

Contract No.:

**GOVERNMENT URBAN DEVELOPMENT COMPANY LIMITED
GANDHINAGAR
[A WHOLLY OWNED GOVERNMENT OF GUJARAT UNDERTAKING]**



**BIDDING DOCUMENT FOR
PROPOSED 2-LANE RAILWAY OVER BRIDGE IN LIEU OF LC. NO. 48A BETWEEN RLY
KM. 629/3 TO 629/4, NEAR DHRANGADHRA RLY. STATION, DHRANGADHRA.**

**VOLUME – II
PART-III (GENERAL TECHNICAL SPECIFICATION- UTILITY SHIFTING OF NAGARPALIKA)
GOVERNMENT OF GUJARAT**

By

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(Through e- Procurement Portal only - <https://gudctender.nprocure.com/>)

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. The 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 conforming 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 scarifies 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, Jungewood and brushwood shall be cut and their roots grubbed-up. All wood and material from the clearing shall be the property of GMC and shall be arranged as directed the GMC 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 than 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 GMC 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 Besalt, 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, GMC 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 GMC.
- 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 GMC 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 GMC 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, GMC 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 GMC shall not be responsible for any type of damages and contractor shall have to bear all the cost for the same and the GMC 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. GMC 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 GMC.

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 ornnetal 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 bend cold to specified shape and dismensions or as directed, attain proper raduis of bends, Bars shall not be bent or staightened in a manner that will injure the materials. Bars bend during transport of 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 inveriably 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 or without hooks at the ends. Deformed bars without hooks shall however, comply with relevant enchorage requirements.

Bars crossing each other where required shall be secured by binding wores (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 butt welded so as to transmit their full stresses. Welded joints shall preferably located at points when 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 viods 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 MASONARY 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 theroughly wetted with clean water for amount two hours before use or as directed. The cassation of bubbles, when the bricks are wetted with water is an indication of through 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 bear 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 chambering 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 ± 5 mm and ± 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 grip 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 copping 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

Grade of Cover	Type	Load	Diameter of Block
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 steel bars and hard drawn steel wires for concrete reinforcement.
(Part 1 and 2)
8. IS : 1786 - Specification for high strength deformed steel bars and wires for concrete reinforcement.

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| 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

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| 1. | IS : 4031
(Parts 1 to 15) | - Methods of physical tests for hydraulic cement. |
| 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
(Parts 1 to 8) | - Methods of test for aggregates for concrete. |
| 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

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| 1. | IS : 4082 | - Recommendations on stacking and storing of construction materials at site. |
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D.7.2.5 Code for Concrete Mix Design

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

D.7.2.6 Code for Concrete Testing

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| 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 :

Sr. No.	Foreign Material	Percentage by weight	
		Uncrushed	Crushed
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.

IS : Sieve Designation	Grading Zone-I	Grading Zone-II	Grading Zone-III	Grading Zone-IV
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 $\frac{1}{4}$ th 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 stressed 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 understood 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 beam 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 be 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/cm². 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 war page 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 except 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 : DUCTILE IRON PIPE AND FITTINGS

SECTION - D: 8

D.8.1 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.8.2 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.8.3 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.8.4 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.8.5 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.8.6 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.8.7 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.8.8 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.8.9 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.8.10 Hydraulic Test

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

D.8.11 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.8.12 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.8.13 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.8.14 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.8.15 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.8.16 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.8.17 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.8.18 Inspection

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

D.8.19 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 of 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 and 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 champherped 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 in 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, anchorages are not normally necessary. However, on 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.8.20 Method of Measurement and Payment

The measurement shall be made in running meter basis.

D.8.21 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.8.22 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.8.22.1 The Vendor list for DI pipe shall be Jindal Saw Ltd. / Rashmi Metaliks/ Electro Steel casting.

D-9 : SLUICE VALVES, AIR VALVE

SECTION - D: 9

D.9.1 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.9.2. 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.9.3. TEMPERATURE VARIATIONS

All sluice valves, manufactured, supplied, tested and delivered shall be subjected to drinking water under variable temperature conditions ranging from 4⁰ to 45⁰ C.

D.9.4. 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.9.5. 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 GMC.

D.9.6. 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

PN Rating	Test for Body / Seat	Test Pressure MPa (Gauge)
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.9.7. 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.9.8. 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.9.9. 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.9.9.1 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.9.10. 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.9.11. 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.9.12. 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.9.13. PAYMENT

The payment will be made on No. basis.

