

## **Water Supply**

### **Part A – Bore well**

#### **ITEM NO 01:- Drilling of 250 mm dia pilot bore hole in alluvial strata by DR Rig.**

The drilling shall be done by mud flush direct circulation rotary rig with hydraulic movements fitted with heavy duty reciprocating mud pump. The contractor shall have to drill 3.0 meters extra depth below the bottom of casing pipe without any extra cost.

All tools and equipment required for drilling operation should be brought to site of work by contractor at his own cost. Arrangement of fresh potable (i.e. not higher than 2000PPM) water for drilling operation should be done by contractor at his own cost in un-avoidable circumstances drilling water of salinity higher than 2000 PPM may be considered after obtaining the permission of Engineer in charge.

The drilling agency has to collect and furnish following information.

Samples of drilled cuttings from different strata shall be collected at suitable intervals preferably at every 2 meters depth drilled and across intervals if a change in the strata is met with the opinion of the Executive Engineer or his agent shall be binding to the contractor. The samples should be washed properly as the drilling is in progress. An accurate drilling time log shall be kept indicating the time taken for drilling every two meters. This log will enable interpretation regarding the nature of formation (hard, soft, un-consolidated etc) which has bearing on the water yielding capacity of the formation.

#### **Mode of Measurements & Payment:-**

The 80% of quoted rate payment shall be paid as per meter depth of drilling on completion works as per approved drawing and remaining 20% will be paid after commissioning of system/ pipeline. This item shall be measured and paid on running meter basis.

#### **ITEM NO 02:- Conducting Electro logging Test of 250 mm dia bore hole including carting and idle hours.**

Before the assembly and lowering of pipe Electro-logging shall be done by electro-logger and on the basis of result received strainer shall be provided in sweet water requirement. The works shall be carried out to entire satisfaction of Engineer in charge and no extra payment shall be made on carting charges assembly of the strainer and clock housing shall be done in the above results.

#### **HANDING OVER THE TUBE WELL:-**

The housing pipe should be closed by a bore cap. The contractor has to clean the drilling site filling the mud pump by clay. The following information should be furnished by the drilling agency on completion of the tube well.

Strata chart of the tube well including the different types of soil met with as per dig hole in three sets.

Samples of strata collected should be actually packed and carried marked in sample bags.

Chart of actual assembly lowered indicating the slice of the pipes, depth range where housing, strainer pipe casing have been used, depth of bore different hole with diameter and total depth.

Position of every joint in the assembly lowered.

Hours of development of carried out by Air Compressor.

Static water level and pumping water level.

Dates of each function started and completed.

Above details should be furnished with duly signed by Engineer.

#### **ELECTROLOGGING TEST:-**

The contractor should inform well in advance to Engineer in charge for the above test after completion of 250mm diameter pilot bore hole. In no case logging test in pilot bore hole exceeding 250mm diameter size shall be carried out. The logging electrode must reach at specified depth of bore hole as stated in the schedule. Otherwise second time logging test should be carried out. The charge for second time logging shall be borne by the contractor.

In case of drilling area having sticky / plastic clay strata where contractor has drilled pilot bore of 250mm diameter R. R. Bit for successful logging. Even if the logging is not possible in 250mm diameter because of expanding nature of clay, the agency is not required to pay the re-logging charges.

#### **Mode of Measurements & Payment:-**

Measurement and Payment shall be made for completed **job for each bore**

**ITEM NO 03:- Reaming of 250 mm dia pilot bore hole to 550 mm dia bore hole including assembling, jointing, lowering housing casing, strainer pipe, gravell packing, clay packing etc. comp.**

Reaming 250mm diameter bore hole to 550mm diameter bore hole up to desired depth in all alluvial strata including soft and hard rock by using best quality of bentonite powder. The drilling shall be done by mud flush direct rotary Ring including lowering, jointing of ERW / MS pipes strainer pipes etc. during welding alignment of pipe should be checked with spirit level. Carting of pipes to site including welding, jointing etc. complete as directed by Engineer in charge for specified depth and as per pipe assembly given is to be done by the contractor.

In case, Cement sealing is proposed below the total depth of housing, then the upper reaming shall be continued up to the upper limit of cement sealing. The lowering of pipe assembly at required depth of 3meters more reaming should be carried out beyond the full depth of pipe assembly to ensure the safe lowering against any cutting remaining in the bore hole. No payment will be made for this 3 meters extra drilling.

The pipe assembly (as per the size of tube well) suggested by hydrologist should be lowered as per instruction of Engineer in charge and pipe lowering work shall be started by mutual understanding with in charge Deputy Executive Engineer. Contractor should ensure that each joint of pipe assembly perfectly welded.

The required suggested size of casing, case type trapezoidal strainer pipes etc. shall be brought by contractor as per pipe assembly. The pipes should be lowered in a vertical position necessary steel bedded Plates should brought by contractor. No extra cost for welding rods. There should not be air gap left so that there is no chance of water leakage from outside of pipe assembly throughout welding joints in housing length of pipe assembly. Welding of each joint has to be done initially by 8 SWG welding rod followed by removal of extra slag / flux there after second line of welding shall be carried out to ensure perfect welding joint, welding rod shall be of reputed make.

If the bore is required to be drilled more than specified depth the contractor shall be bound to carry out such additional works including drilling jointing and lowering casing and strainer pipes etc. as may be necessary. The relevant specifications regarding drilling, lowering, jointing, welding of pipes and strata samples etc. shall also be completed.

The gravel packing around housing, casing and strainer pipes shall have to be carried out by the contractor.

Before gravel packing is started, it should be ensured that the thickness of mud plaster is reduced to minimum and perfect back washing should be carried out.

The tube well should be gravel packed with at least minimum calculated quantity. The gravel packing operation shall be continued till filter is constructed around the slotted pipe or screen, so as to ensure that no sand flows in the tube well under normal operational conditions of the tube well. After gravel packing no mud slurry should remain at bottom and it should be cleaned by fresh water.

Record of quantity of gravel packed in the bore should be kept by contractor and should be supplied along with strata chart.

Extra quantity of gravel should be used, if required, during development of the bore. Clay packing (if required) should be done by the contractor by providing sticky clay balls only as desired by Engineer in charge during or after developing the bore with Air compressor etc.

#### **Mode of Measurements & Payment:-**

The 80% of quoted rate payment shall be paid as per meter depth of drilling on completion works as per approved drawing and remaining 20% will be paid after commissioning of system/ pipeline. This item shall be measured and paid in running meter basis.

**Item No 04 : Development of Each water bearing zones comes / across upto the full depth of tube well (Size 200/250/300 mm dia depth more then 150 mts.) by lowering 100 mm dia droplining and 32 mm dia GI air line for each zone with suitable capacity Air compressor upto the availability of sand free discharge.**

This item shall be executed as per directions of engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid in completed number of job basis.

**Item No 05: Development of above mentioned by Air compressor 1100 C.F.M. / 300 PSI capacity upto 6 hrs. minimum untill sand free discharge of the bore whichever is lesser.**

Development of above mentioned by Air compressor 1100 C.F.M. / 300 PSI capacity upto 12 hrs. or sand free discharge of the bore whichever is lesser.

Initial development should be carried out by means of compressed Air within one week after completion of gravel packing / cement sealing. Air Compressor to be used should be of minimum capacity as stated in Schedule – B and drop line should be used for development of zones of the bore.

Compressor test shall be carried out as per following procedure. Contractor has to cart all the required materials machinery and accessories like education / drop line, Air line, required capacity compressor and accessories required to lower air line, education line, drop line etc. at site of work at his own risk and cost. No carting charge shall be for handling such machinery materials and accessories.

Contractor has to carry out compressor test in each zone by lowering air line in to drop line lowered in each zone by keeping lower end of drop line in each zone till sand free discharge is obtained. Thus after cleaning of the first zone the contractor has to carry out compressor test of this zone till sand free discharge is obtained by this way the contractor has to carryout cleaning and development of each separate zone sequentially.

The entire work is to be carried out under strict supervision of concerned Engineer in charge and after completion of work the contractor has to obtain the necessary certificate for satisfactory completion of work from him.

To carry out the work shown in Paragraph – (2) the contractor has to pull out the air line fist and then the drop line for each zone. By this way the contractor has to clean all the water bearing zones, sequentially, cleaning and development of bore, carried out by this way shall be treated as one full job and payment shall be for complete job.

The test will be carried out as under:-

For the depth above 150 meters 1100 CFM / 300 PSI capacity of compressor should be used with drop line for minimum 12 hours or till sand free discharge is obtained whichever is later.

**Mode of Measurements & Payment:-**

Measurement and Payment shall be made for Lump sum Basis.

**ITEM NO 06:- M.s ERW plain end medium duty pipes confirming to IS: 4270/2001with latest amendments Rates are exclusive of GST. as per GWSSB R/C . for 250 mm dia (min. 7.10 mm thick)**

The pipes to be used shall be of leak proof rust less E.R.W. blank pipe of approved quality and even texture. The pipe shall be conforming to IS3589/1981. The pipes shall be stacked on site as instruction of Engineer in charge. The pipes shall be got approved by Executive Engineer before bringing on site.

Anti-corrosive painting shall be done by contractor at his own cost. The measurement shall be paid on Rmt. basis.

Before lowering the pipes complete collection of materials shall be done and got checked by Engineer in charge. The thickness pipes shall be 7.1mm thickness and internal diameter of pipe shall be or 250mm diameter. The pipe shall be used as per IS/4270/2001.

**Steel bent plate** suitable for 250mm diameter well welded with pipes. Every joint shall be provided with Nos. steel bent plate. The whole work shall be carried out as per instruction given by engineer-in-charge or his authorized agent

The pipes shall be of approved make of Asian, Tulu & Jindal or as approved by engineer incharge.

**Mode of Measurements & Payment:-**

The 80% of quoted rate payment shall be paid as per Rmt. Basis. on completion works as per approved drawing and remaining 20% will be paid after commissioning of system/ pipeline. This item shall be measured and paid in running meter basis.

**ITEM NO 07 :- Manufacture, supply and delivery of cage type Trapezoidal shape ('V') wire wound low carbon, galvanized screen pipe, confirming IS8110**

**E) 250mm Dia Heavy**

**1) 1.00mm Slot size**

The pipes to be used shall be of approved quality. The pipe shall be conforming to relevant IS codes. The pipes shall be stacked on site as instruction of Engineer in charge. The pipes shall be got approved by Executive Engineer before bringing on site.

Anti-corrosive painting shall be done by contractor at his own cost. The measurement shall be paid on Rmt. basis.

Before lowering the pipes complete collection of materials shall be done and got checked by Engineer in charge.

The pipes shall be of approved make of Asian, Tulu & Jindal or as approved by engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid in running meter basis.

**ITEM NO 08:- Supply of best quality of well sorted "Sevaliya" Gravel having size of 4 mm to 10 mm**

Clay balls of required quantity should be supply at site of work by the contractor before the pipe lowering work is started. The clay ball should be prepared from sticky clay only. The size of clay

balls should be 25mm to 50mm clay balls should be packed as suggested in the assembly given by the Hydrologist.

Cement sealing should be carried out by the help of mud pump and air line at specified depth given in the pipe assembly suggested by the Hydrologist. The work should be carried out as the instruction of Engineer in charge and Geologist / Hydrologist.

Bottom sealing should be carried out by contractor desired depth as suggested in pipe assembly in single operation with the help of mud pump and bottom cement sealing of suitable size in the presence of geologist / Hydrologist and in charge Engineer.

**Mode of Measurements & Payment:-**

Payment shall be made on cubic meter basis.

**Item No.:09: Supply of clayball made from sticky clay of size 25 mm to 50 mm at site of work (as certified by Hydrologist)**

Providing of gravel of selected size 25 mm to 50 mm at site of work hard well rounded uniform particles, free from dust clay, foreign particles etc. and should be approved by engineer in charge.

**Mode of Measurements & Payment:-**

Payment shall be made on cubic meter basis

**Item No 10 - Supply of Clamp made from M.S. Plate with three holes on either side with nuts & bolts of Std. make and suitable size 900 mm x 100 mm x 16 mm Flat Suitable for 250 mm dia pipe.**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid in pair basis.

**Item No 11 - Bore Plug having 100 mm height made from M.S. Plate with three holes at equal distance on circumference for nut bolts type locking arrangement with nuts - bolts and lock nuts of Std make complete from 5 mm thick MS plate (for Top Also) Suitable for 250 mm dia pipe.**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on number basis.

**ITEM NO 12 - MS Bail Plug having Length 0.45 Mt. from Medium class pipe as per I.S.S. suitable for 250 mm dia pipe**

The E.R.W. pipe of 250 mm diameter having length of 3.0 meters should be welded with bail plug having a length of 1.0 meter.

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on number basis.

**ITEM NO 13 - Steel Bent Plate suitable to 250 mm dia ERW pipe size 200 mm x 150 mm x 6 mm**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on number basis.

**ITEM NO 14 - Supply of Portland Cement**

Standard specifications of cement shall be followed.

Agency shall get the brand of cement as approved by engineer incharge.

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on MT basis.

**ITEM NO 15 - Cement sealing if necessary without cost of cement by means of mud pump.**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on Completed Job basis.

**ITEM NO 16 - Geophysical & Geohydrological ground water investigations for finalisation of one pin point (With vehicle charges)**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on Completed Bore basis.

**ITEM NO 17: Bottom Sealing**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on Completed Job basis.

**ITEM NO 18: Geohydrological ground water investigations. (With vehicle charges)**

**ii) 200 / 250mm dia Deep tubewell (with water sample)**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on Completed Job basis.

**ITEM NO 19: Medium duty M.S. coupling as per I.S. specification of following size**

**iii) 300 mm dia.**

This item shall be executed as per directions of Engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid on number basis.

## **Part B – Water Supply Distribution Line**

**Item No 01 :-** Excavation for pipe line trenches for water supply line including all with shoring and strutting if required as per required gradient and line including safety provision using site rails and stacking excavated stuff including up to all required lead cleaning the site etc complete for all lifts and strata as specified. Excavated material to be disposed off within estate as directed by Engineer Incharge.

**In all Strata**

**1 General:** Excavation for pipe line trenches to be carried out as per approved layout.

### **2 Clearing the site**

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

2.2 The rate of site clearance is deemed to be included in the rate of earth work for which no extra will be paid.

### **3 Setting out**

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

### **4 Excavation**

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

### **5 Disposal of excavated stuff:**

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



5.2 The balance of the excavated quantity shall be removed by the contractor from the site of work to a places as directed with lead within the estate and all lift. Excavated material to be disposed off within estate as directed by Engineer Incharge.

**6 Mode of measurement and payment:**

6.1 The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by Engineer-in-charge. No payment shall be made for surplus excavations made in excess of above requirements or due to slopping and sloping back as found necessary on account of conditions of soil and requirement of safety.

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

**ITEM NO 02:- Providing and supplying in standard length ISI mark rigid unplasticised 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 , Test Pressure 6 Kg/cm<sup>2</sup>.**

- a. 90 mm dia
- b. 110 mm dia
- c. 125mm dia
- d. 140 mm dia
- e. 180 mm dia
- f. 200 mm dia
- g. 225 mm dia

**1.0 MATERIALS:**

This section includes the supply of materials, equipment, labour and services necessary for the construction of water supply distribution network. This standard covers supply, underground installation and hydrostatic testing procedures for polyvinyl chloride (PVC) pressure pipe and fittings that comply with IS: 4985-1981,IS:7634-1975 PART-III It may be necessary to supplement this standard with provisions for special requirements not included herein. Such special requirements should be incorporated into the EMPLOYER specifications.

**2.0 STANDARDS (PVC Pipes Dimensions and laying)**

IS: 4985-1981                      -                      Dimensions of PVC pipes

IS: 7634-1975 (Part-III)                      -                      Code of practice for Laying of PVC  
plastics pipes work for potable water supplies

ANSI/AWWA C900                      -                      Standard for Polyvinyl Chloride (PVC)

Pressure Pipe, 4 Inch. Through 12 Inch.,

for Water Distribution.

ANSI/AWWA C905 - Standard for Polyvinyl Chloride (PVC)

Water Transmission Pipe, Nominal

Diameters 14 In. Through 36 Inch.

### **3.0 MATERIALS**

#### **3.1 Pipes and Fittings.**

Pipes and fittings shall comply with the relevant Indian Standards or as per piping material specification.

