

GANDHIDHAM MUNICIPAL CORPORATION



Bid Documents For

Providing, Lowering, Laying, Jointing, Testing and Commissioning of Drainage pipeline for Meghpar (Borichi & Kumbhardi) Area with Pump House and Rising Main Line under Gandhidham Municipal Corporation (3rd Attempt).

Volume-II

Technical Specifications

Milestone dates for e-tendering is as under	
1. Downloading of e-Tender documents	As per NIT.
2. Online submission of e – Tender	As per NIT.
3. Pre-Bid Meeting	As per NIT.
4. Physical submission of EMD, Tender fee and other necessary documents required for pre-qualification as per Financial and Experience criteria.	As per NIT.
5. Opening of online Primary Bid (Technical Bid)	As per NIT.
6. Opening of Commercial Bid (Price Bid) of technically qualified bidders only.	As per NIT.
7. Bid Validity	120 Days
For further particulars please visit us on www.gmc.nprocure.com	

CITY ENGINEER

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Gandhidham, Gujarat 370201

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:: TECHNICAL SPECIFICATIONS ::

A. GENERAL

1. SCOPE OF CONTRACT :

The work entitled comprise of excavation of trenches with shoring and strutting wherever required bailing out water wherever necessary, laying of pipes, jointing including supply of material and material required for jointing, testing as per specifications, Construction of appurtenances such as brick Masonry / RCC chambers etc. as per the type design specified entirely of the specification of various works stipulated in the e- Tender. Other material like cement etc shall have to supplied by the contractor from open market.

The scope of works comprises the following:

- ✓ Carrying out necessary topographical survey and geotechnical investigations
- ✓ Preparation of all required Drawings
- ✓ Excavation of pipe trenches in soil, soft rock, hard rock, WBM and concrete roads, including dewatering.
- ✓ Supplying and Laying of DI pipes with all specials along the route as per the network map
- ✓ Jointing of pipes with existing pipes (wherever required) with all required accessories
- ✓ The sanction from State/National Hghway Authority/Railway/GSPC /PGVCL/Telephone Department etc. Concern authority department for the purpose of road/Railway crossing will have to be obtained by the Tenderer. Agency shall have to do whole liaisoning work at his own level, however, GMC will recommend for the same wherever necessary. The charges occurred for obtaining such permission will have to be initially borne by the tenderer. However, GMC will reimburse only such relevant charges paid to such department(s), upon submission of necessary document i.e. Receipt etc. in original
- ✓ Contractor shall plan and accordingly phase the supply of items according to his requirement to best utilize the available storage space at site.
- ✓ Providing and fixing sluice valves, Scour valves and Air Valves on the existing as well as new pipeline, as specified in relevant datasheets, detailed technical specifications, particular technical specifications and BOQ.
- ✓ Providing pipe bedding as per the requirements.
- ✓ Backfilling of pipe trench with selected soil immediately after erection of pipe excluding pipe joints.
- ✓ Encasing of underground pipelines as per specifications.
- ✓ Hydro testing of pipeline in segments.

- ✓ Backfilling of pipe trench at pipe joints.
- ✓ Construction of RCC Sluice/ Butterfly Valve Chambers/RCC Thrust blocks/ Saddles/ Anchor blocks. The typical drawings for various structures are enclosed in Bid drawings for reference.
- ✓ Reinstatement of WBM, Tar and Concrete Roads after laying and testing of pipeline.
- ✓ Demolishing old structures in the route of pipeline, if required.
- ✓ Flushing of entire pipeline with clean water at least for 24 hours.
- ✓ Testing and commissioning.
- ✓ Preparation of as-built drawings.

2. e-TENDER PRICE:

The rates quoted in the bill of quantities shall cover everything necessary for the due and complete execution of the work according to the drawings and other condition and stipulations of the contract including specifications of the evident, intend and meaning of all or either of them or according to customary usage and for periodical and final inspection and test and proof of the work in every respect and for measuring, numbering or weighing the same, including setting out and laying or fixing in position and the provision of all materials, power, tools, rammers, labour, tackle, platforms with impervious lapped joints for scaffolding, ranging roads, straight edged, cantering and boxing, wedges, moulds, templates, posts, straight rods, straight edged, cantering and boxing, wedges, moulds, templates, posts, straight rails, boning staves strutting, barriers, fencing lighting pumping apparatus, temporary arrangement for passage of traffic access to premises and continuance to drainage water supply and lighting (if interrupted by contractor's work) temporary sheds, painting, varnishing, polishing establishment for efficient supervision and stating arrangements for the efficient protective of life and property and all requisite plant and machinery of every kind.

The contractor shall keep every portion of the work clear of accumulation from time to time and shall leave every portion of the work clean, clear, perfect and at the conclusion of whole, providing at their own cost all such material implement, appliances and labour as the Engineer in charge may require to prove if it to be so.

3. COMPLETION SCHEDULE:

The contract period shall be as prescribed in tender document, from the date of notice to proceed i.e Work Order. The Contractor shall submit his completion schedule and the program of works together with this e-Tender in conformity with completion schedule given in the documents.

4. Packing and Handling:

- 4.1. Necessary care shall be taken and required packing shall be provided to avoid damage to pipe barrels and the edges of the pipe ends in transit.
- 4.2. Where the goods are required to be dispatched at Railway risk, special packing as per IRCA rules are absolutely necessary, which would be payable by the contractor himself.
- 4.3. The contractor shall use proper handling equipment or follow suitable standard handling method for **DI pipes & DI Specials** as approved by the Engineer-in-charge to unload the materials at the delivery site to prevent damage to the goods.
- 4.4. The contractor shall take all care for Transportation

5. GENERAL TECHNICAL GUIDELINE:

- 5.1. All the items occurring in the work and as found necessary during actual execution shall be carried out in the best workman like manner as per specifications and the written order of the Engineer in charge
- 5.2. Extra Claim in respect of extra work shall be allowed only if such work is ordered to be carried out in writing by the Engineer in charge
- 5.3. The contractor shall engage a qualified Engineer for the Execution of work who will remain present for all the time on site and will receive instructions and orders from the Engineer in charge or his authorized representative. The instruction and orders given to the contractor representative on site shall be considered as it given to the contractor himself.
- 5.4. The work order book as prescribed shall be maintained on the site of the work by the contractor and the contractor shall sign the orders given by the inspecting officers and shall carry out them properly.
- 5.5. Quantities specified in the e-Tender may vary at the time of actual execution and the contractor shall have no claim for compensation on account of such variation
- 5.6. Unexcavated lengths shall be left wherever required and so directed by the Engineer in charge during the currency of the contract and shall be tackled. If required, before completion of work.
- 5.7. Diversion of road, if necessary, shall be provided and maintained during the currency of the contract by the contractor at his cost.
- 5.8. Figured Dimensions of drawing shall supersede measurements

by scale, special dimensions or directions in the specifications shall supersede all other dimensions.

- 5.9. All levels are given on drawings and the contractor shall be responsible to take regular level on the approved alignment before actually starting the work. The levels shall be commence to the G.T.S. levels and shall be got approved from the Engineer in charge
- 5.10. If the arrangement of temporary drainage is required to be made during any work of this Contract, this shall be made by the Contractor without claiming any extra cost.

6. CLASSIFICATION OF STRATA:

- 6.1. All materials encountered in excavation will be classified in the following groups irrespective of mode of excavating the materials and the decision of the Engineer in charge in this regard shall be final and binding to the contractor.
 - 6.2. Soils :
Soils of all sorts, silt, sand, gravel, soft murrum, stiff clay, kunkar and other soft excavation not covered in the items mentioned hereunder.
 - 6.3. Hard Murrum :
Hard Materials comprising of all kinds of disintegrated rock or shale or indurate conglomerate interspersed with boulders, weathered and decomposed rock which could be removed with pick, bar, shove, wedges and hammers, though not without some difficulties.
 - 6.4. Soft – Rock:
This shall include all materials which is rock but which does not need blasting and can be removed with a pick bar, wedges, pavement breakers, pneumatic tools etc.
 - 6.5. Hard Rock:
This shall include rock accusing in mass or boulders which need blasting, this will also include rock to be removed by chiseling or any other method where blasting is not permissible.
- 7. The rates are inclusive of dewatering, if required.
 - 8. Regarding water supply for hydro testing, necessary water, power, labour, etc. required for necessary test shall be arranged by the contractor at his own cost.
 - 9. During construction activity, proper care must be taken for labour safety and must follow the provisions of the Labour laws.

- 10.** TMT bars of Fe-415/500 should be confirming to IS:1786. The approved makes shall be TATA, SAIL, Vizag, Gallent, Electrotherm or other equivalent make as approved by engineer-in-charge.
- 11.** Cement shall be ordinary Portland cement conforming to IS:269, IS:8112 or IS:12269 for all the works as per the instructions of engineer-in-charge. The approved makes shall be Ambuja, Ultratect, LOTUS, Siddhi, Sanghi, Hathi or as per IS confirming.
- 12.** Minimum Cement content for the work should be as per attached circular No.GMC/C/Vigi.(Tech)/231 dt. 11/03/2022.
- 13.** Testing of the materials like Brick, Sand, Aggregate, Reinforcement steel, etc. should have to be tested periodically as suggested by the Engineer-in-charge at Government approved material testing Laboratory and testing charges for the same has to be borne by the contractor.
- 14.** In case of any ambiguity found in inspections / drawings etc, the decision of engineer-in-charge shall be final and binding to the contractor.

DETAILED SPECIFICATIONS OF MATERIALS

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 in R.C.C.. The container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S. 456-2000 (latest revision).
- 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 Sulphate Resistant Cement conforming to IS : 12330, Ordinary portland cement as per I.S. 269-1976 or Portland slag cement as per I.S.455-1976.
- 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	IS Sieve Designation	by weight percentage passing sieve.
4.75 mm	100	600 Micron	30-100
2.36 mm	90 to 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 sieve	IS Sieve Designation	by weight percentage passing 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	IS Sieve Designation	percentage pass- ing through sieve
12.50 mm	100%	4.75 mm	0-20%
10.00 mm	85-100%	2.36 mm	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 approve Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However in case of reinforced cement concrete the maximum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars or 6 mm. less than the cover whichever is smaller.

TABLE

I S Sieve designa- tion	Percentage passing for single sized aggregates of nominal size			IS Sieve desig- nation	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 mm	0.5	--	0.30
40 mm	85-100	100	--	4.75 mm	--	0.20	0.5
20 mm	0-20	85-100	100	2.35 mm	--	0.50	--
16 mm			8-100	--	--	--	--

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 change 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 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 approve 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 CEMENT MORTAR:

6.1 Water shall conform to specification M-1. Cement shall confirm to specification M-2, sand shall confirm to M-3.

6.2 Proportion of Mix :

6.2.1 cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50 Kg/bag of cement being equal to 0.0342 cum. The mortar may be hand mixed or machine mixed as directed

6.3 Preparation of Mortar:

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

6.3.2 The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

M-7 BRICK BATS AGGREGATE :

- 7.1 Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense brick. It shall be homogeneous in texture roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm to 50 mm size unless otherwise specified in the item. The underburnt or overburnt brick bats shall not be allowed
- 7.2 The brick bats shall be measured by volume by suitable boxes or as directed

M-8 BRICKS :

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

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

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

- 8.3 The size of the conventional bricks shall be as under :

(9" x 4.3/8" x 2,3/4") 225 x 110 x 75 mm

- 8.4 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)

- 8.5 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-8A 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 be used on one work. The following tolerances shall be 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-9 MILD STEEL BARS :

- 9.1 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.
- 9.2 All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose of thick rust at the time of placing.
- 9.3 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-10 TMT FE-500 STEEL BARS FOR REINFORCEMENT :

- 10.1 Reinforcement bars shall conform to IS-432, IS-226 or IS-1786 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 bon

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

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

M-11 MILD STEEL BINDING WIRE :

- 11.1 The mild steel wire size and quality shall conform to I.S. 280-1972.
- 11.2 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-12 STRUCTURAL STEEL :

- 12.1 All structural steel conform to I.S.226 - 1975. 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.
- 12.2 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-13 SHUTTERING :

- 13.1 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 bullies properly cross braced together so as to make the centering rigid. In places of bulgie props, brick pillar of adequate section built in mud mortar may be used.
- 13.2 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.
- 13.3 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.
- 13.4 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.
- 13.5 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.
- 13.6 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.
- 13.7 As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.

- 13.8 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.
- 13.9 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-14 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.

DETAIL TECHNICAL SPECIFICATIONS

DRAINAGE DISTRIBUTION NETWORK

Item No. 1:

Excavation for pipe line trenches etc. for all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. (Pipe & Manhole)

Excavation of trench for Pipes in Soft Murrum / Clay / Sand and Hard Murrum with all safety Provisions (with re-filling of trench) for depth from 0.0 to 1.5 mtr (Taking quantity of 50% in 0.0 to 1.5 mtr depth)

And

Excavation of trench for Pipes in Soft Rock and Hard Rock using Breaker /blasting / Chiezale / Hammer with all safety Provisions (with re-filling of trench) for depth from 0.0 to 1.5 mtr (Taking quantity of 50% in 0.0 to 1.5 mtr depth)

And

Excavation of trench for Pipes in Soft Murrum / Clay / Sand and Hard Murrum with all safety Provisions (with re-filling of trench) for depth from 1.51 to 3.0 mtr (Taking quantity of 20% in 1.51 to 3.0 mtr depth)

And

Excavation of trench for Pipes in Soft Rock and Hard Rock using Breaker /blasting / Chiezale / Hammer with all safety Provisions (with re-filling of trench) for depth from 1.51 to 3.0 mtr ((Taking quantity of 80% in 1.51 to 3.0 mtr depth)

And For

3.0 to 4.5 m. depth,

4.5 to 6.0 m. depth,

6.0 to 7.5 m. depth,

7.5 to 9.0 m. depth

Excavation for pipe line trenches with shoring, strutting, bailing or pumping out watered from trenches whenever necessary of required length, width and depth including extra excavations for sockets and all safety measures and provisions such as site rails fencing, lighting, watching including refilling the trenches in layers including ramming and removing the excavated staff with 90m lead and clearing the site etc. as stipulated in the tender specification complete before starting work and after completion of work for all lifts and soil strata as specified

- a) Excavation of Foundation in Soft Murrum and Hard Murrum, Soil or Sand
- b) Excavation of Foundation in Soft Rock and Hard Rock
- c) Excavation of Foundation in Soft Murrum and Hard Murrum
- d) Excavation of Foundation in Soft Rock and Hard Rock with Breaker / Blasting / Gann
- e) Excavation of Foundation in Soft Rock and Hard Rock with Breaker / Blasting / Gann
- f) Excavation of Foundation in Hard Rock with Breaker / Blasting / Gann
- g) Excavation of Foundation in Hard Rock with Breaker / Blasting / Gann
- h) Excavation of Foundation in Hard Rock with Breaker / Blasting / Gann

1.1 Clearing of sites :

- 1.1.1 The site at which the pipe line is to laid and the area required for setting out and other operations shall be cleared of all obstructions , loose stones, and rubbish of all kinds ; stumps of trees, brushwood as well as all trees shall be removed as directed. The roots shall be entirely grubbed up.
- 1.1.2 The products of the clearings to be stacked in such a place and in such a manner. As directed by the Engineer-in-charge.
- 1.1.3 In site clearing, all trees not specially marked for preservation, bamboos jungle wood and brush wood shall be cut down and their roots grubbed up. All wood and materials from the clearing shall be the property of corporation and shall be arranged as directed by the Engineer-in-charge or his authorized agent. The materials found to be useful by the Engineer-in-charge shall be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed
- 1.1.4 All holes or hollows, whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well rammed and leveled off, as may be directed shall not be paid for. The contractor shall get approval of design of shoring. The shoring shall be of sufficient strength to resist side pressure and ensure safety from slips and blows and to prevent damage to work and property and injury to persons. It shall be removed as directed after all the items of work for which it is required are complete

1.1.5 Protection:

- 1.1.5.1 The foundation pits and trenches, etc shall be strongly fenced and red light Signals shall be kept at night in charge of watch- man to prevent accidents. Sufficient care and protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structures. 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, the contractor at his own cost shall provide caution boards etc.

1.6 Classification of Strata :

- 1.6.1 The decision regarding classification of strata shall rest with the Engineer-in- Charge and his decision shall be final and binding to the contractor.
- 1.6.2 All the materials encountered in the excavation shall be classified as described in 2.0 of general specifications.

1.7 Dewatering :

- 1.7.1 Unless specially provided for as a separate item in the contract, the rate of excavation would include bailing or pumping out all water met with in excavation or which may accumulate in the excavation during the progress of the work either, by percolation, seepage, springs , rain or any other cause and diverting surface flow if any, by earthen bunds or by other means. The bunds shall be

removed as soon as the work is complete

- 1.7.2 Unless specially provided as a separate item of contract, pumping of water from foundation pit, trenches etc shall be carried out by the contractor at his won cost and he shall arrange for required numbers of dewatering pumping sets for the above work. He shall take precaution to prevent any damage to the foundation trenches, concrete or masonry or any adjacent structure. The excavation shall be kept free from water by the contractor (1) during inspection and measurement (2) When concrete and/or masonry work are in progress and till the construction work reaches above the natural water level and (3) till the Engineer – in – charge considers that the mortar is sufficiently set. The rate shall be paid for cum. of excavation.

1.8 Excavation in Rock :

1.8.1 Blasting with Gun Power:

Blasting operations shall be carried out with the prior permission and in the presence of the Engineer – in – charge or his authorized representative and during fixed time hours of the day. All safety precautions such as providing safety nylon netting etc. shall be carried out as per instructions of the Engineer – in – charge.

Red danger flags shall be prominently displayed and all the people, except those who have actually to light the fuse must be away to a safe distance, not less than 200 meters.

All fuses shall be cut to the length required before being inserted into the holes.

The number of charges to be fired and the actual number of shots heard shall be compared and the person responsible must satisfy himself by examination that all the charges have exploded before work people are permitted to approach the scene. The withdrawal of a charge which has not exploded shall under no circumstances be permitted, but the tamping and charge shall be flooded with water and the hole marked in a distinguishing manner. The next hole to be fired shall be at a distance of about 500mm from the old hole and fired in the usual way.

The contractor or any of his competent authorized person shall be in charge of the blasting operations and shall be held responsible for strictly observing the safety rules, particularly applicable to blasting operations, in addition to other safety rules.

In blasting rocks with dynamite, the following general principles shall be observe In general, the following diameter of drills shall be used for different depth of boreholes:

- From 1 – 2 metres 25 mm diameter
- From 2 – 3 metres 37 – 50 mm diameter
- From 3 – 4.75 metres 50 – 60 mm diameter

The borehole should generally be not more than 1.3m deep and the distance apart should be from one and half to twice the depth.

Cracks and fissures in the rock to be blasted shall be carefully studied to ascertain the best portion for the boreholes. Charges shall always be placed in a round piece of rock, if possible not nearer than 30mm from the crack.

Rules for blasting with dynamite and other high explosives

The person - in- charge must show that he is thoroughly acquainted with all blasting operations and that he understands the rules herewith laid down. He will be held responsible for any accident that may occur.

Boreholes must be of such sizes that the cartridge can easily pass down them. The position of all holes to be drilled must be marked out with white paint and the person - in - charge must take particular note of these positions.

The drilling operation being finished, the person - in - charge must make a second inspection and satisfy himself that the boreholes marked out by him have been drilled. The person - in - charge must prepare all charges necessary for boreholes.

Only ten holes may be loaded and fixed at one time and the charges should be fixed simultaneously as far as practicable. Boreholes must be thoroughly cleared before a cartridge is inserted.

The loading is to be done by the person - in - charge himself and the position of the charge holes carefully noted by him. Wooden tamping rods only to be used in charging holes (not pointed but cylindrical throughout, one cartridge at a time must be inserted and gently pressed with the tamping rod).

Immediately before firing blast, due warning must be given and the person - in - charge must see that all the labourers have retired to safety.

The safety fuse of the charged holes are to be lighted in the presence of the person - in- charge, who must see that the fuses of the holes charged have properly ignited. After the blast, the person - in - charge must carefully inspect the work and satisfy himself that all the charges have exploded.

1.8.2 Misfires:

Misfires are a source of great danger, if it is suspected that part of the blast failed to fire or is delayed, allow sufficient time to elapse before entering the danger zone. When fuse and blasting caps are used, a safe time, at least of an hour should be allowed.

None of the drillers are to work near this hole until the two following separations have been done by the person - in - charge.

(a) The person - in - charge should very carefully extract the tamping with a wooden scrapper and withdraw the fuse with the primer and detonator attached, after which a fresh primer and detonator with fuse should be placed in this hole and fired or.

The hole may be cleared of 300mm of tamping and the direction then

ascertained by placing a stick in the hole. Another hole may then be drilled 150mm away and parallel to it, the hole to be then charged and fire. The person – in – charge shall also at once report to the Engineer – in charge all cases of misfire, that cause of the same and what steps have been taken in connection herewith.

Precautions against misfire:

The safety fuse should be cut in an oblique direction with a knife.

All saw dust must be cleared from the inside of the detonator this can be done by blowing down the detonator and tapping the open end. No instruments shall be inserted into the detonator for this purpose.

After inserting the fuse in the detonator, it shall be fixed by means of nippers.

If there is water present, or if the boreholes be damp, the junction of the fuse and detonator must be made water tight by means of grease, white or lead

The detonator should be inserted into the cartridge, so that about one third of the copper tube is left exposed outside the explosives. The safety fuse outside the detonator, should be necessarily tied in position in the cartridge. Water proof fuse only to be used in the damp bore holes, or when water is present in the bore-holes.

If a misfire has been found to be due to defective fuse detonator or dynamite, the whole quantity or box from which the defective article was used shall be rejected.

Storage of materials for blasting shall be as per regulations/stipulations of the concerned authorities.

It shall be the contractor's responsibilities to arrange proper storage of explosives and obtain required permission from concerned authorities. No separate payment will be made for the above.

The refilling will generally refer to refilling of trenches up to ground level with excavated stuff. Filling materials shall be from excavated stuff.

Excavated stuff to be used shall be cleared of all rubbish, large size stones, brick bats etc. Big clods shall be broken down to a size of 50 mm or less.

Refilling :

After the pipes have been laid and jointed and the chambers are constructed and as soon as the joints have been inspected and passed by the Engineer-in-charge, the pipe line has been tested for water tightness, and after all concrete work thoroughly set the trenches shall be fulfilled with the materials taken there from. In refilling the trenches, the utmost care shall be exercised so as not to disturb, break or damage the jointed pipes. Over and around every pipe, the finest selected material shall be put. No lumps of rock earth or other material around the pipe or be thrown into the trenches until the same has been broken to specified size and pipes covered by the fine material above referred to. The selected fine materials shall be carefully placed next to the permanent work and well packed and well rammed

in layers of 150mm for a depth of at least 300mm over the top of the pipe. The remaining of the excavation shall be filled in with the best and most suitable portions of the excavated material in layers of not more than 600 mm deep, each layer shall be thoroughly rammed before the next layer is place One man shall be employed for hand ramming for every 30m of refilling up to the level of 300mm over the top of the pipe. Surplus soil shall be piled on top of the filling to the extent possible for expected subsidence. All road materials to from a compact neat surface. The surface of the filled in trench shall be hand rolled by a hand roller weighing not less the ½ tones as directed by the Engineer- in-charge.

The contractor shall maintain all refilling and surfaces until reinstate The contractor shall responsible for claims arising from accidents due to subsidence or inadequate maintenance or improperly refilling work.

The contractor s hall be responsible for any settlement during the defects liability period including monsoon and the same shall be refilled with stuff brought from outside, if necessary.

Where excavated material is not considered suitable for refilling by the Engineer-in-charge, the Contractor will be required to cart selected surplus excavated materials in place of unsuitable materials. The contractor may also be instructed to supply suitable granular or other hard filling material for use in refilling. Such imported filling material s hall be paid for at the rates given in the Bill of quantities.

No payment shall be made for carting away surplus material arising either because of rejection of excavated material for refilling or because of surplus material.

Measurement:

The contractor's shall be for the **unit of one cubic meter** of the quantity excavated limited to the dimensions and provisions specified in the specifications or as directed by the Engineer-in- charge. The extra excavation to provide for jointing pipes, shoring etc. will not be paid for. The rates shall include cleaning and clearing the trench site by cutting grass, shrubs and trees of girth (circumference) not exceeding 10 feet and removing their obstructing roots in the trench cleaning the site, setting out works as per sanctioned plans, provide shoring, excavation and removal of all material from trenches.

(a) Excavations up to depth of 1.5M

The trench section is to be provided with Max. width OD of pipe + 250 mm to 300mm either sides. Depth of trench shall be minimum Bedding + OD of pipe + 0.60mt. cover above the top of pipe. (For 100mm dia. pipe). Depth of trench shall be minimum Bedding + OD of pipe + 1.0mt. cover. above the top of pipe. (For Other dia. pipe).

Refilling the pipeline trenches including ramming, watering, consolidating disposal of surplus staff as directed within a radius of 3km

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches.