D.9.14.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 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 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 be 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 flot (Ball) shall only be risen by the liquid and not by mixer of air and liquid. The sealing shall be design to prevent the flots sricking 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 thr 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 valve 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

Sr. No.	Kinetic Air Valves	Material Description PN 10
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-10 : REINFORCED CEMENT CONCRETE PIPES SOCKET & SPIGOT

SECTION - D: 10

D.10.0 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.10.1 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.10.2 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.10.3 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.10.4 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.10.5 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.10.6 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.10.7 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.10.8 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/mm² 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/mm² 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/mm² 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/mm² 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.10.9 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.10.10 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 GMC Engineers as well as engineer appointed by PMC/TPI agency. Apart from this GMC 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.10.11 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.10.12 MARKING

The following information shall be clearly marked on each pipe :

- a) For GMC 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.10.13 LAYING OF PIPES

The laying of RCC pipes shall conform to Technical Specifications: Section-D-6.

D.10.14 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.10.15 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.10.16 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.10.17 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.10.18 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.10.19 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-11 : DRILLING OF HORIZONTAL BOREHOLE SECTION – D-11

D.11.1 SCOPE

The scope of item includes following :

- Preparing the required drawings & to get the permission / approval for lowering, laying & jointing pipeline below Road under the supervision of concerned authority & also obtaining completion certificate from the concerned authority after completion of work. GMC will reimburse all statutory charges & sign the necessary papers related to the work as per requirement. All other charges shall be borne by the contractor.
- Drilling horizontal bore & providing, fixing RCC casing pipe with jointing.
- Constructing temporary R.C.C. thrust block & base concrete as per requirement for facility of pushing the pipeline and dismantling the same on completion of work
- Fixing of water main pipe.
- Sealing the both ends of pipe with construction of brick work including C.C 1:3:6.

D.11.2 GENERAL TECHNICAL REQUIREMENTS:

Sr. No.	Particulars
1	Casing pipe shall be of mild steel pipes shall be fabricated as per IS: 3589.
2	For insertion of casing pipe, boring shall be carried out by auger type boring device with cutting head to drill a horizontal bore. The hole drilled shall be of suitable size to accommodate casing pipes. The casing pipe shall be inserted along with boring to keep the formation supported to prevent any settlement of the track. The casing pipes will be installed with even bearing throughout its length. The work will be done under the supervision of concerned authority.
3	The casing pipe will be Deep below the natural ground level As Per concerned authority Requirements. The length of casing pipe shall be upto the end of land boundary.
4	Care shall be taken to isolate the pipeline crossing installation from aerial electrical wires & shall be suitably insulated from underground conduits carrying electrical wires.
5	The pipeline shall be tested for specified test pressure to check for leakage.
6	<p>To protect casing pipes as well as carrier pipe against corrosion, following action will be taken:</p> <p>(a) Outer surface of casing pipe will be painted with a coat of zinc rich epoxy primer of thickness 4 mils.</p> <p>(b) Suitably 3 roller support at 4 mts interval of steel pipe shall be welded spacers of high density polyethylene or either similar material shall be installed in between the carrier & casing pipe to prevent carrier pipe forming metallic contact with casing pipe.</p>
7	The alignment of the pipeline shall be so decided that it crosses track nearest to right angle.

Sr. No.	Particulars
8	These special conditions and the schedule of work shall govern the work to be executed under this contract in addition to and/or in part super session of the General Conditions of Contract & Standard Specifications.

The fixing of water main shall be as per detail specifications in section.

D.11.3 Scope also covers

- Shifting of service lines and reinstating the same
- Demolishing all types of R. C. C., masonry work
- Pumping / Bailing out water etc.

No extra payment shall be made for dewatering when any work is done below water level.

The rate quoted by the Contractor/s shall be deemed to include diversions, bunds, approach Drain to the site of work etc. and such other works, necessary for setting out and execution of works in different phases as ordered by the Engineer and / or his representative. No extra payment shall be made for such works or any other phase works carried out which are necessary for satisfactory execution of work. The diversion for traffic shall be made by the agency as per requirement without any extra cost.

Any timbering work required to be done for retaining earth during excavation of foundations will have to be arranged by the contractor which shall conform to the provision laid down in Specification of Timber Shoring.

The working area may be water logged during monsoon or any untimely rains. Contractor should take the special note while preparing the programme schedule for this work. Contractor should also specify the method which they propose to avoid water logging in the working area, however it may be clearly noted that bailing out / pumping out shall not be payable.

The rate is on Rmt. basis for specified length as per detail description in item. However, during execution as per site condition, if the length of pushing is increasing / decreasing the excess / reduce payment will be adjusted accordingly.

D-12 : PUSHING UNDER CROSSING

SECTION - D: 12

D.12.1 Crossing

D.12.1.1 General specifications

The Pipeline is crossing main road which requires Pipe pushing as below :

The length of the Pipe pushing under the crossing will be the existing width of the Crossing at ground level plus one meter on either side beyond this the RCC casing pipe. Pipe will be laid by open excavation with carrier pipe upto Crossing boundary crossing as per drawing and direction of Engineer in charge. The pushing work should be carried out as per contractors own design & as per approved GAD by competent authority. It is the responsibility of contractor for liasoning with concerned authority for getting approval. The charge to be paid for approval will be borne by GMC.