#### **3.2 MATERIALS AND WORKMANSHIP:**

General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process.

All the material shall be new and of high quality.

In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacturer.

#### **3.3 TEST CERTIFICATE:**

The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

The supplier shall also produce in addition to manufacturer's test certificate, the inspection certificate issued by the authorized person/agency appointed by Engineer or Owner for the same purpose.

### **4. STORAGE AND HANDLING**

Materials shall be stored and handled in such a manner necessary to prevent their damage and deterioration. The Contractor shall employ adequate means to safely handle pipes, access chambers and other materials.

Stacking. Stored materials shall be kept safe from damage and deterioration. The interior as well as all sealing surfaces of pipe and appurtenances shall be kept free from dirt and foreign matter per ANSI/AWWA C651. Pipe stored outdoors and expected to be exposed to direct sunlight for periods of one year or more after delivery shall be covered with canvas or other opaque material

with provision for adequate air circulation. PVC pipe shall not be stored close to heat sources, such as heaters, boilers, steam lines, or engine exhaust.

When possible, pipe shall be stored in unit packages on flat surfaces to avoid bending. When unit packages are stacked, care shall be exercised to ensure that the weight of the upper units does not cause deformation to pipe in lower units. Unit packages shall be supported by racks to prevent damage or ending of the pipe.

When unit packages are stacked, care shall be exercised to ensure that the height of the stack does not result in instability that could cause stack collapse, pipe damage, or personal injury. Generally, stack height should not exceed 8 ft (2.4 m). Safe stack height will vary by unit package configuration.

Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

Stringing. In preparation for installation, distribution (stringing) of pipe and appurtenances shall be as close to the trench as practical and, if possible, on the opposite side from the excavated earth stockpile. Pipe shall be protected from traffic and secured to prevent rolling. Bell ends on pipe should be pointed in the direction of work progress. Caution shall be exercised to minimize the contamination of pipe interiors and joint components.

### **3. PIPE LAYING AND JOINTING**

#### **1.1 Material Inspection**

Pipe and appurtenances shall be inspected for defects prior to installation in the trench. Unless otherwise specified by the engineer in charge, any defective, damaged, or unsound material shall be marked and held for inspection by the engineer in charge, who may prescribe corrective repairs or reject the material.

#### **1.2 Precautions**

Proper equipment, tools, and facilities shall be provided and used by the constructor for the safe execution of work. All pipe and appurtenances shall be lowered carefully into the trench using suitable equipment and methods to prevent material damage or personnel injury. Under no circumstances shall pipe or appurtenances be rolled, dropped, or dumped into the trench.

#### **1.3 Trench foundation.**

The trench foundation will be finished to the approval of Engineer-In charge prior to placing of the bedding material.

#### **1.4 Pipe Laying**

1.4.1 Pipe cleaning. Before lowering the pipe into position in the trench, all dirt and foreign matter that cannot be removed by normal flushing shall be cleaned by mechanical means. The Client or Engineer - In charge shall determine when such mechanical cleaning is required. During laying operations, no debris, hand tools, clothing, or other materials shall be placed in the pipe. Pipe shall be kept clean during and after laying.

**Pipe placement** As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to required line and grade within tolerances specified in the specification. The pipe and joint shall be uniformly supported and secured in place with the specified embedment material. The pipe shall be laid with the bell end pointing in the direction of work progress.

**Interrupted operations.** When laying operations are interrupted or terminated at the end of a day, pipe ends shall be sealed temporarily to prevent the entry of water, debris, small animals, and similar types of contamination. Precautions shall be taken to prevent flotation of the sealed pipe during work stoppages.

## 1.5 Cutting and Jointing

1.5.1 Field cuts. Circular saws, handsaws, or similar equipment may be used for cutting PVC pipe. When pipe is cut in the field, the cut shall provide a smooth end at a right angle to the longitudinal axis of the pipe. Pipe spigot ends shall be deburred, beveled, and remarked with insertion line. For optimal performance, the length and angle of field bevels should match the factory bevels. To ensure the proper engagement of the sealing gasket with the PVC pipe spigot when connecting to certain shallow-depth bells, such as those on some cast-iron fittings and valves, the factory bevel shall be cut off to form a deburred, square-cut end with only a slight outer bevel.

1.5.2 Joint preparation. The sealing surface of the pipe spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets shall be cleaned immediately assembly. Factory-installed gaskets should not be removed for cleaning. The joint shall be free of dirt, sand, grit, grease, or any foreign material. When assembling gasketed joints, an approved lubricant shall be applied as specified by the pipe manufacturer. Damage to the gasket(s) may result from the use of improper lubricants. If joints are to be assembled in cold-weather conditions, factory installed gaskets may be removed and taken to a heated truck cab or shelter to restore the gasket's flexibility prior to joint assembly. Not all factory-installed gaskets are field removable. Gasket removal shall only be permitted with the consent of the pipe manufacturer.

1.5.3 Types of gasketed joints. Unless specified otherwise by the engineer in charge, all gasket joints shall be the push-on type. PVC pressure pipe shall be assembled using the following types of joints:

1.5.3.1 Gasketed bell joint Integral with the pipe or fitting shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, and ANSI/AWWA C907.

1.5.3.2 Gasketed coupling. A double-gasketed coupling shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, ANSI/AWWA C907, and ANSI/AWWA C219.

1.5.3.3 Mechanical joint Any of several joint designs that have gaskets and bolts shall be manufactured in accordance with ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, and ANSI/AWWA C153/A21.53.

1.5.3.4 Joint assembly. Joints shall be assembled under conditions that ensure clean mating and sealing surfaces by using proper equipment, materials, and procedures in accordance with recommendations published by the manufacturer.

The integral bell gasketed joint and the gasketed coupling joint shall be assembled by positioning the elastomeric gasket in the annular groove of the bell or coupling (if the gasket is not preinstalled at the factory) and inserting the spigot end of the pipe into the bell or coupling. To assure compatibility, only gaskets supplied by the particular pipe and fittings manufacturer(s) shall be used in the pipes and fittings respectively. Gaskets and sealing surfaces shall be cleaned prior to lubrication and assembly. An approved lubricant shall be applied in accordance with the pipe manufacturer's published recommendations. Application of a non-approved lubricant or too much lubricant can result in a pipeline that is difficult to disinfect and may cause temporary taste or odor problems.

The mechanical joint shall be assembled in accordance with the fittings manufacturer's published recommendations. Pipe spigot bevels may require shortening for use with mechanical joints or fitting joints.

## 1.5.6 Cutting of pipes - Requirements

Where pipes are cut the ends shall be left neat and regular.

## 2.0 BACK FILLING.

Trench backfill above the pipe shall conform to the specifications. If specified, tracing wire or tape shall be placed immediately above the initial backfill material, directly over the pipe.

### **Material.**

The initial backfill material immediately above the top of the pipe shall be free of refuse, cobbles, boulders, large rocks or stones, frozen soil, or other similarly unsuitable material. Sands or gravels or sand and gravel mixtures with fines of low plasticity obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75 mm.

When imported or special backfill material is not defined in the specifications or on the drawings, the excavated native soil may be used, provided that such material consists of loam, sand, clay, or other material that is considered suitable by the Engineer-In charge.

Placement After the embedment material has been placed in accordance with Figure 1, initial backfill material shall be placed to a depth of 6 to 12 in. (150 to 300mm) over the top of the pipe in a manner that will fill the remaining voids and avoid damage to the pipe.

2.4 The balance of the backfill shall contain no stones or rocks larger than 8 in. (200 mm), frozen material, or debris. Backfilling shall follow pipe-laying as closely as possible. In general, backfilling should be no further than 100 ft (30 m) behind pipe-laying. Backfill shall be mounded in unpaved areas to allow for future settlement.

**Compaction.** Unless otherwise specified, trenches under pavement, sidewalks, or roads shall be backfilled and compacted in layers to the density specified by the Client or to the density required by the appropriate government jurisdiction.

Unless otherwise specified by the Client, trenches in locations other than surfaced areas shall be backfilled to the density of the adjacent soils.

**Additional backfill material** shall be supplied by the constructor if needed to backfill trenches completely or to fill depressions caused by subsequent settlement.

#### **Partial backfilling during testing:**

Newly installed pipelines are normally tested after backfilling. When Client specifications require that pressure and leakage testing be accomplished before completion of backfilling or with pipe joints exposed for examination, sufficient backfill material shall be placed over the pipe barrel between the joints to prevent movement, and due consideration shall be given to restraining thrust forces. In particular, pipes

### **3.0 CONNECTION TO EXISTING FACILITIES.**

Connections to existing pipes and access chambers will be undertaken by the Local Authority at the contractor's cost unless otherwise noted on the Drawings. The Contractor shall be responsible for notifying Engineer-In Charge of the requirements for the connection to the existing service fourteen (14) days prior to the need for that connection.

### **4.0 Pipe Bending**

If permitted in the specifications, PVC pressure pipe may accommodate longitudinal bending with the following limitations. The constructor shall block or brace pipe joints to ensure that bending of PVC pressure pipe does not result in axial deflection in the gasketed or mechanical joints that exceed the manufacturer's published limits. Excessive axial joint deflection may result in damaging stresses or leakage. The longitudinal bending in the PVC pipe barrel shall not result in a bending radius less than the minimum limits established in Table 1.

The bending of PVC pipe barrels larger than 12 in. (300 mm) nominal diameter is not recommended due to the forces required. The curved alignment of pipelines larger than nominal

12 in. (300 mm) in diameter shall be determined by the pipe manufacturer's published axial-joint-deflection limits or as otherwise specified by the engineer in charge.

**Table 1** Allowable bending for PVC pressure pipe

Nominal Size In.(mm)	Minimum Bending Radius	
	ft	(M)
4(100)	100	(30.5)
6(150)	144	(43.9)
8 (200)	189	(57.6)
10(250)	231	(70.4)
12(300)	275	(83.8)

\* ANSI/AWWA C900 PVC pipe with cast iron (CI) outside diameters

#### 5.0 Storage and disposal of material.

Excavated material is to be stored in a safe manner and in a location approved by Engineer-In charge. No excavated material will be placed against any fence or wall without the written consent of the owner and the approval of Engineer-In charge. Material will be placed a minimum of 1.0 m clear of the edge of the trench. Surplus material will be disposed of in locations approved by Engineer-In Charge.

#### PIPING MATERIAL SPECIFICATION -

For piping Material specification refer Annexure-I

#### MODE OF MEASUREMENT

##### Payment:

The Payment shall be paid on Running Meter basis. Item rate includes cost of specials for the same like bends, tees, reducers or any other specials as per relevant IS suitable for use with HDPE Pipes.

**Item No. 03: Lowering , laying, fixing and jointing PVC pipes and specials of following class and diameter including cost if conveyance from stores to site if work including cost of labour, material, cement solven, given satisfactory hydraulic testing as per ISI code.**

- a. 90 mm dia
- b. 110 mm dia
- c. 125 mm dia

- d. 140 mm dia
- e. 180 mm dia
- f. 200 mm dia
- g. 225 mm dia

#### **4. PIPE LAYING AND JOINTING**

##### **1.1 Material Inspection**

Pipe and appurtenances shall be inspected for defects prior to installation in the trench. Unless otherwise specified by the engineer in charge, any defective, damaged, or unsound material shall be marked and held for inspection by the engineer in charge, who may prescribe corrective repairs or reject the material.

##### **1.2 Precautions**

Proper equipment, tools, and facilities shall be provided and used by the constructor for the safe execution of work. All pipe and appurtenances shall be lowered carefully into the trench using suitable equipment and methods to prevent material damage or personnel injury. Under no circumstances shall pipe or appurtenances be rolled, dropped, or dumped into the trench.

##### **1.3 Trench foundation.**

The trench foundation will be finished to the approval of Engineer-In charge prior to placing of the bedding material.

##### **1.4 Pipe Laying**

**1.4.1 Pipe cleaning.** Before lowering the pipe into position in the trench, all dirt and foreign matter that cannot be removed by normal flushing shall be cleaned by mechanical means. The Client or Engineer - In charge shall determine when such mechanical cleaning is required. During laying operations, no debris, hand tools, clothing, or other materials shall be placed in the pipe. Pipe shall be kept clean during and after laying.

**Pipe placement** As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to required line and grade within tolerances specified in the specification. The pipe and joint shall be uniformly supported and secured in place with the specified embedment material. The pipe shall be laid with the bell end pointing in the direction of work progress.

**Interrupted operations.** When laying operations are interrupted or terminated at the end of a day, pipe ends shall be sealed temporarily to prevent the entry of water, debris, small animals, and similar types of contamination. Precautions shall be taken to prevent flotation of the sealed pipe during work stoppages.



## 1.5 Cutting and Jointing

1.5.1 Field cuts. Circular saws, handsaws, or similar equipment may be used for cutting PVC pipe. When pipe is cut in the field, the cut shall provide a smooth end at a right angle to the longitudinal axis of the pipe. Pipe spigot ends shall be deburred, beveled, and remarked with insertion line. For optimal performance, the length and angle of field bevels should match the factory bevels. To ensure the proper engagement of the sealing gasket with the PVC pipe spigot when connecting to certain shallow-depth bells, such as those on some cast-iron fittings and valves, the factory bevel shall be cut off to form a deburred, square-cut end with only a slight outer bevel.

1.5.2 Joint preparation. The sealing surface of the pipe spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets shall be cleaned immediately assembly. Factory-installed gaskets should not be removed for cleaning. The joint shall be free of dirt, sand, grit, grease, or any foreign material. When assembling gasketed joints, an approved lubricant shall be applied as specified by the pipe manufacturer. Damage to the gasket(s) may result from the use of improper lubricants. If joints are to be assembled in cold-weather conditions, factory installed gaskets may be removed and taken to a heated truck cab or shelter to restore the gasket's flexibility prior to joint assembly. Not all factory-installed gaskets are field removable. Gasket removal shall only be permitted with the consent of the pipe manufacturer.

1.5.3 Types of gasketed joints. Unless specified otherwise by the engineer in charge, all gasket joints shall be the push-on type. PVC pressure pipe shall be assembled using the following types of joints:

1.5.3.1 Gasketed bell joint Integral with the pipe or fitting shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, and ANSI/AWWA C907.

1.5.3.2 Gasketed coupling. A double-gasketed coupling shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, ANSI/AWWA C907, and ANSI/AWWA C219.

1.5.3.3 Mechanical joint Any of several joint designs that have gaskets and bolts shall be manufactured in accordance with ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, and ANSI/AWWA C153/A21.53.

1.5.3.4 Joint assembly. Joints shall be assembled under conditions that ensure clean mating and sealing surfaces by using proper equipment, materials, and procedures in accordance with recommendations published by the manufacturer.

The integral bell gasketed joint and the gasketed coupling joint shall be assembled by positioning the elastomeric gasket in the annular groove of the bell or coupling (if the gasket is not preinstalled at the factory) and inserting the spigot end of the pipe into the bell or coupling. To assure compatibility, only gaskets supplied by the particular pipe and fittings manufacturer(s) shall be used in the pipes and fittings respectively. Gaskets and sealing surfaces shall be cleaned

prior to lubrication and assembly. An approved lubricant shall be applied in accordance with the pipe manufacturer's published recommendations. Application of a non-approved lubricant or too much lubricant can result in a pipeline that is difficult to disinfect and may cause temporary taste or odor problems.

The mechanical joint shall be assembled in accordance with the fittings manufacturer's published recommendations. Pipe spigot bevels may require shortening for use with mechanical joints or fitting joints.

#### 1.5.6 Cutting of pipes - Requirements

Where pipes are cut the ends shall be left neat and regular.

#### 2.0 BACK FILLING.

Trench backfill above the pipe shall conform to the specifications. If specified, tracing wire or tape shall be placed immediately above the initial backfill material, directly over the pipe.

##### **Material.**

The initial backfill material immediately above the top of the pipe shall be free of refuse, cobbles, boulders, large rocks or stones, frozen soil, or other similarly unsuitable material. Sands or gravels or sand and gravel mixtures with fines of low plasticity obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75 mm.

When imported or special backfill material is not defined in the specifications or on the drawings, the excavated native soil may be used, provided that such material consists of loam, sand, clay, or other material that is considered suitable by the Engineer-In charge.

Placement After the embedment material has been placed in accordance with Figure 1, initial backfill material shall be placed to a depth of 6 to 12 in. (150 to 300mm) over the top of the pipe in a manner that will fill the remaining voids and avoid damage to the pipe.