Pipe laying shall closely follow the progress of Trench Excavation and the Contractor shall not permit unreasonably

excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Engineer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. The excavated material nearest to the trench shall be used filling. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline unless the trench has been filled to height of at least 30cm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench may be filled in with a mixture of hard and soft material free from boulders and clods of earth larger than 150mm in size if sufficient quantity of good earth and murrum are not available. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The top 300mm layer or fertile agricultural soil shall be kept aside during excavation and shall be laid in layers near ground level during refilling.

To prevent buckling of pipe shell of diameters 1200mm and above, pipes shall be strutted from inside while the work of refilling is in progress, for which no separate payment shall be made.

Strutting shall be done by means of strong spiders having at least 6 arms which shall be sufficiently stiff to resist all deformation. Spiders shall be provided at a maximum interval of 2m & shall be welded in such a way that internal coating does not get burnt.

The Engineer shall, at all times, have powers to decide which portion of the excavated materials shall be for filling and in which portion of the site and in what manner it shall be so use

If any material remains as surplus it shall be disposed of as directed by the Engineer, which includes loading, unloading, transporting and spreading as directed within all lea If the Contractor fails to remove the earth from site within 7 days after the period specified in a written notice, the Engineer may arrange to carry out such work at the Contractor's risk and cost or may impose such fine for such omission as he may deem fit. Particular care shall be taken to keep the trench dry during the entire refilling operation.

If suitable material for refilling is not available for excavation the Contractor shall bring earth, murrum of approved quality as directed by the Engineer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval of the Engineer has been obtained Subsidence in filling in : Should any subsidence take place either in the filling of the trenches or near about it during the maintenance period of 24 months from the completion of the Contract Works, the Contractor shall make good the same at his own cost or the Engineer may without notice to the Contractor, make good the same in any way and with any material that he may think proper, at the expense of the Contractor. The Engineer may also, if he anticipates occurrence of any subsidence, employ persons to give him timely notice of the necessity of making good the same, and the expenses on this account shall be charged to the Contractor.

Item No.2:

Providing Bedding for RCC Pipe including ramming, watering, levelling, consolidating, grading etc. complete. (from selected excavated material):

Murum to be used from selected excavated stuff./Murum

Specifications :

Any inherent material like Big clods, tress roots, weeds, big metals and other objectionable material liable to decay shall not be used in the bedding.

The bedding shall be placed uniformly with minimum thickness of 150 mm along the route of the excavated pipe trench as directed by the Engineer-in-charge. The bedding surface shall be smooth without any humps, depressions etc.

The work under this item shall consist of providing and preparing a suitable bedding for laying of reinforced cement concrete (RCC) pipes of all classes and diameters as shown on the approved drawings or as directed by the Engineer-in-Charge. The bedding shall be prepared to the required line, level, and gradient to ensure uniform support along the entire length of the pipeline and to prevent any point loading or differential settlement. The type of bedding—whether in selected earth, sand, granular material, or concrete—shall be as specified in the drawings or in the Bill of Quantities.

The foundation of the trench shall be properly trimmed, leveled, and dressed to the required grade before placement of bedding material. The bedding material shall then be spread in layers not exceeding 150 mm in thickness, uniformly rammed, watered, and consolidated to achieve a dense, firm, and stable surface. Care shall be taken to maintain the designed gradient of the pipeline and to ensure that the bedding provides continuous and uniform support to the barrel of the pipe. Under no circumstances shall the pipe rest unevenly or be supported on projections or un-compacted materials.

Where directed, the bedding shall be prepared using sand, fine murum, or selected granular material free from organic matter, roots, clay lumps, or other deleterious substances. The material shall be placed, leveled, watered, and compacted in layers to obtain the required thickness and density. In case of concrete bedding, plain cement concrete of specified mix (normally M-10 or 1:3:6 proportion) shall be laid to the required thickness and finished to a smooth surface, ensuring uniform contact with the pipe. The finished surface shall be checked with templates and site rails to confirm line and level prior to pipe laying.

The rate for this item shall include the cost of all labour, tools, plants, and materials required for preparing the bedding, including excavation or trimming of the trench bottom, supplying and placing of bedding material, watering, ramming, compacting, leveling, grading, finishing, and all incidental operations necessary for completing the work as per drawings and instructions of the Engineer-in-Charge. All work shall be carried out in accordance with **IS 783: Code of Practice for Laying of Concrete Pipes, IS 458: Specifications for Precast Concrete Pipes (with or without Reinforcement), and IS 1200 (Part 1)** or their latest revisions.

Mode of Measurement :

Measurement for payment shall be made in **cubic meters (m³)** of bedding material actually provided and accepted by the Engineer-in-Charge, measured to the specified dimensions of thickness and width under the laid pipes. The work shall be executed in a sound, workmanlike manner ensuring true alignment, uniform support, and stability of the pipeline throughout its length.

Item No.3 & 4:

Providing, Supplying, Lowering, Laying, and jointing RCC pipes in CM 1:1:1/2 of following diameters in proper position, grade and alignment at all level as directed by Engineer in charge including conveyance from stores to site of work, labour, giving hydraulic testing as per IS code. As per ISI Standard R.C.C. pipes(of Sulphate Resisting Cement) in standard lengths of following

class and diameter suitable for either collar joints or rubber ring joints including all taxes, Insurance, transportation. freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. Note: One collar should be supplied with each full length plain ended RCC pipe, cost included in rates below. NOTE :One rubber ring should be supplied with each full length socketed pipe, cost included in rates below.

Note : One collar should be supplied with each full length plain ended RCC pipe, cost included in rates below. One rubber ring should be supplied with each full length socketed pipe, cost included in rates below.

RCC NP3 200 Dia. Pipe
RCC NP3 250 Dia. Pipe
RCC NP3 300 Dia. Pipe
RCC NP3 350 Dia. Pipe

RCC NP4 450 Dia. Pipe
RCC NP4 600 Dia. Pipe

Supply of RCC Pipes:

For supply of RCC pipes ,all the specifications mentioned in the IS Code458:2003 and its latest revised edition shall be followed. This standard covers the requirements for reinforced precast cement concrete pipe.

Testing of RCC Pipes:

For testing of RCC pipes, all specifications mentioned in IS Code 3597:1998 and its latest revised editions shall be followed.

The work under this item shall consist of providing, manufacturing, testing, and supplying **Reinforced Cement Concrete (R.C.C.) pipes of NP-3 & NP-4 Class**, manufactured using **Ordinary Portland Cement (OPC)**, conforming in all respects to the requirements of **IS: 458-2021 – Precast Concrete Pipes (with and without Reinforcement)** and suitable for **rubber ring (spigot and socket type) joints**.

The R.C.C. pipes shall be of standard length and diameter as specified in the Bill of Quantities and shall bear the **ISI certification mark**, indicating conformity to the above standard. The pipes shall be true to shape, perfectly circular in cross-section, and free from manufacturing defects such as cracks, honeycombing, uneven surfaces, or distortions. Both the internal and external surfaces shall be smooth, dense, and impervious, providing a uniform finish throughout.

Each pipe shall be manufactured by centrifugal spinning or vertical vibration compaction process using high-quality raw materials — Ordinary Portland Cement (OPC) conforming to IS: 269 or IS: 1489, clean well-graded aggregates, and high-tensile steel reinforcement conforming to IS: 1786. The reinforcement shall be of adequate size, spacing, and configuration to ensure the required strength and durability. The concrete used shall achieve a minimum compressive strength of **M-40 grade or higher**, as required by the class of pipe.

The pipes shall be designed for the specified working pressure and test pressure in accordance with IS: 458-2021, and shall be capable of withstanding the specified **hydrostatic test pressure, three-edge bearing test, and permeability test** as prescribed in the code. The jointing ends shall be of **spigot and socket type**, designed to accommodate a rubber ring joint to provide a flexible and watertight connection. The rubber rings shall conform to **IS: 5382 – Rubber Sealing Rings for Gas and Water Mains**, and shall be supplied along with the pipes by the manufacturer.

All pipes shall be tested at the manufacturer's works before dispatch, under the supervision of the inspecting authority or third-party inspection agency as directed by the Engineer-in-Charge. The manufacturer shall furnish test certificates for each batch of pipes, indicating

compliance with IS: 458–2021 requirements. The pipes shall be clearly marked with the manufacturer's name, class, size, date of manufacture, ISI mark, and direction of laying.

The Contractor shall be responsible for arranging inspection, testing, and certification at the manufacturer's premises, including all associated charges, travel expenses, and coordination as required. After inspection and approval, the pipes shall be properly loaded, transported, and unloaded at site or departmental stores using suitable mechanical means to avoid damage. Stacking at site shall be done on firm, level ground with timber supports, ensuring no direct contact between socket and spigot ends to prevent chipping or cracking. The Contractor shall provide adequate insurance coverage for the materials during transit, unloading, and storage until final acceptance.

The rate quoted for this item shall include the cost of **manufacture, inspection, testing, ISI certification, rubber rings, loading, unloading, stacking, transportation, transit insurance, all taxes, duties, octroi, and all other incidental charges** necessary to complete the supply of pipes in all respects as per the direction of the Engineer-in-Charge. No extra payment shall be made for damages, breakages, or rejections during transit or handling.

Measurement for payment shall be made in **running meters (RM)** of pipes of specified diameter and class, actually supplied and accepted by the Engineer-in-Charge, measured along the centerline of the pipe. Only those pipes that bear a valid ISI mark and conform fully to IS: 458–2021 shall be accepted for payment.

The work shall be carried out in accordance with the provisions of **IS: 458–2021, IS: 5382, and IS: 784 (for laying of concrete pressure pipes)** and to the satisfaction of the Engineer-in-Charge.

The work under this item shall consist of **lowering, laying, aligning, and jointing reinforced cement concrete (R.C.C.) pipes of NP–3 & NP–4 class**, of the specified diameters, in proper position, grade, and alignment at all levels, as shown on the approved drawings and as directed by the Engineer-in-Charge. The work shall include the conveyance of pipes from departmental stores to the site of work, handling, loading, unloading, laying, jointing, and testing of the pipeline as per relevant Indian Standards, complete in all respects.

The R.C.C. pipes shall conform in all respects to **IS: 458–2021 (Precast Concrete Pipes with or without Reinforcement)** and shall be of **spigot and socket type**, suitable for **rubber ring joints** unless otherwise specified. The pipes shall be ISI-marked, sound, and free from cracks, honeycombing, or other defects. The rubber rings used for jointing shall conform to **IS: 5382 (Rubber Sealing Rings for Gas and Water Mains)**, of approved make and quality, and shall be supplied along with the pipes by the manufacturer.

The Contractor shall transport the pipes carefully from the stores to the site using mechanical means, ensuring no damage during handling or transit. Proper lifting equipment, slings, or cranes shall be used for lowering the pipes into the trench. Pipes shall not be dropped, rolled, or dragged along the ground. The trench shall be prepared and the bedding checked and approved before laying. Each pipe shall be laid true to line and level, with the socket end facing uphill or in the direction of flow. Site rails and boning rods shall be used to maintain uniform alignment and gradient.

Jointing shall be done as per the manufacturer's recommendations and the provisions of IS: 783 (Code of Practice for Laying of Concrete Pipes). Before jointing, the spigot and socket surfaces shall be cleaned thoroughly and lubricated with approved rubber lubricant. The rubber ring shall be placed evenly in the groove of the socket and compressed uniformly when the spigot end is inserted to ensure a watertight and flexible joint. Special care shall be taken to prevent displacement or twisting of the rubber ring during insertion. Each joint shall be checked visually for alignment, gap uniformity, and proper seating of the ring.

After laying and jointing, the pipeline shall be subjected to **hydraulic testing** as per IS: 5329 (Testing of Concrete Pipes) or as directed by the Engineer-in-Charge. The test shall be carried out by plugging both ends of the section and filling the pipeline with water under the specified pressure. The section shall be inspected for visible leaks or pressure drops, and any defective joint or pipe shall be repaired or replaced at the Contractor's cost. Testing shall continue until

satisfactory results are achieved and approved by the Engineer-in-Charge.

The rate for this item shall be inclusive of the cost of all labour, tools, plants, materials, equipment, and operations required for the complete work including handling, transportation from stores to site, unloading, lowering, laying, aligning, jointing with rubber rings and lubricant, hydraulic testing, and making good any leaks or defects. The rate shall also include all incidental works such as dewatering (if required), cleaning of pipes, removal of debris, and safety precautions during execution. No separate payment shall be made for testing, jointing materials, or dewatering as these are deemed to be included in the quoted rate.

Measurement for payment shall be made in **running meters (RM)** of the R.C.C. pipeline of the specified diameter and class, actually laid, jointed, tested, and accepted by the Engineer-in-Charge. The work shall conform to the requirements of **IS: 458-2021, IS: 5382, IS: 783, and IS: 5329**, and shall be completed in a sound and workmanlike manner to the full satisfaction of the Engineer-in-Charge.

Item No.5

Providing and supplying in standard length ISI mark rigid unplasticized PVC pipes suitable for potable water with ring fit joint including cost of rings, as per IS specification no. 4985/1988 including all local and central taxes, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to the departmental stores and including cost of jointing material etc. complete.

Note :

1. One coupler / ring shall be provided with each full length pipe cost of which is included in rates below.

2. 3% (Three) Discounted rate to be consider for Coupler jointed pipe

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Item No.6

Lowering, laying, fixing and jointing PVC/uPVC/cPVC pipes and specials of following class and diameter including cost of conveyance from stores to site of works including cost of labour, material, cement solvent, giving satisfactory hydraulic testing as per ISI code.

FOR 110MM DIA. 6 KG PIPE

Material

The low density polythene pipe of specified diameter with 6 kg/sq.cm working pressure shall conform to IS: 3076-Latest Edition. The specifically s and fittings required shall be of best quality.

Workmanship

The PVC pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid PVC pipes, due allowance shall be made particularly in over ground pipelines for any change in length of pipeline which may occur during installation or when pipeline is in service. Above ground installation of rigid PVC pipe should be undertaken after preparations are observed for their protection against direct sun rays and mechanical damage.

The rigid PVC pipe lines should not be kept exposed above ground when it passes through public places, railway lines, road side and footpaths.

PVC pipes shall be supported at the following intervals. 20 mm dia. 500 mm, 25 mm dia. 750 mm, 32 mm dia. 900 mm. Close support spacing shall be provided if recommended by the manufacturer. The guidelines indicated by the manufacturer regarding handling,

transportation, storing, laying and jointing of pipes shall be kept in view during execution. PVC pipes shall be fixed on wall with wooden plugs and suitable plastic clamp.

Jointing the Pipes:

The pipes and sockets shall be accurately cut. The ends of the pipes and fittings should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement joint. Since solvent cement is aggressive to PVC care must be taken to avoid applying excessive cement to the inside of pipe sockets as any surplus cement cannot be wiped off after jointing. Empty solvent cement tins, brushes, rags, or paper unpronated with cement should not be buried in the trenches. They should be gathered not left scattered about, as they can prove to be a hazard to animals, which may chew them.

If any manufacturer recommends its own methods of jointing the same shall be adopted after necessary approval from the engineer-in-charge.

Laying of pipes in trenches:

The pipes shall be laid over uniform relatively soft fine-grained soil found to be free of presence of hard objects such as large flints, rocky projections, large tree roots etc. The width of the trenches shall be minimum width required for working.

The pipes laid underground shall not be less than one meter from the ground level. They pipe shall be positioned in the trenches so as to avoid any induced stressed due to deflection. Any deviation required shall be obtained by using proper type of rubber ring joints.

Item No.7: Sewer Manholes

Providing and constructing Sewer Machinehole as per the type design in brick masonry in C.M. 1 : 5 and inside and outside 20 mm thick plastering in C.M. 1:3 necessary 100 mm coping with reinforcement in R.C.C. M 200, providing and fixing P.V.C steps and fixing Machinehole frame and covers (But excluding supply of Machinehole frame and covers) over Machinehole etc. complete, providing and fixing safety chain wherever necessary as per the stipulations in the type design complete as per latest CPHEEO manual. (excl. excavation)

A Machinehole type "A" circular type having inside diameter of 1200 mm for depth upto 1.5 m depth (For 150 mm to 500 mm dia sewer)

B Machinehole type "B" circular type having inside diameter of 1500 mm and for depth from 1.5 m to 4.0 mt. (For 150 mm to 600 mm dia sewer)

C Machinehole type "C" circular type having inside diameter of 1500 mm and for depth beyond 4.0 m to 6.0 mt. (For 150 mm to 1800 mm dia sewer)

D Machinehole type "D1" circular type having inside diameter of 1500 mm and for depth beyond 6.0 m to 10.0 mt. (For 150 mm to 500 mm dia sewer)

The work comprises construction of circular brick-masonry sewer manholes to approved type designs A1, A, B, C, D1, D2, and D3, executed in cement mortar 1:5 with 20 mm thick internal and external plaster in cement mortar 1:3, formation of bench and channel in CC 1:2:4 (or M-20 as shown on drawings), provision of 100 mm thick RCC M-20 coping with reinforcement as detailed, ISI-marked encapsulated PVC footrests fixed at 300 mm vertical spacing (first step 450 mm below cover level), hot-dip galvanized 8 mm safety chain wherever required, and fixing (excluding supply) of DI/CI manhole frames and covers conforming to IS 1726 with rigid seating on RCC coping. Manhole internal diameters and depth ranges shall be as follows: Type A1—ID 900 mm for depths up to 1.0 m (sewers 150–500 mm); Type A—ID 1200 mm for depths up to 1.5 m (sewers 150–500

mm); Type B—ID 1500 mm for depths 1.5–4.0 m (sewers 150–600 mm); Type C—ID 1500 mm for depths >4.0–6.0 m (sewers 150–1800 mm); Type D1—ID 1500 mm for depths >6.0–10.0 m (sewers 150–500 mm); Type D2—ID ≥ 1500 mm for depths >6.0–10.0 m (sewers 600–1000 mm); Type D3—ID ≥ 1900 mm for depths >6.0–10.0 m (sewers 1100–1800 mm). Masonry shall be true to line, level, and plumb; joints shall not exceed 10 mm; plaster shall be dense, even, and watertight. The bench shall be trowel-smooth with a 1:12 fall to the channel; the channel shall match pipe diameter and invert levels without lips. Frames and covers shall be fixed level with the finished surface, bedded in rich mortar or seating concrete, and grouted to eliminate rocking. All concrete and masonry shall be cured for not less than seven days (or as per IS 456). Dimensional tolerances shall limit verticality deviation to ≤ 10 mm per metre (max 20 mm overall), and internal diameters and depths to ± 10 mm unless otherwise specified. Works shall comply with the CPHEEO Manual (latest) and relevant IS codes (IS 456, IS 1077, IS 1786, IS 383, IS 8112/12269, IS 516, IS 1726, and applicable parts of IS 2720 and IS 3764 for safety). Measurement shall be per number of completed manholes by type, inclusive of all materials, labour, RCC coping, bench and channel, plastering, PVC steps, safety chain, and fixing of frames and covers; excavation, dewatering, shoring, backfilling, disposal, and the **supply** of frames and covers are excluded and paid under separate items. Prior to execution, the contractor shall submit type drawings (including bar-bending and setting details), product data for footrests/frames/covers/safety chain, and a method statement covering sequence, QA/QC, curing, and confined-space safety.

Point-Wise (Numbered) Format

1. **Scope & Compliance:** Construct circular brick-masonry sewer manholes (Types A1, A, B, C, D1, D2, D3) per approved drawings, CPHEEO (latest), and relevant IS codes; excavation/backfill measured separately.
2. **Manhole Sizes:**
 - A1—ID 900 mm, depth ≤ 1.0 m (sewer 150–500 mm) • A—ID 1200 mm, depth ≤ 1.5 m (150–500 mm) • B—ID 1500 mm, depth 1.5–4.0 m (150–600 mm) • C—ID 1500 mm, depth >4.0–6.0 m (150–1800 mm) • D1—ID 1500 mm, depth >6.0–10.0 m (150–500 mm)
 - D2—ID ≥ 1500 mm, depth >6.0–10.0 m (600–1000 mm) • D3—ID ≥ 1900 mm, depth >6.0–10.0 m (1100–1800 mm).
3. **Materials:** Bricks to IS 1077; OPC 43/53 (IS 8112/12269); aggregates/sand to IS 383; steel Fe-500 (IS 1786); frames and covers DI/CI to IS 1726 (heavy duty where trafficable).
4. **Masonry & Plaster:** Brickwork in CM 1:5; joints ≤ 10 mm; 20 mm plaster inside and outside in CM 1:3; smooth, dense, watertight finish.
5. **RCC Coping:** 100 mm thick M-20 with reinforcement as per drawings; frames/covers fixed on coping in rich mortar/seating concrete; levels flush with finished surface and fully grouted.
6. **Bench & Channel:** Channel in CC 1:2:4 (or M-20) matched to pipe dia and invert; bench both sides with 1:12 slope to channel; smooth trowel finish; no lips.
7. **Footrests & Safety:** ISI-marked encapsulated PVC steps at 300 mm vertical spacing (first at 450 mm below cover); embed ≥ 75 mm; provide 8 mm galvanized safety chain where required by depth or as directed.
8. **Curing & Tolerances:** Cure concrete/masonry ≥ 7 days; verticality deviation ≤ 10 mm/m (max 20 mm overall); ID and depth within ± 10 mm unless noted.
9. **Quality Control:** Approvals for materials; concrete cubes (IS 456/IS 516); mortar control; plaster thickness/evenness checks; verification of step spacing/anchorage; dimensional checks; inspection before cover fixing and after installation.
10. **Safety:** Confined-space procedures per IS 3764 and statutory norms; gas testing/ventilation; barricades, signage, and lighting until handover.
11. **Submittals:** Type drawings with bar-bend/setting details; product data for

footrests/frames/covers/safety chain; method statement for sequence, QA/QC, curing, and safety.

12. **Measurement & Payment:** Unit—Each manhole by type, complete including RCC coping, bench/channel, plaster, PVC steps, safety chain, and fixing of frames/covers. Exclusions—excavation, dewatering, shoring, backfill/disposal, and **supply** of frames/covers, payable under separate items.

Item No.8 :

Providing F.R.C. MH seat cover incl. carting to the work site etc. comp. Directed. F.R.C. Extra Heavy Duty (EHD-35) Machinehole Covers & Frames Cover: 728mm ø & 100 mm thick circular cover, 35.00MT load design, 100 x 2mm MS flat all round, 16mm ø plain round bar for lifting the cover & should be fitted with plastic cups. Frame: 560mm ø clear opening, -888 x 888 x 175mm. On the upper periphery off frame 25x3 mm wide MS flat should be well embed in concrete to protect the edges off frame. FRC E.H.D.-35 Machinehole cover & frame described as above.

Providing, supplying and fixing Fibre Reinforced Concrete (F.R.C.) Extra Heavy Duty (EHD-35) Manhole Cover and Frame suitable for heavy traffic / carriageway areas, designed for a minimum load bearing capacity of 35 Metric Tons (350 kN proof load), conforming to relevant IRC and IS standards, complete in all respects as directed by the Engineer-in-Charge.

The cover shall be circular of 728 mm diameter and 100 mm thickness, manufactured using high strength Fibre Reinforced Concrete of minimum M-40 grade. The cover shall be machine vibrated, properly compacted and water cured to achieve required strength and durability. It shall be reinforced with 100 x 2 mm MS flat provided all around the periphery and shall be fitted with a 16 mm diameter plain MS round bar lifting handle. The lifting arrangement shall be provided with heavy-duty plastic cups to prevent direct metal contact, noise and corrosion. The top surface shall be anti-skid, textured or chequered, and shall bear permanent marking of EHD-35, manufacturer's name and year of manufacture. The unit shall be free from cracks, honeycombing, segregation or dimensional defects.

The frame shall have a clear opening of 560 mm diameter with outer dimensions of 888 mm x 888 mm and overall depth of 175 mm. It shall be manufactured from M-40 grade Fibre Reinforced Concrete, properly compacted and cured. A 25 x 3 mm MS flat shall be provided and firmly embedded along the upper periphery of the frame to protect edges from damage and impact under heavy vehicular movement. The seating surface shall be accurately finished to ensure proper fitting of the cover without rocking and to allow uniform load transfer.

All mild steel components shall conform to IS 2062 and shall be free from rust, scale or defects. Cement shall conform to IS 8112 or IS 12269 and aggregates shall comply with IS 383. Synthetic fibres used in concrete shall be suitable for structural FRC applications. The entire unit shall be factory load tested for 35 MT capacity and manufacturer's test certificate shall be submitted if required.

The frame shall be installed in position over a PCC/RCC collar of minimum M-20 grade concrete, aligned properly to finished road level and camber. It shall be firmly embedded to prevent displacement under traffic loads. The joint between frame and concrete shall be filled with 1:3 cement mortar or approved non-shrink grout to ensure rigid seating. The finished level shall be flush with surrounding pavement surface.

The rate shall include cost of all materials, labour, transportation, loading and unloading, curing, taxes, embedding in concrete, testing and complete fixing in position as directed by the Engineer-in-Charge. Measurement shall be made on number basis for complete manhole cover and frame installed.

Item No.9 :

Providing and constructing rectangular brick masonry chamber for house connection as per type design in brick masonry in C M 1 3 including M-100 in foundation M-150 in benching inside plastering in C. M. 1 3 and outside plastering in C. M. 1:3 coping in M200 and f1x1ng RCC precast manhole frame and covers and all necessary fittings engineer in charge.