The carrier pipeline of various diameters will be laid in RCC Pipe of required diameter.

D.12.1.2 Crossing :

- (a) At crossings the work shall be performed as per specifications and under the supervision of authorities.
- (b) In case, however the minimum requirements of the governing agencies are less than those set out in the drawing or the specifications given herein, then the requirements given in the drawings and the specifications given for carrier line shall be followed.
- (c) The method of carrying out a pipe crossing by pushing shall be jointly inspected by the representative of the Company and Tenderer and Crossing / engineer for each category of work prior to commencement of actual work.

D.12.2 PUSHING OF RCC PIPE

The methodology of Pipe jacking essentially consists of pushing forward the precast RCC. Pipe segments through road embankment by hydraulic jacks. The Pipe jacking work is executed in the following stages:

1. Excavation.
2. Casting of thrust bed with strips for longitudinal/side shifting of Pipe segments.
3. Fabrication of Front and Rear Shield.
4. Pipe Casting.
5. Pushing of Pipe segment.
6. Shifting of succeeding Pipe segments.
7. Completion.

1. **Excavation :** Open excavation is carried out for construction of Pipe or ancillary works necessary for successful completion of the work. Open excavation is done by excavator and final level of excavation is done by manual excavation. Shear keys are excavated as per drawing by manual excavation.

2. **Casting thrust bed and strips :** The thrust bed and strips for shifting of Pipe segments are casted integral with each other. The first segment of Pipe is casted on the thrust bed while the remaining segments are casted on additional thrust beds from where they are shifted and brought on to the thrust beds from where they are shifted and brought on to the thrust bed after the completion of pushing of previous segment. The Thrust bed and strips are provided with pockets both in longitudinal and transverse direction to house the pins which take up the pushing force applied on the Pipe by hydraulic jacks. The pushing force is absorbed by the passive pressure of soil on the thrust wall and shear keys.

3. **Fabrication of Front and Rear shield :** While the above activities are in progress, fabrication of front and rear shield is taken up on the site workshop. The front shield is fitted on the first segment of the Pipe through anchor bolts at the time of casting of Pipe. It pierces through the soil under the pushing force of the jacks by cutting the soil, combined with manual excavation from inside the Pipe. The rear shield is also fitted with anchor bolts at the rear end of each Pipe segment to prevent soil caving in at the junction of Pipe segments and also to facilitate intermediate jacking.

4. **Pipe Casting :** The first segment of the Pipe is cast on the thrust bed after tying reinforcement in accordance with drawing and the front and rear shields are placed in position. After the Pipe segment is casted, it is cured and the form work is removed. An epoxy coat is applied on the top slab of the Pipe to reduce friction between soil and the Pipe during jacking. The Pipe segment is now ready for pushing

through the embankment. Simultaneously casting of other segment is done on the strips while pushing is on.

Technical Data :	Road
Pipe size :	As per BOQ & as per approved GAD by authority
Length of Pushing :	(As per G.A.D)

5. **Pushing of Pipe :** Number of pins are placed in the pockets provided in the thrust bed and hydraulic jacks of required capacity are placed in the space between the pin and rear end of Pipe. The spacer pins are then provided in front of jacks are next operated through the hydraulic system and the force generated by oil pressure pushes the Pipe towards the embankment. After the ram of jack is exposed fully the oil pressure is released to force the ram jack inside the cylinder. Another spacer pin is provided as above in from jack heads and the process is repeated. When the next row of pockets of thrust bed is exposed, the pins are removed from the earlier row of pockets ad placed in the exposed row of pockets. Pushing is then started as described above and continued till the Pipe segment is pushed through. Manual excavation is carried out from inside the Pipe as required for pushing the Pipe.
6. **Shifting of Succeeding Pipe segments :** The Pipe segment casted on strips is brought on to the thrust bed by jacking and is aligned with the already pushed Pipe segment. Hydraulic jacks are placed in rear shield region and also in the pockets of the rear end of Pipe segment. The jacks in the rear shield region are operated to push further the already pushed Pipe segment, holding in the process the Pipe segment on the thrust bed firmly, against the jacks provided in the row of pockets. After the ram of jacks in rear shield is exposed, the oil pressure is released to close these jacks and pushing of rear segment is started with the help of jacks provided in the pockets. This is called “Intermediate Jacking”. The process of jacking is continued till the entire of Pipe is pushed.
7. **Completion :** After completion of pushing the Pipe the pockets in the junction of the Pipes and joint of Pipes are filled up with reinforced concrete and cement grouting is done to make joints of each Pipe segment leak proof.
8. **Payment :** Payment will be given on Running meter basis.