2.4 The balance of the backfill shall contain no stones or rocks larger than 8 in. (200 mm), frozen material, or debris. Backfilling shall follow pipe-laying as closely as possible. In general, backfilling should be no further than 100 ft (30 m) behind pipe-laying. Backfill shall be mounded in unpaved areas to allow for future settlement.

**Compaction.** Unless otherwise specified, trenches under pavement, sidewalks, or roads shall be backfilled and compacted in layers to the density specified by the Client or to the density required by the appropriate government jurisdiction.

Unless otherwise specified by the Client, trenches in locations other than surfaced areas shall be backfilled to the density of the adjacent soils.

**Additional backfill material** shall be supplied by the constructor if needed to backfill trenches completely or to fill depressions caused by subsequent settlement.

**Partial backfilling during testing:**

Newly installed pipelines are normally tested after backfilling. When Client specifications require that pressure and leakage testing be accomplished before completion of backfilling or with pipe joints exposed for examination, sufficient backfill material shall be placed over the pipe barrel between the joints to prevent movement, and due consideration shall be given to restraining thrust forces. In particular, pipes

**3.0 CONNECTION TO EXISTING FACILITIES.**

Connections to existing pipes and access chambers will be undertaken by the Local Authority at the contractor's cost unless otherwise noted on the Drawings. The Contractor shall be responsible for notifying Engineer-In Charge of the requirements for the connection to the existing service fourteen (14) days prior to the need for that connection.

**4.0 Pipe Bending**

If permitted in the specifications, PVC pressure pipe may accommodate longitudinal bending with the following limitations. The constructor shall block or brace pipe joints to ensure that bending of PVC pressure pipe does not result in axial deflection in the gasketed or mechanical joints that exceed the manufacturer's published limits. Excessive axial joint deflection may result in damaging stresses or leakage. The longitudinal bending in the PVC pipe barrel shall not result in a bending radius less than the minimum limits established in Table 1.

The bending of PVC pipe barrels larger than 12 in. (300 mm) nominal diameter is not recommended due to the forces required. The curved alignment of pipelines larger than nominal 12 in. (300 mm) in diameter shall be determined by the pipe manufacturer's published axial-joint-deflection limits or as otherwise specified by the engineer in charge.

**Table 1** Allowable bending for PVC pressure pipe

Nominal Size In.(mm)	Minimum Bending Radius	
	ft	(M)
4(100)	100	(30.5)
6(150)	144	(43.9)
8 (200)	189	(57.6)

10(250)	231	(70.4)
12(300)	275	(83.8)

\* ANSI/AWWA C900 PVC pipe with cast iron (CI) outside diameters

## 5.0 Storage and disposal of material.

Excavated material is to be stored in a safe manner and in a location approved by Engineer-In charge. No excavated material will be placed against any fence or wall without the written consent of the owner and the approval of Engineer-In charge. Material will be placed a minimum of 1.0 m clear of the edge of the trench. Surplus material will be disposed of in locations approved by Engineer-In Charge.

## PIPING MATERIAL SPECIFICATION -

For piping Material specification refer Annexure-I

## MODE OF MEASUREMENT

The rate shall be running meter.

**Item no. 04 : Refilling the pipeline trenches including ramming, watering, consolidating disposing of surplus stuff as directed within the radius of 3 Km.**

### 1.0 GENERAL

The refilling will generally refer to refilling of trenches up to GL with excavated stuff or selected soil brought from outside if required.

### 2.0 FILLING MATERIAL

Filling materials may be either excavated stuff on the selected soil, if required, if excavated stuff in any section of pipe line is not suitable for refilling in the trenches as per the opinion of Engineer-in-charge, the contractor shall have to bring the material from outside without any extra cost.

### 3.0 REFILLING

The contractor shall do refilling in a systematic manner. Each layer of 15 cms thickness shall be well watered and compacted before the upper layer is laid, till the final level is reached to form a thoroughly compacted base. Trenches for line shall be back filled after the pipe line is laid and engineer in charge has permitted for filling. The refilling shall be done up to 30 cm above the pipe except the joint portion. The remaining portion of trench to be refilled after completion the hydraulic testing of pipe line. Refilling on top of pipe shall be carried out carefully with the excavated soft stuff. The filling shall be raised 250 mm above G.L for settlement. The contractor shall be fully responsible for any settlement after passing of time or during monsoon and the same shall be refilled with soil brought from outside if necessary without any extra cost. The process of refilling in 15 cm. Layers including watering, ramming etc. shall be carried out in such a way as not to damage the pipe line or foundation, footing, masonry already laid or built up. Surplus excavated stuff shall be disposed of within the estate. As directed by Engineer in charge.

#### **4.0 MODE OF MEASUREMENT AND PAYMENT:**

The rate shall be paid per cum. of refilled volume to original ground level. The measurement shall be worked out on the basis of quantity of excavation as per item of this tender less the volume of pipe line. The rate includes the loading, carting, unloading loads, ramming watering, consolidating, bringing selected materials brought from outside if required. Payment of refilling shall be made on cu.m. basis after satisfactory testing of pipe line is given by contractor.

#### **Item No 05:-**

i) Providing & Supplying ISI mark CI D/F sluice valves as per IS: 14846 (Latest Edition) of following class and diameters including all taxes, insurances, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to site, stacking etc. complete

PN-1. with hand wheel/ cap operated (PD type short body)

ii) Lowering, laying and jointing in position following C .I / D/F reflux valves, Butterfly valves, sluice valves and air valve including cost of all labour, jointing material, including nuts bolts, packing and satisfactory hydraulic testing etc. complete

Sluice valve PN 1 Class

100 mm dia PN-1 class

125 mm dia PN-1 class

150 mm dia PN-1 class

200 mm dia PN-1 class

#### **SLUICE VALVE**

Sluice valve as per I.S: 780 & 2906/1984

##### **1.0 GENERAL**

The contractor shall be covering manufacturing, supplying and delivery of:

Sluice valve conforming to IS: 2906-1984 & IS: 780-1984 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification

##### **2.0 STANDARDS**

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

##### **3.0 TEMPERATURE VARIATION**

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

##### **4.0 MARKING**

The legible and in deniable marking upon each valve shall indicate the following:

- (1) ISI certification mark on each sluice valve only.
- (2) Manufacture's brand name and/or trade mark.
- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch

(6) Where a valve has been tested for only open and test, it should be marked 'O' distinctly and permanently.

(7) Any other important matter that the manufacturer deems fit to be inscribed embossed.

## 5.0 TEST CERTIFICATE

5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

5.2 The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by EIC for the same purpose. The inspection charges of the authorized person/agency as fixed by EIC shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of EIC.

## 6.0 NOMINAL PRESSURE

6.1 Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-II" ( Mpa= 10 kgf/m<sup>2</sup> approx)

6.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

## 7.0 MATERIAL:

7.1 The materials for the different component parts of the sluice valve shall confirm to requirements given in Table

Sr.No	Component	Material	Ref.to	Grade of designation
1	Body, bonnet wedge stuffing box, gland thrust plate, cap.	Grey cast iron	210-FG 1978(1)	
2	Steam	High tensile brass	320- 1962(2)	Ally 1 of 2
3	Wedge nut	Leadedt in bronze	318- 1962(3)	2
4	Body seat ring, wedge facing ring	Leadedt in bronze	318- 1962(3)	2
5	Bolts	Carbon steel	1367- 1967(4)	Class 4.6
6	Nuts	Carbon steel	1367- 1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712- 1971(5)	C
8	Gland packing	Jute & hemp	5414- 1969(6)	--

(1) Specification for grey iron castings (third revision).

(2) Specification for high tensile brass rods and sections (revised).

(3) Specification for leaded tin bronze ingots and casting (revised).

(4) Specification for technical supply condition threaded fasteners (first revision)

(5) Specification for compressed asbestos fiber jointing (first revision)

(6) Specification for glee packing, jute and hemp.

## **8.0 MANUFACTURE**

Sluice valve bodies for 150 mm size valves shall be provided with double flanged ends connection.

### **9.0 FLANGES**

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538 (Part I to XXII) 1976 (Specification for cast Iron fittings for pressure pipes for water gas and sewage) or its latest revision.

## **3.0 MATERIALS**

### **3.1 CAST IRON**

Cast Iron for bodies' pressure covers, splash covers, glands, caps, and joints support rings shall be best gray iron of selected grade, 20 of I-S-210-1978 specification for grey iron castings.

### **3.2 GUN METAL**

Gunmetal shall be of mixture of 88% copper, 10% tin 2% Zinc having excellent hard wearing qualities, Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gunmetal.

### **3.3 FORGED BRASS**

Nipples, spindles shall be machined from rolled, extruded or forged high tensile brass or aluminum bronze. The produce shall possess much greater strength than ordinary cast product.

### **3.4 MILD STEEL**

Bolts, nuts, flanges etc. shall be of mild steel unless otherwise specified and shall conform to I.S. 226-1975 specification for structural steel.

### **3.5 MATERIALS FOR BALLS**

The balls shall be of rubber covered and vulcanite covered. The rubber shall have a smooth and hard surface. It shall be as per I.S. 638-1965 specification for rubber and insertion jointing.

### **3.6 FLANGE JOINTING MATERIALS**

- The jointing material used between the flanges of components part of the valve shall be compressed fiberboard or rubber of thickness between 1.5 mm to 3 mm. The rubber shall be as per I.S. 683:1965 specifications for rubber and Insertion jointing. The fiberboard shall be impregnated with chemically natural mineral oil and shall have a smooth and hard surface.

## **4.0 DIMENSION**

Dimension of the Air valves shall be as per relative item mentioned in schedule B of the tender.

## **5.0 CHARACTERISTICS**

5.1 Small orifice valves shall have rubber covered balls and nipples of forged bronze or special alloy in to brass plug.

5.2 Large orifice valve shall have vulcanite-covered ball closing on rubber sealing backed with leather and gunmetal outlet bushes. They shall be screwed or flanged. The flanged shall be faces and drilled to I.S.S.

5.3 For sewage mains, the air valves shall be actuated by mild steel floats bronze spindles and shall be fitted with synthetic rubber seals.

5.4 Air valves shall be sound in all respect and uniformly forged so as to have uniform bore. They shall be free from any defects such as unwanted projection, holes or roughness and shall have inner and outer surface perfectly smooth.

#### **6.0 COATING**

6.1 Immediately after casting and before machining, all cast iron parts shall be thoroughly cleaned and before rusting commences shall be coated by dipping in a bath containing a composition having a tar base.

6.2 The coating shall be such that it shall not impose any test of small to water. The coating shall be smoothing glossy and sufficiently hard. It shall not chip when scratched lightly with the point of penknife.

#### **7.0 INSPECTION AND TESTING**

7.1 The engineer in charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials, which does not confirm to the specified requirements.

7.2 The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show no sign of leakage under these tests i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

#### **8.0 MANUFACTURERS GUARANTEE**

8.1 The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

#### **9.0 The following information shall be cast on each valve body:**

(a) Manufacturer's name or trademark.

(b) Size of valve

#### **10.0 TENDER PRICE:**

The tender price shall include all labour, material and machinery cost necessitated to be utilized for;

- a) Proper manufacturing of the valves.
- b) All tests required to be undertaken at manufacturer's premises.
- c) Transportation of the valves either by Rail and/or Road services with all the covers duly and appropriately insured.
- d) Delivery of specials with proper loading, unloading, stacking at site as indicated by Engineer-in-charge.
  - Further towards proper discharge of all contractual obligations. The storage of all specials to be manufactured, supplied and delivered under the scope of contracts shall be in general be made as described in Technical specification document.
  - Cost of Required GI /CI air raises Flanged pipe (3.0 meter above GL) Foundation block and Column in CC M-150.

#### **11.0 DELIVERY SCHEDULE:**

The delivery schedule shall be governed by EIC

#### **12.0 MARKING**



The methods of marking all the valves 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 valves shall indicate the followings:

- i) Manufactures brand name and/or trademark.
- ii) Purchasers mark as "GIDC" is inscribed.
- iii) Diameter and class of valves.
- iv) Any other important matter that the manufacturer or purchase or deems fit to be inscribed.

#### **13.0 PACKING AND HANDLING:**

13.1 The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.

13.2 When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.

13.3 The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

#### **14.0 MATERIALS AND WORKMANSHIP:**

14.1 General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.

14.2 All the material shall be new and of high quality.

14.3 In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacturer.

#### **15.0 TEST CERTIFICATE:**

15.1 The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

15.2 The supplier shall also produce in addition to manufacturer's test certificate as mentioned in Para

7.1 above, the inspection certificate issued by the authorized person/agency appointed by Chief Officer for the same purpose.

#### **16.0 INSPECTION**

This clause is applicable in general to all materials such as all types of valves, Pre-cast chambers, other specials and materials etc. which are to be supplied by the contractor.

Inspection of materials will be carried out at factory site by Inspecting agency to be fixed and authorized by EIC. The supplier on receipt of supply order from EIC shall intimate inspecting agency to carry out inspection as soon as material is ready.

The inspection call for Air valve should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled. Manufacturer does not load material after sunset to avoid inadvertent dispatch of wrong material.

Inspection note issued by the inspection agency to supplier as well as consignee (EIC) materials with inspection mark will be dispatched to stores stipulated in supply order and on receipt at stores the verification will be carried out by concerned Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Engineer after verifying and satisfying the above requirements.

#### **[A] SLUICE VALVES, BUTTERFLY VALVES, REFLUX VALVE, AIR VALVE, SCOUR VALVE**

##### **1.0 SUPPLY OF MATERIAL**

- 1.1 Cast iron double-flanged sluice valve/butterfly valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.
- 1.2 The sluice valve/butterfly valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.
- 1.3 The sluice valves/butterfly valves shall be operated before laying.
- 1.4 All grits and foreign materials shall be removed from the inside of the valves before placing.
- 1.5 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.
- 1.6 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

##### **2.0 JOINTING MATERIAL**

- 2.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool etc.
- 2.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.
- 2.3 All jointing materials shall be not approved from the engineer-in-charge before use
- 2.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.
- 2.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.

##### **3.0 INSTALLATION**

- 3.1 The sluice valve/butterfly valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.
- 3.2 If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.
- 3.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice/butterfly valve bore. It shall be even at both the inner and outer edges.

- 3.4 The flange faces thoroughly greased.
- 3.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.
- 3.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.
- 3.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.
- 3.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- 3.9 The sluice valve/butterfly valve shall be installed in such a way that its Spindle shall remain in truly vertical position.
- 3.10 The other end of tailpiece shall be fitted with pipes so that continuous lines can work.
- 3.11 Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

#### **4.0 TESTING**

- 4.1 After installation of sluice valve/butterfly valve the same is tested to 11/2 times of its test pressure.
- 4.2 The joints sluice valve/butterfly valve shall withstand the test pressure of pipelines.
- 4.3 Defects noticed during test and operation of sluice valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

#### **16.1 MODE OF MEASUREMENT AND PAYMENT**

Item includes providing, supplying, lowering, laying jointing etc. complete. Measurement shall be paid on number basis.

**Item No. 06:**

**i) Providing & Supplying C.I temper proof Air Valve with SS 304 float gun metal nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to site, stacking etc. complete**

**ii) Lowering, laying and jointing in position following C .I / D/F reflux valves, Butterfly valves, sluice valves and air valve including cost of all labour, jointing material, including nuts bolts, packing and satisfactory hydraulic testing etc. complete**

**With isolating sluice valve PN 1**

**50 mm**

#### **1.0 GENERAL**

The contractor shall be covering manufacturing, supplying, delivery, lowering, laying, jointing etc of air valve conforming to relevant IS codes latest revision.

#### **2.0 STANDARDS**

The C.I. air valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

### **3.0 TEMPERATURE VARIATION**

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

### **4.0 MARKING**

The legible and in deniable marking upon each valve shall indicate the following:

- (1) ISI certification mark on each valve only.
- (2) Manufacture's brand name and/or trade mark.
- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch
- (6) Where a valve has been tested for only open and test, it should be marked 'O' distinctly and permanently.
- (7) Any other important matter that the manufacturer deems fit to be inscribed embossed.

### **5.0 TEST CERTIFICATE**

5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

5.2 The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by EIC for the same purpose. The inspection charges of the authorized person/agency as fixed by EIC shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of EIC.