BRICK MASONRY HOUSE CONNECTION CHAMBER**1.1 Location**

House connection chambers shall be constructed at places approved by the Employer's Representative.

In case of manhole along the river or drain the top of Manhole shall be raised to safe height above the highest flood level of river /drain as directed by E.I.C.

1.2 Excavation

Excavation, shoring, dewatering etc. for the pits of manholes,/ House connection chamber laying of pipes and fittings/specials shall be done in accordance with Employer's Requirements described elsewhere in the document.

1.3 PLAIN CEMENT CONCRETE:

The water, sand, cement & stone aggregate of 40 mm nominal size shall be used of approved quality as per standard specification in I.S. 456. Detail specification of materials as given in General Technical Specification shall be observed.

1.3.1 Workmanship:

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

1.3.2 Mixing:

The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quality of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of breakdown of machineries and in the interest of the work, it shall be carried out on a water tight platform and shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

1.3.3 Transporting and placing the concrete:

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

commences.

The concrete shall be laid as per the drawing dimension.

1.3.4 Compacting:

The concrete shall be rammed rapidly with heavy iron rammers to get the required compaction and to allow all the interstices to be filled with mortar.

1.3.5 Curing:

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

1.4 Bricks

Bricks used for construction of sewer manholes shall conform to the relevant Indian Standards IS: 4883-1988. They shall be sound, hard, and homogeneous in texture, well burnt in kiln without being vitrified, table molded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing ungrounded particles and/or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 50 kg/sq.cm. Unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in relevant IS.

The size of the brick shall be 23.0 x 11.5 x 7.5 cm. unless otherwise specified; but tolerance up to 3 mm in each direction shall be permitted. Only full size brick shall be used for masonry work. Brickbats shall be used only with the permission of Employer's Representative to make up required wall length or for bonding. Sample bricks shall be submitted to the Employer's Representative for approval and bricks supplied shall conform to approved samples. If required by the Employer's Representative, brick sample shall be tested as per IS: 3495 by Contractor. Bricks rejected by the Employer's Representative shall be removed from the Site within 24 hours.

1.5 Cement Mortar

Mortar for brick masonry shall be prepared as per IS: 2250. Manholes shall be constructed in brick masonry with cement mortar (1:3) unless otherwise specified. Gauge boxes for sand shall be of such dimensions that one bag containing 50 kg. Of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be as approved by the Employer's Representative. If required by the Employer's Representative Sand shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry conditions. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected. The Contractor shall arrange for tests on mortar samples if so required by Employer's Representative. Re-tempering of mortar shall not be permitted.

1.6 Brick Masonry

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work of manholes shall be in the proportion specified in drawing. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115 mm thick brick work shall be laid with

stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

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

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plastering to be done. When plastering is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If mortar in the lower courses has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.

1.7 Cement Plaster

All joints in masonry shall be raked to a depth of 12 mm with hooked tool made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

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

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

Water proof Plastering shall be done on inner face of brick masonry in cement mortar (1:3) and 20 mm thick unless otherwise specified with required water proofing compared.

Plastering work shall be carried out in two layers, to the inner face the first layer being

14 mm thick and the second layer being 6 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise approved by the Employer's Representative.

1.8 Cement Concrete Channel

The channel for the manhole or chamber shall be constructed in cement concrete of M15 grade. Both sides of the channel shall be taken up to the level of the crown of the outgoing sewer. They shall be benched up in concrete and rendered in cement mortar (1:1) of 20 mm thickness and formed to a slope of 1 in 12 towards the channel.

1.9 Pipe Entering or Leaving Manhole/ House connection chambers

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

1.10 Scaffolding

For brick work in M.H., single scaffolding shall be permitted. In such cases, the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one meter in width, or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purpose shall be filled and made good before plastering.

1.11 Precast Manhole Frame & cover shall be fixed on manhole chamber in RCC M 30 as provided in a drawing.

1.12 Deformed / TMT bars conforming to relevant IS of grade Fe 500 shall be used with RCC coping work for fixing M.H. frame & cover on M.H.

1.13 C.I. Steps:

The steps as per detail specification shall be fixed in the fashion narrated in drawing. if required as per drawing.

Where the depth of invert of manhole chamber exceeds 800 mm, steps of approved pattern shall be fixed in the brickwork at the interval of 300 mm vertically and staggered at 380 mm horizontally centre to centre with C.C. M15.

1.14 75 mm all round vata in C.M. 1:3 shall be provided at bottom of outer periphery of masonry work over foundation concrete as per drawing.

1.15 Coping:

Coping in M-20 shall be carried out on all sides of House Connection chamber for 100 in thickness. No reinforcement is required.

1.16 Fixing:

Frame and Cover brought as per the *item no.2 schedule B1* checked for creakiness or any damages, damages frame and cover will be rejected and remove for the site.

Frame shall be fixed on laid coping on wall after placing rich cement slurry over it so that frame shall be fixed tightly.

1.17 Curing:

All PCC, R.C.C., Brick masonry, plaster, etc. shall be kept wet for seven days. During this period it shall be suitably protected from all damages.

1.18 Making holes in existing manhole chamber of sewer collecting system for house connection & repairing the same will be in contractor's scope. No extra payment will be made for this job.

1.19 Mode of Measurement & payment:

The measurement of House connection chamber will be taken on Number basis as per type design for specified depth up to 0.9 mt.

Scope of Work

This item shall include **providing and constructing a rectangular brick masonry chamber for house sewer connection**, as per **approved type design and drawings**, complete in all respects, including **earthwork preparation, PCC foundation, brick masonry, internal benching, plastering, coping, fixing of RCC precast manhole frame and cover, curing, finishing and all incidental works**, as directed by the Engineer-in-Charge.

Applicable Standards

- **IS 2212** – Code of Practice for Brickwork
- **IS 3495** – Tests on Burnt Clay Building Bricks
- **IS 456** – Plain and Reinforced Concrete
- **IS 2250** – Code of Practice for Masonry Mortars
- **IS 383** – Aggregates for Concrete
- **IS 8112 / IS 12269** – OPC Cement
- **CPHEEO Manual on Sewerage and Sewage Treatment**
- Relevant State PWD / GWSSB specifications
- Latest amendments shall apply

Type & Location

- **Chamber Type:** Rectangular house connection chamber
- **Purpose:** Inspection / cleaning / connection of house sewer to street sewer
- **Location:** As shown on drawings or as directed by Engineer-in-Charge

Materials

Bricks

- First-class burnt clay bricks
- Uniform in shape, size and colour
- Free from cracks and defects
- Minimum compressive strength: **as per IS 3495**
- Water absorption $\leq 20\%$

Cement

- Ordinary Portland Cement (OPC) 43 / 53 Grade
- Conforming to IS standards
- Fresh and free from lumps

Sand

- Clean, well-graded river sand
- Free from silt, clay, organic matter
- Conforming to IS 383

Coarse Aggregate

- Hard, durable crushed stone aggregate
- Free from deleterious materials
- Conforming to IS 383

Water

- Clean, potable water conforming to IS 456

Foundation

- **Plain Cement Concrete (PCC)** in **M-100 grade**
- Nominal mix: **1 : 4 : 8 (Cement : Sand : Aggregate)** or equivalent
- Laid to required thickness and dimensions as per drawings
- Properly compacted and cured

Brick Masonry

- Brick masonry shall be carried out in **Cement Mortar 1 : 3 (1 cement : 3 sand)**
- Bricks shall be well soaked in water before laying
- Courses shall be truly horizontal and joints vertical
- Mortar joints shall be uniform, fully filled and properly finished
- Thickness and dimensions shall strictly follow approved type design

Internal Benching

- Internal benching shall be provided in **PCC M-150 grade**
- Benching shall be smooth, properly sloped towards outlet/invert
- No sharp edges or depressions shall be allowed
- Finished surface shall be dense and impervious

Plastering

Internal Plaster

- Internal surfaces shall be plastered in **Cement Mortar 1 : 3**
- Minimum thickness: **12 mm**
- Finished smooth and even
- Cured for minimum **7 days**

External Plaster

- External surfaces shall be plastered in **Cement Mortar 1 : 3**
- Minimum thickness: **12 mm**
- Finished smooth and neat
- Proper curing shall be ensured

Coping

- Coping shall be provided in **PCC M-200 grade**
- Finished to proper level and slope
- Edges shall be neat and rounded
- Proper curing shall be done

RCC Precast Manhole Frame & Cover

- RCC precast frame and cover of **approved design and load class**
- Free from cracks, honeycombing, and surface defects
- Properly seated, aligned, and fixed in position
- Top level shall match finished ground / road level

Pipe Connections & Fittings

- Proper openings shall be formed for inlet and outlet pipes
- Connections shall be made watertight using approved mortar
- All necessary fittings required for proper functioning shall be included

Curing

- All masonry, concrete and plastered surfaces shall be cured for a **minimum of 7 days**
- Curing shall be done by ponding or continuous sprinkling

Workmanship & Finish

- All works shall be executed in a **workmanlike manner**
- Chamber shall be watertight and structurally sound
- Internal surfaces shall be smooth and easy to clean
- No honeycombing, cracks, or loose plaster shall be permitted

Measurements

- Measurement shall be made in **numbers (Each)** of chambers constructed

- Only completed, approved chambers shall be measured for payment

Rate to Include

The rate shall include:

- All materials including bricks, cement, sand, aggregates
- PCC foundation, brick masonry, benching, plastering, coping
- RCC precast frame and cover
- Labour, tools, plants and scaffolding
- All taxes, GST, royalties, duties, freight and insurance
- Complete construction as per drawings and specifications

No extra payment shall be made for incidental or ancillary works.

Rejection Clause

- Chambers not conforming to drawings, dimensions, or specifications shall be rejected
- Defective work shall be dismantled and reconstructed at contractor's cost
- Engineer-in-Charge's decision shall be final and binding

Item No.10:

Refilling the pipeline trenches including ramming, watering, consolidating disposal of surplus staff as directed within a radius of 3km

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of Trench Excavation and the Contractor shall not permit unreasonably

excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Engineer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. The excavated material nearest to the trench shall be used filling. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline unless the trench has been filled to height of at least 30cm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench may be filled in with a mixture of hard and soft material free from boulders and clods of earth larger than 150mm in size if sufficient quantity of good earth and murrum are not available. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The top 300mm layer or fertile agricultural soil shall be kept aside during excavation and shall be laid in layers near ground level during refilling.

To prevent buckling of pipe shell of diameters 1200mm and above, pipes shall be strutted from inside while the work of refilling is in progress, for which no separate payment shall be made.

Strutting shall be done by means of strong spiders having at least 6 arms which shall be sufficiently stiff to resist all deformation. Spiders shall be provided at a maximum interval of 2m & shall be welded in such a way that internal coating does not get burnt.

The Engineer shall, at all times, have powers to decide which portion of the excavated materials shall be for filling and in which portion of the site and in what manner it shall be so

use

If any material remains as surplus it shall be disposed of as directed by the Engineer, which includes loading, unloading, transporting and spreading as directed within all lea If the Contractor fails to remove the earth from site within

7 days after the period specified in a written notice, the Engineer may arrange to carry out such work at the Contractor's risk and cost or may impose such fine for such omission as he may deem fit. Particular care shall be taken to keep the trench dry during the entire refilling operation.

If suitable material for refilling is not available for excavation the Contractor shall bring earth, murrum of approved quality as directed by the Engineer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval of the Engineer has been obtained Subsidence in filling in : Should any subsidence take place either in the filling of the trenches or near about it during the maintenance period of 24 months from the completion of the Contract Works, the Contractor shall make good the same at his own cost or the Engineer may without notice to the Contractor, make good the same in any way and with any material that he may think proper, at the expense of the Contractor. The Engineer may also, if he anticipates occurrence of any subsidence, employ persons to give him timely notice of the necessity of making good the same, and the expenses on this account shall be charged to the Contractor.

The work under this item shall consist of **refilling the excavated pipeline trenches, manhole pits, and chamber foundations** after completion of pipe laying, jointing, testing, and other related works, using the excavated material or approved borrow earth, including ramming, watering, and consolidation in layers, and disposal of surplus earth within a lead of 3.0 km as directed by the Engineer-in-Charge.

After successful hydraulic testing and approval of the pipeline and manholes, the trenches shall be refilled in layers not exceeding **150 mm (0.15 m)** thickness, using the **selected available excavated material** free from boulders, debris, organic matter, and roots. Each layer shall be **properly watered and compacted** by manual or mechanical means such as wooden rammers or plate compactors to obtain maximum possible compaction and avoid future settlement.

Special care shall be taken while refilling around the **sides and crown of the pipeline** to prevent damage or displacement of the pipes. The first layer of filling up to 300 mm above the crown of the pipe shall be done with **fine sieved soil or sand** to avoid concentrated loading and to protect the pipeline coating or joints. The filling shall be carried out **symmetrically on both sides** of the pipeline to maintain uniform pressure and alignment.

For **manholes, chambers, and appurtenant structures**, the refilling shall be executed carefully in layers, ensuring that the masonry or concrete structure is not damaged. Where mechanical compaction is not possible due to space constraints, hand ramming with adequate watering shall be adopted. All refilled material shall be **compacted to achieve near-original ground density**, ensuring no settlement around the manholes or chambers after backfilling.

The **surplus excavated material**, unsuitable for refilling, shall be transported and disposed of within a **radius of 3 km** or as directed by the Engineer-in-Charge, at approved disposal sites, in a manner that does not obstruct drainage, traffic, or cause environmental nuisance. All leads, lifts, loading, unloading, and spreading operations shall be deemed included in the scope of this item.

During refilling operations, proper precautions shall be taken to protect nearby utilities, structures, and roads. The top surface of the refilled trench shall be dressed, leveled, and rammed flush with the surrounding ground, or prepared to receive further layers of road crust, pavement, or other specified surface treatments as applicable.

The rate shall include the cost of all labour, materials, tools, equipment, watering, ramming, compaction, dressing, and transportation of surplus material up to 3.0 km, including all incidental charges required for the satisfactory completion of the work as directed by the Engineer-in-Charge.

Payment shall be made **per cubic metre (m³) of approved compacted fill** measured after completion of the work, in accordance with the specifications and approved drawings.

Item No.11:

Providing and casting in situ C.C. in grade M-20 (proportions as per mix design or as per table 9 of IS 456 2000 in masses by weigh batching) using granite. quartzite trap metal of size 6 mm to 20 mm for RCC work, including scaffolding centering, formwork, needle vibrated consolidation, curing complete up to 6 meter depth or height (excluding cost of reinforcement and neat finishing) with centering and shuttering/deshuttering etc. complete for structure other than water retaining (Below G.L) (without formwork)

1. Scope of Work

This item shall include **providing, batching, mixing, transporting, placing, compacting, finishing and curing in-situ Reinforced Cement Concrete (RCC) of Grade M-20**, for structural components **below ground level**, complete in all respects, excluding **cost of reinforcement steel and neat finishing**, but including **centering, shuttering, scaffolding, vibration and curing**, as directed by the Engineer-in-Charge. The work shall be carried out up to a **maximum depth or height of 6.0 metres** from ground level.

2. Applicable Standards & Codes

- **IS: 456 – 2000** – Plain and Reinforced Concrete
- **IS: 10262** – Concrete Mix Proportioning
- **IS: 383** – Aggregates for Concrete
- **IS: 9103** – Concrete Admixtures (if permitted)
- **IS: 1199 / IS: 516** – Sampling & Testing of Concrete
- **CPHEEO Manual** (where applicable)
- Relevant State PWD / GWSSB specifications
- Latest amendments shall apply

3. Grade of Concrete

- **Concrete Grade: M-20**
- **Characteristic Compressive Strength:**
 - 20 N/mm² at 28 days

4. Mix Proportion & Batching

4.1 Mix Design

- Concrete shall be produced either:
 - As per **approved design mix**, or
 - As per **Table-9 of IS:456-2000** (Nominal mix)

4.2 Batching

- **Weigh batching only** shall be permitted
- Volume batching shall not be allowed

5. Materials

5.1 Cement

- Ordinary Portland Cement (OPC) **43 / 53 Grade**
- Conforming to **IS:8112 / IS:12269**
- Fresh, free from lumps, and stored properly

5.2 Fine Aggregate

- Clean natural river sand or crushed sand
- Free from silt, clay, organic impurities
- Conforming to **IS:383**

5.3 Coarse Aggregate

- Hard, durable **granite / quartzite / trap metal**
- Size range: **6 mm to 20 mm**, well graded
- Free from flaky, elongated or deleterious materials
- Conforming to **IS:383**

5.4 Water

- Clean, potable water
- Free from oils, acids, alkalis, salts
- Conforming to **IS:456**

5.5 Admixtures (if permitted)

- Only approved admixtures conforming to **IS:9103**
- Use only with prior written approval of Engineer-in-Charge

6. Formwork / Centering & Scaffolding

Note: Item is specified as "*Below Ground Level (Without Formwork)*"; however, **wherever required for shape, alignment or safety**, centering and shuttering shall be provided.

- Formwork shall be rigid, true to line, level and plumb
- Joints shall be tight to prevent leakage of slurry
- Proper supports, props and scaffolding shall be provided
- Deshuttering shall be done only after concrete attains sufficient strength
- Removal shall not damage concrete edges or surfaces

7. Mixing of Concrete

- Concrete shall be mixed in **mechanical mixer** of approved capacity
- Mixing time shall be adequate to achieve uniform consistency
- No re-tempering with water shall be allowed

8. Transportation & Placing

- Concrete shall be transported without segregation or loss of workability
- Placement shall be continuous and completed within initial setting time
- Concrete shall not be dropped from excessive height
- Construction joints, if unavoidable, shall be located as approved

9. Compaction

- Concrete shall be **thoroughly compacted using needle vibrators**
- Over-vibration leading to segregation shall be avoided
- All voids and honeycombs shall be eliminated

10. Finishing

- Exposed surfaces shall be even and free from honeycombing
- Neat cement finishing is **excluded from this item**
- Minor surface irregularities shall be rectified immediately

11. Curing

- Concrete shall be cured for a **minimum period of 7 days**
- Curing shall be done by ponding, wet hessian, or continuous sprinkling
- Concrete shall be protected from premature drying, shock, or damage

12. Depth / Height Clause

- Rate includes execution of work **up to 6.0 metres depth or height**
- Any work beyond this limit shall be paid separately, if specified

13. Quality Control & Testing

- Slump test shall be conducted as directed
- Concrete cubes shall be cast and tested for compressive strength
- Frequency of testing shall be as per IS:456
- Concrete failing to meet strength requirements shall be rejected

14. Measurements

- Measurement shall be in **cubic metres (m³)** of finished concrete
- Reinforcement steel volume shall **not be deducted**
- No extra payment for formwork unless separately specified

15. Rate to Include

The quoted rate shall include:

- Cost of cement, sand, aggregates, water
- Mix design / weigh batching
- Mixing, transporting, placing, vibrating, curing
- Centering, shuttering, scaffolding and deshuttering
- Labour, tools, plant and machinery
- All leads, lifts, taxes, royalties, GST, duties
- Complete execution as per drawings and specifications

Cost of reinforcement steel and neat cement finishing is excluded.

16. Rejection Clause

- Concrete not conforming to specifications, line, level or strength shall be rejected
- Defective concrete shall be dismantled and re-cast at contractor's cost
- Decision of Engineer-in-Charge shall be final and binding

Item no 12: Drilling Horizontal bore

Drilling of 500 mm dia Horizontal borehole for watermain pipeline under the railway tracks incl all strata with required length including fixing of 400 mm dia MS casing pipe of minimum 6 mm thick with welding pushing etc. complete. Providing & fixing various size of pipe for 193.7 mm/219.10 mm/ 244.5 mm dia watermain of GI MS pipe of minimum 0.3 mm thick for railway premises as per instructions & regulations of Railway Authority & under supervision of Railway authority incl providing supplying & fixing of space at specified interval if required in between casing pipe and water main ISI make sluice valve of required size at both side at railway boundary with construction of brickege pavement incl CC encasing 1:3:6 in 10 mtr length of pipe at both side incl providing & fixing of MS/Iron manhole frame with cover for valve chamber with locking arrangement etc complete with all material labour fabrication, hydraulic testing, of pipe and valve etc complete for 45 m length which includes horizontal pushing and with all open excavation

MS casing pipe + water Main size 219 mm

Pushing of the completed segments of the pipe shall be commenced as per the procedure described in above paras till the entire length of the pipe in the embankment is built up.

- Permission for Highway & Canal crossing shall be procured by agency/department from competent authority of the concerned department. Necessary letter of recommendation shall be given by department.

- At canal, public state highways, at such other crossings as are shown in the construction drawings issued by the company the pipeline shall be installed in MS casing of as recommended by canal / state highway authority casing pipes conforming to the specifications given herein.
- The casing pipes / box shall be installed in accordance with the details given in drawing and the casing, bushing and insulators, etc., shall be installed on the carrier pipe as detailed in drawings. Casing pipe size shall be as per Engineer in charge instruction to facilitate the insertion of the later without disturbing the casing pipe and to provide adequate drainage, Casing shall be installed with even bearing throughout its length and shall slope towards one end, as specified or desired by the engineer-in-charge. The ends of the casing shall be sealed to outside of carrier pipe inss accordance with the details given in drawing.
- Before installation, holes for installing vent pipes shall be cut and burrs if any shall be removed. The welding of both carrier pipe and casing pipe shall be done in accordance with the welding specifications, given herein. Before installing the casing pipe, it should be cleaned of all internal obstructions and during installation care should be taken to keep the inside clean
- The section of carrier pipe to be placed in any casing shall be closed at each end, hydrostatically tested preferably with dead weight tester for at least two hours. Only on successful completion of this test, the carrier pipe shall be inserted in the casing pipe. The installation of casing may open cut as circumstances may permit or require as directed by the engineer-in- charge.
- The installation of casing in bended section of the carrier pipe shall be performed by meter bends of the casing pipe provided that the length of each meter cut out of casing pipe shall be such as to provide a clearance of at least 1-1/2" between the inside of the casing pipe and the outside of the coated carrier pipe.
- Excavation for casing installation shall be immediately backfilled at the completion of the work with suitable solid matter and packed thoroughly to prevent seepage of water into the excavation.
- ROAD, RAILWAY AND IRRIGATION CANAL CROSSINGS:
- At road, canal and railway crossings the work shall be performed to the specifications of local authorities or such public bodies as may be in charge
- (S) of roads, railways and canals to be crossed.
- 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 encased line shall be followed.
- Whereas the casing pipe in the case of encased line to be laid normal by boring, tunneling, engineer- in-charge may at his discretion permit open-cuts to be made for the installation of casing provided, however, that the TENDERER shall procure the necessary permit / license for the same from competent authority. At locations wherein the open cut methods are permitted, the TENDERER shall pass the carrier pipe through the casing located in the trench after the approval of the engineer-in- charge in writing and care shall be exercised to avoid damage to pipe coating and wrapping during this operation. The TENDERER shall produce a certificate in writing from concerned authorities for its satisfactory restoration and payment therefore.

- At all crossings the carrier pipe shall be laid straight without bends so that if necessary the pipe at a later date may be replaced without cutting the casing. The carrier pipe shall extend at least 2 meters beyond the end of casing pipe at either end.
- At railway crossings the TENDERER shall eliminate unnecessary bending of pipe to conform to the contour of ground by gradually deepening the ditch at such approaches as directed by the engineer-in-charge. Where the installation of the casing has been made by open cut TENDERER shall install suitable temporary bridge work ensuring the safety of the traffic aids and safeguards for protection of the public safety, or he shall provide suitable diversions as desired by the engineer-in-charge.
- At all railways pipeline crossings shall be bored with horizontal boring machine. The method of carrying out a cased crossing by boring for various crossings on this pipeline route shall be jointly inspected by the representative of the COMPANY and TENDERER for each category of work prior to commencement of actual work.
- Pipeline under railway track and irrigation canal an applicable portion of the right-of-way shall be encased in accordance with the specification. This item of work shall include, necessary clearing and grading required therefore, trenching to the depths and widths required, welding of casing and carrier

pipes, testing, lowering in, installation of vent assemblies, end seals, insulator and all other fittings that may be required, backfilling, clean up, complete restoration to the original condition and further strengthening and protective works as may be required. The work shall be carried out in accordance with the drawings and as directed by the engineer-in-charge. For various operations mentioned above, the specifications pertaining to these operations shall apply in Addition to the specifications given herein.

- The TENDERER shall be permitted to use William Sons type Neoprene seals in place of concrete end seals for the crossings. The item shall be procured by the TENDERER himself as per the provisions under the appropriate head of work in case TENDERER so desires. The representative of the COMPANY may also be associated to determine the quality of the material and its delivery schedule from the open market. However, the particular work defined under the proper head shall not be delayed on account of non-availability of Neoprene end seals. In such case, concrete seals may be provided.
- On both ends of pushing concrete supports are to be provided as per direction of engineer in- charge.

MODE OF PAYMENT:

The payment shall be made on actual running meter basis as shown in relevant schedule.

Item no 13: Drilling Horizontal bore

Drilling of 900 mm dia Horizontal borehole for watermain pipeline under the railway tracks incl all strata with required length including fixing of 400 mm dia MS casing pipe of minimum 6 mm thick with welding pushing etc. complete.

