 meters long stand pipe and filling the entire system with water. Pipes shall be deemed to have passed the test, if water levels in the stand pipe remains reasonably constant for a period of one hour.

#### **D.17.10 MEASUREMENT**

- D.17.10.1 Unless otherwise stated, all pipes such as C.I., G.I., lead, etc. shall be measured net, length as actually laid or fixed shall be measured over all fittings, like bends, tees, junctions, etc.(which shall not be measured separately), in running meters correct to a cm. The length shall be taken along the centre line of the pipes and fittings. No allowance shall be made for any wastage etc. The rate shall include the cost of material and labour involved and inclusive of laying, jointing, testing necessary excavating and backfilling, shoring, dewatering, etc. complete for pipes for laid below ground. In case the pipes are laid above ground the rate shall include the cost of material and labour involved and inclusive of fixing, jointing, testing, painting, necessary scaffolding, cutting through walls, floors, etc. and making good the same etc. complete. This shall however, not include concealed pipe work in which case the length of pipes and fittings concealed shall be measured and paid separately.
- D.17.10.2 The lengths of salt glazed stoneware pipes shall be measure in running metres nearest to a cm as actually laid from inside face of one manhole / chamber to the inside face of the other manhole/ chamber. The length shall be taken along the centre line of the pipes over all fittings such as bends, junction, etc. shall not be measured separately.
- D.17.10.3 All valves (sluice, gate, globe, check etc.) and taps (bib, stop, pillar, etc.) and similar fittings used for water supply system shall be enumerated and paid separately unless otherwise included in the items of work for sanitary appliances. The rate shall include the cost of materials and labour involved inclusive of fixing, testing, etc. complete.
- D.17.10.4 Sanitary appliances such as water closets, urinals, wash basins, sinks etc. shall be enumerated and shall cover all the relevant items as described in respective

items of work for sanitary appliances. The rate shall include the cost of materials and labour involved inclusive of supporting fixing, testing, making necessary connections etc. complete.

D.17.10.5 Gully traps, floor traps, intercepting traps, etc. shall be separately enumerated as per their sizes and shall cover all the relevant items as described in the respective items of work for traps. The rate shall include the cost of materials and labour involved inclusive of fixing the traps, necessary chamber, excavation, backfilling, dewatering, testing, etc. complete.

D.17.10.6 Manholes and inspection chambers shall be separately enumerated as per their sizes and shall cover all the relevant items as described in the respective items of work for manhole/inspection chamber. The depth of the manhole shall be reckoned from the top level of C. I. /precast R.C.C. cover to the invert level of channel. The depth shall be measured correct to cm. The extra depth shall be measured as an extra over the specified depth in the enumerated item, and paid in running metre under separate item following the main item. The rate shall include the cost of materials and labour involved inclusive of necessary excavation, backfilling, dewatering, testing etc. complete.

D.17.10.7 Rain water pipe and fittings shall be measured in running meters correct to a cm, the length being taken along their centre line. The rate shall include the cost of materials and labour involved inclusive of fixing, joint, painting, etc.

#### **D.17.11 NAHNI TRAP**

##### **D.17.11.1 Materials :**

D.17.11.1.1 Nahni trap shall be of cast iron and shall be sound and free from porosity or other defects which affect serviceability. The thickness of the base metal shall not be less than 6.5 mm. The surface shall be smooth and free from craze, ships and other flaws or any other kind of defects which affect serviceability. The size of nahni trap shall be as specified and shall be self cleaning design.

D.17.11.1.2 The nahni trap shall be of quality approved by the Engineer in charge and shall generally conform to the relevant Indian Standards.

D.17.11.1.3 The Nahni trap provided shall be with deep seal, minimum 50 mm, except at places where trap with deep seal can not be accommodated. The cover shall be cast iron. Perforated cover shall be provided on the trap of appropriate size.

D.17.11.1.4 The C.I. hinged or screwed down cover shall be of best quality.

##### **D.17.11.2 Workmanship :**

D.17.11.2.1 The Nahni trap with 100 mm. dia. inlet and 50 mm. dia. outlet shall be fixed as per drawing or as directed.

D.17.11.2.2 The Nahni trap shall be jointed with C. I. pipe, 75 mm. dia. with lead joints. The lead joints shall be done in confirmation with IS 782-1976.

**D.17.11.3 Mode of measurements & payment :**

D.17.11.3.1 The rate includes cost of all labour, materials, tools and plants etc. required for satisfactory completion of this item including lead jointing and testing.

D.17.11.3.2 The rate shall be for a unit of one number.