### **6.0 NOMINAL PRESSURE**

6.1 valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-II" ( Mpa= 10 kgf/m<sup>2</sup> approx)

6.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

### **7.0 MATERIAL:**

7.1 The materials for the different component parts of the valve shall confirm to requirements given in Table

Sr.No	Component	Material	Ref.to	Grade of designation
1	Body, bonnet wedge stuffing box, gland thrust plate, cap.	Grey cast iron	210-FG 1978(1)	
2	Steam	High tensile brass	320- 1962(2)	Ally 1 of 2

3	Wedge nut	Leadedt in bronze	318- 1962(3)	2
4	Body seat ring, wedge facing ring	Leadedt in bronze	318- 1962(3)	2
5	Bolts	Carbon steel	1367- 1967(4)	Class 4.6
6	Nuts	Carbon steel	1367- 1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712- 1971(5)	C
8	Gland packing	Jute & hemp	5414- 1969(6)	--

- (1) Specification for grey iron castings (third revision).
- (2) Specification for high tensile brass roads and sections (revised).
- (3) Specification for leaded tin bronze ingots and casting (revised).
- (4) Specification for technical supply condition threaded fasteners (first revision)
- (5) Specification for compressed asbestos fiber jointing (first revision)
- (6) Specification for glen packing, jute and hemp.

### **8.0 MANUFACTURE**

valve bodies for 50 mm size valves shall be provided with double flanged ends connection.

### **9.0 FLANGES**

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538 (Part I to XXII) 1976 (Specification for cast Iron fittings for pressure pipes for water gas and sewage) or its latest revision.

### **3.0 MATERIALS**

#### **3.1 CAST IRON**

Cast Iron for bodies' pressure covers, splash covers, glands, caps, and joints support rings shall be best gray iron of selected grade, 20 of I-S-210-1978 specification for grey iron castings.

#### **3.2 GUN METAL**

Gunmetal shall be of mixture of 88% copper, 10% tin 2% Zinc having excellent hard wearing qualities, Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gunmetal.

#### **3.3 FOREGED BROZNE**

Nipples, spindles shall be machined from rolled, extruded or forged high tensile brass or aluminium bronze. The produce shall possess much greater strength than ordinary cast product.

#### **3.4 MILD STEEL**

Bolts, nuts, flanges etc. shall be of mild steel unless otherwise specified and shall confirm to I.S. 226-1975 specification for structural steel.

#### **3.5 MATERIALS FOR BALLS**

The balls shall be of rubber covered and vulcanite covered. The rubber shall have a smooth and hard surface. It shall be as per I.S. 638-1965 specification for rubber and insertion jointing.

#### **3.6 FLANGE JOINTING MATERIALS**

The jointing material used between the flanges of components part of the valve shall be compressed fiberboard or rubber of thickness between 1.5 mm to 3 mm. The rubber shall be as per I.S. 683:1965 specifications for rubber and Insertion jointing. The fiberboard shall be impregnated with chemically natural mineral oil and shall have a smooth and hard surface.

#### **4.0 DIMENSION**

Dimension of the Air valves shall be as per relative item mentioned in schedule B of the tender.

#### **5.0 CHARACTERISTICS**

5.1 Small orifice valves shall have rubber covered balls and nipples of forged bronze or special alloy in to brass plug.

5.2 Large orifice valve shall have vulcanite-covered ball closing on rubber sealing backed with leather and gunmetal outlet bushes. They shall be screwed or flanged. The flanged shall be faces and drilled to I.S.S.

5.3 For sewage mains, the air valves shall be actuated by mild steel floats bronze spindles and shall be fitted with synthetic rubber seals.

5.4 Air valves shall be sound in all respect and uniformly forged so as to have uniform bore. They shall be free from any defects such as unwanted projection, holes or roughness and shall have inner and outer surface perfectly smooth.

#### **6.0 COATING**

6.1 Immediately after casting and before machining, all cast iron parts shall be thoroughly cleaned and before rusting commences shall be coated by dipping in a bath containing a composition having a tar base.

6.2 The coating shall be such that it shall not impose any test of small to water. The coating shall be smoothing glossy and sufficiently hard. It shall not chip when scratched lightly with the point of penknife.

#### **7.0 INSPECTION AND TESTING**

7.1 The engineer in charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials, which does not confirm to the specified requirements.

7.2 The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show no sign of leakage under these tests i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

#### **8.0 MANUFACTURERS GUARANTEE**

8.1 The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

#### **9.0 The following information shall be cast on each valve body:**

(a) Manufacturer's name or trademark.

(b) Size of valve

#### **10.0 TENDER PRICE:**

The tender price shall include all labour, material and machinery cost necessitated to be utilized for;

- a) Proper manufacturing of the valves.
- b) All tests required to be undertaken at manufacturer's premises.
- c) Transportation of the valves either by Rail and/or Road services with all the covers duly and appropriately insured.
- d) Delivery of specials with proper loading, unloading, stacking at site or as indicated by Engineer-in-charge.
  - Further towards proper discharge of all contractual obligations. The storage of all specials to be manufactured, supplied and delivered under the scope of contracts shall be in general be made as described in Technical specification document.
  - Cost of Required GI /CI air raises Flanged pipe (3.0 meter above GL) Foundation block and Column in CC M-150.

#### **11.0 DELIVERY SCHEDULE:**

The delivery schedule shall be governed by the engineer incharge

#### **12.0 MARKING**

The methods of marking all the valves 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 valves shall indicate the followings:

- i) Manufactures brand name and/or trademark.
- ii) Purchasers mark as "GIDC" is inscribed.
- iii) Diameter and class of valves.
- iv) Any other important matter that the manufacturer or purchase or deems fit to be inscribed.

#### **13.0 PACKING AND HANDLING:**

- 13.1 The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.
- 13.2 When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.
- 13.3 The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

#### **14.0 MATERIALS AND WORKMANSHIP:**

- 14.1 General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.
- 14.2 All the material shall be new and of high quality.
- 14.3 In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacturer.

#### **15.0 TEST CERTIFICATE:**

- 15.1 The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

15.2 The supplier shall also produce in addition to manufacturer's test certificate as mentioned in Para

7.1 above, the inspection certificate issued by the authorized person/agency appointed by Chief Officer for the same purpose.

## **16.0 INSPECTION**

This clause is applicable in general to all materials such as all types of valves, Pre-cast chambers, other specials and materials etc. which are to be supplied by the contractor.

Inspection of materials will be carried out at factory site by Inspecting agency to be fixed and authorized by Engineer incharge. The supplier on receipt of supply order from EIC shall intimate inspecting agency to carry out inspection as soon as material is ready.

The inspection call for Air valve should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled. Manufacturer does not load material after sunset to avoid inadvertent dispatch of wrong material.

Inspection note issued by the inspection agency to supplier as well as consignee (Chief officer) materials with inspection mark will be dispatched to stores stipulated in supply order and on receipt at stores the verification will be carried out by concerned Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Engineer after verifying and satisfying the above requirements.

### **[A] SLUICE VALVES, BUTTERFLY VALVES, REFLUX VALVE, AIR VALVE, SCOUR VALVE**

#### **Item No. 07:**

**Providing & Supplying ISI mark CI D/F scour valve for diameters with internal cement mortar lining including all taxes , insurances , transportation, freight charges, octrol inspection charges, loading, unloading , conveyance to site , stacking etc. complete**

**PN-1 with hand wheel/ cap operated (PD type short body)**

**65 mm**

#### **1.0 SUPPLY OF MATERIAL**

1.1 Cast iron double-ball flanged air valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.

1.2 The valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.

1.3 The valves shall be operated before laying.



- 1.4 All grits and foreign materials shall be removed from the inside of the valves before placing.
- 1.5 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.
- 1.6 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

## **2.0 JOINTING MATERIAL**

- 2.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool etc.
- 2.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.
- 2.3 All jointing materials shall be not approved from the engineer-in-charge before use
- 2.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.
- 2.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.

## **3.0 INSTALLATION**

- 3.1 The valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.
- 3.2 If necessary tail pieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.
- 3.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the valve bore. It shall be even at both the inner and outer edges.
- 3.4 The flange faces thoroughly greased.
- 3.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.
- 3.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.
- 3.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.
- 3.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- 3.9 The valve shall be installed in such a way that its Spindle shall remain in truly vertical position.
- 3.10 The other end of tailpiece shall be fitted with pipes so that continuous lines can work.
- 3.11 Extra excavation required for facility of lowering and fixing valve shall not be paid for.

## **4.0 TESTING**

- 4.1 After installation of valve the same is tested to 1 1/2 times of its test pressure.
- 4.2 The joints valve shall withstand the test pressure of pipelines.
- 4.3 Defects noticed during test and operation of valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

## **MODE OF MEASUREMENT AND PAYMENT**

Measurement shall be paid on number basis.

## **ITEM NO. 08**

Lowering , laying and jointing in position following C .I / D/F reflux valves, Butterfly valves, sluice valves and air valve including cost of all labour, jointing material ,including nuts bolts, packing and satisfactory hydraulic testing etc. complete Sluice valve

50 mm dia air valve

100 mm dia PN-1 class

125 mm dia PN-1 class

150 mm dia PN-1 class

200 mm dia PN-1 class

This item shall be executed as per directions of engineer incharge.

**Mode of Measurements & Payment:-**

This item shall be measured and paid in completed number of job basis.

**ITEM NO. 09**

Construction of valve chambers in bricks or bela stone masonry, locally available in C.M 1:6 foundation concrete 150 mm thick in C C (1:4:8) of trap metal of size 25mm to 40mm thick, inside cement plaster in C.M (1:3) and cement pointing outside in C.M 1:3 and top cover of precast RCC slab 100 mm thick (with key holes in two parts, each with handles or MS bars etc. complete as given size ) up to 1Mts from GL to pipe invert level including complete civil works. with cast in situ RCC slab of 150 mm tk in two part. with 230 mm thick brick masonry wall in CM (1:6) size 1.30 m X 1.30 m and 1.0 m deep

**1 Material**

Water shall confirm toe M-1. Cement shall conform to M-3. Sand shall conform to M- 6. Brick shall conform to M-15. Cement mortar shall conform to M-11, Graded stone aggregate 20 mm & 40 mm nominal size shall conform to M-12,M.S .bar shall be confirm to M-18 Mild steel binding wire shall conform to M-21.

**2 General**

**2.1 Proportion of Mix**

Cement and sand shall be mixed to specified proportion and shall be measured by measuring box. The proportion of cement will be by volume on basis of 50 kg. Per bag may be hand mixed or machine mixed as directed by the Engineer.

**2.2 Proportion of Mortar**

In hand mix mortar, cement and sand with the specified proportion shall be thoroughly mixed dry on hard impervious platform as directed by Engineer.

**2.3 Foundation Concrete**

The relevant specification of item No. 13 shall be followed except that in the concrete mix black trap machine crushed graded stone aggregates shall be used and thickness of concrete shall be 150 mm.

#### 2.4 IPS Flooring 50 mm thick

The relevant specification of item No. 11 of ordinary concrete shall be followed except that the concrete mix shall be 1:2:4 & thickness shall be 50 mm & finishing with smooth with neat cement

#### 2.5 R.C.C SLAB

The relevant specification of item No. 11 of ordinary concrete shall be followed except that the concrete mix shall be M-20 & Precast slab cover thickness shall be 100 mm.

#### 2.6 M.S. Reinforcement

The M.S. reinforcement shall be placed as per design and drawing and as per the direction of the Engineer. It shall be got approved from the Engineer.

### **3 Workmanship**

3.1 The necessary excavation as per line and level and-size of the chamber, the chamber pit shall be excavated as per drawing or as ordered by the Engineer as per Item of tender shall be done for construction of valve chamber and paid extra.

3.2 The foundation concrete 1:4:8 and 150 mm thick as per drawings as ordered shall be laid after compacting the bottom of the pit.

3.3 The bottom flooring 50 mm thick IPS flooring with C. C. 1: 2: 4 finished smooth with neat cement slurry shall be laid after laying of foundation concrete &proper curing.

3.4 The clear inside size of chamber shall be as per Item of tender and as directed by the Engineer as per drawing. The joints in B.B. masonry shall not exceed 12 mm in thickness and this thickness shall be uniform through out.

3.5 Brick masonry walls in 1:6 cement Mortar and 230 mm thick shall be constructed, as per drawing and as directed by the Engineer.

3.6 The masonry wall shall be plastered inside with 15 mm thick 1:3 cement mortar and outside with cement pointing with 1:3 cement mortar, as per the instruction of the Engineer for the covered portion and shall be struck in cement Mortar along with the progress of masonry work. The off set for the concrete foundation shall be as per drawing.

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

3.8 On the top of masonry walls 1:1 cement mortar shall be laid and then 100 mm thick R.C.C slab grade M 15 with reinforcement as necessary and as directed by the Engineer with coarse aggregate of trap metal of 12 mm to 20 mm size, as per Item No.19(clause 2.4) shall be laid.

#### **4. Mode of Measurement and Payment**

Measurement and payment shall be made on the basis as per number of masonry chamber constructed with all constructing materials, labour, curing finishing, etc. complete civil work but excluding cost of excavation and refilling in all respect as per size and type of chamber in items of the BOQ. refilling in all respect as per size and type of chamber in items of the BOQ.

#### **Part 3 – ESR**

**Designing structurally (and aesthetically) complying provisions of relevant Indian standards and constructing RCC Elevated service Reservoir of the following capacity and height, using data of S.B.C of proposed site, Seismic zone, Wind speed Zone. Including:**

**(1) Container shape any suitable type(or as specified), (2) Staging consisting of column brace trestle / shaft / combination column- brace trestle and shaft as appropriate(or as specified) and (3) Appropriate foundation system. This includes excavation in all types of soil strata(including hard rock ), casting 100 mm thick P.C.C. levelling course in M-10 , Refilling the pit with proper soil and disposing of the surplus stuff within a lead of 50 meters. (4) This will also include cement plaster in CM 1:2 with approved water proofing compound to inside face of container. (5) All types of labour & material charges of lowering , laying, erecting / hoisting & joining of pipe assembly of Inlet, Outlet overflow, washout and bye pass arrangement as per hydraulic design are including. (6) Providing and fixing accessories(specified) like MS / GI Ladder CI Manhole frame and covers, water level indicator , lightening conductor, GI Pipe railing around walk way, at roof level, at gallery and around landing of inside shaft, Adequate cowl type ventilators or lantern type ventilator with stainless steel jali. (7) Scope of work includes constructing RCC spiral staircase with adequate tie beams, staircase footing, B.B. Masonry chambers for valves. ventilating shaft and ventilators as well as door in shaft .(8) including providing and applying three coats of cement paint/snowcem (as specified) to the whole structure. (9) It also includes satisfactory water tightness test as per relevant I.S. Code and painting name of scheme & capacity on the tank as per direction of engineer in charge.**

#### **NOTE:**

1. The structural design of ESR shall be in accordance with provisions relevant I.Ss.
  - (1) I.S. 3370 part I to IV 1965 or latest revised
  - (2) IS 456-2000 or latest revised
  - (3) IS 11682- 1985 or latest revised
  - (4) IS 1893-2002 part I to V or latest revised
  - (5) IS 13920-1993 or latest revised
  - (6) IS 875 part I to III,1987 or latest revised

(7) IS 11089- 1987 or latest revised

2. The Min. concrete grade for RCC shall be M :25. Proportion of concrete ingredients shall be as per Mix design using weigh batching.
3. HYSD( Fe 415)or higher grade reinforcing bars confirming to IS 1786/1139 or CRS /TMT bars shall be used as per detailed specification.
4. Incase of column –brace trestle type staging having more than 6 columns internal horizontal bracing is obligatory. One bracing shall be at foundation level incase of Individual footings
5. Min. size/ thickness of various components shall be provided as per design criteria/specifications ( or as per std. practice )
6. Minimum dimensions specified for various components in tender data /specifications shall be provided without fail.
7. The Safe bearing capacity (SBC) /allowable pressure on soil shall be referred from SBC test report or tender datasheet. If poor soil strata is met with or ground water table is met with ,the SBC shall have to be re ascertained scientifically and the design shall be revised.
8. Maximum spacing between horizontal bracings shall be 5 m (storey height).
9. The BB Masonry cabin with MS door shall be constructed when spiral staircase is outside the staging.
10. M.S. ladder shall be provided and fixed for access to roof when height of roof from G.L. is up to 10 m. For ESR having more than 10 m height RCC Spiral staircase or suitable RC staircase shall be constructed
11. For ESR-having staging height more than 15 m the spiral staircase shall be provided inside the staging with effective tie beams in more than one direction.
12. Water level indicator shall be provided and fixed float type /electronic (as specified).
13. The rate shall include providing and fixing pipes, specials, and valves required for inlet, outlet, wash out, over flow and bye pass arrangement. The scope of work includes constructing supporting RC pillars, erecting, laying, fixing and joining pipes and specials etc. upto 5 m length from face of staging (outer most column).
14. DI pipes & specials shall only be used
15. The rate shall include cost of dewatering during execution making all arrangement and any dewatering technic.
16. The structure shall be designed properly for uplift due to Ground water table specified in data or GWT met with during execution. No extra shall be Paid.
17. Effective curing shall be carried out as per specifications.
18. Agency shall engage qualified (at least graduate) consulting engineer for designing the structure and he/she shall visit the site for guidance of work at least 3 times.
18. 75 % part rate shall be payable for Concrete, Reinforcement and Plastering items of container until satisfactory hydraulic testing for water tightness is performed as per tender condition. Till then the work shall be treated as incomplete.