Providing & fixing various size of pipe for 193.7 mm/219.10 mm/ 244.5 mm dia watermain of GI MS pipe of minimum 0.3 mm thick for railway premises as per instructions & regulations of Railway Authority & under supervision of Railway authority incl providing supplying & fixing of space at specified interval if required in between casing pipe and water main ISI make sluice valve of required size at both side at railway boundary with construction of brickege pavement incl CC encasing 1:3:6 in 10 mtr length of pipe at both side incl providing & fixing of MS/Iron manhole frame with cover for valve chamber with locking arrangement etc complete with all material labour fabrication, hydraulic testing, of pipe and valve etc complete for 45 m length which includes horizontal pushing and with all open excavation.

MS casing pipe + water Main size 457 mm

Pushing of the completed segments of the pipe shall be commenced as per the procedure described in above paras till the entire length of the pipe in the embankment is built up.

- Permission for Highway & Canal crossing shall be procured by agency/department from competent authority of the concerned department. Necessary letter of recommendation shall be given by department.
- At canal, public state highways, at such other crossings as are shown in the construction drawings issued by the company the pipeline shall be installed in MS casing of as recommended by canal / state highway authority casing pipes conforming to the specifications given herein.
- The casing pipes / box shall be installed in accordance with the details given in drawing and the casing, bushing and insulators, etc., shall be installed on the carrier pipe as detailed in drawings. Casing pipe size shall be as per Engineer in charge instruction to facilitate the insertion of the later without disturbing the casing pipe and to provide adequate drainage, Casing shall be installed with even bearing throughout its length and shall slope towards one end, as specified or desired by the engineer-in-charge. The ends of the casing shall be sealed to outside of carrier pipe inss accordance with the details given in drawing.
- Before installation, holes for installing vent pipes shall be cut and burrs if any shall be removed. The welding of both carrier pipe and casing pipe shall be done in accordance with the welding specifications, given herein. Before installing the casing pipe, it should be cleaned of all internal obstructions and during installation care should be taken to keep the inside clean
- The section of carrier pipe to be placed in any casing shall be closed at each end, hydrostatically tested preferably with dead weight tester for at least two hours. Only on successful completion of this test, the carrier pipe shall be inserted in the casing pipe. The installation of casing may open cut as circumstances may permit or require as directed by the engineer-in- charge.
- The installation of casing in bended section of the carrier pipe shall be performed by meter bends of the casing pipe provided that the length of each meter cut out of casing pipe shall be such as to provide a clearance of at least 1-1/2" between the inside of the casing pipe and the outside of the coated carrier pipe.
- Excavation for casing installation shall be immediately backfilled at the completion of the work with suitable solid matter and packed thoroughly to prevent seepage of water into the excavation.

- ROAD, RAILWAY AND IRRIGATION CANAL CROSSINGS:

- At road, canal and railway crossings the work shall be performed to the specifications of local authorities or such public bodies as may be in charge
- (S) of roads, railways and canals to be crossed.
- 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 encased line shall be followed.
- Whereas the casing pipe in the case of encased line to be laid normal by boring, tunneling, engineer- in-charge may at his discretion permit open-cuts to be made for the installation of casing provided, however, that the TENDERER shall procure the necessary permit / license for the same from competent authority. At locations wherein the open cut methods are permitted, the TENDERER shall pass the carrier pipe through the casing located in the trench after the approval of the engineer-in- charge in writing and care shall be exercised to avoid damage to pipe coating and wrapping during this operation. The TENDERER shall produce a certificate in writing from concerned authorities for its satisfactory restoration and payment therefore.
- At all crossings the carrier pipe shall be laid straight without bends so that if necessary the pipe at a later date may be replaced without cutting the casing. The carrier pipe shall extend at least 2 meters beyond the end of casing pipe at either end.
- At railway crossings the TENDERER shall eliminate unnecessary bending of pipe to conform to the contour of ground by gradually deepening the ditch at such approaches as directed by the engineer- in-charge. Where the installation of the casing has been made by open cut TENDERER shall install suitable temporary bridge work ensuring the safety of the traffic aids and safeguards for protection of the public safety, or he shall provide suitable diversions as desired by the engineer-in-charge.
- At all railways pipeline crossings shall be bored with horizontal boring machine. The method of carrying out a cased crossing by boring for various crossings on this pipeline route shall be jointly inspected by the representative of the COMPANY and TENDERER for each category of work prior to commencement of actual work.
- Pipeline under railway track and irrigation canal an applicable portion of the right-of-way shall be encased in accordance with the specification. This item of work shall include, necessary clearing and grading required therefore, trenching to the depths and widths required, welding of casing and carrier

pipes, testing, lowering in, installation of vent assemblies, end seals, insulator and all other fittings that may be required, backfilling, clean up, complete restoration to the original condition and further strengthening and protective works as may be required. The work shall be carried out in accordance with the drawings and as directed by the engineer-in-charge. For various operations mentioned above, the specifications pertaining to these operations shall apply in Addition to the specifications given herein.

- The TENDERER shall be permitted to use William Sons type Neoprene seals in place of concrete end seals for the crossings. The item shall be procured by the TENDERER himself as per the provisions under the appropriate head of work in case TENDERER so desires. The representative of the COMPANY may also be associated to determine the quality of the material and its delivery schedule from the open market. However, the

particular work defined under the proper head shall not be delayed on account of non-availability of Neoprene end seals. In such case, concrete seals may be provided.

- On both ends of pushing concrete supports are to be provided as per direction of engineer in- charge.

MODE OF PAYMENT:

The payment shall be made on actual running meter basis as shown in relevant schedule.

PUMPHOUSE AND RISING MAIN LINE

Item no 1: Submersible non Clog pump

Supply, installation, testing & commissioning of non clog sewage vertically mounted end suction type Submersible Non Clog pump set of required capacity & head with suitable TEFC squirrel cage foot mounted induction motor (with minimum IE-3 efficiency class), working on three phase 50 Hz \pm 3%, 415 V \pm 10% AC supply, 1500 RPM synchronous speed including suitable provision of extended shaft of 2 meters length to couple with motor along with base frame, coupling with guard, foundation bolts, strainer etc. complete set as per relevant IS & following M.O.C: Casing: 1.5 to 2% Ni. CI; Impeller & wearing ring: SS / CF8M, Shaft with sleeve: SS & Base frame: CI; Guide Pipe: SS. Providing submersible, Non clog type with required capacity & head as per IS 8034 suitable for water having upto 10000 PPM turbidity with suitable submersible wet type, water cooled, squirrel cage motor to IS 9283, working on three phase, 50 Hz \pm 3%, 415V \pm 10%, AC supply, 2900 RPM synchronous speed with 10 mtr copper conductor flat cable from pump to starter panel with cable end terminations (4) all supports, clamps, pipe fittings alongwith mechanical seal, bearing bush, strainer etc. complete set & following M.O.C: Casing CI, SS CF8M impeller, Bronze: wearing ring & Bearing bush, TC mechanical seal, CS/S.S.bearing, S.S shaft with sleeve, SS strainer & MS motor body.

Discharge : 31.25 m³/hr
Head: 11 meter
Motor Rating : 1.5 Kw

&

Item no 2: Submersible non Clog pump

Supply, installation, testing & commissioning of non clog sewage vertically mounted end suction type Submersible Non Clog pump set of required capacity & head with suitable TEFC squirrel cage foot mounted induction motor (with minimum IE-3 efficiency class), working on three phase 50 Hz \pm 3%, 415 V \pm 10% AC supply, 1500 RPM synchronous speed including suitable provision of extended shaft of 2 meters length to couple with motor along with base frame, coupling with guard, foundation bolts, strainer etc. complete set as per relevant IS & following M.O.C: Casing: 1.5 to 2% Ni. CI; Impeller & wearing ring: SS / CF8M, Shaft with sleeve: SS & Base frame: CI; Guide Pipe: SS. Providing submersible, Non clog type with required capacity & head as per IS 8034 suitable for water having upto 10000 PPM turbidity with suitable submersible wet type, water cooled, squirrel cage motor to IS 9283, working on three phase, 50 Hz \pm 3%, 415V \pm 10%, AC supply, 2900 RPM synchronous speed with 10 mtr copper conductor flat cable from pump to starter panel with cable end terminations (4) all supports, clamps, pipe fittings alongwith mechanical seal, bearing bush, strainer etc. complete set & following M.O.C: Casing CI, SS CF8M impeller, Bronze: wearing ring & Bearing bush, TC mechanical seal, CS/S.S.bearing, S.S shaft with sleeve, SS strainer & MS motor body.

Discharge : 15.75 m³/hr
Head: 13 meter
Motor Rating : 0.80 Kw

&

Item no 3: Submersible non Clog pump

Supply, installation, testing & commissioning of non clog sewage vertically mounted end suction type Submersible Non Clog pump set of required capacity & head with suitable TEFC squirrel cage foot mounted induction motor (with minimum IE-3 efficiency class), working on three phase 50 Hz \pm 3%, 415 V \pm 10% AC supply, 1500 RPM synchronous speed including suitable provision of extended shaft of 2 meters length to couple with motor along with base frame, coupling with guard, foundation bolts, strainer etc. complete set as per relevant IS & following M.O.C: Casing: 1.5 to 2% Ni. CI; Impeller & wearing ring: SS / CF8M, Shaft with sleeve: SS & Base frame: CI; Guide Pipe: SS.

Providing submersible, Non clog type with required capacity & head as per IS 8034 suitable for water having upto 10000 PPM turbidity with suitable submersible wet type, water cooled, squirrel cage motor to IS 9283, working on three phase, 50 Hz +/-3%, 415V +/- 10%, AC supply, 2900 RPM synchronize speed with 10 mtr copper conductor flat cable from pump to starter panel with cable end terminations (4) all supports, clamps, pipe fittings alongwith mechanical seal, bearing bush, strainer etc. complete set & following M.O.C: Casing CI, SS CF8M impeller, Bronze: wearing ring & Bearing bush, TC mechanical seal, CS/S.S.bearing, S.S shaft with sleeve, SS strainer & MS motor body.
Discharge : 226.63 m3/hr
Head: 13 meter
Motor Rating : 11.5 Kw

a) The pump set shall be of compact unitary construction. The pump casing shall be of high efficiency, volute casing or bowl type with the impeller mounted directly onto the extended solid motor shaft (without any couplings). The pump design shall be suitable for water sump de-watering purpose. Pump shall be suitable to handle Mud, debris etc. Pump shall be of Non-clog design. Maximum solids handling capacity of the pump shall be provided accordingly.

b) The pump is to be mounted directly in submerged condition in to the water storage area. It may suck up silt, clay, pebbles etc. Hence it should be of appropriate reliable & robust design.

INSTALLATION

a) The pumps shall be suitable for portable installation either horizontal or vertical & shall be interchangeable between these modes throughout their working life time. The pump will be discharging water through vertical column pipes.

b) The pump shall be offered with vertical column discharge with or without any bottom supporting arrangement. Bottom anchoring with auto coupling type or horizontal axis pump suitable to the requirement may be provided.

c) The scope of works shall be inclusive of the Pump-motor sets with Discharge / Column Pipes and necessary supporting arrangements at the top floor.

d) To "fish out" a Vertically Installed Submerged pump-set (even if a chain has not been attached to the lifting hook prior to the pump-set being lowered) the pump should have a self centering lifting hook. Its design should be such that the lifting chain's hook can be engaged to the pump's lifting hook without the need for man to enter the wet sump to engage the same.

PUMP DESIGN

a) Speed: Speed is required to be decided on achievable efficiency of pump.

b) The pump shall be capable of developing the required total head at rated capacity for its continuous operation. Pumps of particular category shall be identical and shall be suitable for parallel operation.

c) The head capacity curve shall be continuously rising towards shut off with the highest at shut off. The shut off head shall be at least 120% of the specified duty point head. The Impeller shall be of high efficiency Multi Channel Enclosed type (except for Specific Speeds ≥ 90 where Semi Open Impellers shall be allowable).

d) Suction Strainer: Provision of a suction strainer shall be dependent on the material to be handled by the pump.

e) The pump set shall be suitable for starting with delivery valve open as well as closed at any operating point. The motor should also start accordingly. The pump set shall be capable of withstanding the accidental rotation in reverse direction.

f) Fully filled up & Stamped Data Sheets as per attached format shall be submitted along with the Technical Bid.

g) Pump shall be horizontal or vertical single shaft machine having a common shaft for pump and motor

h) A filter / screen arrangement is to be provided at the inlet of the in coming water, i.e. at the source of water to enter in to the water storage area. However, the Pump shall be suitably designed to handle the silt / mud / sand / debris / grass / any other foreign material, which is likely to come along with the water.

i) Pump-motor unit shall be provided with suitable lowering and lifting arrangements

j) The Pump-motor unit shall be supplied with a suitable and sufficiently long copper cable for a

direct connection with the electric power / control panel without any joints when the pump-motor unit is installed in side the water.

k) The Characteristic curves of the Pump Head, Efficiency, BkW and the NPSHR against the Discharge Flow Rate shall be furnished by Pump-motor Vendor.

l) The Pump-motor unit shall be of water proof design suitable for total submergence in the water and compatible to operate normally against the minimum, maximum and normal water levels in the water storage area & for continuous operation.

m) The Pump-motor unit shall be provided with a suitable moisture sensing arrangement so that the pump-motor unit shall be electrically tripped when moisture is sensed.

n) There shall be a suitable provision like: Thermister Relay / any other for tripping of the unit against pump over load / motor over heating.

o) The Pump-motor unit shall be provided with the necessary supporting arrangement at the top of the well and the flanged discharge bend at the outlet for further connecting with the expansion elbows etc. Apart from this, the pump vendor shall provide any other auxiliary / accessories that are required for his

design of pumps for smooth, safe and efficient operation and it will be included in their offer of the pump-set.

MOTOR DESIGN:

(I) TYPE OF MOTOR

a) The motor shall be of Squirrel Cage, Induction type, Air Filled, yet suitable for the actual, maximum water immersion in to the water & also suitable for S1 duty. It may be rated for LT - 415 Volt ($\pm 10\%$), 3 phase, 50 Hz ($\pm 5\%$) or HT AC electric supply as suitable. Its winding should be of Class "F" insulation * (withstanding winding hot spot temperature of up to 185°C) while the nominal temp rise of winding hotspot should not exceed that of class "B".

b) It should be wound using Dual Coated, Super Enameled; Copper wire with high temperature index as per IS: 4800 Part-13. PVC / Poly Propylene / Poly Ethylene insulation for winding wires shall not be allowed. Motor's Insulation should be Vacuum Varnish Impregnated & Oven Baked to ensure Moisture Impervious & Mechanically Robust insulation. Dip or Pour type Air Dry Varnishing shall not be allowed.

(II) MOTOR RATING

The Motor Rating should be higher of the following two criteria:

a) 10% margin on Maximum Power consumption through out the range of performance at 50 Hz (Including voltage and frequency variation) OR

b) 15 % more Brake Kilowatt Power (BkW) consumed at duty point at 50 Hz (Including voltage and frequency variation).

(III) ROTOR OF MOTOR

The Motor's Rotor shall be of Dual Cage Copper Bar Brazed type to assure following:

a) Long Corrosion free Service life (in presence of high moisture inevitable in submerged motors. Aluminum corrodes much faster than Copper)

b) Ease of Onsite Repairing & beneficial Fly Wheel type Inertial effect (as compared to aluminum rotor, copper rotor is heavy) which reduces detrimental effects of water hammer

c) Better Motor Efficiency & Cooler Operating Temperature

(IV) MOTOR COOLING:

To restrict the Dead Water Level (in case of Vertical Installation) in the Sump to 1m, Medium sized, Vertical pumps ($\geq 55\text{kW}$) should have a Cooling Jacket – i.e. motor cooling is accomplished by circulation of pumped water between the motor casing & the jacket shell - this jacket shell is fed by cold water from the pump casing & discharges its heated water back into the sump (in case of Wet Installation) or Pump

casing (in case of Dry Installation) by integrally cast ducts. There should not be any pipes, hoses, etc for this circulation.

(V) MOTOR PROTECTION:

Thermal Overload Protectors (Bi Metallic Over Load Relays) should be embedded in each phase of the stator winding to detect overheating & trip the motor from the control panel in the event of the

temperature exceeding the safe operating limit (above 130 degree C).

To detect primary Mechanical Seal's Leakage a Moisture Sensor shall be provided in intermediately Oil Chamber (& not in the Motor casing or else where) – this shall detect water mixing in oil by mode of increased leakage current from the moisture sensor.

(VI) CABLES:

- a) A watertight Cable Junction Box sealed from the motor shall be provided for the motor power and signaling cables.
- b) The cable shall be brought directly out of the submerged motor without joints, and shall be of sufficient length, minimum 10 m to be terminated in an IP 67 junction box (in the scope of electrical contractor) outside adjacent to the wet well & above the HFL. They shall be sized in accordance with the electricity utility regulations and BS 7671.
- c) It should have Power as well as Control Cables of Dual Sheathed EPRS / PVC Armored type with Copper Core of required size as per detail engineering. However the Cross Section of the cable shall be ample enough to ensure a Voltage Drop of not more than **2%** at actual site conditions.

(VII) SHAFT & BEARINGS:

- a) The Solid Shaft shall be supported by heavy duty Ball or Roller bearings with a minimum **L10** life of 75,000 hours in accordance with BS 5512. The bearings should be Permanently Greased with Premium Quality, High Temperature, Long Life Grease thereby obviating the need of re-lubrication for upto **L10** life of the bearings. The bearing should be of Metric Series & not Imperial ones.
- b) Oil Lubricated bearings shall not be allowed.
- c) In case the motor is to be driven via a VFD, atleast one of the bearings (DE or NDE) should be Current Insulated to prevent "electric fluting damage" caused by Harmonics.

(VIII) STUFFING BOX / OIL CHAMBER:

- a) The pressurized entry of water into the motor (from the pump's volute/Bowl casing) should be prevented by Two separate mechanical seals in mounted in a Tandem mode within an oil chamber.
- b) The Primary (Inboard) seal should always be of Silicon Carbide or Tungsten Carbide faces to withstand erosive wear due to any silt particles.
- c) The Secondary (Outboard) seal should be of Carbon v/s Cast Chrome Molybdenum Steel or Silicon Carbide or Tungsten Carbide – i.e. Thermally Unstable materials like Alumina/ Aluminum Oxide shall not be allowed.

(IX) TESTING:

- a) The pumpsets shall be tested in accordance with ISO 9906, IS 10981, IS 5120 (Tolerance Class 2); with or without VFD as per the provision in the tender specifications.
- b) The Flow shall be measured by full Bore Electro-Magnetic or Ultrasonic Flow Meters (of 0.5% or less accuracy class.)
- c) The Testing shall include the following:

(A) Motor Routine Tests at Pump manufacture place:

- 1. IR
- 2. HV
- 3. No Load Amperes, Vibration, Noise Levels, etc.

Note: Job pump shall be tested with job motor.

(B) Pump Performance Test:

In accordance with IS 5120 / ISO 9906, Grade 2 -5% / ISO 2548-5% shall include measurements of Head, Discharge, Motor Input at least 6 different points to plot the Actual Performance Curves

(C) All the Extra Charges for such Testing shall be borne by the Contractor. It is clarified that, in case of Field Testing Failure; Engineer-In-Charge / TPI reserves the right to detain the pumps in their custody until the contractor replaces the failed pumps with new pumps which shall again be subjected to Re-Testing. No extra charges shall be allowed by owner to the contractor.

(D) Pump testing should be carried out preferably with VFD or without VFD as per the provision of the tender. In case the pump sets are to be used with VFD then the testing has to be conducted compulsorily with VFD (to ascertain compatibility with VFD)

Item no 4:

Providing and supplying D.I. K-9 grade pipes for following nominal bore diameter with internal cement mortar lining including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. (IS 8329-2000). Rate for DI pipe based on wholesale Price Index of Pig Iron as 149.2 for the month of Jan-22. For Sewerage project cement mortar lining shall be with sulphate resistance cement

150 mm dia.

450 mm dia.

This item includes:

Note: Wherever International Standards or Indian standards / specifications are mentioned, their equivalent or higher standards / specifications are also acceptable Supply and Delivery of Ductile Iron Pipe as per IS:8329-2000 or its latest revision or amendments if any including jointing material as EPDM ring as per IS 5382- 1985 and ISO: 4633-1996 or its latest revision or amendments if any Standards

The following standards, specifications and codes are part of this specification. In all cases, the latest revision of the including all applicable official amendments and revisions shall be referred to. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

- ✓ ISO: 10803-1997 Design method for ductile iron pipes
- ✓ IS:8329-2000 Centrifugally Cast (spun) ductile iron pressure pipes for water, gas and sewage
- ✓ ISO:2531-1991 Ductile iron pipes, fittings and accessories for pressure pipelines.
- ✓ ISO:4179-1985 Ductile iron pipes for pressure and non pressure-Centrifugal
- ✓ cement mortar lining - General requirements.
- ✓ IS:8112 Specification for 43 Grade ordinary Portland cement.
- ✓ BS:3416 Bitumen based coatings for cold application, suitable for use in contact with potable water.
- ✓ ISO:8179-1995 Ductile iron pipes-External coating- Part-1 Metallic Zinc with finishing layer.
- ✓ IS:638 Sheet rubber jointing and rubber insertion jointing.
- ✓ ISO:4633-1996 Rubber seals-Joint rings.
- ✓ IS:5382-1985 Specification for Rubber sealing rings for gas mains, water mains and sewers.
- ✓ AWWA C600 Installation of ductile iron water mains and their appurtenances.

1.0 Internal Diameter:

The nominal values of the internal diameters of pipe, expressed in millimeters are approximately equal to the number indicating their nominal sizes DN.

2.0 Length:

The working length of socket and spigot pipes shall be 5 m, 5.5 m, or 6 metres.

3.0 Thickness:

The wall thickness of pipe 'e' in mm shall be calculated as a function of the nominal diameter by the following equation with minimum of 5 mm

$$e = K(0.5 + 0.001 \text{ DN})$$

where : e = wall thickness in mm, DN = the nominal diameter, K = the whole number coefficient

4.0 EPDM Rubber Gasket:

Rubber Gasket shall be suitably for Push-on-Joint.

The spigot ends shall be suitably chamfered or rounded off to facilitate smooth entry of pipe in the socket fitted with the rubber gasket Rubber Gasket shall confirm to IS 5382-1985 and ISO : 4633-1996 its latest revision or amendments if any

5.0 Sampling Criteria:

Sampling criteria for various tests, unless specified in IS 8329-2000, shall be as laid down in IS 11606. Mechanical test, Brinell Hardness test, Hydrostatic test etc. are shall be as per IS 8329-2000

6.0 Tolerances on External Diameter:

The nominal external diameter (DE) of the spigot end of socket and spigot pipes and when measured circumferentially using a diameter tape shall confirm to the requirements specified as follow. The positive tolerance is +1 mm and applies to all thickness classes of pipes. The maximum negative tolerance of the external diameter are specified as follow:

DN	Nominal	Positive Tolerance	Negative Tolerance
80	98	+1	-2.2
100	11	+1	-2.8
125	14	+1	-2.8
150	17	+1	-2.9
200	22	+1	-3.0
250	27	+1	-3.1
300	32	+1	-3.3
350	37	+1	-3.4
400	42	+1	-3.5
450	48	+1	-3.6
500	53	+1	-3.8
600	63	+1	-4.0

7.0 Tolerance on Ovality:

Pipes shall be as far as possible circular internally and externally. The tolerance for out-or- roundness of the socket and spigot ends is given below:

Nominal Diameter	Allowable Difference Between Minor Axis
80 to 300	1.0

350 to 600	1.7
700	2.0
750 to 800	2.4
900 to 1000	3.5

8.0 Tolerance in thickness

The tolerance on wall thickness (e) and the flange thickness (b) of the pipes shall be as below:

Dimensions	Tolerance in mm
Wal thickness	- (1.3 + 0.001 DN
Flange thickness	+ (2+0.05b)

9.0 Coating

Pipe shall be delivered internally and externally coated.

External Coating: Pipe shall be metallic zinc coated and after that it shall be given a finishing layer of bituminous paint as per IS - 8329-2000 Zinc coating shall comply with IS:8329/EN 545/ ISO 8179. Only molten zinc spray coating shall be acceptable. The average mass of sprayed metal shall not be less than 130 g/sqm with a local minimum of 110 g/sqm.

Bitumen overcoat shall be of normal thickness of 70 microns unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II suitable for tropical climates factory applied preferably through an automatic process. Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

Internal lining: Internally pipe shall be Portland Cement mortar lined (as per IS - 8329-2000). The mortar shall contain by mass at least one part of cement to 3.5 part of sand. All pipes and fittings shall be internally lined with cement mortar using high speed centrifugal process in accordance with IWO 4179/IS 8329. Cement mortar lining shall be applied at the pipe manufacturing shop in conformity with the aforesaid standards. No admixtures in the mortar shall be used without the approval of the Engineer. The sand to cement proportion of sand if justified by the sieve analysis.

Pipe lining shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Engineer.

Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be as per IS: 8329 Annex-B or ISO 4179.

10.0 Joint

Jointing of DI pipes and fittings shall be push-on type Push-on-joints. The Contractor shall source the push-on-joint gaskets only from the pipe manufacturer. In turn the pipe manufacturer shall supply at least 10% additional quantity of gaskets over and above the requirement to the Contractor at no extra cost.

The gasket used for joints shall be suitable for natural and purified water conveyance. In jointing DI pipes and fittings, the

Contractor shall take into account the manufacturer's recommendations as to the methods and equipments to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that once the rubber ring is correctly positioned before the joint is made, does not get damaged by friction or sharp edges of the spigot Chamfer. The rubber rings and the recommend lubricant shall be obtained only through the pipe manufacturer.

Rubber ring bundles form every lot shall carry with them manufacturers test certificate for the following mechanical properties.

1. Hardness
2. Tensile strength
3. Compression test
4. Accelerated again test
5. Water absorption test
6. Stress relaxation test

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacturer's name and trade mark, the month and year of manufacture and the shelf life.

11.0 Testing of Pipe:

The main test among others to be conducted shall be as per IS:8329-2000 or with its latest revision/amendments.

[a] Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes as specified in the Standards. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS 11606-1986. The test results so obtained for all the pipes and fittings of different sizes shall be submitted to Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS;8329/EN 545 for pipes and IS:9523/EN 545 for fittings.

[b] Brinell Hardness Test

For checking the Brinell hardness the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS:1500. The test shall comply with the requirements specified in IS:1500/ISO 6506.

[c] Re-tests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements the lot shall be accepted Should either of these additional test pieces fall to pass the test, the lot shall be liable for rejection.

[d] Flow Test shall be done in two stage:

Stage 1

Pipe line shall be laid by resting the pipe line on supports at joints. The pipeline and all joints of pipes shall be made

thoroughly sound and water tight and any joint which may be observed to be leaky shall be immediately corrected. Thus after satisfactory flow test sand bedding shall be fill pipe line after laying pipe line. The refilling of trench shall be carried out then after.

Stage 2

After total laying & refilling of trenches, flow test shall be carried out again for particular section of length as suggested by engineer in charge.

12.0 Quality Assurance

The manufacturer shall have a laid down Quality Assurance Plan for the manufacture of the products offered which shall be submitted along with the tenders.

MARKING :

The methods of marking all the pipes to be delivered under scope of contract shall ensure that all the information will remain legible even after transportation, storage in open space etc. In general the legible and indelible marking upon the goods shall indicate the followings;

- i) Certification mark on each pipe.
- ii) Manufacturers brand name and/or trademark.
- iii) Purchasers mark as "MMC" be inscribe
- iv) The outside diameter and pressure rating.
- v) Batch number or lot number.
- vi) Inspector's mark on each pipe

INSPECTION

Inspection of pipes and specials will be carried out by Executive engineer or his representative agency appointed by MMC. All the expenditure for inspection shall be borne by the contractor except inspection charges if any in case of inspection agency appointed by MMC shall be paid by MMC.

PAYMENT

The payment shall be on RMT basis.

Mode of Payment : Payment restricted to 70% on receipt of material at project site, 20% payment on lowering, laying, jointing, refilling and disposal of surplus stuff, 10% payment on hydraulic testing and commissioning of project. Payment for 2 Km. of unlayed pipes of each diameter except 100 mm dia. will be paid on receipt at site. Payment for 100 mm dia. Pipe upto 5 Km. will be paid on receipt at site.

Item no 5:

Lowering, laying and jointing C. I. S & S Spun pipes suitable for Tyton joints / Mortar lined D. I. Pipes of various classes with CI / MS specials of following diameters in proper position, grade and alignment as directed by Engineer-in-charge including hydraulic testing etc. comp.

The pipes & joints shall be procured, supplied by the Contractor at work site at his own cost. Every care shall be taken in carting them to site. During transportation any damage shall be occurring to pipes for fittings the replacement of pipes given by the contractor at his own cost.

The trenches shall be well leveled so that pipes are laid evenly among them. The pipes shall be fixed within two rubber rings to be supplied by department at the place shown in schedule A, if directed by the Engineer-in-charge or mentioned in item of schedule B. The specification for titan joints i.e. Rubber Rings shall be as per details specification material section.

The contractor shall make his own arrangement for obtaining permission for storing & stacking of pipes etc. from land boards whether they are Government, Municipal Local Bodies or Private land owner.

Every pipes before lowering into the trenches shall be got checked and thoroughly cleaned and the beds of the trenches shall be properly graded and leveled as required on the line, without any claim for extra cost whether it is require The pipe shall be carefully lowered into the trenches with the help of a suitable type of chain pulley blocks, which shall first be approved by the Engineer-in-Charge. Each pipe shall be properly jacked and the spigot perfectly fixed into the socket. No jointing operation shall be started unless the gradients levels are approved by the Engineer-in-Charge or his representatives.

The pipes shall be laid complete in centerline ranged accurately by means of a string attached to both marked center of site rails and no deviation shall be permissible without the permission of Engineer-in-Charge. The pipe shall be laid in reasonably dry trenches and no circumstances on slushy bedding.

The pipes shall be brushed before lowering any laying or remove any soil or dirt etc. that may have accumulate

The inside socket and outside of the spigot-shall be carefully cleaned The pipe shall be lowered carefully with socket and toward and the flow of water or up till or as directed and spigot and should be carefully inserted into the socket and the space shall be filled with the joint.

TESTING OF WATER PIPES:

After each section of the pipeline has been completed it shall be tested for water tightness before being covered. The contractor shall at his own cost fill up water in pipe line and given necessary hydraulic test section by section and the pipe line shall stand the pressure which shall stand the pressure which shall exceed the working pressure by

- (a) 50% of the highest pressure in the section.
- (b) 30m whichever is less without showing any leakage or sweating anywhere in the pipes joints specials valves etc. if any defect are found the contractor shall be made good the same at his own cost.

Any leaking joints shall be made good and above test pressure in to be lowered gradually after satisfactory test is & over.

MMC/ OWNER will not be able to provide water for testing of the pipelines & water containers of the project. This shall have to be managed by the contractor at his costs and risk.

The hydraulic test shall be given again if considered necessary by the Executive Engineer or his representative to show that no further leakages or sweating is there. The contractor shall have to make necessary arrangements for water testing as well as plugging the opening of pipes etc. as directed without claiming any extra cost. The pipelines shall be kept filled with water for a work lines shall be kept filled with water for a week or till it is situated for testing is done.

If the pipe lines are laid in detached sanctioned & not in continuous length due to any reasons such as non-availability of specials or due to obstacle etc. The contractor shall see that no end of pipes length is kept open-ends are immediately covered up either by suitable blank flange or cap slug or by means of double layer gunny bags clothes tied properly by mild steel wire without any claim for extra- cost. The rate shall be per meter of pipe line laid including all specials and fitting jointly etc. Cutting and waste shall not be paid separately. The length shall be measured not on the straight line and curves along the center line over the pipe and specials correct up to 1 cm.

Method Of Measurement Of Pipes:

The measurement shall be recorded in running meter of pipe length laid along center line or axis of pipe line..

No payment shall be made for overlaps etc.

The payment shall be paid after completion of whole item as mentioned in price bid on Running Meter basis.

Mode of Payment : Payment restricted to 70 % on completion of laying & jointing & 30% on giving hydraulic test.

Item no 6:

Pump House Designing (Aesthetically) and constructing RCC frame structure of pump room with all necessary Electrification, Earthing with allied all civil work, with positive suction/Negative suction With gantry Structure (Min Height 4.5 m) upto 6.00 m plinth level to top slab beam, bottom (10*10=100 Sqmt.) With Gantry Structure Min Height 4.5 Mtr

&

Item no 7:

Pump House Designing (Aesthetically) and constructing RCC frame structure of pump room with all necessary Electrification, Earthing with allied all civil work, with positive suction/Negative suction With gantry Structure (Min Height 4.5 m) upto 6.00 m plinth level to top slab beam, bottom (10*20=100 Sqmt.) With Gantry Structure Min Height 4.5 Mtr

1. Scope of Work

The work shall include **architectural designing, structural designing, construction, finishing, electrification, earthing, gantry installation, and all allied civil works** for a Pump House building of size **10.0 m × 10.0 m (100 Sq.m)** internal floor area.

The structure shall be an **RCC framed structure** with minimum **4.5 m clear internal height** suitable for installation and maintenance of pumps, motors, valves, and crane/gantry operation. The total height from plinth level to bottom of roof slab shall be approximately **6.0 m**.

The work shall include arrangements for **positive suction or negative suction systems** as per approved drawings and site conditions.

All works shall conform to relevant **IS codes**, CPWD/GWSSB specifications (where applicable), and good engineering practices.

Contractor has to submit the detailed General Arrangement drawings (GAD) along with detailed structural drawings for various components with Electro-Mechanical Arrangement drawings with all allied components. Agency has to approve the drawings before starting the work at site from PMC and Client.

- **2. Design Requirements**

- **2.1 Structural Design**

- The structure shall be designed as an **RCC framed structure** consisting of:
 - Isolated/combined raft foundation (as per SBC)
 - RCC columns
 - RCC beams
 - RCC roof slab
- Structural design shall be based on:
 - Soil Bearing Capacity (based on geotechnical investigation)
 - Seismic Zone (as per IS 1893)
 - Wind Load (IS 875 Part III)
 - Dead & Live loads (IS 875 Part I & II)
 - Crane/Gantry load
 - **Codes to be Followed**
- IS 456 – Plain & Reinforced Concrete
- IS 800 – Steel Structures (for gantry)
- IS 875 – Loads
- IS 1893 – Seismic design
- IS 3370 – Concrete structures for water retaining (if sump integrated)
- NBC (Latest Revision)

- **3. Site Preparation and Earthwork**

- Site clearing, leveling and removal of debris.
- Excavation for foundation including shoring if required.
- Dewatering if required.
- Disposal of surplus excavated material within 50 m lead.
- Backfilling with selected excavated material and compaction in layers.

- **4. Foundation Works**

- PCC 1:4:8 (minimum 100 mm thick) below footings.
- RCC footings of minimum grade **M30**.
- Reinforcement: Fe-500 TMT bars.
- Anti-termite treatment before foundation concreting.
- Proper curing minimum 14 days.

- If negative suction system is provided, foundation shall accommodate:
- Pump sump well (RCC watertight structure)
- Thrust blocks for pipeline

- **5. RCC Superstructure**

- **5.1 Columns**

- RCC columns designed for structural loads.
- Concrete Grade: M25
- Reinforcement: Fe-500 TMT
- Proper cover blocks as per IS 456.

- **5.2 Beams**

- RCC beams at lintel and roof level.
- Gantry beam provision integrated structurally.
- Designed for crane load including impact factor.

- **5.3 Roof Slab**

- RCC slab minimum thickness 150 mm (or as per design).
- Designed for:
 - Maintenance load
 - Crane support (if required)
- Waterproofing treatment with polymer-modified membrane.
- Proper rainwater drainage slope.

- **6. Flooring**

- Floor finished with:
 - Heavy-duty industrial IPS flooring OR
 - VDF flooring (minimum 100 mm thick)
- Non-slip finish.
- Proper slope towards drainage channel.
- Chemical-resistant epoxy coating (if specified).

- **Masonry & Finishing**

- **7.1 Walling**

- External walls: 230 mm thick brick masonry / AAC block.
- Internal walls: 150 mm thick.
 - **Plaster**
- Internal plaster: 12 mm thick 1:6 cement mortar.
- External plaster: 15 mm thick 1:4 cement mortar with waterproof compound.
 - **Painting**
- Internal: Primer + 2 coats acrylic emulsion.
- External: Weatherproof exterior paint.
- Structural steel: 1 coat red oxide primer + 2 coats enamel paint.

- **Doors & Windows**

- Main entry: MS double-leaf door (min 2.5 m width for equipment movement).
- Ventilators with louvers.
- Aluminum/UPVC windows with safety grills.
- Proper natural ventilation provision.

- **Gantry Structure**

- **9.1 General**

- Structural steel gantry system with minimum clear height of **4.5 m**.
- Capacity: As per pump weight (minimum 2–5 Ton, unless specified).
- Includes:
 - Gantry beam (ISMB/ISWB section)
 - End carriage
 - Manual/Electric chain pulley block
 - Travel mechanism

- **9.2 Design**

- Designed as per IS 800.

- Load consideration:
 - Dead load
 - Live load
 - Impact load
- Anchor bolts embedded in RCC.
 - **Corrosion Protection**
- Two coats epoxy paint.
- Anti-rust treatment.

- **10. Pump Installation Provisions**
- **10.1 Positive Suction Arrangement**
 - Pump installed above sump level.
 - Proper suction pipeline with foot valve.
 - Thrust block.
 - Air release valve provision.
 - **Negative Suction Arrangement**
- Wet well construction.
- RCC sump chamber.
- Adequate submergence depth.
- Access ladder (SS).

- **11. Electrification Works**
- **11.1 Internal Wiring**
 - Concealed copper wiring (FRLS).
 - PVC conduits.
 - Industrial type switches.
 - Distribution Board (DB) with MCB/MCCB.
 - **Lighting**
 - LED industrial fixtures.
 - Emergency light provision.
 - External flood light.
 - **Power**
- Cable tray system.
- Proper gland & termination.
- Panel foundation block.

- **Earthing System**
 - Minimum **2 Nos. GI/Copper plate earthings.**
 - Earth pit size: 600 × 600 × 3000 mm.
 - Filled with charcoal and salt.
 - Earth resistance less than 5 ohms.
 - Separate earthing for:
 - Electrical panel
 - Motor body
 - Gantry structure

- **Plumbing & Drainage**
 - Floor drain connected to storm water drain.
 - Gully trap.
 - Pipe sleeves in slab.

- **Ventilation & Safety**
 - Exhaust fan provision.
 - Fire extinguisher (ABC type).
 - Safety signage.
 - Rubber mat near panel board.

- **External Development**
 - PCC apron 1.5 m wide around building.
 - Proper storm water drainage.
 - Plinth protection.

- **Quality Control**
- Cube testing for concrete.
- Steel test certificates.
- Slump test during concreting.
- Third-party inspection if required.
- **Measurement & Payment**
 - Design
 - Drawings
 - Structural proof check
 - All materials, labour, T&P
 - Testing & commissioning
- No extra payment shall be made for minor variations required for functional completion.
- **Completion Requirements**
- As-built drawings submission.
- Structural stability certificate.
- Electrical safety certificate.
- Earthing resistance test report.
- Trial run of gantry system.

Item no 8:

C.I. D/F VALVES: SLUICE VALVE:

Supply, installation, painting, testing and commissioning of double flanged, short body, C.I. Sluice valve confirming to IS 14846 PN 1.5 with bronze seat rings and SS 316 spindle with all carbon steel hardware's, gaskets with required accessories to be installed on suction & delivery side of each pump and bypass pipe. The valves of size 300 mm and above shall be provided with gear arrangement with all other necessary hot dipped galvanized hardware's, etc. along with spare parts as per data sheet and specifications. Sluice valves shall be electrically operated with limit switches, valve position indicator, forward/reverse integral and local & panel mounted starter, open/close indicating lamps push button, cable up to starter, hand wheel for emergency operation and all other necessary hot dipped galvanized hardware's along with spare parts as per data sheet and specification.

150 mm dia.

450 mm dia.

Design Requirements and construction Features

Sluice valve shall be non-rising spindle type resilient seated (Manually operated) confirming to IS: 14846/BS 5163 having PN 1.0/PN 1.6 rating free from sharp projections which are likely to catch and hold stringy materials.

Sluice valve shall be rising spindle type when operated through electric actuators confirming to IS: 14846/ BS 5163 having PN 1.0/PN 1.6 rating.

For valve size 50mm and above end connection shall be flanged and for sizes below 50mm shall be flanged/threaded type.

Body of the valve shall be designed for 1.5 times the rating of the valve.

Valve flange face shall be parallel to each other and flange face should be at right angle to the valve centerline.

Back side of valve flange shall be machined or spot faced for proper seating of bolt head and nut. Wherever extension spindle is provided, the valve shall also be provided with suitable headstock.

Valve shall close with clockwise rotation of the hand wheel. The direction of closing shall be marked on the hand wheel.

Valve shall be non-rising or rising spindle type and rated for nominal pressure of PN 1.0/PN 1.6 as per SOQ/BOQ or as specified in tender specification or as per application requirement.

Stem sealing shall be done with NBR wiper ring in case of resilient seated and bonnet gasket shall be of EPDM. Valve shall be powder coated electrostatically internally as well as externally by RAL blue colour.

Accessories shall be provided as under.

1. Valves 300mm and above size shall be provided with repacking arrangement as per IS: 14846.
2. The valves 600mm and above size shall have channel and shoe arrangement as per IS: 14846.
3. The valves 350mm size and above shall have spur/bevel gear arrangement as per IS: 14846.
4. All valves shall have valve's OPEN/CLOSE indicator arrangement as per IS: 14846.

Materials of Construction

a) Body and Bonnet	:	CI IS: 210 FG 200 OR DI IS: 1865 Gr. 500/7
b) Wedge	:	CI IS: 210 FG 200 OR DI IS: 1865 Gr. 500/7 and core fully Encapsulated with EPDM rubber with integral wedge nut (For non-rising resilient seated valves)
c) Spindle Nut	:	Bronze IS: 318 Gr. LTB2
d) Spindle	:	SS BS 970 Gr. 304 S16
e) Seat Rings	:	SS BS 970 Gr. 304 S16
f) Back Seat Bush	:	Bronze IS: 318 Gr. LTB2
g) Shoe and Channel Linings	:	SS to BS 970 Gr. 304 S16

For valve size 50mm and above end connection shall be flanged and for sizes below 50mm shall be flanged/threaded type.

However, valves 15mm to 40mm size shall be generally as per API 6D/API 602 and having Carbon Steel Body (Body: forged carbon steel A105/cast carbon steel Gr WCB, Trim: 13% Cr) in class 150 or higher rating and shall be screwed/flanged ended.

Item no 9:

Full Bore Electromagnetic Flow Meter- Regular Power operated Design, Supply, Installation, Testing, Commissioning of Full Bore Electromagnetic flow meter with factory calibration, Inbuilt Battery Power Operated, flanged connection, Flow sensor, Indicator, transmitter and totaliser with all accessories viz. surge arrestor, associated cables, cabinets, hardwares, etc complete as per following specifications Flow Meter/ Sensor:DC pulsed type, IP 68 Protection, Flanged process connection as per IS 1538 or equivalent standard, SS304/ Metallic Alloy Flow Tube, SS316/ SS 316 L/ Hastelloy Sensor, SS316/ Hastelloy Grounding Ring/ Inbuilt Grounding Electrode, Neoprene/Polyurethane/ Hard Rubber/ Rilsan lining, SS304/ Die Cast Aluminium/ Carbon steel with Anticorrosive Paint Coil Housing with Junction Box, CS flanges. Flow Transmitter/ Converter (Remote Field Mounted):Microprocessor based, Modular design, 2 line LCD for indication of actual flow rate, forward, reverse, sum totaliser display, $\pm 0.5\%$ accuracy at 0.3 to 4 m/sec velocity, 4 to 20 mA with HART/Modbus output, one scalable pulse, one status output, IP 67 protection, Die cast aluminium/ polycarbonate/ SS316 with Anticorrosive Paint/ PU finish with glass window enclosure, Inbuilt EEPROM and Data Logger, 20 meters cable length for sensor to transmitter communication etc along with wall mounted/ stand mounted cabinet.

150 mm dia.

450 mm dia.

Generally, the flow meter shall be as follows.

Flow metering System

Each flow metering system shall consist of the primary transducer, earthing rings, the necessary signal converter and power supply unit and all cabling between the primary transducer and signal converter and power supply unit. Flowmeter in general shall be sized considering maximum design line velocity as specified in this tender specifications (2.5m/sec maximum for pumped flow).

Each of the signal converts/power supply units shall be supplied for remote mounting, unless otherwise specified.

The signal converts/power supply units shall be provided with a 4-20 mA output signal, linear with flow and suitable for retransmission to remote instrumentation. The above units shall operate from a 230 V AC/24V DC supply.

The contractor shall provide sufficient suitable cable to allow for the primary transducers to be situated up to **30** meters from their signal converters, unless a longer length is specified.

The Contractor shall provide full details of the cable; he

proposes to use. The general specifications for

electromagnetic flow meter shall be as under.

Service		Clear Water Application
Function		To measure and indicate Instantaneous Flow and Totalised Flow/Transmit (Flow)
Fluid Conductivity		> 5 $\mu\text{S}/\text{cm}$
Installation		Indoor or Outdoor, Below or Above Ground as per piping/site conditions
Operating Temperature		0 to 50 $^{\circ}\text{C}$
Accuracy		$\pm 0.5\%$ of Flow Rate/Measured Value or better

Flow Sensor/Tube/ Element		
Type of Sensor		Full Bore type
Flange Materials		CS/MS with anti-corrosive epoxy paint or better as per manufacturers' standards
Tube Material		SS 304 or SS 316
Liner Material		Hard Rubber/PU
Body Material/Coil Housing		MS/CS or better with anti-corrosive epoxy paint
Electrode Material		SS 316L or Ha-C
Power Supply		From Transmitter
Grounding	Type/Material	Earthing Electrode/Set of earth rings SS 316
Protection Class		IP 68
Cable Entry (for separated/ remote version) and Glands		Shall be as per manufacturers' standards and suitable to maintain the specified protection class at site
Cable Length	Sensor to Transmitter	Minimum 30m, dual shielded cable
Painting, where applicable	CS/other	Chemical Resistant, Epoxy Painted
Transmitter		
Function		Transmit and Indicate
Type		Remote (Non-Integral) type, Microprocessor based, User Programmable, 2-Wire or 4-Wire type as per mfr. Std.
Flow/Velocity Measurement Range	Maximum Flow Velocity	Flowmeter shall be capable to measure flow with velocity up to maximum 5 meter/second
	Minimum Flow Velocity	up to 0.3 meter/second (shall measure flow without loss of accuracy up to 0.5 m/sec and below that, accuracy shall be as per manufacturers' standards)

Accuracy	Flow Velocity \geq 0.5 m/s	\pm 0.5% of Flow Rate/Measured Value or better
	Flow Velocity $<$ 0.5 m/s	as per manufacturers' standards for flow velocity up to 0.3 m/s
Analogue Output Signal	For Flow	Isolated, 4 -20 mA DC with HART/Modbus RS 485
Pulsed O/P		Required For Totalized flow
Instrument Power Supply		100 to 240V AC \pm 10%, 50 Hz \pm 5% or 24V DC as per manufacturers' standards
Cable/Conduit Entry		1/2" NPT.
Local Indicator / Display	Inst. and Total Flow	LCD Display (Instantaneous flow and 8/9 digit internal totalized flow)
Enclosure	Type and Protection Class	Weather Proof to IP 66 as minimum or better
	MOC	Cast Aluminum or equivalent as per manufacturers' standards suitable for withstanding harsh environment with chemical resistant/epoxy coating
	Type	Wall mounting/Pipe mounting
Vibration Conditions		Conformity with IEC 60068-2-6 or equivalent, shall be able to endure vibration, when in service, without any degradation in performance
Pipe Not Full (Partial Full) Detection/Empty Pipe Detection		Required

Cabinet for Transmitter	To prevent from direct sun and rain	Required. Lockable MSEP housing with front transparent door cover for viewing
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Flow (Instantaneous and Totalised) readings shall be continuously displayed locally as well as in remote at SCADA at control room.

Flow meter shall be mounted as per manufacturer's recommendation and good engineering practices and each flow meter shall be provided with a bellows at suitable location to enable ease of removal/ insertion of flow meter for maintenance. For flow meter mounted below ground level, chamber shall be sized suitably to accommodate flowmeter and bellows in the same chamber.

Item no 10:

Supply, testing & commissioning of flange ends Expansion Bellow as per EJMA standards of overall length of minimum 300 mm, designed for 15 mm axial compression and 5 mm axial extension with tie rods etc. of following MOC & pressure ratings MOC: Bellows: SA 240 Gr. 304; Internal Sleeve: SA 240 Gr. 304; Weldends: IS 2062 Gr. B; Flanges: IS 2062 Gr. B (Drilling as per IS 1538 /IS 6392) & Limit Rods & Nuts: CS - IS 1367.

150 mm dia.

450 mm dia.

Expansion bellow shall be fabricated in accordance with the EJMA/ASME standard.

The bellows shall be metallic corrugated design of MOC as specified and shall have flanged ends on both sides with liner/internal sleeve. The fatigue life expectancy considered for EB shall be minimum 3000 cycles. The drilling standard of EB flange shall be matched on piping side to ensure proper alignment and bellows is not subjected to torsional forces due to misalignment. It shall be single bellow design and suitable for axial movement of up to total 30mm (20mm axial compression and 10mm axial extension). Further it shall be suitable accommodate angular misalignment of piping for up to minimum 5mm/3 degrees for installation. The overall length of expansion joint for up to 300mm dia. size shall be 250mm, for above 300mm and up to 1000mm it shall be 300mm and for above 1000mm the same shall be 350mm. The austenitic stainless steel shall be welded using the TIG welding method. The shipping bracket of bellows shall be removed only after installation of the bellows at site.