**ESR rate includes following additional work of supply and fixing as directed by EIC**

**10m length Extra overflow Pipe 200mm dia DI K9 D/F**

**30m Length Extra Outlet Pipe, Inlet & Washout 200mm dia DI K9 D/F**

**1 Extra Sluice Valve of 200mm diameter**

## **1 Extra Air Valve of 50mm diameter**

### **RCC ESR having 1.50 lacs lit. Capacity and 12 mt Staging Height**

#### **1.0 SCOPE OF WORK**

This section includes the supply of materials, equipment, labour and services necessary for the construction of 1,00,000 liters capacity RCC Ground Service Reservoir / Sump. This standard covers supply, construction, installation and hydrostatic testing procedures for Sump. It may be necessary to supplement this standard with provisions for special requirements not included.

Here in Such special requirements should be incorporated into the EMPLOYER specifications.

ESR rate includes following additional work of supply and fixing as directed by EIC

10m length Extra overflow Pipe 200mm dia DI K9 D/F

30m Length Extra Outlet Pipe, Inlet & Washout 200mm dia DI K9 D/F

1 Extra Sluice Valve of 200mm diameter

1 Extra Air Valve of 50mm diameter

RCC ESR having 1.50 lacs lit. Capacity and 12 mt Staging Height

#### **2.0 DETAILED SPECIFICATIONS**

##### **ORDINARY BRICKWORK:**

##### **BRICKS:**

Bricks shall conform to IS: 3102 (latest revision).

The bricks shall be local best quality and of regular & uniform size, shape & colour, uniformly well burnt through out but not over burnt. They shall have plain rectangular parallel sides & sharp, straight & right angled edges. They shall be free from cracks or other flaws. They shall have a frog of 10 mm. depth on one of the flat faces. They shall give a ringing sound when struck with each other.

The bricks shall show a fine grained, uniform, homogeneous & dense texture on fracture and shall be free from lumps of lime, laminations, cracks, air holes, soluble salts causing efflorescence or other defects which may in any way impair their strength, durability, appearance or usefulness for the purpose intended. They shall not break when thrown; on the ground on their flat face in a saturated condition from a height of 600mm.

The size of brick shall be 230 x 115 x 76 mm (or locally available sizes) only bricks of one standard size shall be used on one work unless specially permitted by the Architects.

After 24 hours immersion in water, absorption by weight shall not exceed 20 percent of the dry weight of the bricks, when tested according to IS: 1077 -1976.

Unless otherwise specified, crushing strength of brick shall not be less than 50 Kg./Sq.cm.

Bricks rejected by the Engineer shall be removed from the site of work within 24 hours.

##### **MORTAR:**

The mortar, which is used, shall be mixed in proper proportion as specified in tender item, it shall be thoroughly mixed on an impervious platform by being turned over at least twice dry and twice wet; water in required quantity shall be added gradually. Mortar shall not be ground. Cement mortar shall be prepared in required quantity and not with more than one bag of cement at a time and this quantity shall be consumed within half of an hour after mixing.

## CONSTRUCTION DETAILS:

### SOAKING:

All bricks shall be immersed in water for two hours before being put into works so that they will be saturated and will not absorb water from the mortar. Alternatively the bricks shall be well soaked with watering so that they will not absorb water from the mortar.

### BATS:

No bats or cut bricks shall be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different courses and for closer in which case, full bricks shall be laid at corners, the bats being placed in the middle of courses.

### LAYING:

The bricks shall be laid in mortar to line, level and shapes shown on the plans slightly pressed and thoroughly bedded in mortar and all joints shall be properly flushed and packed with mortar so that they will be completely filled with mortar and no hollows are left anywhere. Bricks shall be handled carefully so as not to damage their edge. They should not be thrown from any height to the ground; these should be put down gently.

Bricks shall be laid with frogs up and every 4th course shall be grouted. Seven courses should not exceed 600 mm. in height and in no case brick work shall be raised more than 14 courses per day.

All courses shall be laid truly horizontal and all vertical joints made truly vertical. Vertical joints in one course and the course below shall not come over one another and shall not normally be nearer than quarter of a brick length. For battered faces, bedding shall be at right angles to the face, care shall be taken during construction to see that edges of bricks at quoin, sills head etc. are not damaged. The verticality of the wall and horizontally of the courses shall be checked very often with plumb and spirit level respectively.

All uneven, irregular and bad brickwork shall be demolished, if deemed necessary by Engineer-in-Charge and rebuilt at contractor's expenses.

Pipes or fitting shall be fixed during the progress of brick work or all chases or holes shall be neatly cut in the brick work later or shall be formed as the work proceeds and shall be filled with (1:2:4) P.C.C. and made good after pipes or fittings have been fixed.

Wherever possible bricks shall be bedded in sand instead of cutting and this method is to be used particularly for the fixing of lugs and holdfasts to doors and windows and to rakes of staircases. The bricks shall then be removed only when the fixings are to be made.

### BOND:

Brickwork shall be done in English bond unless directed otherwise by the Engineer- in-Charge.

### JOINT:

- Joints shall not exceed 12mm in thickness and this shall be uniform through out. The Joints shall be raked out not less than 12 mm deep when the mortar is green where pointing is to be done.

- When the brick surface is to be plastered, the joints shall be raked to a depth of 6 mm. when the mortar is still green, so as to provide key to plaster.

### SCAFFOLDING:

Scaffolding will be double or single as warranted for the particular work and as approved by The Engineer-in-Charge. Holes shall be made good by bricks to match the work when scaffolding is removed.

#### CURING:

All brickwork shall be kept well watered for at least 10 days.

#### EXPOSED BRICK WORK:

Where exposed brick work is specified, the usual specification for Exposed Brick shall be Applicable and in addition, selected brick shall be used for facing, ensuring regular and clean faces of uniform colour. No bricks, which are broken, chipped, wrinkled, or which have irregular edges or corners, shall be used. Depending on the quality of bricks and if instructed by Engineer-in-Charge, the exposed face of every brick shall be rubbed before laying without any extra charge. Wooden fillets 12 mm thick and 12 mm. wide shall be placed at the edge of joints so that no mortar come on the surface of the bricks and a regular thickness of joint is maintained. The surface shall be rubbed down with brushes or bricks if necessary, and thoroughly washed. No mortar shall be allowed to stick to the surface, which shall be left clean with all joints even and true to straight line. Double scaffolding shall be used in exposed brickwork.

As specified in the tender, pointing (1:1) shall be done to brick joints. Before pointing, the joints shall be raked out to a depth 15 mm. and the surface of the wall shall be cleaned, washed and well watered at least for two days.

The mortar shall be prepared by mixing cement and sand in proportions as specified in Bills of Quantities. The material shall be thoroughly mixed in dry condition before water is added to them. The mixing shall be done on a water tight platform and mortar of one cement bag only shall be prepared at a time which shall be consumed within 30 minutes after adding water. The mortar shall be placed in the joints in the best workman like manner. The extra mortar shall be removed so that the edges of bricks shall be clearly defined. The finished work shall be kept well watered at least for 10 days.

#### RATES TO INCLUDE:

##### ORDINARY BRICK WORK:

The rate shall include the cost of materials, labour required for all the operations described above. This shall include the following:

All raking or false cutting and wastage,

Chamfering all external angles if instructed.

Extra cutting and wastage for forming rebated, reveals or squint or birds mouth angles.

Cutting and fitting brick work to steel.

Wedging and pinning up brick work to ceiling.

Bedding and pointing to wood frames.

Cutting and pinning ends of timbers, lintels, steps etc.

Leaving small holes as necessary for pipes, conduits etc.

Scaffolding double or single for the brick wall, as directed.

Necessary tools, plant etc. required for this work.

Leaving teeth or steps for proper bond with future masonry work.

Soaking of bricks in water and curing of work done.



#### EXPOSED BRICK WORK:

Rate includes the following, in addition to those included for ordinary brick work and all the cost of materials, labour required for all the operations described above.

Rubbing the bricks with bricks or on girder,

Pointing the exposed brick work.

Raking out the bricks up to 15 mm.

#### CONCRETE:

##### CEMENT CONCRETE:

■ Placing of concrete shall start after the bottom of foundation is well dressed, watered and rammed by means of rammers. After laying and consolidation is completed, watering twice a day for a week from the next day shall be done.

The measurements shall be exact to length, breadth and depth as per drawing.

If cement concrete is to be used, mixing shall be done either in a mixer machine or as required by Engineer-in-Charge of works in grades of M-10 / M-15 / M-20 / M-25 or as specified in the tender item. Concrete shall be laid in layer of maximum 150 mm. thickness with sufficient water and well consolidated with rammer and shall be roughened, in order to have proper bond before the next layer is laid. Placing of concrete, by curing and measurements shall be done as per lime concrete.

##### MATERIALS - CEMENT AND AGGREGATES: CEMENT:

The Cement used shall be only of the following with prior approval of the Engineer-in-Charge.

Ordinary Portland cement conforming to IS: 269 (For 33 Grade) IS: 8112 (For 43 Grade) and IS: 12269 (For 53 Grade).

Rapid Hardening Portland Cement conforming to IS: 8041.

Portland Pozzolana Cement conforming to IS: 1489.

Portland slag Cement conforming to IS: 455.

Hydrophobic cement conforming to IS: 8043.

Low Heat Portland Cement conforming to IS: 12600

g) Sulphate Resisting Portland cement conforming to IS: 12330  
the cement shall satisfy the physical requirements given in Table 2.1

##### AGGREGATE:

Aggregate shall conform to IS: 383. Aggregate shall consist of naturally occurring sand and gravel or stone, crushed or uncrushed or a combination thereof from source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, dense, durable against weathering. It shall have limited porosity and shall be free from veins and adhering coatings, iron pyrites, coal, mica, shale or similar laminated material, sea shells, alkali, clay lumps, coal residues, clinkers, slag, organic and other impurities that may cause corrosion of the reinforcements or may impair the strength and/or durability of the concrete. The grading shall be arranged by the contractor that will produce dense concrete of the specified proportions and consistency that will work readily into position without segregation and without the use of excessive water. The contractor shall submit to the Engineer for approval, a representative sample and sieve analysis of the aggregate at the site. Coarse and fine aggregates shall be

delivered at the site separately. The size of the aggregate and sieve analysis furnished below are for the guidance only. The grading of the aggregate shall be based on the mix design and preliminary tests on concrete specified later in this Specification.

TABLE 2.1

PHYSICAL REQUIREMENTS (TEST TO BE DONE AS PER IS: 4031)

	Ordinary Portland Cement	Low Heat Portland Cement	Portland Pozzolana Cement	Hydrophobic Portland Cement
Fineness (Blaine's Air Permeability) Specific Surface cm <sup>2</sup> /gm	Not less than 2250	Not less than 3200	Not less than 3000	Not less than 3500
Soundness (Le Chatelier method) Expansion	Not more than 10mm	Not more than 10mm	—	Not more than 10 mm
Setting Time (Vicat Apparatus)	30 minutes	60 minutes	30	60 minutes
Final Setting Time - Not more	600 minutes	600 minutes	600	600 minutes
Compressive Strength (Avg. of 3 Mortar Cubes (Area of Face 50 sq.	(Not less than)	(Not less than)	(Not less than)	(Not less than)
72 + 1 hour	160 kg/cm <sup>2</sup>	100 kg/cm <sup>2</sup>	~	160 kg/cm <sup>2</sup>
168+ 2 hour	220 kg/cm <sup>2</sup>	160 kg/cm <sup>2</sup>	220	220 kg/cm <sup>2</sup>
672 + 4 hours	—	350 kg/cm <sup>2</sup>	310	310 kg/cm
Heat of Hydration 7 days 28 days	•-	Not more than 65 cal/gm 75 cal/gm	o	

#### SAMPLING AND TESTING AGGREGATES:

Samples of the aggregate for mix design and determination of suitability shall be taken under the supervision of the Engineer-in-Charge and delivered to the laboratory well in advance of the scheduled placing of concrete. Records of the tests, which have been made on proposed aggregate and on concrete, made from the source of aggregate, shall be furnished to the Engineer in advance of the work of use in determining aggregate suitability.

#### CHEMICAL REQUIREMENTS:

The chemical requirement as given in relevant codes shall be satisfied when tested in accordance with IS: 4032.

#### FINE AGGREGATE:

Fine aggregate shall consist of natural sand and/or manufactured sand. The sand shall be sharp, hard, strong, durable and free from organic materials and other deleterious substances.

#### MACHINE MADE SAND:

Machine made sand will be acceptable upon approval by the Engineer, provided that the base rock composition shall be sound, hard, dense, non-organic, uncoated and durable against weathering.

**SCREENING AND WASHING:**

Sand shall be prepared for use by such screening or washing or both as necessary to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

**FOREIGN MATERIAL LIMITATIONS:**

Sand shall be free from all vegetable and injurious substances, dust, clay lumps, soft or elongated or flaky particles, shale, alkali, organic matter, loam mica and other deleterious substances. The percentages of deleterious substances in sand delivered to the mixer shall not exceed the following: Percentage by weight

Material passing IS: 460 - 75 Micron sieve

Shale

Coal and lignite

Clay lumps

Total of all above substances

Not to exceed five percent

**GRADATION:**

The sand shall be so graded that concrete of the required quality, workability, density and Strength can be produced using the specified water cement ratio. Unless otherwise directed, sand shall be graded as indicated in Table -2.2.

**TABLE -2.2 FINE AGGREGATE**

IS Sieve Designation	Percentage			
	Grading Zone-I	Grading Zone-II	Grading Zone-III	Grading Zone-IV
10 mm	100	100	100	100
4.74 mm	50-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-95	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-10

**Note:**

For crushed stone sands permissible limit on 150 micron IS Sieve is increased to 20 percent (in addition to 5 percent tolerance allowed). Where concrete of high strength and good quality is required, fine aggregate conforming to any one of the four grading zones may be used; however the concrete mix should be properly designed.

As the fine aggregate grading becomes progressively finer, that is, from grading zones I to IV, the ratio of fine aggregate to coarse aggregate should be progressively reduced. The most suitable fine aggregate to coarse aggregate ratio to be used for any particular mix will, however, depend upon the actual grading, particle shape and surface texture of both fine and coarse aggregates.

■ It is recommended that the fine aggregates conforming to grading zone IV should not be used in reinforced concrete unless tests have been made to ascertain the suitability of proposed mix proportions. Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron I.S. sieve by total amount not exceeding 5 percent, it shall be regarded as falling within the grading zone. This\* tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve on the coarser limit of grading zone I or the finer limit of grading zone II.

#### FINENESS MODULUS:

The sand shall have fineness modulus of not less than 2.8 nor more than 3.2. The fineness Modulus shall be determined by adding cumulative percentages retained on the five IS: 460 sieve designations viz 2 mm, 1 mm, 500 micron, 300 micron and 150 micron and dividing it by 100. The sieves generally adopted are 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron.

#### SPECIFIC GRAVITY:

Sand having specific gravity below 2.60 (saturated surface - dry basis) shall not be used Without special permission of the Engineer.