To achieve maximum flexibility coupled with required resistance to pressure, bellows shall be formed with single or multiple walls using a number of concentric cylinders (multi-ply construction) of specified MOC, each longitudinally welded. However for the blower application the bellows shall be of multi-ply construction only.

Generally the expansion joint is provided of single bellow design as a dismantling/disassembly joint in piping near valve or pump or flow meter or such device or equipment for ease of removal and jointing. Tie rods/threaded draw bars attached to expansion joint assembly shall be provided for this application.

In case of bellows used for air piping application/in air blower discharge piping or such application witnessing vibration and temperature variations the expansion joint shall be single bellow with or without limit rods as recommended by manufacturer suitable to absorb axial movement and to suit this requirement. In case of bellows used for diaphragm type dosing pump or such pulsating service the expansion joint shall be single bellow with or without limit rods as recommended by manufacturer suitable to absorb axial movement and to suit this requirement.

The weld end pipe shall be suitable for design pressure (Minimum PN 10 or higher as per design) and for CS/MS weld end pipe shall be with minimum corrosion allowance of 3mm for water/waste water application. However for blower application the bellows shall be designed for a working pressure of minimum 1 Bar or higher as per design and for a temperature of minimum 115°C or higher as per design and for velocity of minimum 25 m/sec or higher as per design and the liner thickness shall be suitable for the same.

During installation the bellows as a practice shall always to be placed between two fixed points. Thrust block or saddle welded to pipe to make it fixed must be provided on both sides of EB. For blower application generally after the bellow the first support (saddle or suitable) shall be provided at 4D distance and second support 14D distance from bellows to dampen the vibrations.

Materials of Construction

Component	Water/Sewage/Sec. Treated Indl. Effluent/Air Application	Indl. Effluent/Bio-Gas/ Chemicals or Corrosive Application
Bellows	SS 304 (ASTM A 240 Tp. 304)	SS 316 (ASTM A 240 Tp. 316)
Internal Sleeves/Liners	SS 304 (ASTM A 240 Tp. 304)	SS 316 (ASTM A 240 Tp. 316)
Weld End Pipe	CS/MS	SS 316L
Flanges	IS: 2062 with drilling as per IS: 1538, PN 10	IS: 2062 with drilling as per IS: 1538, PN 10 with SS lining (all wetted portion with SS lining)
Tie/Limit Rods	Carbon Steel as per IS: 1367	SS 316
Nut, Bolt, Hardware	Carbon Steel as per IS: 1367	SS 316

Note: For Chemical (Alum, polyelectrolyte etc.) or Corrosive applications the above specified MOC are minimum and higher/better/suitable MOC shall be provided as per the nature of chemical/fluid.

Item no 11:

Manufacture, Supply & Delivery of Ductile Iron Flange socket spigot bends, tees, reducers or any other specials as per BS-EN-545/1995 Class-A series K12 suitable for use with D.I. Pipes manufactured as per IS:8329/1994 delivery of specials is to be made to site of works including all taxes, loading, unloading, carting, stacking, insurance, inspection charges, octroi etc. complete.

Manufacture, supply and delivery of Ductile Iron Flange Socket spigot bends, tees, reducers or any other specials as per BS-EN-545 / 1995 class-A series K-12 suitable for use with DI pipes manufactured as per IS 8329/1994 delivery of specials is to be made to site of works

including all taxes, loading, unloading, carting, stacking, insurance, inspection charges, Octroi etc. complete with internal cement mortar lining with EPDM rubber gaskets.

- B) Manufacture, supply and delivery of flanges, Tee, bends, tail piece, reducers, air valve raiser pipes or any other specials suitable for use with DI pipes and delivery of specials is to be made to site of works anywhere in Gujarat including all taxes, loading, unloading, carting, stacking, insurance, inspection charges, Octroi etc. complete.
- C) Manufacture, supply and delivery of CID joints with Rubber Rings of Standard quality or any other specials suitable for use with I. pipes and delivery of specials is to be made to site of works anywhere in Gujarat including all taxes, loading, unloading, carting, stacking, insurance, inspection charges, Octroi etc. complete
- D) DI Specials with all types of diameters suitable of K9 grade pipes with Inner cement mortal lining. The necessary DI Specials required during the lowering & lying of Ductile Iron Pipe shall be supplied by the agency and shall be as per standard specification.
- E) It shall be of best quality as per requirement Rate shall be including loading,
- F) unloading, carting, insurance and labour charge etc. complete.

PAYMENT

The payment shall be made on kg. basis.

Mode of Payment : Payment restricted to 70 % on completion of laying & jointing & 30% on giving hydraulic test.

ROAD RESTORATION WORK

Item no 1:

Construction of 200mm thick Granular Sub Base (Grading I) by providing coarse graded Black Trap material, mixing by mechanical means / rotavator, spreading in uniform layers with motor grader as per required slope and gradient on prepared surface and compacting with vibratory roller at OMC to achieve the desired compaction complete as per MORT & H clause 401

Materials :-

Maximum particle size of the corresponding grading for the natural sand, gravel materials are given at Table 9-1. The grading to be adopted for a project shall be as specified in the Contract. If the thickness of GSB layer is more than 150 mm then the sub-base is required to laid in two layers as upper sub-base and lower sub-base.

Table 9-1 : Grading for Granular Sub-base Materials

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55 –90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	–	–	35-65	55-75
4.75 mm	25 – 55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20- 40	30-50	–	–	10-20	10-25
0.85 mm	–	–	–	–	2-10	–
0.425 mm	10-15	10- 15	–	–	0-5	0-8
0.075 mm	<5	< 5	< 5	< 5	–	0-3

Table 9-2 : Physical Requirements for Materials for Granular Sub-base

Aggregate Value (AIV)	Impact	IS:2386(Part4) or IS:5640	Maximum 40
Liquid Limit		IS:2720 (Part 5)	Maximum 25
Plasticity Index		IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)		IS:2720 (Part 5)	Minimum 30

Construction Operations :-

Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished shall be prepared

by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

Spreading and Compacting

The sub-base material of the grading specified in the Contract shall be spread on the prepared sub grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations as in small sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall or on super elevation. For carriageway having cross fall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Surface Finish and Quality Control of Work :-

CONTROL OF ALIGNMENT, LEVEL AND SURFACE REGULARITY

General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer, subject to the permitted tolerances described herein-after.

Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a

tolerance of ± 10 mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 25 mm.

Surface Levels

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in below Table.

Table: Tolerances in Surface Levels

1)	Subgrade	± 20 mm
2)	Sub-base a) Flexible pavement b) Concrete pavement	± 10 mm ± 6 mm
3)	Base-course for flexible pavement a) Bituminous Base/Binder course b) Granular i) Machine laid ii) Manually laid	± 6 mm ± 10 mm ± 15 mm
4)	Wearing course for flexible pavement a) Machine laid b) Manually laid	± 6 mm ± 10 mm
5)	Cement concrete pavement	± 5 mm

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than the following limits:

- 4 mm for bituminous wearing course of thickness 40 mm or more
- 3 mm for bituminous wearing course of thickness less than 40 mm
- 5 mm for concrete pavement slab

For checking compliance with the above requirement for subgrade, sub-base and base course, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

For checking the compliance with the above requirement for bituminous wearing courses and concrete pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25 m along the length and at 0.5 m from the edges and at the centre of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 metre long straight edge/moving straightedge as directed by the Engineer at the middle of each traffic lane along a line parallel

to the centre line of the road.

The maximum permitted number of surface irregularities shall be as per given Table

Table : Maximum Permitted Number of Surface Irregularities

	Surfaces of Carriageways and Paved Shoulders				Surfaces of Laybys, Service Areas and all Bituminous Base Courses			
Irregularity	4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
Number of Surface Irregularities on National Highways/ Expressways*	15	9	2	1	40	18	4	2
Number of Surface Irregularities on Roads of lower Category*	40	18	4	2	60	27	6	3

* Category of each section of road as described in the Contract.

The maximum allowable difference between the road surface and underside of a 3 m straightedge when placed parallel with, or at right angles to the centre line of the road at points decided by the Engineer shall be:

for pavement surface (bituminous and cement concrete)	3 mm
for bituminous base courses	6 mm
for granular sub-base/base courses	8 mm
for sub-bases under concrete pavements	10 mm
for subgrade	15 mm

Rectification

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances, the Contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

- i) Subgrade: Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of tender document.
- ii) Granular Sub-base: Same as at (i) above, except that the degree of compaction and the type of material to be used shall conform to the requirements of tender document.
- iii) Lime/Cement Stabilized Soil Sub-base: For lime/cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below. For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material is less than 2 hours, the surface shall be scarified to a depth of 50 mm, supplemented with freshly mixed materials as necessary and recompacted as per the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material to Specification. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

- iv) Water Bound Macadam /Wet Mix Macadam Sub-base/Base: Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompactd
- v) Bituminous Constructions: For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat, if needed, and recompacting as per specifications. Where the surface is high, the extra thickness in the affected layer shall be removed and replaced with fresh material and compacted to Specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3.5 m in width

If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerances shall be demolished and reconstructed at the Contractor's cost.

Riding Quality

The riding quality of bituminous concrete wearing surface, as measured by a standard towed fifth wheel bump integrator, shall not be more than 2000 mm per Km.

Control on the quality of materials and works shall be exercised by the Engineer as per

Table 9-3 : Test and Frequency for Materials for Granular Sub-base

Type of Construction	Test	Frequency (As per Circular No. 66)	IS Code
Granular Sub- Base	Gradation	One test per 400 Cu.m.	IS:2386, Part-I-1963
	Atterberg Limits (Liquid Limit, Plasticity Index)	One test per 400 Cu.m.	IS:2720, Part-V
	Moisture content prior to compaction	One test per 400 Cu.m.	IS:2720, Part-II
	Density of compacted layer	One test per 1000 sq.m	IS:2720, Part-VIII
	CBR	As required	IS:2720, Part-XVI

Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be provided. The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per instruction of the Engineer-in-charge.

Measurements for Payment

The rate shall be for a unit of one cubic meter.

Item no 2:

Providing, laying, spreading and compacting graded stone aggregates to Wet Mix Macadam in 150 mm thickness as per MORT & H specification including premixing the material with water at OMC in mechanical mix plant, carriage of mixed material by

tipplers to site, laying in uniform layers with paver or motor grader in sub base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density. complete as per MORT & H clause 406

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub- base/ base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be upto 200 mm with the approval of the Engineer.

Materials

Physical Requirements

Coarse aggregates shall be crushed stone. The aggregates shall conform to the physical requirements set forth in Table 10-1. **Beti, Rampar special aggregate is only acceptable.** If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

Table 10-1 : Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base/Base Courses

S. No.	Test	Test Method	Requirements
1.	Los Angeles Abrasion value or Aggregate Impact value	IS:2386 (Part-4)	40 percent (Max.)
		IS:2386 (Part-4) or IS:5640	30 percent (Max.)
2.	Combined Flakiness and Elongation indices (Total)	IS:2386(Part-1)	35 percent (Max.)*

* To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up

Grading Requirements

The aggregates shall conform to the grading given in Table 10-2.

Table 10-2 : Grading Requirements of Aggregates for Wet Mix Macadam

IS Sieve Designation	Percent by weight passing the IS Sieve
53.0 mm	100
45.0 mm	95-100
26.5 mm	-
22.40 mm	60-80

11.20 mm	40-60
4.45 mm	25-40
2.36 mm	15-30
600 micron	8-22
75 micron	0-5

Material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

Construction Operations:-

Preparation of Base

The surface of the sub-grade/sub-base/base to receive the Wet mix macadam course shall be prepared to the specified grade and camber and cleaned of dust, dirt and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained.

Where the Wet mix macadam is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for Wet mix macadam.

Preparation of Mix

Wet Mix Macadam should be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.

Quantity of water should not vary from OMC determined as per IS : 2720 (part VIII) by more than agreed limit. The mixed material should be uniformly wet and no segregation should be permitted.

Spreading of mix

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub grade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self-propelled, having the following features:

- (i) Loading hoppers and suitable distribution mechanism
- (ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
- (iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The surface of the aggregate shall be carefully checked with templates and all high or low

sports remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of layer and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

Compaction:

After the mix has been laid to the required thickness, grade and cross fall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, smooth wheel roller of 80 to 100 KN weight may be used. For a compacted single layer up to 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions. Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS : 2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

Setting and drying:

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

Opening to Traffic

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

Surface Finish and Quality Control of Work

Quality control:

Control on the quality of materials and works shall be exercised by the Engineer as per Table 10-3.

Table 10-3 : Test and Frequency for Materials for Wet Mix Macadam

Type of Construction	Test	Frequency (As per Circular No. 66)	IS Code
Wet Mix Macadam	Gradation	One test per 200 Cu.m.	IS:2386, Part-I-1963
	Aggregate Impact Value	One test per 1000 Cu.m.	IS:2386, Part-IV
	Combined Flakiness and Elongation Indices	One test per 500 Cu.m.	IS:2386, Part-I
	Atterberg Limits of portion of aggregates passing 425-micron sieve	One test per 200 Cu.m.	IS:2720, Part-V
	Density of compacted layer	One set of three tests per 1000 sq.m	IS:2720, Part-VIII

Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompact. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

Arrangement for Traffic

During the period of construction, arrangements for the traffic shall be provided. The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per instruction of the Engineer-in-charge.

Measurements for Payment

The rate shall be for a unit of **one cubic meter**.

Item no 3:

Providing and laying 50 mm thick compacted bitumenous macadam (BM) with Emulsion tack coat @ 2.50 Kg./ 10 Sqmt using crushed stone aggregate as per MORT & H gradation VG-30 grade bitumen at the rate of 3.40% by weight of total mix (i.e. 34kg/mt by wt. of total mix) for binding including heating and mixing the asphalt and aggregates by continuous batch mix plant and transporting the mix and spreading the same by paver finisher and consolidation with vibratory road roller including using all necessary equipments, tools, plants, including cost of all materials, firewood, oil, lubricants, labour

charges etc. complete.

Materials

Bitumen

The bitumen shall be viscosity grade (VG-40) paving bitumen complying with the Indian Standard Specification IS:73.

Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. The aggregates shall satisfy the requirements specified in Table 13-1 and these property of aggregate should be checked by the Engineer in charge in the Mix Design submitted by the contractor.

Table 13-1 : Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS: 2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS: 2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS: 2386 Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS: 2386 Part V
Water Absorption	Water Absorption	Max 2%	IS: 2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min 80%	AASHTO 283

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.

Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

Fine Aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However, natural sand upto 50 percent of the fine aggregate may be allowed in base courses.

Filler

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the following limits :-

Table 13-2 : Grading Requirements for Mineral Filler

IS sieve (mm)	Cumulative Percent Passing by Weight of Total Aggregate
0.6	100
0.3	95-100
0.075	85-100

The filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. 505.2.5 Aggregate

Grading and Binder Content

When tested in accordance with IS.2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in Table 13-3 for grading 2.

Table 13-3 : Composition of Dense Graded Bituminous Macadam

Grading	2
Nominal aggregate size*	26.5
Layer Thickness	50 - 75 00 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing
45	-
37.5	100
26.5	90-100
19	71-95
13.2	56-80
9.5	-
4.75	38-54
2.36	28-42
0.3	7-21
0.15	-
0.075	2-8
Bitumen content % by mass of total mix	Min 4.5**

* The nominal maximum particle size is the largest specified sieve size upon which any of the

aggregate is retained.

** Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 10°C or lower, the bitumen content may be increased by 0.5 percent. Bitumen content indicated in above Table is the minimum quantity. The quantity shall be determined in accordance with Clause of Mix Design.

Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2.

The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2.

Requirements for the Mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 13-4.

Table 13-4 : Requirements for Dense Graded Bituminous Macadam

Properties	Viscosity Grade Paving Bitumen	Test Method
Compaction level	75 blows on each face of the specimen	
Minimum stability (kN at 600C)	9.0	AASHTO T245
Marshall flow (mm)	2 - 4	AASHTO T245
Marshall Quotient (Stability / flow)	2 - 5	MS-2 and ASTM D2041
% air voids	3-5	
% Voids Filled with Bitumen (VFB)	65-75	
Coating of aggregate particle	95% minimum	IS:6241
Tensile Strength ratio	80% Minimum	AASHTO T 283
% Voids in Mineral Aggregate (VMA)	11.0 – 13.0	

Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in Table 13-4. The binder content shall be selected to obtain 4 percent air voids in the mix design. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2.

Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method

using 150 mm diameter specimen described in MS-2 and ASTM D 5581 shall be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

Minimum Percent Voids In Mineral Aggregate (VMA)

Nominal Maximum Particle Size ¹ (mm)	Minimum VMA Percent Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Note : Interpolate minimum voids in the mineral aggregate (VMA) for designed percentage
Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows:
 - a) Binder type, and percentage by weight of total mix;
 - b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The individual gradings of the individual aggregate fraction, and the proportion of each in the combined grading;
- v) The results of mix design such as maximum specific gravity of loose mix (G_{mm}), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test:
- vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch;
- vii) Test results of physical characteristics of aggregates to be used;
- viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

Permissible variation from job mix formula:

It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in below Table.

Table 13-5 : Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	±8%
Aggregate passing 13.2 mm, 9.5 mm	±7%
Aggregate passing 4.75 mm	± 6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±5%
Aggregate passing 0.3 mm, 0.15 mm	±4%
Aggregate passing 0.075 mm	±2%
Binder content	± 0.3%
Mixing temperature	± 10°C

Construction Operations

Preparation of Base

The base on which Dense Bituminous Macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical means cannot reach, other approved method shall be used. A priming coat where needed, shall be applied as directed by the Engineer

Prime Coat

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified in the tender specification or as directed by the Engineer.

Tack Coat

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified in the tender specification or as directed by the Engineer.

Mixing and Transportation of the Mix

Pre-mixed bituminous materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures are given in Table 13-6 of these Specifications, the difference in temperature between the binder and aggregate shall at no time exceed 14°C. In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time.

Table 13-6 : Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celsius)

Bitumen Viscosity Grade	Bitumen Temperature	Aggregate Temperature	Mixed Material Temperature
VG-40	150-165	150-170	150-165

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Bituminous materials shall be transported in clean insulated and covered vehicles. An asphalt release agent, such as soap or lime water, may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

Spreading

The mix transported from the hot mix plant to the site shall be spread by means of a self-propelled paver with suitable screeds capable of spreading, tamping and finishing the mix to specified grade, lines and cross-section. The paver finisher shall have the following essential features:

- (a) Loading hoppers and suitable distributing mechanism.
- (b) All drives having hydrostatic drive/control.
- (c) The machine shall have a hydraulically extendable screed for appropriate width requirement.
- (d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting of otherwise marring the surface. It shall have adjustable amplitude and variable frequency.
- (e) The paver shall be equipment with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- (f) The paver shall be fitted with an electronic sensing device for automatic levelling and profile control within the specified tolerances.
- (g) The screed shall have the internal heating arrangement.
- (h) The paver shall be capable of laying width 7.50 mt. to extended up to 9.5mt.),
- (i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation.

However, in restricted locations and in narrow widths where the available equipment cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix. Similarly for smaller jobs, mechanical paver may be used with the approval of the Engineer.

The temperature of mix at the time of laying shall be more than 120° C.

Mixes with a temperature of less than 120° C shall not be put into paver spreader. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal and transverse joints shall be offset by at least 250 mm from those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter and the surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80° C laying of adjacent material.

Rolling

After spreading the mix by paver, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not more than 5 km/h, immediately following close to the paver. Generally the initial or breakdown rolling shall be done with 80-100 kN static weight smooth wheeled roller. The intermediate rolling shall be done with 80-100 kN static weight vibratory roller or with a pneumatic tyred roller of 150-250 kN weight having a tyre pressure of at least 0.7 MPa. The finish rolling shall be done with 60-80 kN weight smooth wheeled tandem roller. All the compaction operations, i.e., breakdown rolling and intermediate rolling can be accomplished by using vibratory tandem roller of 80-100 kN static weight. During initial breakdown rolling and finish rolling, no vibratory compaction shall be resorted to. The exact

pattern of rolling shall be established after trial compaction as approved by the Engineer. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good. The rollers shall not be permitted to stand on pavement which has not been fully compacted and where temperature is still more than 70° C. Necessary precautions shall be taken to prevent dropping of oil, grease, petrol or other foreign matter on the pavement either when the rollers are operating or standing.

The wheels of roller shall be kept moist to prevent the mix from adhering to them. But in no case shall fuel/lubricating oil be used for this purpose nor excessive water poured on the wheels. Rolling shall commence longitudinally from edges and proceed towards the centre, except that on superelevated and unidirectional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller shall proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall overlap the preceding one by half the width of the rear wheel. Rolling shall be continued till the proper density is achieved and all roller marks are eliminated. Skin patching of an area that has been rolled will not be permitted. Rolling operations shall be completed in all respects before the temperature of the mix falls below 100° C.

Opening to Traffic

It shall be ensured that the traffic is not allowed on the surface until the dense bituminous layer has cooled to the ambient temperature.

Surface Finish and Quality Control of Work

Quality control:

Control on the quality of materials and works shall be exercised by the Engineer as per

Table 13-7 : Control Tests for Bituminous Works and their Minimum Frequency

Type of Construction	Test	Frequency (Min.)
Dense Bituminous Macadam / Bituminous Concrete	Quality of binder	Material Testing Certificate (MTC) is required from IOC as per number of samples per lot.
	Aggregate Impact Value/ Los Angeles Abrasion Value	One test per 100 cu.m of aggregate for each source and whenever there is change in the quality of aggregate
	Flakiness and Elongation Indices	One test per 100 cu.m of aggregate for each source and whenever there is change in the quality of aggregate
	Water absorption of aggregates	One test for each source and whenever there is change in the quality of aggregate
	Mix grading	One test per 200 cmt subject to minimum of two tests per day per plant.
	Marshall stability and	Three tests for stability, flow value,

	voids analysis of mix	density and void contents for each 400 tonne of mix subject to minimum of two tests per day per plant.
	Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	At regular intervals
	Binder content	One set for each 400 tonnes of mix subject to minimum of two tests per day per plant
	Density of Compacted layer	One test per 300 mt length of road

Arrangement for Traffic

During the period of construction, arrangements for the traffic shall be provided. The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per instruction of the Engineer-in-charge.

Measurements for Payment

The rate shall be for a unit of one MT.

In addition to above, the contract unit rate of bituminous work shall also includes:

1. Finding of buried man hole during resurfacing activity if any
2. Cleaning of bitumen from all catch pits.
3. Submission of colored photographs of cleaned catch pits
4. Removal of all debris from site.

Item no 4:

Providing & laying 30 mm. thick Compacted Bitumen Concrete(BC) with BT aggregate as per M.O.R.T.&H. gradation & asphalt grade VG-30 for mixing at the rate of 54 Kg./M.T. i.e. 5.40% of total weight of total mix including heating the aggregate & asphalt in continuous batch mix plant & spreading the same by sensor paver finisher & consolidation with vibratory roller & flushing sand @ 0.30 Cum/ 100 Smt. including providing all materials equipment, tools & plants, fire wood, oil, kerosene, labour charges etc complete using contractors own machinery drum mix plant & paver finisher etc complete.

Materials

Bitumen

The bitumen shall be viscosity grade (VG-40 / modified Bitumenous) paving bitumen complying with the Indian Standard Specification IS:73.

Coarse Aggregates

Clause of Dense Bituminous Macadam (DBM) shall apply. The aggregates shall satisfy the requirements specified in Table 14 -1 and these property of aggregate should be checked by the Engineer in charge in the Mix Design submitted by the contractor.

Table 14-1 : Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS: 2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS: 2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 30% Max 24%	IS: 2386 Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS: 2386 Part V
Polishing	Polished Stone Value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS: 2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min 80%	AASHTO 283

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.

Fine Aggregates

Clause of Dense Bituminous Macadam (DBM) shall apply.

Filler

Clause of Dense Bituminous Macadam (DBM) shall apply.

Grading and Binder Content

When tested in accordance with IS.2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in Table 14-2 for grading 2.

Table 14-2 : Composition of Bituminous Concrete.

Grading	1	2
Nominal aggregate size*	19 mm	13.2 mm
Layer Thickness	50 mm	30-40 mm
IS Sieve1 (mm)	Cumulative % by weight of total aggregate passing	
26.5	100	-
19	90 - 100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix	Min 5.4**	Min 5.4**

* The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

** Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is - 10°C or lower, the bitumen content may be increased by 0.5 percent. Bitumen content indicated in above Table is the minimum quantity. The quantity shall be determined in accordance with Clause of Mix Design.

Mix Design

Requirements for the Mix

Clause of Dense Bituminous Macadam (DBM) shall apply.

Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in Table 14-2.

Clause of Dense Bituminous Macadam (DBM) shall apply.

Job Mix Formula

Clause of Dense Bituminous Macadam (DBM) shall apply.

Permissible variation from job mix formula:

It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in below Table.

Table 14-3 : Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	±7%
Aggregate passing 13.2 mm, 9.5 mm	±6%
Aggregate passing 4.75 mm	± 5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±4%
Aggregate passing 0.3 mm, 0.15 mm	±3%
Aggregate passing 0.075 mm	±1.5%
Binder content	± 0.3%
Mixing temperature	± 10°C

Construction Operations**Preparation of Base**

The base on which Bituminous Concrete is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical means cannot reach, other approved method shall be used as per instruction of engineer in charge.

Tack Coat

Where the material on which the Bituminous Concrete is to be laid, tack coat shall be applied, as specified in the tender specification or as directed by the Engineer.

Mixing and Transportation of the Mix

Clause of Dense Bituminous Macadam (DBM) shall apply.

Spreading

Clause of Dense Bituminous Macadam (DBM) shall apply.

Rolling

Clause of Dense Bituminous Macadam (DBM) shall apply.

Opening to Traffic

It shall be ensured that the traffic is not allowed on the surface until the bituminous concrete layer has cooled to the ambient temperature.

Surface Finish and Quality Control of Work

Arrangement for Traffic

Clause of Dense Bituminous Macadam (DBM) shall apply.

Measurements for Payment

The rate shall be for a unit of one MT.

In addition to above, the contract unit rate of bituminous work shall also includes:

1. Finding of buried man hole during resurfacing activity if any
2. Cleaning of bitumen from all catch pits.
3. Submission of colored photographs of cleaned catch pits
4. Removal of all debris from site.

Item no 5:

Providing and laying in position Control concrete M-300 grade concrete for using cement content as per approved design mix, improve workability without impiring strength and durability as per direction of the engineer-in-charge. (Min cement level as per latest IS 456 shall be maintained) (Cement level 360kg) for 150mm thick Trimix C.C. Road with trimix vaccum dewatering system work with power trowling sheet form with M.S. Channles, surface vibrator , finishing with floor hardner necessary all equipments, all labour charges complete.

1. Scope of Work

The work comprises **designing the concrete mix, providing, laying, compacting, vacuum dewatering, finishing, curing, testing and completing** 150 mm thick **M-30 grade (M-300) cement concrete road** using **Trimix Vacuum Dewatering System**, including:

- Approved Design Mix Concrete (Minimum cement content: 360 kg/m³)
- Use of admixtures to improve workability without impairing strength and durability
- MS channel side formwork
- Mechanical batching and mixing
- Surface and screed vibration
- Vacuum dewatering system
- Application of floor hardener
- Power trowel finishing
- Joint cutting and sealing
- Curing and protection
- Testing and quality control
- All labour, machinery, tools, consumables, and incidental works complete

The work shall be executed strictly as per latest IS Codes, IRC guidelines, and directions of the Engineer-in-Charge.

2. Applicable Standards

- IS 456 – Plain & Reinforced Concrete
- IS 10262 – Concrete Mix Design
- IS 383 – Aggregates for Concrete
- IS 9103 – Chemical Admixtures
- IS 1199 – Methods of Sampling & Analysis
- IS 516 – Compressive Strength Test
- IRC 15 – Concrete Road Construction

Latest amendments shall apply.

3. Materials

3.1 Cement

- OPC 43/53 Grade or PPC conforming to relevant IS.
- Minimum cement content: **360 kg per cubic meter.**

- Stored in dry condition.

3.2 Aggregates

- Coarse Aggregate: 20 mm down graded, angular, clean.
- Fine Aggregate: Zone II/III sand.
- Free from deleterious materials.

3.3 Water

- Potable quality.
- Free from oils, acids, and salts.

3.4 Admixtures

- Approved plasticizer/superplasticizer.
- Improves workability.
- Shall not reduce strength or durability.
- Dosage as per manufacturer and design mix approval.

3.5 Floor Hardener

- Metallic or non-metallic type.
- Abrasion resistant.
- Application rate: 3–5 kg/m².

4. Concrete Specifications

- Grade: M-30 (Characteristic strength = 30 MPa at 28 days)
- Minimum Cement: 360 kg/m³
- W/C Ratio: As per approved design mix and durability requirements
- Slump: 75–100 mm (suitable for Trimix process)
- Batching: Weigh batching only

5. EXECUTION METHODOLOGY

5.1 Subgrade Preparation

1. Subgrade shall be compacted to minimum 95% Modified Proctor Density.
2. Leveling and dressing shall be completed to required camber and slope.
3. Soft spots shall be removed and replaced.
4. Final level approval shall be obtained before concreting.

5.2 Formwork Installation

1. M.S. channel sections shall be used as side forms.
2. Proper alignment, line and level shall be ensured.
3. Forms shall be rigidly supported to prevent displacement.
4. Internal surfaces shall be oiled before concreting.
5. Forms shall be capable of withstanding vibration loads.

5.3 Batching & Mixing

1. Concrete shall be produced using mechanical batching plant.
2. Weigh batching shall be strictly followed.
3. Mixing time shall ensure uniform consistency.
4. No re-tempering with water shall be permitted.

5.4 Transportation

1. Concrete shall be transported by transit mixer or mechanical means.
2. No segregation or loss of workability shall occur.
3. Concrete shall be placed within initial setting time.

5.5 Placing of Concrete Concrete shall be laid uniformly to slightly higher than required level.

1. Thickness shall be controlled to ensure **150 mm compacted thickness**.
2. Panels shall be laid in predetermined sequence.
3. Continuous placing shall be ensured to avoid cold joints.

5.6 Compaction

1. Initial compaction using screed vibrator.
2. Surface vibrators shall be used to remove entrapped air.
3. Vibration shall be sufficient to achieve full compaction.
4. Over-vibration causing segregation shall be avoided.

5.7 Trimix Vacuum Dewatering Process

Equipment:

- Vacuum pump
- Suction hoses
- Filter pads
- Vacuum mats

Procedure:

1. After vibration and leveling, filter pads shall be placed over concrete.
2. Vacuum mats shall be positioned and sealed.
3. Vacuum pump shall be started to create suction.
4. Excess water shall be extracted.
5. Duration shall depend on slab thickness (approx. 1–2 minutes per cm thickness).
6. Process shall reduce surface water-cement ratio.
7. Resulting concrete shall achieve:
 - Higher early strength
 - Reduced permeability
 - Increased abrasion resistance
 - Reduced shrinkage cracking

5.8 Application of Floor Hardener

1. Immediately after vacuum dewatering.
2. Spread uniformly in two stages.
3. First broadcast: 2/3 quantity.
4. Second broadcast: Remaining quantity.
5. Ensure uniform distribution.
6. Surface shall be floated before troweling.

5.9 Power Trowel Finishing

1. Mechanical power trowels shall be used.
2. Multiple passes to achieve smooth dense finish.
3. Surface shall be free from undulations.
4. Final finish shall be hard, abrasion-resistant, and level.
5. Tolerance: Max 3 mm variation under 3 m straight edge.

5.10 Joint Formation

Contraction Joints:

- Saw cutting within 24 hours.
- Depth: Minimum 50 mm (1/3 slab thickness).
- Spacing: 3.5 m to 4.5 m.

Expansion Joints:

- As per design interval.
- Pre-moulded filler board.
- Sealed with approved sealant.

Construction Joints:

- Dowels/tie bars as per design.

5.11 Curing

1. Curing shall begin immediately after finishing.
2. Continuous water curing for minimum 14 days.
OR
3. Approved curing compound may be applied.
4. Surface shall be protected from traffic for minimum 14 days.

6. Quality Control

6.1 Field Tests

- Slump test (every batch or 25 m³)
- Cube test (minimum 3 cubes per 30 m³)
- Thickness measurement
- Surface regularity check

6.2 Acceptance Criteria

- 28-day compressive strength ≥ 30 MPa
- Proper surface finish
- Correct thickness
- No visible cracks or honeycombing

7. Tolerances

- Thickness: ± 10 mm
- Level: ± 5 mm
- Alignment: Within specified limits

8. Safety & Protection

- Barricading during execution
- Safety PPE for workers
- Electrical safety for equipment
- Proper handling of vacuum equipment

9. Measurement

Measured in **Square Meter (Sq.m)** of finished surface area.

Thickness considered: 150 mm compacted thickness.

10. Rate Includes

The quoted rate shall include:

- Design mix preparation
- Cement (minimum 360 kg/m³)
- All aggregates and admixtures
- Mechanical batching & mixing
- Trimix vacuum system
- Power troweling
- Floor hardener
- MS channel formwork
- Labour and supervision
- Testing and QC
- Curing
- Joint cutting and sealing
- All tools, plants, machinery
- All leads, lifts, royalties, taxes

No extra payment shall be made for vacuum dewatering, troweling, or equipment usage.

11. Completion Criteria

The work shall be deemed complete only after:

- Achieving required compressive strength
- Joint cutting and sealing completed
- Surface finishing approved
- Engineer-in-Charge certification obtained

Asst. Engineer
G.M.C.

Dy. Ex. Engineer
G.M.C.

CITY ENGINEER
G.M.C.

Signature of Contractor

APPROVED VENDOR LIST – CIVIL EQUIPMENT AND COMPONENTS

ITEMS	Approved Brands / Quality
CEMENT	Ultra Tech, Ambuja, ACC, Sanghi, Siddhi, Hathi, TATA, Kamal
Steel	CRS Fe 500 or higher grade steel procured from approved manufacturer like TISCO [TATA] , SAIL, VIZAG , Electrotherm, JSW , Essar
TILES	Somany, Kajaria, Jonson, Asian , Simpolo, Varmora
Plastic Paint	Asian / Dulux
EXTERIOR WEATHER PROOF EMULSION PAINT	Asian / Dulux
Oil Paint	Asian / Dulux/ Jotun/ Indigo/ Global
SANITARY WARE	Cera / Hindware / Parryware/ Kohler/ jaguar/ Simpolo
CAST IRON PIPES and FITTINGS.	TATA, SAIL, ESSAR , 1 [JSW],RATNAMANI, Electrosteel
CAST IRON Gate Valve/ SLUICE / BUTTER FLY VALVES/Air Valve i.e. all type of valve.	[PROCURE OF ANY OF BRAND, VALVE SHALL BE WITH ISI MARK ONLY]
	KIRLOSHKAR
	Fouress Engineering (India)
	VAG Valves (India) Private Limited
	Bharat Engineering Works, Dhrangadhra
	K.P. Mondal- Hawrah
	Jupiter Engineering Co- Hawrah
	HAWA ENGINEERS LTD- Ahmedabad
	Veeson Valves Pvt. Ltd.- Jalandhar
	Sachdeva Metal Works- Jalandhar
G M ENGINEERING PVT. LTD.-	

ITEMS	Approved Brands / Quality
	<div>Morbi</div> <div>Zoloto Industries, Jalandhar</div> <div>R & D MULTIPES PVT. LTD. (Plant-2 , Valsad)</div> <div>G. M. Dalui & Sons Pvt. Ltd- Howrah</div> <div>SSPR Valve Manufacturing Private Limited, Howrah</div> <div>Perfect Valves Pvt. Ltd. Jalandhar</div>
MS PIPES & SPECIALS	SAIL, ESSAR , ESPAT AND JINDAL [JSW], WELSPUN, RATNAMANI
D.I. DF PIPE K-9 TYPE WITH SPECIALS AND FITTINGS OF K - 9/K-12 TYPE	JINDAL, ELECTROTHERM, Electrosteel , TATA, ESL Steel ltd, K M Metals, Welspun D.I. Pipes Ltd,
P.V.C. PIPES AND FITTING (UPVC/CPVC)	Finolex, Supreme, Jain, Kings, Ashirwad, Astral, Dutron,
CHROMIUM PLATED WATER SUPPLY FITTINGS	ESSCO, Crown, Metro, Prince Jaguar, SUNT, Leader, Ebco
GALVANIZED PIPE	'B' class Zenith, Ambica, Tata
GALVANIZED FITTINGS	'R' Brand, NVR, Unik, Sun
C.I. MANHOLE COVER	Manish, Sil, NECO,RISHI
PLUMBING FIXTURES	Jaguar / Cera/ Hindware/ Simpolo
PVC WATER TANK (100% VIRGIN PVC)	Syntex / Aqua / National
ALUMINIUM SHEETS AND ACCESSORIES	Jindal, Hindalco, Banko
ALUMINIUM EXTRUDED DOOR/ WINDOW SECTION	Indal, Jindal, Ajin India, Aldowin, Alumilite
ALUMINIUM HARDWARE	Rajdoot, Belu, Diamond, Glider
M.S. ANGLE SECTION	Any I.S.I. BRAND
WATER PROOFING MATERIALS	Zycosil, Dr. Fixit, Polychem SIKKA FORCEROCK,SUN KOLL Asian, Mapie, or as directed by engineer in charge
Electro Magnetic Flow Meter	ABB, E+H, Krohne Marshall, Siemens, Yokogawa , Arohi, Itron

Notes:

- The contractor shall produce samples of the materials for approval of the MMC/PMC. The materials of the makes out of the above as approved by the MMC/PMC shall be used on the work. Consultant/MMC/PMC member has not abide to give any reason for rejection of any brand from the above list and its decision will be consider as final.

APPROVED VENDOR LIST – ELECTRICAL EQUIPMENT AND COMPONENTS

ITEM DESCRIPTION	APPROVED MAKE
MV SWITCHBOARD & MV SWITCHGEAR / HT PANEL-11 / 33kV - INDOOR / OUTDOOR TYPE (VCB/SF6)	ABB / BHEL / GE / JYOTI / L&T / SCHNEIDER / SIEMENS
RING MAIN UNIT (RMU) MV - 11 / 33kV - INDOOR / OUTDOOR TYPE (VCB/SF6)	ABB / BHEL / GE / JYOTI / L&T / SCHNEIDER / SIEMENS
PROTECTIVE RELAYS (NUMERICAL TYPE)	ABB / ALSTOM / GE / L&T / SCHNEIDER / SIEMENS
PROTECTIVE / AUXILIARY RELAYS (ELECTROMECHANICAL TYPE)	ABB / ALSTOM / EASUN REYROLLE / GE / L & T / SCHNEIDER / SIEMENS
INSTRUMENT TRANSFORMERS (CT / PT / CBCT)	AUTOMATIC ELECTRIC / AEP / ASHMOR / ECS / GILBERT AND MAXWELL / INDCOIL / JYOTI / G SONS POWER/ KAPPA / PRAGATI / PRECISE / SILKAANS
SURGE SUPPRESSORS	ABB / EMERSON / ERICO / MTL / OBLUM / PEPPERL+FUCHS / PHOENIX / RAYCHEM SCHNEIDER / SIEMENS / WEID MULLER
LIGHTNING ARRESTORS	BIRLA NGK INSULATORS / DHURVA/ ELPRO / JEF / JAYSHREE / OBLUM / WS
ALARM ANNUNCIATORS (SOLID STATE TYPE WITH LED ILLUMINATION) / FACIA ANNUNCIATOR	APLAB / ALSTOM / DIGICONT / ICA / IICP / MINILEC / PROCON INST. (P) LTD / PROTON ELECTRONICS
BATTERY BACKED POWER PACK	ALAN / BHARANI / GOGATE / G'LEC
BATTERY CHARGER & DCDB	AMARA RAJA / AMCO POWER / AUTOMATIC ELECTRIC / CALDYNE AUTOMATICS / CHHABI ELECTRICALS / EXIDE / ELECTRONIC SYSTEMS / HBL POWER SYSTEMS / HIREL-HITACHI / MASS-TECH CONTROLS / UNIVERSAL INSTRUMENTS / SERVILINK
SMF / VRLA / NI-CD / LEAD ACID (PLANTE / TUBULAR) BATTERY	AUTOMATIC ELECTRIC / AMARA RAJA BATTERIES LTD / AMCO / EXIDE / FUJIYAMA / HBL POWER SYSTEMS LTD / LUMINOUS POWER / OKAYA
ELECTRONIC CIRCUIT RELAY	ALLEN BRADLEY / OEN / OMRON / PLA
CONTROL AND RELAY PANEL	ABB / ALSTOM / GE / EASUN REYROLLE / L&T / SCHNEIDER / SIEMENS
DISTRIBUTION TRANSFORMERS	ABB / BBL / BHEL / GE / KEC / SCHNEIDER / G SONS POWER/TRANSFORMERS & RECTIFIERS INDIA LIMITED / VOLTAMP

SANDWICH BUS TRUNKING (BUS DUCT)	ABB / L&T / SCHNEIDER / SIEMENS
PANEL CRCA / MS / GI PLATES & SHEET	ARCEL OR MITTAL / ASIAN / ESSAR / JINDAL / SAIL / TATA
ALUMINIUM BUSBAR MATERIAL	BANCO / HINDALCO / JINDAL / STERLITE
COPPER BUSBAR MATERIAL	HINDALCO / JINDAL / STERLITE
LV SWITCHBOARD - DRAWOUT / FIXED TYPE (PCC-LVDB / PMCC / MCC / MLDB / MPDB / MOVDB / APFC)	ABB / ALPHA NIPPON / INDUSTRIAL CONTROLS / L&T / SCHNEIDER / SIEMENS / ALSTOM / JYOTI / G SONS POWER / ELEMBICA / SWATI SWITCH GEAR
ACTIVE HARMONIC FILTER SOLUTION / PANEL	ABB / AMTECH / AB LIFASA / CONSULE NEOWATT / DANFOSS / EPCOS / FUJI ELECTRIC / NEPTUNE / SCHNEIDER / SCHNEFFER / SUBODHAN / SHREEM / TRINITY
APFC PANEL	ABB / ASIAN / ALSTOM / DATAR / EPCOS / L&T / SCHNEIDER / SIEMENS / ALL APPROVED VENDORS FOR LT PANEL
DETUNED SERIES REACTORS WITH TEMPERATURE MICRO SWITCH (HARMONIC FILTER REACTOR)	ABB / EPCOS / NEPTUNE / SUBODHAN / VISHAY / YESHA / WHEPL
DYNAMIC POWER FACTOR CORRECTION THYRISTOR MODULE	ABB / EPCOS / NEPTUNE / SUBODHAN / SCHNEIDER
CAPACITOR DUTY CONTACTOR	ABB / EPCOS / L & T / SCHNEIDER / SIEMENS
AC/DC POWER & AUXILLARY CONTACTOR	ABB / BCH / GE / INDO ASIAN / L&T / SCHNEIDER / SIEMENS
MV CAPACITORS	ABB / EPCOS / SHREEM / UNIVERSAL / VISHAY
LV CAPACITORS / POWER CAPACITOR	ABB / ASIAN / BHEL / EPCOS / GE / HAVELLS / KHATAU JUNKER / MADHAV / MALDE / NEPTUNE / PRABODHAN / POWER MATRIX / SCHNEIDER / SUBODHAN / SHREEM / SIEMENS / UNIVERSAL /VISHAY
SOFT STARTER (MICRO PROCESSOR BASED)	ABB / DANFOSS / ROCKWELL / SCHNEIDER / SIEMENS / L&T
VVVF DRIVES (VFD)	ABB / DANFOSS / ROCKWELL / SCHNEIDER / SIEMENS / YASKAWA
SEMICONDUCTOR FUSE	BUSSMANN / FERRAZ / GE / SIEMENS
HRC FUSE (POWER & CONTROL)	ABB / GE / INDO ASIAN / L & T / SCHNEIDER / SIEMENS / TECHNOELECTRIC
AIR CIRCUIT BREAKERS	ABB / LEGRAND / L&T / MITSUBISHI / SCHNEIDER / SIEMENS
MCCB'S	ABB / GE / LEGRAND / L&T / MITSUBISHI /

	SCHNEIDER / SIEMENS
MPCB	ABB / INDO ASIAN / L&T / MITSUBISHI / SCHNEIDER / SIEMENS
MCB / RCCB / RCBO / ISOLATORS	ABB / GE / HAVELLS / INDO ASIAN / LEGRAND / L&T / MITSUBISHI / MOELLER / SCHNEIDER / SIEMENS
SWITCH DISCONNECTOR FUSE UNIT (SDF) AND SWITCH DISCONNECTOR ISOLATOR	ABB / GE / INDOASIAN / L&T / MITSUBISHI / SCHNEIDER / SIEMENS
CHANGE OVER SWITCH	ABB / BCH / GE / HAVELLS / HPL / KRAUS & NAIMER / L & T / SCHNEIDER / SIEMENS
TEMPERATURE SCANNER WITH RS 485 MODBUS COMMUNICATION	ELECTRONET / MULTISPAN / MASIBUS / NIVAM / NISHKO / REDIX / SELEC
KWH / LOAD MANAGER / MULTI FUNCTION METER	ABB / CONZERV / ENERCON / IMP / KRYKARD / L&T / MECO / RISHABH / SCHNEIDER / SECURE
DIGITAL AMMETER / VOLTMETER / POWER FACTOR METER	ABB / ALSTOM / AE / ASIAN / CONZERV / IMP KRYKARD / L&T / MECO / MASIBUS / MULTISPAN / NEWTEK ELECTRICALS / RISHABH / SCHNEIDER / SECURE / SIEMENS
ANALOG (ELECTROMECHANICAL) METERS – AMMETER & VOLTMETER	AE / IMP / MECO / RISHABH / SELEC
HANDHELD DIGITAL MULTIMETER / CLIP-ON METER / MEGGER	FLUKE / IMP / MECO / MOTWANE / RISHABH
CONTROL / SELECTOR SWITCH	ABB / ALSTOM / BCH / EE / GE / HAVELLS / JYOTI KAYCEE / L&T / RECOM / SCHNEIDER / SIEMENS / SULZER
INDICATING LAMPS	ABB / BCH / EE / IEC / L&T / SCHNEIDER / SIEMENS / TEKNIC CONTROLS / VAISHNO
PUSHBUTTONS	ABB / BCH / L & T / RASS / SCHNEIDER / SIEMENS / TEKNIC / VAISHNO
CONSTANT VOLTAGE TRANSFORMER/CONTROL TRANSFORMER	AE / ASHMORE / G & M / INDCOIL / NEC / PRAGATI / PRECISE / SILKAANS
MICROPROCESSOR BASED MOTOR PROTECTION RELAY WITH RS 485	ABB / EXCEL-TECH INDIA / L & T / PROK DEVICES / SCHNEIDER / SIEMENS
BI-METAL / ELECTRONIC / MICROPROCESSOR BASED OVERLOAD RELAY	ABB / ALSTOM / CG POWER / GE / INDO ASIAN / L&T / SCHNEIDER / SIEMENS
THERMISTER RELAY	ALSTOM / INSTA CONTROLS / MINILEC / SELEC
SINGLE PHASING PREVENTER WITH UV/OV PROTECTION	ABB / GE / L&T / MINILEC / SCHNEIDER / SIEMENS

TIME SWITCH	GIC / LEGRAND / SCHNEIDER / SIEMENS / THEBEN
TIMERS / TIME DELAY RELAY	ABB / BCH / EAPL / ELICO / INDO ASIAN / LEGRAND / L&T/ MINILEC / OMRON / PLA / SCHNEIDER / SIEMENS / TEKNIC / THEBEN
PANEL VENTILATION FAN	COOLTRON / HICOOL / NADI / REXNORD
TERMINAL BLOCK/CONNECTORS	CONNECTWELL / ELMEX / PHEONIX / TELEMECHANIQUE / WAGO
LIGHTING / SMALL POWER DISTRIBUTION BOARDS / ENCLOSURES	ABB / BCH / ELDON / ENCLOTEK / HENSEL / HAVELLS / INDO ASIAN / LEGRAND / L&T / RITTAL / SCHNEIDER / SIEMENS / STANDARD ELECTRIC / ALL APPROVED VENDORS FOR LT PANEL
PUSH BUTTON STATIONS / JUNCTION BOX (FOR CAST ALUMINIUM ONLY)	BALIGA / BCH / CEAG / EXPROTECTA / EXCEL / FCG FLEXPRO / HANSU / HENSEL / PUSTRON / SCHNEIDER / SIEMENS / SUDHIR
NON METALLIC ENCLOSURES (INCLUDING INDUSTRIAL RECEPTACLES / PB STATION)	BCH / HENSEL / LEGRAND / PUSTRON / RITTAL / SCHNEIDER / SIEMENS / SINTEX
MOTORS (LV)	ABB / BBL / BHEL / CG POWER / JYOTI / KEC / LHP / MARATHON / SIEMENS
CABLES HV - XLPE INSULATED	ASIAN CABLE / FINOLEX / GLOSTER / HAVELLS / KEI / POLYCAB / TORRENT CABLES / UNIVERSAL
CABLES LV - POWER & CONTROL CABLES / EARTHING CABLES	ASIAN CABLE / AVOCAB / FINOLEX / GLOSTER / HAVELLS / KEI / LAPP / POLYCAB / RR KABEL / TORRENT / UNIVERSAL CABLES
WIRES - FLEXIBLES (ALL TYPES)	AVOCAB / ANCHOR / ATLAS / FINOLEX / GLOSTER / HAVELLS / KEI / L&T / LAPP / POLYCAB / RR KABEL / UNIVERSAL
GI / FRP CABLE TRAYS, ANY OTHER FRP ITEMS	DUDHAT INFRA / FIBER TECH COMPOSITE / GLOBE / INDIANA / JACINTH / LEGRAND / KISMAT ENGITECH LLP / M.M. ENGINEERING / SHARDA / SILVERLINE POWER / SHREE KRISHNA ENGG. / SUPER ELECTRO / SUMIP / SATYAM COMPOSITES / VATCO
CABLE GLANDS (SINGLE / DOUBLE COMPRESSION, NI PLATTED BRASS)	BALIGA / BRACO / COMET / EX-PROTECTA / ELECTROMECH / FCG / HMI / JAINSON / SIEMENS / SUDHIR
CABLE GLANDS – POLYAMIDE	FIBOX / GEWISS / HENSEL / LAPP
CABLE LUGS	3D / 3M / COMET / CONNECTWELL / DOWELLS / JAINSON
CABLE TERMINATION/JOINTING KITS	3M / ABB / CCI / KABELDON / M SEAL / RAYCHEM / XICOM
UPVC CONDUIT & ACCESSORIES	AKG / BHAGYALAXMI PIPE INDUSTRY / CLIPSAL / L&T / POLYCAB / PRECISION / SALZER / ANY OTHER FOR UPVC PIPES AS PER MECHANICAL VENDOR LIST
MS / GI CONDUIT & PIPES	BEC INDUSTRIES / JINDAL / JK TUBE / SAIL / TATA

	STEEL / ZENITH / ANY OTHER FOR MS/GI PIPES AS PER MECHANICAL VENDOR LIST
HIGH MAST LIGHTING SYSTEM	BAJAJ / CGL / PHILIPS / SURYA / VALMONT
MS / GI LIGHTING POLES & BRACKETS (TUBULAR SWAGED / OCTAGONAL)	AMBICA POLES PVT LTD / BAJAJ / BOMBAY TUBES AND POLES / FABIRON / KISMAT ENGITECH LLP / GAYATRI ELECTRICALS / INDIA ELECTRIC POLES / UTKARSH INDIA
LIGHT FIXTURES	BAJAJ / CGL / GE / HAVELLS / L&T / PHILIPS / SCHREDER / WIPRO
DECORATIVE / MODULAR SWITCH & SOCKET	ABB / ANCHOR / CLIPSAL / CRABTREE / HAVELLS / INDO ASIAN / L&T / LEGRAND / MK-HONEYWELL / MDS / SIEMENS / SCHNEIDER / TOYAMA
CEILING / WALL MOUNTING / PEDASTAL/ EXHAUST FANS	ATOMBERG / ALMONARD / BAJAJ / CGL / HAVELLS / KHAITAN / ORIENT / USHA
CHEMICAL TYPE EARTHING INCLUDING COPPER BONDED ELECTRODE & BACK FILL COMPOUND	ASHLOK / CURSP / ECO TECHNOLOGY & PROJECTS/ ENNOV INFRA / ERICO / ISG GLOBAL / JEF / PRAGATI ELECTROCOM / SAARA EARTHING/ EQUIVALENT REPUTED MAKE SUBJECT TO CLIENT APPROVAL
DIESEL ENGINES	BAUDOUIN / CATERPILLAR / CUMMINS / KOEL / MITSUBISHI / PERKINS / VOLVO
ALTERNATORS FOR DG SETS	BHEL / CGL / JYOTI / KEC / KOEL / LEROY SOMER / NGEF / STAMFORD
AMF RELAY, SYNCHRONIZING RELAY (WITH RS 485)	DEEP SEA / DEIF / WOODWARD

Remarks:-The contractor shall distinctly understand that it will not be their prerogative to insist on a particular brand from the list, and final selection will be done with the approval of Engineer-in- charge.