TABLE - 2.3

#### GRADING LIMITS FOR COARSE AGGREGATES

IS Sieve Designation	Percentage Passing for Single Sized Aggregate of Normal Size						Percentage Passing for Graded Aggregate of Nominal Size			
	60 mm	60 mm 40 mm	40 mm 20 mm	20 mm 16 mm	16 mm 12.5 mm	10 mm	40 mm	40 mm 20 mm	15mm	12.5 m m
80mm	100	-	-	-	-	-	100	-	-	-
53mm	85-	100	-	-	-	-	-	-	-	-
40mm	0-80	85-100	100	-	-	-	95-100	100	-	-
20mm	0-5	0-20	85-	100	-	-	30-70	95-	100	100
16mm	-	-	-	85-	100	-	-	-	90-100	-
12.5mm	-	-	-	-	85-100	100	-	-	-	90-
10mm	-	0-5	0-20	0-30	0-45	85-	10-35	25-	30-70	40-
4.75mm	-	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36mm	-	-	-	-	-	0-5	-	-	-	-

#### COARSE AGGREGATE STONE:

This shall consist of broken trap, granite or any suitable rock from a source to be approved by the Engineer. It shall be machine crushed, hard, strong, durable, free from clay films or loamy admixture, vegetable or organic matter.

#### SCREENING & WASHING:

Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by the Engineer.

The pieces shall be regular in shape, shall have granular or crystal like shape. Friable, flaking and laminated pieces, mica, shale shall be present only in such quantities that will not, in the opinion of the Engineer, effect adversely the strength and/or durability of concrete.

The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1% determined by laboratory sedimentation tests, after 24 hours immersion in water. A previously dried sample shall not have gained more than 10% of the weight

#### GRADING:

The aggregate shall be well graded. The grading limits for coarse aggregates shall be as given in Table-2.3.

#### SPECIFIC GRAVITY:

No coarse aggregate of less than 2.6 specific gravity (saturated surface - dry basis) shall be used without written approval of the Engineer.

#### FOREIGN MATERIAL LIMITATIONS:

The percentage of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the following:

Materials passing IS 460-75 Micron sieve Coal and lignite

Percentage by Weight 1 1

Clay lumps /\_\_

Total of all the above substances 3

#### ALL-IN-AGGREGATES:

If combined aggregates are available, they need not be separated into fine and coarse, but necessary adjustments may be made in the grading by the addition of single-sized aggregate. The grading of All in Aggregate shall be as given in

TABLE-2.4  
GRADING OF ALL-IN-AGGREGATE

IS Sieve Designation	Percentage passing for All in Aggregate of	
	40 mm nominal size	20 mm nominal size
80mm	100	—
40mm	95-100	100

20mm	45-75	95-100
4.75mm	25-75	30-50
600 micron	8-30	10-35
150 micron	0-6	0-6

#### MECHANICAL PROPERTIES OF AGGREGATES:

The aggregates shall have following mechanical properties:

Aggregate Crushing Value	-	45 percent for concretes other than for wearing surfaces
		30 percent for concrete for wearing surface
Aggregate Abrasion Value		12 percent
Aggregate Impact Value (Alternative to Aggregate Crushing Value)	-	45 percent by weight for concretes other than for wearing surfaces 30 percent by weight for concrete for wearing surface

#### COARSE AGGREGATE - SLAG:

Aggregate shall conform to the following in addition to para 2.4.2 to 2.4.8 above, which are applicable in this case also. °

Approval for Use	Blast furnace slag as aggregate may be used for concrete work if such use is permitted by the Engineer
Separating and Grading	Slag shall be crushed as required and over Magnetic Separators to remove stray bits of iron and then graded as required
Sulphur Content	Sulphur contents shall be controlled as per laboratory tests and as required by the Engineer
Specific Gravity	No aggregate of less than 2.1 specific and Weight gravity shall be used. Weight of dry compact graded material (6-40 mm) shall range between 1300 -1450 kg. Per cu. m. °
Weight of slag Concrete	The weight of concrete made from slag aggregate should be 2170 to 2245 kg. per cum.
Test for approval	In addition to the tests mentioned for coarse aggregate stone, contractor shall perform tests for sulphur and iron contents and any other test required by the Engineer. The Test results shall be approved by the Engineer before the material is used for work

#### WATER:

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to steel or concrete. Potable Water is generally considered satisfactory for mixing concrete. pH value of

water shall generally be not less than 6. Mixing or curing of concrete with seawater is not recommended because of presence of harmful salts in seawater. Under unavoidable circumstances, seawater may be used for mixing or curing in plain concrete or such reinforced concrete constructions, which are permanently under seawater.

#### ADMIXTURES:

Admixtures may be used in concrete, only with the approval of the Engineer-in-Charge based upon evidence that, with the passage of time, neither the compressive strength of concrete is reduced by more than 10 percent nor are other requisite qualities of concrete and steel impaired by the use of such admixtures. Calcium chloride should not be used. Admixtures, if used shall comply with IS: 9103.

#### STORAGE OF MATERIALS:

##### CEMENT:

Cement shall be stored in weather-tight buildings, bins, or silos, which exclude moisture and contaminants. Storage of cement at site shall be at contractor's expense and risk. In the event of any damage occurring to cement due to faulty storage in contractor's shed or on account of negligence on his part, such damages shall be the liability of Contractor. In case cement is stored and stacked in bags, storing shall be done in weather tight and properly ventilated structures to prevent absorption of moisture. The bags shall be stacked at least 100 - 200 mm clear above the floor. A space of 600 mm all around shall be kept between exterior walls and stacks. Cement bags shall be placed close together in the stack to reduce circulation of air as much as possible. Cement bags should not be stacked more than 10 bags high to avoid lumping under pressure. If the stack is more than 7 bags high, arrange the bags in header and stretcher fashion, that is, alternatively length-wise and cross-wise so as to tie them together and lessen the danger to toppling over. For extra safety during the monsoon or when it is expected to store the cement for an unusually long period, enclose the stack completely in polythene sheets or any other suitable water proofing materials (covering). The flap will close on the top of stack. Care should be taken that the polythene sheet is not damaged any time during use. When removing bags from storage some bags should be removed from two or three tiers back rather than all from one tier. If the rows are thus stepped back, there is less chance of over turning. When removing cement bags for use, apply "first in, first out" rule, that is, take the oldest cement out first. Each consignment of cement shall be stacked separately to permit easy access for inspection and to facilitate removal.

##### AGGREGATES:

The aggregate shall be stored in such a way as to prevent mixing of and with foreign materials. The heaps of fine and coarse aggregates shall be kept separately. When different sizes of fine or coarse aggregate are procured separately, they shall be stored in separate stockpiles sufficiently away from each other to prevent the material at the edges of the piles from getting intermixed.

#### WORKMANSHIP - CONCRETE:

Note:

In the designation of a concrete mix letter M refers to the mix and the number to the specified characteristic compressive strength of 150 mm. cube at 28 days expressed in N/mm<sup>2</sup>.

IS: 516 and IS: 1199 shall be followed for sample sizes, sampling and testing of all samples.

#### STRENGTH REQUIREMENTS OF CONCRETE:

Where Ordinary and Low Heat Portland Cement conforming to IS: 269, Portland Pozzolana Cement conforming to IS: 1489 or Portland Blast Furnace Slag Cement conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given in Table 2.7. Where Rapid Hardening Portland Cement (IS: 8041) is used, the 28 days compressive strength requirements specified in Table 2.7 shall be met at 7 days.

The strength requirements specified in Table 2.7 shall apply to both Controlled Concrete i.e. Design Mix Concrete and Ordinary Concrete i.e. Nominal Mix Concrete.

In order to get a relatively quicker idea of the quality of concrete, optional works tests on beams for modulus of rupture at 72 + 2 hours or 7 days or compressive strength at 7 days may be carried out in addition to 28 days compressive strength test. The Engineer-in-Charge may suitably relax the frequency of 28 days compressive strength test specified in Table 2.7 of IS: 456 - 2000 provided the expected strength values at the specified early age are consistently met. For this purpose, the values given in Table 2.8 may be taken for general guidance in the case of concrete made with Ordinary Portland Cement.

Where the strength of a concrete mix, as indicated by tests lies in between the strength for any two grades specified in Table 2.7, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

TABLE-2.7

#### STRENGTH REQUIREMENTS OF CONCRETE

Group Grade of Compressive Strength of 150mm Cubes at 28 days after mixing, conducted in accordance with IS: 516 N/mm<sup>2</sup>

Ordinary concrete	M-10	10
	M-15	15
	M-20	20
Standard Concrete	M-25	25
	M-30	30

The concrete mix shall be designed to have an average strength corresponding to the values specified for preliminary tests in Table - 2.7. The proportions chosen should be such that the concrete is of adequate workability for the conditions prevailing on the work in question, and can be properly compacted with the means available. The maximum total Quantity of aggregate by weight per 50 kg. of cement shall not exceed 450 kg. except where otherwise specially permitted by the Engineer-in-Charge.



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

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

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

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

#### WORKABILITY OF CONCRETE:

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

TABLE - 2.9 WORKABILITY OF CONCRETE

Placing conditions	Degree of Workability	Slump (mm)	Values of Workability	
c			Vee-Bee	Compacting Factor
Blinding concrete; Shallow Sections; Pavements using	Very Low		20-10 sees	0.75 - 0.80

Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strip	Low	25-75	10-5 sees	0.80 - 0.85
Heavily reinforced sections in slabs, beams walls, columns; Slip form work; Pumped	Medium	50-100 75-100	5-2 sees	0.85 - 0.92*
Trench fill; In-situ piling * Termite concrete	High Very high	100-150 Workability to be decided by determination of flow (IS: 9103)		Above 0.92** Above 0.92**

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

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

#### 2.10.5 NOMINAL MIX CONCRETE:

Nominal mix concrete may be used for concretes of grades M-5, M-7.5, M-10, M-15, M-20.

The proportions of materials for nominal mix concrete shall be as specified in Table 2.10.

TABLE-10

#### PROPORTIONS OF NOMINAL MIX CONCRETE

Grades of Concrete	Total Quantity of Dry Aggregate by Mass per 50 kg. of Cement. Sum of Masses of Fine and Coarse Aggregates	Proportion of Fine Aggregate to Coarse Aggregate (by Mass)	Quantity of Water for 50 kg. of Cement (Max.) Lit
M-5 M-7.5	800 kg 635 kg	Generally 1:2 but subject to upper limit of 1:1.5 and a lower limit of 1:2.5	60 45
M-10 M-15 M-20	480 kg 350 kg 250 kg	Adjust from upper to lower limit as grading fine aggregates becomes finer and maximum sizes of coarse aggregate	34 32 30
The maximum water cement ratio shall be maintained as per Table 2.12			

NOTE:

The Contractor will be required to prepare his own mix design and establish from preliminary tests as per Indian Standards that the mix design is according to that specified for each concrete. The same shall be adopted only after the Consulting Engineer/Architect approves it.

Workability of the concrete should be controlled by direct measurement of water content, making allowance for any surface water in the fine and coarse aggregates. The slump test in accordance with IS: 1199 may be used as a guide. Allowances should be made for surface water present in the aggregate when computing water content. Surface water shall be determined by one of the field methods described in IS: 2386 (Part III). In the absence of exact data, the amount of surface water may be estimated from the values given in Table -2.11.

TABLE-2.11

SURFACE WATER CARRIED BY AGGREGATE

Aggregate	Percent by Mass	Approximate Qty. of Surface Water Lit/Cum
Water wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist gravel or crushed rock	1.25-2.5	20 to 40

2.10.6 REQUIREMENT FOR DURABILITY:

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

TABLE-2.12

Minimum Cement Content, Maximum Water Cement Ratio And Minimum Grade Of Concrete For Different Exposures With Normal Weight Aggregates Of 20mm Nominal Maximum Size

Sr. No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m <sup>3</sup>	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m <sup>3</sup>	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
1.	Mild	220	0.60	—	300	0.55	M-20

2.	Moderate	240	0.60	M-15	300	0.50	M-25
3.	Severe	250	0.50	M-20	320	0.45	M-30
4.	Very Severe	260	0.45	M-20	340	0.45	M-35
5.	Extreme	280	0.40	M-25	360	0.40	M-40

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

TABLE 2.13  
ENVIRONMENTAL EXPOSURE CONDITIONS

Sr. No.	Environment	Exposure Conditions
1.	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
2	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet. Concrete exposed to condensation and rain Concrete continuously under water Concrete in contact or buried under non-aggressive soil/ground water Concrete surfaces sheltered from saturated salt air in coastal

Sr. No.	Environment	Exposure Conditions
		area
3.	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation. Concrete completely immersed in seawater Concrete exposed to coastal environment
4.	Very Severe	Concrete surfaces exposed to seawater spray, corrosive fumes or severe freezing conditions whilst wet. Concrete in contact with or buried under aggressive sub-soil/ground water
5.	Extreme	Surface of members in tidal zone Members in direct contact with liquid/solid aggressive chemicals

PRELIMINARY TESTS:

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

#### Mixing:

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

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

#### Note:

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

#### CONCRETE CUBES:

##### Size of test specimen & moulds:

Test specimens cubical in shape shall be 150 x 150 x 150 mm. If the largest nominal size of the aggregate does not exceed 200mm, 100 mm cubes may be used as an alternative. A cube mould should be of metal and stout enough to prevent distortion. It shall be constructed in such a manner as to facilitate the removal of the moulded specimen without damage, and shall be so machined that, when it is assembled ready for use, the dimensions and internal faces shall be accurate within the following limits:

Height of mould and distance between opposite faces:

Specified size + 0.2 mm.

Angle between adjacent faces:  $90 \pm 0.5$  degree

Each mould shall have a plane face metal base plate of such size as to support the mould during the filling without leakage and shall be attached to the moulds; when assembled shall be

positively and rigidly held together and suitable methods of ensuring this, both during filling and on subsequent handling of the filled mould, shall be provided. In assembling the mould for use, the joints between the sections of mould shall be thinly

- coated with mould oil and a similar coating of mould oil shall be applied between the contact surfaces of the bottom of the mould and the base plate in order to ensure that no water escapes during filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete. The tamping bar shall be a steel bar 16 mm. in diameter, 0.6 m. long and bullet pointed at the lower end.

#### Compacting:

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

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

#### Curing:

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

#### Tests for Cube Specimen:

The concrete cubes shall be tested in standard testing machines by skilled personnel. Tests shall be made at recognized ages of the test specimen, the most usual being 7 and 28 days. Tests may be made at 24 hours + 1/2 hour and 72 hours + 2 hours if early strengths are needed. The age shall be calculated from the time of the addition of water to the dry ingredients.

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

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

The bearing surface of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen, which are to be in contact with the compression platens. The specimen shall be so placed in the machine that the load shall be applied to the opposite sides of the cubes as cast, that is, not to the top and bottom. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing plates shall be used between specimen and platens of the machine. Once the uniform seating is obtained, load shall be applied without shock and increased continuously at a rate of approximately 14.0 N/mm<sup>2</sup> /Min. until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

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

#### Frequency of Sampling of Concrete Cubes:

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

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

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

Concrete shall be assessed daily for compliance. The contractor shall keep a record at site of all such tests identifying them with the proportion of the work to which they relate. The Architects will check this record from time to time. The said record shall give the following details and shall be initiated by the Engineer-in-Charge.

Reference to specific structural member receiving the batch of concrete from which the cubes were cast.

Mark on cubes. Mix of concrete.

Data and time of casting.

Water cement ratio by weight and slump.

Crushing strength as obtained at the end of 7 days for 3 cubes out of a set of 6 cubes and the end of 28 days for the remaining 3 cubes.

Laboratory in which tested and reference to test certificates.

The quantity of concrete, incorporated in work, that is represented by the quantity of concrete of the set of the cubes.

Any other information required by Architects. Consistency:

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

Record of Temperature:

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

OPTIONAL TESTS:

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

Tests on cement shall include:

Fineness Test,

Test for Normal Consistency,

Test for Setting Time,

Test for Soundness,

Test for Tensile Strength,

Test for Heat of Hydration (by experiment and by calculations) in accordance with BIS or any other approved standard for cements.

Test on sand shall include:

Sieve Test

Test for Organic Impurities

Decantation Test for Determining Clay

Specific Gravity Test

Test for Sieve Analysis and Fineness Modulus.



Tests on coarse aggregate shall include:

Sieve Analysis

Specific Gravity and Unit Weight of Dry Loose and Rodded Aggregate (Bulk Density Test)

Determination of Yield of a Dry Mixture

Petrographic Examination of Deleterious Minerals in Aggregates. Test for Aggregate Crushing Value and 10% Fine Value Test.