APPROVED VENDOR LIST FOR MECHANICAL EQUIPMENT

ITEM DESCRIPTION	APPROVED MAKE
Centrifugal / Centrifugal Non-Clog Pumps (For Dry Pit Installation)	Beacon Weir / Jyoti / Kirloskar / KSB / Wilo / Worthington (WPIL) / Grundfoss / Xylem
All Accessories and Equipment / Fixtures/ Instruments / Machinery related to Floating Intake well (Including Metallic Pontoon jetty, Flexible Corrugated Pipes, HSCF pump	GWSSB Approved Vendor List from GWSSB web site

set, Floaters etc. all allied equipment's)	
Vertical Turbine (V.T.) Pumps	Kirloskar / Mather & Platt (Wilo) / Worthington (WPIL) / Xylem
Submersible Centrifugal / Centrifugal Non-clog Pumps (For Wet Pit Installation)	Aqua / Kirloskar / Kishor / KSB / ABS / Xylem / Grundfoss / Wilo / Ebara
Submersible Centrifugal / Centrifugal Non-clog Pumps (For Dry Pit Installation)	Aqua / Ebara / KSB / Xylem / Grundfoss / Wilo
Drain / Dewatering / De-silting Pumps (Submersible / Horizontal)	Aqua / Kirloskar / Kishor / KSB / ABS / Xylem / Grundfoss / Wilo / Jasco / Lubi / MBH / Pullen
Valves (Sluice Valves / Butterfly Valve / Non-Return Valves (Single / Multi door) / Dual Plate Check Valves / Butterfly Valves / Air Valves)	Kirloskar / R&D Multiple / GM Engineering
Zero Velocity Valve	Flownix / IVC / IVI / L&T / Jash / Vag Valves
Knife Gate Valve	Jash / Fouress / Hi-Tech / Vass (Dezurick) / Vag / Orbinox
Ball Valves	Audco / BDk-Weir / Intervolve / Kirloskar / Saunders / Mevada (Saturn) / Hi-Tech / Virgo / Hawa Engineers / GM Engineering
PP / uPVC Valves (Ball, NRV, Gate, etc.)	GF-GEORG Fischer / Dinesh Plastic / UNP / Astral / Parth
Expansion Bellows	Dhruv / Precision / Technoflex / Precise Engg. / Flexican Bellows & Hoses / Flexpert Bellows / Sur Industries (Surflex) / Athulya Bellows / Stanfab Engineering
Sluice Gates / Open Channel Gates	Jash / IVC / IVI / Apollo Screens
Electric Actuator	Auma / Rotork / Emerson
HOT / EOT Crane and Pulley block / Grit Removal Mechanism with Grab Bucket	Morris / Indef / Safex / W.H. Brady / Anker / Japs / Apollo Screens

Gear Boxes – For Process and such equipment (Not applicable for valves, gates, etc.)	Elecon / CPEC / Premium Transmission (PTPL) / Bonfiglioli / Radicon (PBL) / Shanthi Gears
D.I. Pipes	Electro Steel / Kejriwal / Lanco / Jindal / Electrotherm / Srikalahasthi / Welspun
D.I. Double Flanged (DI DF) Pipes & Fittings.	Electro Steel / Kejriwal / Lanco / Jindal / Electrotherm / Srikalahasthi / Kiswok / Truform / Chandranchal / / Welspun (DI pipe for DI DF Pipe manufacturing shall be as per approved make of DI Pipes only)
C.I. Pipes & fittings.	Electro Steel / Kejriwal / Upadhaya Valves / NJMW / Eskay (Howrah) / Oriental Castings / BIC
HDPE Pipes	Astral / Dutron / Duraline / Narmada / RIL (PIL) / Penwalt / Anjney / Jain Irrigation / Sangir / Supreme / Prince / Ashirvad / Balson
PVC / uPVC / CPVC Pipes	Astral / Supreme / Prince / Dutron / Finolex / Jain Irrigation / Vectus Industries / Ashirvad / Caption Pipes / Balson
MS / GI Plates & Sheets	Arcelor Mittal / Tata / Jindal / SAIL / Asian
M.S. / C.S. / G.I. Pipes	Jindal / Tata / Welspun / Asian / SAIL / Any reputed Manufacturer with approved make of MS/GI plates & sheets
Bearing for all rotary equipment	SKF / FAG / NBC / NTN / Timken
Mechanical Seal	Eagle Burgmann / Flow serve / Aesseal / Chesterton / Flexaseal / John Crane / Durametallic
Air Conditioner	Blue Star / Carrier / Daikin / Hitachi / LG / O-General / Samsung / Voltas / Mitsubishi
Paint	Asian Paints / Shalimar / Berger / Dulux / Deep Seal
Chlorination System (Chlorinator, Chlorine Scrubber, etc.)	Allidos (Grundfos) / Banaco / Capital Controls (DeNora) / Chlorotech / Metito / Supreme Technologies (Evoqua / CIT) / Toshcon Jesco
Chlorine Flow Control Valve / system (Pneumatic type)	Capital Control / Chlorinators inc. & regal systems intl. inc.– USA / Emerson / Forbes Marshall Arca / Samson / ABB / SPX

	valves & controls (Dezurik) / Mil Controls
Chlorine Scrubber - Air Blower (Centrifugal Fan type) – PP / FRP	Supreme Plastic, Nu Fibro Tech, BS Projects (BSF), Patels Airflow (PAF), Bhagwati Engineering
Chlorine Scrubber - PP Pump	Leak proof / Propeller / BEW-Bhagwati / ALFA Pumps / Engineer Combine / ANTICO
Chlorine Container	ISGEC / Anup / PESO approved Vendor
Chlorine Emergency Kit	Saviour (Sure Safety) / Joseph Leslie / Draeger / Anmol Safety Products / Chlorotech / Toshcon Jesco
Self-Breathing Apparatus	Saviour (Sure Safety) / Joseph Leslie / Draeger / Scott (3M) / MSA Safety / Honeywell
Air Compressor	Ingersoll-Rand / Khosla / Kirloskar / Chicago Pneumatic / Atlas Copco
Agitator / Mixer	Remi / Schurtek / Fibre & Fibre / Milton Roy / Jash (Shivpad) / Ceecon / Triveni / Positive Metering Pumps, Rathi Vessels & Systems / All vendors of Process Equipment - Gravity Settling Tanks / Apollo Screens
Process Equipment - Gravity Settling Tanks: Grit (Detritor) Mechanism (Conventional), Primary Clarifier / Secondary Clarifier, Sludge Thickener / Clari-flocculator / Reactor Clarifier	Eimco-KCP / HDO / Jash (Shivpad) / Triveni / Voltas / Geo Miller / Ovivo/ Apollo Screens
Screw (Progressive Cavity) Pumps	Roto / Netzsch / Tushaco / Seepex / UT Pumps / Positive Metering / Hydro Prokav Pumps
Metering / Dosing Pumps	Swellore / V.K. Pumps / Shapotools / Milton Roy / S.R. Metering / Positive Metering Pumps / ProMinent
Centrifuge	Humboldt / Alpha Laval / Hiller / Gea Westfalia / Flottweg
Air Blower - Twin Lobe	Kay / Swam / Everest / Usha Compressors / Garden Denver / Aerzen / TMVT / ACME
Weighing Scale	AVERY/ ACME / ATCO / AVON / Mettler-Toledo
Tools	Taparia / Everest / Gedor / Jhalani /

	Mekaster
Office Furniture	Godrej / HOF / Featherlite / Ikea / Nilkamal

LIST OF APPROVED VENDORS FOR INSTRUMENTATION SYSTEM

Item Description	Approved Vendors
Process Analyzers (pH, DO, Free/Residual Chlorine, Nitrate, Phosphate, ORP, Conductivity, TSS, Turbidity, MLSS, BOD/COD, Hardness, etc.)	E+H, Emerson, Hach, Yokogawa, Xylem / WTW, Krohne, Forbes Marshall (Forbes Marshall make for pH analyzer & Conductivity Analyzer; Optex, Japan make for Turbidity analyzer)
Laboratory Instrument (Portable / Handheld) - pH / Turbidity / TDS (conductivity meter), etc.	Hach, Orion, YSI, Radiometer, Denver, Hanna
Ultrasonic Type Level / Diff. Level / Open Channel Flow Transmitter/ Radar Type Level Tx.	Endress+Hauser, Siemens, Krohne, Vega, Emerson, ABB
Hydrostatic type level transmitter	ABB, E+H, Siemens, Krohne Marshall, Emerson
Electro Magnetic Flow Meter	ABB, E+H, Krohne Marshall, Yokogawa, Siemens Aarohi Embedded Systems,
Ultrasonic Flow Meter (Insertion / Clamp on type)	ABB, E+H, Krohne Marshall, Siemens
Differential Pressure / Pressure / Temperature Transmitter	ABB, Emerson, Fuji, Honeywell, Siemens, E+H Yokogawa
Pressure/Diff. Pressure Switch, DP Gauge	Dag Process Instruments, Danfoss, E+H, Indfoss, N.K. Instruments, Verma Trafog, Orion, Switzer
Pressure / Compound Pressure Gauges	Wika, General Instru. Consortium, Pricol, Manometer (I) P. Ltd., Baumer, Excel Instrument, Precision Mass, Forbes Marshall, H. Guru
Displacer / Float / Buoyancy Level Switch	ATMI, Baumer, E+H, Nivelco, P+F, Pune Techtrol, SBEM, Levcon, Nivo/Toshbro
Float & Board type Level Gauge/ Tubular type Level gauge	Nivo/Toshbro, Pune Techtrol, Revathi, SBEM, Levcon, Jayati Instrumentation, General Instrument Consortium
Programmable Logic Controller (PLC) System / HMI/SCADA Software	ABB, Rockwell (Allen Bradley), Schneider, Siemens, Honeywell, Mechatronicssystems
Panel Enclosures	BCH, Bartakke, Eldon (nVent Hoffman), Enklotek, Rittal, Pyrotech
DC Power Supplies (DIN Rail mounted)	Phoenix, Omron, Aplab, IFM, Schneider, Allen Bradley, Siemens, Intex, Microtex, Schneider, IFM, Meanwell
GSM/GPRS Modem	Maestro (Lantronix), Axitech, Netgear, D-link, Moxa, Robustel, Teltonika
Ethernet Switch	D-Link, Rockwell, Siemens, Schneider, Cisco, Phoenix Contact
Media Converter	Digisol, TP link, Microtek D-link, Moxa

Receiver Indicators (Panel Mounted)	Masibus, Nivam, Nishko, Selec , Yokogawa ,Multispan
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Miniature Relay	ABB, Omron, Phoenix, Schneider, Rockwell
Indication Pilot Lamps (LED Type)	Teknic, Schneider, Siemens, Salzer, Vaishno
Push Button/ Selector Switch (with NO/NC Element)	Teknic, Schneider, Siemens, Salzer, L&T, Rass, Vaishno, Kaycee, Binay
Lightning Protection Unit	Rittmeyer, MTL, Crompton, P+F
Terminals	Elmex, Phoenix, Wago, Connectwell
Panel Wires	Finolex, Havell's, R R Kabel, Lapp Cable, L&T, Polycab
Panel Illumination	Philips, Crompton, GE, Bajaj, Havells, Surya
Alarm Annunciator	Aplab Ltd., Minilec, IIC, ICA, Protons
Computer System including Monitor / Laptop computer	HP-Compaq, Dell, Acer. IBM – Lenovo, Asus
Anti-virus software	Quick heal, McAfee, Norton
UPS	Emerson (Liebert / Vertiv), Schneider (APC), Merlin Gerin, Socomec, Hirel-Hitchi, Eaton, Numeric, ABB
LED / LCD TV	Samsung, Sony, Panasonic, LG
Printer (Inkjet/Laser Jet)	HP, Canon, Samsung, Ricoh, Epson
Instrument Cables (Power , Signal, Control)	Associated Cables, Associated Flexible and Wires P.Ltd. Brook Cables, Thermo cables, Udey Pyro, RPG Cables. Polycab, Rolliflex, RR Kabel, Havells
Fiber optic cable	Tyco-AMP , Panduit, Systimax, D-link, R & M
Communication Cables	D-Link, Delton, Finolex, Lapp Cable, Molex, Udey Pyro
Junction Box (Metallic / Cast Alu.)	Ex- Protecta, CEAG, Sudhir, Baliga, FCG, VSM Plast, Phoenix Mecano, Hensel
Junction Box / Enclosures (Polycarbonate / ABS or such Polymer)	EPP Composites, Eaton, VSM Plast, Phoenix Mecano, Hensel, Legrand, Sintex
Cable Glands	Ex-Protecta, Braco, Comet, HMI, 3D, Sudhir, Connectwell
Cable Tray (GI / FRP), Any Other FRP item	M.M.Engineering, Globe, Jacinth, Silver line Power, Shree Krishna Electrical, Sumip, Fiber Tech Composite/ Satyam Composites, Dudhat Infra, Indiana ,Legrand, Sharda , Vatco , Super Electro, Kismat Engitech LLP
Instrument Valves and Manifolds, Tube Fittings, Pneum. Brass Fittings	Excel Hydropneumatic, Industrial Enterprise, Festo, Multimetal Industries, Placka, SMC, Technomatic, Wesmec, Fluid Controls, Aptek , Anmol (Superlok), General, Smart, Instrument Consortium
Solenoid Valves	Asco, Rotex, Schrader, Janatics, Uflow, Avcon, Alcon Alexander, Indfoss, Precision Instruments

Air Conditioners	O General, Hitachi, Panasonic, Voltas, Mitsubishi, Blue Star, Carrier, LG, Samsung, Daikin
Office Furniture	Godrej, Blind Men's Associations, HOF, Equi. reputed
CCTV Camera	Siemens, GE, Honeywell, H.K Vision, Godrej, Zicom, Zebronic, CP Plus, Bosch, Panasonic, Samsung, Canon, Pelco, Smart Guard, Indigo Vision, Dvtel

The contractor shall distinctly understand that it will not be their prerogative to insist on a particular brand from the list, final selection will be done with the approval of Engineer in charge.

ADDITIONAL CONDITIONS

1. The contractor shall have to provide his own level instrument for this work.
2. Lowering, laying and jointing works of all the pipelines shall have to be carried out by using Sight Rails and Boning Staves.
3. Work is required to be carried out in residential area where all the services like water supply, sullage water pipeline, telephone / electric cable are existing.
Under the circumstances, prior to starting the work agency shall have to excavate the trenches manually for up to 1 mt. depth. During the course of execution, all the services shall have to be maintained by the agency and any damage to any services or property, the agency shall have to get it repair at their cost.
4. For excavation of trench, use of JCB machine will not be permitted directly on the top surface of the road. After excavation up to minimum 1.00 mt. depth from road surface or existing ground level, same shall have to be carried out manually or by using Breaker and after locating underground services like; water supply pipeline, water connection lines, pipe gutters, telephone cables, electric cables etc., and thereafter upon taking the prior approval of the Engineer-In-Charge, the excavation can be carried out by using JCB machine.
5. Gandhidham Municipal Corporation shall recommend to the competent authority to give Controlled Blasting License to the contractor for carrying out excavation in hard rock. In case of blasting license not permissible from the competent authority in some places then excavation is to be done by using wedges and hammers, chiseling, breakers, pneumatic tools, etc. Also in case where blasting license is permitted but even then if there is no possibility of carrying out the blasting for whatsoever reason, the excavation is to be done by using Wedges and hammers, chiseling, breakers, pneumatic tools etc. No extra payment shall be made for excavation to be carried out in any of the above mentioned both the situations.
6. Excavation in soft rock and hard rock shall have to be carried out only by Chiseling, Breaker (pneumatic tools) etc., as far as possible. If excavation is not possible in terms of above and if excavation is required to be carried out with the help of blasting then the same shall have to be carried out only after taking prior approval and necessary license for blasting from the competent authority.
7. In case of excavation not possible manually or by chiseling in certain place(s) as well as if blasting is also not possible due to various reasons i.e. to avoid damage to nearby water pipeline, pipe gutter, telephone cables / Duct, Raw houses / week buildings / narrow street etc., then the excavation by blasting will not be permitted. Under these circumstances, excavation shall have to be carried out only by Breaker (pneumatic tools) as per the instructions of the Engineer- In- Charge. No extra payment will be made for such type of excavation done by using Breaker. The rate for excavation shall be paid as per the rate of related item mentioned in Schedule-B.
8. The safety of the trenches is the prime important factor. Along the trenches on both the side, a hump of excavated stuff of minimum height 3 to 5 ft shall have to be provided till the work is got complete. However, where there is no defined road, in such area, the fencing/ lighting etc., requires to be provided as per clause 1.1.15. Sign Board shall have to be provided at required locations, so that there will not be any fatal accident.

9. Regarding the width of excavation, as (a) it is difficult to carry out the vertical trench excavation, (b) possibility of sliding the soil, and (c) uneven excavation trench width in case of blasting. In this connection, for every 1.5 mt lift if there is less width upto 5 cm at the bottom then the top width of excavated trench, it shall be considered as per the specified trench width or actual trench width carried out at the ground level by the contractor whichever is less. If excavation is carried out more than the specified width then the payment will be made only for the specified width of excavation. For mode of measurement for excavation, the width of excavation will be considered as given at the time of line out by engineer-in-charge or actual width done whichever is less.
10. The pipes shall be with ISI mark whereas that of manhole frame and cover shall be confirming to relevant IS.
11. After entering into an agreement, the agency shall have to finalize the agency for supply of the material like pipes, manhole / house connection chamber frame and covers etc., and the name of manufacturer / supplier should immediately be informed to Gandhidham Municipal Corporation so that Gandhidham Municipal Corporation can also expedite the manufacturer / supplier for the material. If necessary, Gandhidham Municipal Corporation will visit and inspect the factory. During the inspection, if Gandhidham Municipal Corporation is not satisfied then the contractor shall have to procure the material from other manufacturer(s).
12. While the work in progress, there is possibility of change in drainage line routes according to the site conditions. Under these circumstances, the contractor shall have to carry out the work accordingly, for which, no extra payment shall be made in such situations. Over and above, the decision of Engineer-in-charge for change in drainage line routes shall be final and binding to the contractor.
13. The quantity of various items mentioned in the schedule is liable to increase or decrease up to any extent. Under the circumstances, the contractor shall have to carry out the work accordingly without any rate escalation. Gandhidham Municipal Corporation will not entertain any dispute in this regard.
14. In excavation, the decision regarding classification of strata shall rest with the Engineer-In-Charge and his decision in this regards shall be final and binding to the Contractor.
15. The rates are inclusive of dewatering, if require
16. Regarding water supply for hydro / flow testing, necessary water, power, labour etc. required for the necessary test shall be arranged by the contractor at his own cost.
17. During construction activity, proper care must be taken for labour safety and must follow the provisions of the Labour Laws.
18. Testing of material like; Brick, Sand, Aggregate etc. should have to be tested periodically as suggested by the engineer- in-charge at Government approved material testing Laboratory and testing charges for the same has to be borne by the contractor.
19. In case of any ambiguity found in specifications / drawings etc. the engineer-in-charge is empowered to take necessary decision for rectification and same shall be final and binding to the contractor.
20. The contractor shall have to get registered under ESI (Employer's State Insurance)

21. Act and obtain ESI Registration number if the number of workers are 10 Nos. or more. Also, the agency shall have to give all the benefits to the workers as available under the ESI Act. The agency should follow all the rules and regulations of ESI Act as per prevailing norms.
22. The contractor will be responsible to avail P F Code as per the prevailing Circular of Government for the employees on work. The required documents regarding deduction of P F shall have to be submitted by the contractor to the competent authority.
23. For this project works Third Party Inspection PMC is mandatory.
The PMC agency will be appointed by Gandhidham Municipal Corporation and remittance of charges @ 1.15% or (as per latest resolution by GMC standing committee) of contract value for the same is to be borne by the agency, which will be deducted from the contractor's bill.
24. Gandhidham Municipal Corporation at its discretion employs services of PMC. The contractor shall fulfill the entire requirement related to quality control as instructed by PMC / GMC at no extra cost.
25. The restoration work for the excavation done is to be carried out immediately as per the instructions of engineer in charge. The excess material shall have to be disposed with no extra cost at the site specified by engineer-in-charge. Agency has to restore and repair (in original form as before) any utilities which is damaged and affected during the work execution without any extra payment.
26. Wherever its necessary and as per the instruction of engineering in charge and site in charge agency has to provide sufficient/significant amount of thrust block for the safety of the pipeline.
27. Agency intending to carry out excavation has to will be able to carry out excavation / digging only after prior intimation through "Call before U Dig" mobile application.

CITY ENGINEER
Gandhidham Municipal Corporation

Signature of Contractor

BILL OF QUANTITIES AND PRICE

The Bill of quantities consists of following sections :

CIVIL WORKS:

Civil works requires following:

Excavation of Trenches

- ✓ Providing, supplying, lowering, laying, jointing, testing and commissioning of RCC main Drainage Line as per the detailed specifications shown in Vol-II.
- ✓ Bedding for pipes with selected murrum
- ✓ Support of piping system, Thrust blocks of RCC in various concrete etc.
- ✓ Refilling the pipeline trenches with proper ramming

✓ All required necessary items as directed by engineer in charge. The bill of quantities forms the most important part of the e- tender documents.

The supply, lowering laying jointing, erection testing and commissioning of pipeline which form a part of total works are indicated in the schedules separated include in the documents. The e-tendering contractors shall price of this document.

Performance testing and commissioning:

The bill of quantities, general conditions of contractor and the specifications which form an integral part of this contractor shall be read in conjugation.

The bill of quantities, general conditions of contractor and the specifications which form an integral part of this contractor shall be read in conjugation.

Payment for different items shall be paid on % (percentage) above or below quoted by the contractor online in the given price bid. However for any extra items to be carried out with permission of engineer in charge rates will be decided by the Gandhidham Municipal Corporation as per GC-70 wherever not specified in the tender.

Whenever manufacturer is separate and contractor for lowering, laying, joining and testing is separate, the principal contractor shall enter in to an agreement with DI pipes & DI Specials manufacturer for satisfactory manufacturing as per the relevant code of practice, testing, transporting, stacking & testing after laying at site as per GMC requirement.