Aggregate Impact Value

Toughness Test

Soundness Test

Hardness Test

Alkali Aggregate Reaction

Deleterious Material

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

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

#### LOAD TEST ON MEMBERS OR ANY OTHER TEST:

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

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

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

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

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

#### TESTING CONCRETE OF TANKS FOR LEAKAGE:

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

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

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

#### Costs of Tests:

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

#### Unsatisfactory Test:

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

#### PLACING:

The procedure for placing of concrete shall be as follows: Preparation before placing of concrete shall be as given below. Engineer's Approval of Equipment & Method:

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

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

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

No concrete shall be placed on watered surface.

Rain or Wash Water:

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

Time interval between mixing and placing:

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

Concrete placing by manual labour:

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

Avoiding segregation:

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

Concrete placing by Mechanical Equipment:

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

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

Type of Buckets:

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

#### Operation of Bucket:

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

#### Placement in Restricted Forms:

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

#### Chuting:

Where it is necessary to use transfer chutes between mixer, containers or hoppers, and point of deposit in the forms, specific approval of the Engineer must be obtained as regards the type, length, slopes, baffles and vertical terminals. Concrete shall not be permitted to fall from the end of the chutes or tube more than 1.00 M. Chutes, when approved for use shall have slope not flatter than 1to3 and not steeper than 1tp2.

#### Placing by Pumping:

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

#### Bonding Mortar:

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

#### Thickness of Layers:

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

#### Bedding of layers:

Bedding planes shall be approximately horizontal unless otherwise instructed.

#### Compaction:

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

#### TYPE OF VIBRATORS:

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

- Use of Vibrators:

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

- Successive Batches:

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

- Vibrator Penetration of under layer:

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

- Vibrating Against Reinforcement

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

- Use of form attached Vibrators:

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

- Use of Surface Vibrators:

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

- Stone pockets and Mortar Pondages:

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

#### CONSTRUCTION JOINTS AND KEYS:

Concrete shall be placed continuously unless otherwise specified.

If stopping of concreting becomes unavoidable anywhere, the construction joint shall be made, where the work is stopped, concrete that is in the process of setting shall not be disturbed or

shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and bonding keys shall be located and shall conform in details to the requirements of the plans unless and otherwise directed by the Engineer. Where not described, the joint shall be in accordance with the following:

#### CURING, PROTECTING, REPAIRING AND FINISHING:

All concrete shall be cured by keeping it damp for the period of time required for complete hydration and hardening to take place. Certain types of finish, or preparation for overlaying, concreting must be done at certain stages of the process and special treatment may be required for specific concrete surface finish.

##### Curing with water:

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

##### Continuous Spraying:

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

##### Alternate Curing Methods:

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

##### Curing compounds:

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

##### Ponding:

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

##### Curing Equipments:

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

##### Protection of Fresh Concrete:

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

#### Repair and Replacement of Unsatisfactory Concrete:

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

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

#### CURING OF DIFFERENT ITEMS:

For all the time during construction, curing shall be carried out especially from 7.00 AM to 7.00 PM even on holidays with proper manpower, necessary pumps and pipe lines, connections, etc. Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, hessian or similar material and kept constantly wet for at least seven days from the date of placing concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 (jays for concrete exposed to dry and hot weather conditions. In the case of concrete where mineral admixtures or blended cements are used it is recommended that above minimum periods may be extended to 14 days. For the concretes containing PPC or Portland Slag Cements, period of curing may be increased.

For other items the curing shall be done as follows or as directed by the Engineer-in-Charge.

Brickwork      At least for 10 days.

Plaster work    At least for 7 days.

Sand faced plaster      At least for 15 days.

Tiles or stone flooring and dado      At least for 10 days.

#### FORM WORK:

#### General:

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

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

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

#### Materials:

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

Chamfer strips shall be placed in corner of forms to produce bevelled edges on permanent exposed surface, if specified.

Temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.

#### Mould Oil:

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

#### Chamfers and fillets:

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

#### Vertical construction joint chamfers:

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

#### Reuse of Forms:

Before reuse, all forms shall be thoroughly scraped, cleaned, joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of the



Engineer. The Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

The contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from. Striking of forms in the case of sides of beams, columns and slabs can be carried out after 24 hours of concreting. Striking shall be done with utmost care without shock or vibration by gently easing the wedges. If, after removing the formwork, it is found that the timber is embedded in the concrete, it has to be cut out and made good with fine concrete. Due care shall be given to the provision of correct form work for holes and openings in the slabs, inserts, grounding cables, conduits and pipe sleeves, foundation or anchor bolts etc. as per approved drawings or as directed by the Engineer.

#### CLEANING AND TREATMENT OF FORMS:

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

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

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

In columns of any forms where access to the interior is not available otherwise, a sufficient area of one side shall be left loose so that it may be removed for cleaning out all chips, dirt, sawdust and other extra materials.

Where the shoring bores on the ground, the Contractor shall spread the load from shores by suitable brick platforms in order to prevent settlement.

#### ARCHITECTURAL EXPOSED REINFORCED CEMENT CONCRETE:

##### General:

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

##### Materials:

Cement used for such work shall be of a uniform colour and obtained from one source of manufacture

.

##### Aggregate:

Fine Aggregates:

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

#### Coarse Aggregate:

The colour of the aggregate shall be maintained the same through out. Unless otherwise specified, exposed concrete in walls, fences and parapets which are nonload bearing and are less than 120 mm. in thickness the maximum size of coarse aggregate shall be limited to 12 mm for which nothing extra shall be admissible. Flat and flaky pieces shall not be allowed.

Reinforcement & Cover of the Concrete: Correct placing of the reinforcement with proper cover is important in all exposed work to avoid discolouration by rusting. The minimum cover specified in the Specification shall be maintained throughout. Concrete blocks or spacers shall be sparingly used at exposed surfaces. When used, such blocks shall preferably be cast on vibrating tables or in some other similar manner so that it may match the concrete surface in texture and colour. Cove/ blocks of materials other than precast blocks shall not be allowed to be used.

#### Construction of shuttering:

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

#### Timber Shuttering:

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

#### Plywood Shuttering:

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

#### Steel shuttering:

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

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

Any holes for the supports, which the contractor may need, shall be permitted only if approved by the Architects. All such holes shall be subsequently filled in carefully as to match with the other surface. Walls, columns etc. shall generally be cast to the full height in one operation and the formwork shall be provided accordingly. If permitted by the Architects, these may be completed in two or more heights when the formwork shall be carefully and correctly raised for further height so as to ensure a neat joint without disturbing the pattern. Any groove desired by the Architect at the joint shall be provided by the Contractor at no extra cost.

#### Coating for shuttering:

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

#### Measurements and proportioning of concrete materials:

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

#### Preparation for placing concrete:

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

#### Mechanical vibration:

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

#### Curing and protection of concrete:

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

#### Removal of shuttering:

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

#### Finishing:

Finishing of exposed concrete surface shall be as specified.

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

#### STRIPPING TIME:

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

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

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

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

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

Note:

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

#### PROCEDURE WHEN REMOVING THE FORMWORK:

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

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

#### TOLERANCES:

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

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

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

#### FOUNDATION BEDDING, BONDING AND JOINING:

All surfaces upon or against which concrete will be placed shall be suitably prepared by thoroughly cleaning, washing and dewatering as may be indicated in the drawing, or as the Engineer may direct to meet various situations encountered in the work.

#### SPACE OF CROSS SECTION:

No line on the cross section of unit shall deviate from its correct position by an angle exceeding one degree. Contractor shall not make any change in the cross section of the units in any case.

#### PREPARATION OF EARTH FOUNDATION:

All earth surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft yielding soil shall be removed and replaced. Where specified, lean concrete shall be provided on earth for receiving the concrete. The surface of absorbing types of soils against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn from the freshly placed concrete.

#### PREPARATION OF CONCRETE SURFACES:

The preparation of concrete surfaces upon which additional concrete is to be placed shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting of the surface with picks and stiff brooms and by use of an approved combination of air and water\* jet, as directed by the Engineer. Great care shall be taken in performing this work to avoid removal of too much of mortar and weakening of the surface by loosening of aggregate.

When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt; unsound concrete, laitance and glazed mortar have been removed.

#### BONDING TREATMENT (MORTAR):

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, they shall receive a bonding treatment, immediately before placement of the concrete.

The bonding medium shall be a coat of cement sand mortar. The mortar shall have the same cement-sand content as the concrete, which will be placed on it. The water-cement ratio shall be determined by conditions and as approved by the Engineer.

Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 12.5 mm thick for rock surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions, and shall be brushed out to a satisfactory degree, as determined by the Engineer.

Mortar shall be placed at a rate that it can be brushed over the foundation just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar take place. The amount of mortar that will be permitted to be placed at any one time, or the area which it is to cover, shall be in accordance with the Engineer's direction.

#### CLEANING AND BONDING FORMED CONSTRUCTION JOINTS:

Vertical construction joints shall be cleaned as specified above or by other methods approved by the Engineer. In placing concrete against formed construction joints, the surface shall be coated thoroughly with the specified bed joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by careful puddling and spading with aid of suitable tools.

When re-shoring is permitted or required, the operation shall be planned in advance and shall be subject to approval of Architect. When re-shoring is underway, no live load shall be permitted on the construction.

In no case during re-shoring shall concrete in beam, slab, column or any other structural member be subjected to combined dead and construction loads in excess of the loads permitted by Architect/Engineer for the concrete strength developed at the time of re-shoring. Re-shore shall be tightened to carry their required load without overstressing the construction.

Floors supporting shores under newly placed concrete shall have their original supporting shores left in places or shall be re-shored. The re-shoring system shall have capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one half of the capacity of the shoring system above.

The re-shores shall be located directly under a shore position above unless other location is permitted.

#### EXPANSION AND CONSTRUCTION:

Provision will be made for expansion joints and construction joints in concrete by use of special types of joints located as shown on the drawings. Construction joint surfaces are to be treated as shown on the drawings or as directed by the Engineer.

#### ADVERSE WEATHER CONDITIONS:

When concrete is to be placed under adverse weather conditions special provisions shall be made in the handling and placing methods and in protection during the curing period to ensure that concrete of full strength and free from damage will be obtained.

Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. The use of calcium chloride in mass concrete of footings and similar occasions will be permitted only upon written approval of the Engineer. When calcium chloride is used, it shall be liquefied and added to the mixing water in an amount not exceeding 2 % of the weight of the cement in each batch of concrete. If calcium chloride added is:

1% of weight of cement, it serves the purpose of acceleration. But if the quantity exceeds 2% it causes delay in the initial setting time; it acts as retarder. 8% of weight of cement, it causes slash-set. Calcium Chloride should not be used in the pre-stressed concrete works at all and more amount of it reduces the resistance of the cement to the sulphur attacks.

#### OPENINGS, INSERTS ETC.

Slots, openings or holes, pockets, etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by the Engineer. Any deviation from the approved drawings shall be made good by the contractor without damaging any other work. Sleeves, bolts, inserts etc. shall also be provided in concrete work, where so specified.

#### RATES ALL INCLUSIVE:

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

#### PAYMENT FOR CONCRETE WORK:

Payments for concrete will be made on the unit rates quoted for the respective items in the Bills of Quantities. No deduction in the concrete quantity would be made for reinforcements, inserts, etc. and opening less than one twentieth of the square meter and 1/150 Cmt. Where concrete is measured in cubic meters. It shall be very clearly understood that payment for "concrete work formwork" is inclusive formwork, shuttering shoring, propping, scaffolding, etc.

Rate for all concrete work shall be based on 20 mm maximum size aggregate. Contractor shall also quote the reduction offered for using 40 mm maximum size aggregate, if permitted by the Engineer.

#### TESTS AND INSPECTIONS:

##### Rejection of work:

The Engineer-in-Charge reserves the right to condemn any work, which appears unsatisfactory or does not comply with the specifications or working drawings. The contractor shall at his own expense cut out the condemned work and replace it with new work to the satisfaction of the Engineer-in-Charge.

1.1 T.M.T. BARS shall conform to IS 1786-FE415 Mild steel binding wires shall conform to relevant IS.

##### Workmanship:

The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed.

Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting

Reinforcing steel shall conform accurately to the given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed using a proper bar bender operated by hand or power to attain proper radius of bends, Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or



handling shall be straightened before being used on the work. They shall not be heated to facilitate bending. Unless otherwise specified a 'IT type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be at least four times the diameter of the round bar and the length of straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In case of bars which are not found and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

All the reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using stay blocks or metal chair spacers metal hangers supporting wires or other approved devices at sufficiently close intervals. Bars shall not be allowed to sag between supports nor displaced during converting or any other operations of the work. AH devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete except where shown on drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces or broken stone tfr brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, pre-cast mortar blocks or other approved devices. Reinforcement after being placed shall be maintained in a condition until complete embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement concrete already placed. To prevent reinforcement from corrosion concrete cover shall be provided as indicated on drawings. All the bars protruding from concrete and to which other bars are to be spliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

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

As far as possible bars of full length shall be used. In case this is not possible overlapping of bars shall not touch each other but be kept apart by 25 mm. Or 1.25 times the maximum size of the coarse aggregate whichever is greater by concrete between them. Where not feasible overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted light. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending movement is maximum.

Wherever indicated on the drawings or desired by the Engineer - in- charge bars shall be joined by couplings, which shall have a cross section sufficient to transmit the full stress of bars. The ends of the bars that are joined by coupling shall be of sufficient length that the effective cross section at the base of threads is not less than normal cross-section of the bar. Threads shall be standard threads. Steel for coupling shall conform to IS 226.

When permitted or specified on the drawings joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded.

Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only complete welders shall be employed on the work. The M.S. electrodes used for welding shall conform to I.S. 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

#### PLASTER:

##### PREPARATION OF SURFACE:

Before plastering, masonry joints are to be raked out. Mortar powder and dust shall be brushed out from joints, and the surface shall be washed with clean water and shall be watered well. Cement slurry shall be applied to R.C.C. surface before plastering. The minimum thickness of mortar to be applied shall be as specified. To ensure proper thickness, gauged patches shall be made at 1.5 to 2 m. apart. Plastering shall be started from top and worked to bottom.

##### PREPARATION OF MORTAR:

The mortar shall be prepared in required proportion as specified in Tender. The mortar shall be thoroughly mixed on an impervious platform by turning over at least twice dry and twice wet. Water shall then be added gradually in required quantity. Mortar shall not be ground.

Cement mortar shall be prepared in required quantity and not with more than one bag of cement at a time. This quantity shall be consumed within 30 minutes after adding water and mixing.

#### SCAFFOLDING:

Scaffolding will be double or single stage as warranted for the particular work and as approved by the Engineer-in-Charge. Holes shall be made good by bricks to match the work when scaffolding is removed.

#### PLASTERING:

##### CEMENT FINISH CEMENT PLASTER:

Before plastering the surface, gauge marks with cement mortar should be carried out in line level and plumb at distances less than the gauge patti. These gauge marks should be prepared one day prior to commencement of plastering work. Mortar shall be uniformly applied all over the surface to a thickness of 13 mm and finished true to level, line and plumb taking special care to finish jambs of windows, doors, junction etc. A thin layer of cement paste with 5% slake lime slurry for easy application shall then be applied initially with wooden gutka and then with MS mala / trowel to avoid air bubbles and rubbed into the surface and finished by means of trowel until the surface is even and smooth. Before applying cement paste, care shall be taken that previous coat of mortar shall not be dried. All corner, angles and junctions shall be truly vertical or horizontal and finished. Any cracks

which appear in the surface and portions which found hollow when tapped or found soft or otherwise defective shall be cut and redone. Curing shall be started after 24 hours and surface kept wet for seven days.

#### NEEROO FINISH CEMENT PLASTER:

General specifications shall be as per cement finish cement plaster, except applying a thin layer of neeroo paste instead of cement paste. In neeroo paste some quantity of cement paste, shall be added. A thin layer of neeroo paste shall then be applied to the under coat and rubbed into the surface and finished by means of trowel until the surface is even and smooth. Surface shall be cured for seven days, after a laps of 24 hours.

#### MALA FINISH PLASTER:

Specification are same as sand face plaster, except in second coat, mortar shall be mixed in proportion as specified in Bills of Quantities and surface shall be finished with Mala only, as directed by Engineer-in-Charge.

#### RATE TO INCLUDE (All Plasters):

The rate shall include the cost of materials and labour required for all the operations, described above. This shall include the following:

- (i) Raking out joints of brickwork, stonework or raking concrete for key.
- (ii) Work done overhead or in confined spaces and in narrow widths.
- (iii) Thoroughly watering surfaces before the plastering.
- (iv) Protection of plaster until handing over.
- (v) Forming coves at Junction.
- (vi) Forming 10 mm to 30 mm wide and 12 mm deep grooves vertically or horizontally as required at junction of ceiling and wall, skirting, dado floors and at joints of concrete and masonry work.
- (vii) Forming drip and weathering where necessary and directed,
- (viii) Scaffolding, single or double stage, as warranted for the particular work and as approved by the Architects.
- (ix) Making sample for respective item for approval if instructed by Engineer-in-Charge, without any extra charges.
- (x) Watering the brick surface and applying cement slurry to R.C.C. surface before pfastering.
- (xi) Curing of work executed, (xii) Necessary patta as required.

#### FILLING EARTH:

This work shall be consist of laying and compacting embankment of selected soil brought from outside other than GIDC land. The embankment shall constructed in accordance with the requirement of these specifications and in conforming with lines, grades and cross sections shown on the drawing or as directed by Engineer in charge.

#### MATERIALS:-

#### SOURCE

The selected soil shall be obtained from outside sources/area other than GIDC land. The contractor will have to make his own arrangement to get sources /area for obtaining the selected soil of approved quality with all lead and lifts at his own cost. The general specifications for collection of road materials attached here with shall also follow.

The source / quarries arranged by the contractor to obtain the selected soil shall got approved from the Executive Engineer prior to use in the work. The ample of selected soil collected from approved quarries shall be got tested at Govt. recognized laboratory as may be directed to the contractor at his own cost. The results shall conform to the standard requirement set down hereunder. The selected soil of the approved quality shall be only permitted for use in the work.

#### GENERAL REQUIREMENTS:

The material to be used for the work shall be natural murrum / soil. The selected soil shall be free from logs/stumps, roots, rubbish or any other matter likely to deteriorate or to affect the stability of the embankment / Sub grade.

If inferior quality of selected soil is used in the work, same shall be removed by the -contractor at his own cost.

#### PHYSICAL REQUIREMENT

The selected soil shall conform to the physical requirement set forth in table below.

TABLE

Sr. No.	Kind of material	Requirement
1	Selected soil	Maximum laboratory dry unit weight when tested as per IS-2720 (Part-A) value not less than 19.50 KN/ Cubic meter

The Engineer-in-charge may however relax this requirement by taking into account the availability of materials for construction and other relevant factors.

#### CONSTRUCTION OPERATIONS:

##### SITE CLEARANCE:

Immediately prior to the laying of selected soil, original ground/Sub-grade/ Sub- base shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with one or more pass of 80/100 KN static weight vibratory roller, with plain drum or heavy pneumatic tired roller of minimum 200/300 KN weight having a minimum tyre pressure of 070 MN/m<sup>2</sup>. as directed by the Engineer-in-charge. The relevant specification of M.O.R.T. & H. clause No.201 shall also be followed.

##### SETTING OUT:

After clearing the site or preparing the sub-grade/sub-base the alignment of the road shall be properly set out true to lines curves, slopes, grades and sections as shown in the plan or as directed by the Engineer-in-charge. The contractors shall provide all labours and materials such as lime, string, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out,

establishing temporary & permanent bench marks center line stones & other marks and giving profiles, alignments and other marks, as long as they are required for the marks and long as opinion of the Engineer-in-charge.

**DEWATERING:**

M.O.R.T. & H. Clause No.305.3.2. Shall be followed.

**COMPACTING GROUND SUPPORTING EMBANKMENT/SUB-GRADE:**

The original ground shall be leveled to facilitate placement of first layer of embankment mix with water & then compacted by rolling so as to achieve minimum dry density. The specification under paras No. 3.3 of Item No. 1 of Part-A shall be followed.

**SPREADING MATERIALS IN LAYERS & BRINGING TO APPROPRIATE MOISTURE**

**CONTENT:**

Earth work shall not be proceed until the foundation of embankment have been inspected by the Engineer-in-charge for satisfactory condition and approval. The selected soil shall be spread on the prepared road foundation with the help of a drag spreader, motor graders or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of the each layer after consolidation does not exceed 200 mm or required thickness, shown on the drawing or as directed by the Engineer-in-charge. Successive layers of soil shall not be placed until the layers under construction have been thoroughly compacted to the requirements set down hereunder and accepted by the Engineer in charge. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve specific slope and grade.

The operation of laying the successive layers of selected soil shall have to be suitably synchronized with the consolidation work. Moisture content of the selected soil shall be checked at the site of placement prior to recommencement of compaction, if found to be out of agreed limit, the same shall be made good. Where water is required to be added in such construction, water shall be sprinkled from a water tanker fitted with sprinkle capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly & thoroughly mixed in murrum by blading, discing or harrowing until a unit of moisture content is obtained through out the depth of the layer. If the selected soil delivered to the road bed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Such circumstances arises, where owing to wet weather the moisture content can not be reduced to the required amount by the above procedure, compaction shall be suspended. Moisture content of the each layer of selected soil shall be checked in accordance with IS : 2720 ( Part-2 ) and unless otherwise mentioned, shall be so adjusted, making due allowances for evaporation losses, that at the time of compaction, it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with corresponding to IS : 2720 (Part-7 ) of IS : 2780 ( Part - 8 ). After water has been added the material shall be processed by mechanical or other approved means if so

directed by the Engineer-in-charge until the layer is uniformly wet confirming to M.O.R. T.& H. specification clause no. 305.3.5.2

#### COMPACTION

Only the compaction equipment approved by the Engineer shall be employed to compact the selected soil. The compaction shall be done with the help of vibrator roller of 80 to 100 KN static weight with plain drum or heavy pneumatic tired roller of minimum 200/300 KN weight having a minimum tyre pressure of 0.70 MN/M<sup>2</sup> as approved by the Engineer-in-charge, capable for achieving required compaction. The contractor shall demonstrate the efficiency of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted this site trials shall first be submitted to the Engineer-in-charge for approval. Immediately there after rolling shall be started with approved roller or other approved plant. Rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of roller shall uniformly overlap not less than one third of the track made in the proceeding pass. During rolling the grade and camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding fresh material. Rolling shall be continued till the density achieved is at least 100% of the maximum dry density for the material determined as per IS : 2720 ( Part - 8 ). The surface of any layer of selected soil on completion of compaction shall be well closed free from movement under compaction plant 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.

#### FINISHING OPERATIONS

The embankment shall be finished in conformity with the alignments, levels, cross sections and dimensions shown on the plans or as directed by the Engineer-in-charge. Finishing operations shall include work of shaping and dressing the sub-base / shoulders and the side slopes to conform to the cross section. When earthwork operations have been subsequently completed, the road way area shall be cleared of all debris and ugly scrubs in the construction area, responsible for objectionable appearance shall be eliminated. The defective portion shall be removed and re-constructed as directed by the Engineer-in-charge.

The surface finish of construction shall conform to the requirement as per general technical specification for quality control on works and materials attached herewith.

M.O.R.T.& H. specification clause no. 305.3.9 shall be also followed.

#### ARRANGEMENT OF TRAFFIC:

M.O.R.T. & H. specification clause no. 112 shall be followed.

#### QUALITY CONTROL OF WORK:

Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with these specifications and general technical specifications for quality control on works and materials attached herewith. The Engineer-in-charge shall have the right to modify the frequencies of testing according to the needs.

### 3.0 MATERIALS

As per General Technical Specification for relevant material.

For other materials following specifications apply:

#### VALVES - SLUICE VALVES

##### 3.2.1 GENERAL

The contractor shall be covering manufacturing, supplying and delivery of Sluice valve conforming to IS: 2906-1984 & IS: 780-1984 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification

##### 3.2.2 STANDARDS

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

##### 3.2.3 TEMPERATURE VARIATION

All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 4° to 45° C.

#### MARKING

The legible and in deliable marking upon each valve shall indicate the following:

ISI certification mark on each sluice valve only.

Manufacture's brand name and/or trade mark.

Size of valve and nominal pressure of valve.

Serial number of cast.

Serial number in punch

Where a valve is tested for "open" condition, it should be marked "O" distinctly & permanently.

Any other important matter that the manufacturer deems fit to be inscribed/embossed.

##### 3.2.5 TEST CERTIFICATE

(a) The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

(b) The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by Engineer for the same purpose.

The inspection charges of the authorized person/agency as fixed by GIDC shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor.

### 3.2.6 NOMINAL PRESSURE

(a) Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-H" (Mpa= 10 kgf/m<sup>2</sup> approx)

The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

### 3.2.7 MATERIAL:

(a) The materials for the different component parts of the sluice valve shall conform to requirements given in Table-A.

Table A Materials for components parts of sluice valve

Sr No	Component	Material	Ref. IS No.	Grade of Designation
1	Body, bonnet wedge stuffing box, gland thrust plate, cap.	Grey cast iron	210-FG 1978(1)	
2	Stem	High tensile brass	320-1962(2)	Alloy 1 of 2
3	Wedge nut	Leaded tin bronze	318-1962(3)	2
4	Body seat ring, wedge facing ring	Leaded tin bronze	318-1962(3)	2
5	Bolts	Carbon steel	1367-1967(4)	Class 4.6
6	Nuts	Carbon steel	1367-1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712-1971(5)	C
8	Gland packing	Jute & hemp	5414-1969(6)	

Specification for grey iron castings (third revision)

Specification for high tensile brass rods and sections (revised)

Specification for leaded tin bronze ingots and casting (revised)

Technical specification - supply of threaded fasteners

Specification for compressed asbestos fiber jointing (first revision)

### 3.2.8 MANUFACTURE

Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double-flanged ends connection.

### 3.2.9 FLANGES



The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538-1976 (Specification for cast Iron fittings for pressure pipes for water, gas and sewage) or its latest revision.

## AIR VALVES

### 3.4.1 SCOPE OF CONTRACT:

The contract shall be covering manufacturing, supplying and delivering of Air valves-single ball flanged /screw type, Air valve-double ball flanged, Air isolated valves-double ball flanged, Air cushion valve with C.I. body etc. as per item of tender.

### GENERAL

The air valve shall conform to the I.S.S. as and when published and shall be of approved make and quality. The standard applies to air valves used for water and sewage mains.

The details given below briefly cover the requirement for materials, dimensions and test for air valves.

### 3.4.2 CLASSIFICATION

Air valve shall be of two types

#### (a) Single Air valve

Single air valve shall have single small or large orifice for releasing air during pipe filling and ventilating the pipe during emptying. Air valves up to 40 mm dia directly shall be screwed on the main.

#### (b) Double Air valve

Double air valve shall have two ball chambers, one outlet of large capacity shall be provided for admission and release of bulk volume of air during emptying and filling of the main, another of small outlet type for the escape of smaller quantities of air accumulating under pressure. They shall be of flanged type.

### 3.4.3 MATERIALS

#### > CAST IRON

Cast Iron for bodies pressure covers, splash covers, glands, caps, joints support rings shall be best grey iron of selected grade, 20 of IS-210-1978 specification for grey iron castings.

#### > GUN METAL

Gunmetal shall be of mixture of 88% copper, 10% tin and 2% Zinc having excellent hard wearing qualities. Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gunmetal.

#### > FOREGED BROZNE

Nipples, spindles shall be machined from rolled, extruded or forged high Tensile brass or aluminium bronze. The produce shall possess much greater strength than ordinary cast product.

#### > MILD STEEL

Bolts, nuts, flanges etc. shall be of mild steel unless otherwise specified and( shall conform to I.S. 226-1975 specification for structural steel.

#### > MATERIALS FOR BALLS

The balls shall be of rubber covered and vulcanite covered. The rubber shall have a smooth and hard surface. It shall be as per I.S. 638-1965 specification for rubber and insertion jointing.

> FLANGE JOINTING MATERIALS

The jointing material used between the flanges of components part of the valve shall be compressed fiberboard or rubber of thickness between 1.5 mm to 3 mm. The rubber shall be as per I.S. 683:1965 specifications for rubber and insertion jointing. The fiber board shall be impregnated with chemically natural mineral oil and shall have a smooth and hard surface.

3.4.4 DIMENSION

Dimension of the Air valves shall be as per relevant IS code.

3.4.5 CHARACTERISTICS

> Small orifice valves shall have rubber-covered balls and nipples of forged bronze or special alloy of brass plug.

Large orifice valve shall have vulcanite-covered ball closing on rubber sealing backed with leather and gunmetal outlet bushes. They shall be screwed or flanged.

For sewage mains, the air valves shall be actuated by mild steel floats bronze spindles and shall be fitted with synthetic rubber seals.

Air valves shall be sound in all respect and uniformly forged so as to have uniform bore. They shall be free from any defects such as unwanted projection, holes or roughness and shall have inner and outer surfaces perfectly smooth.

3.4.6 COATING

> Immediately after casting and before machining, all cast iron parts shall be Thoroughly cleaned, and before rusting commences, shall be coated by dipping in a bath containing a composition having a tar base.

> The coating shall be such that it shall not impose any test of smell to water. The coating shall be smooth glossy and sufficiently hard. It shall not chip when scratched lightly with the point of pen knife.

3.4.7 INSPECTION AND TESTING

The engineer in charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials which does not conform to the specified requirements.

The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show no sign of leakage under these tests i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

3.4.8 MANUFACTURER'S GUARANTEE

> The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch, shall replace any part that prove defective, free of charge at the place of dispatch.

3.4.9 The following information shall be cast on each valve body:

Manufacturer's name or trademark.

Size of valve

#### 3.4.10 TENDER PRICE:

The tender price shall include all labour, material and machinery cost necessitated to be utilized for;

Proper manufacturing of the valves.

All tests required to be undertaken at manufacturer's premises.

Transportation of the valves either by Rail and/or Road services with all the covers duly and appropriately insured.

Delivery of specials with proper loading, unloading, stacking at site as indicated by Engineer-in-charge.

The storage of all specials to be manufactured supplied and delivered under the scope of contracts as per Technical specifications.

#### 3.4.11 DELIVERY SCHEDULE:

The delivery schedule shall be governed by clients' the Executive Engineer.

#### 3.4.12 MARKING

The methods of marking all the valves 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 valves shall indicate the followings:

- i) Manufactures brand name and/or trademark.
- ii) Purchasers mark as "GIDC" be inscribed.
- iii) Diameter and class of valves.
- iv) Any other important matter that the manufacturer or owner deems fit to be inscribed.

#### 3.4.13 PACKING AND HANDLING:

The materials shall always be packed separately and dispatched from manufacturers works with adequate protective measures to prevent damages/deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.

When the materials are transported at railway risk, special packing as per I RCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.

The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the site.

#### 3.4.14 MATERIALS AND WORKMANSHIP:

> General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process.

All the material shall be new and of high quality.

In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacturer.

#### 3.4.15 TEST CERTIFICATE:

The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

The supplier shall also produce in addition to manufacturer's test certificate, the inspection certificate issued by the authorized person/agency appointed by Engineer or Owner for the same purpose.

#### STORAGE AND HANDLING

Materials shall be stored and handled in such a manner necessary to prevent their damage and deterioration. The Contractor shall employ adequate means to safely handle pipes, access chambers and other materials.

Stacking. Stored materials shall be kept safe from damage and deterioration. The interior as well as all sealing surfaces of pipe and appurtenances shall be kept free from dirt and foreign matter per ANSI/AWWA C651. Pipe stored outdoors and expected to be exposed to direct sunlight for periods of one year or more after delivery shall be covered with canvas or other opaque material with provision for adequate air circulation. PVC pipe shall not be stored close to heat sources, such as heaters, boilers, steam lines, or engine exhaust.

When possible, pipe shall be stored in unit packages on flat surfaces to avoid bending. When unit packages are stacked, care shall be exercised to ensure that the weight of the upper units does not cause deformation to pipe in lower units. Unit packages shall be supported by racks to prevent damage or ending of the pipe.

When unit packages are stacked, care shall be exercised to ensure that the height of the stack does not result in instability that could cause stack collapse, pipe damage, or personal injury. Generally, stack height should not exceed 8 ft (2.4 m). Safe stack height will vary by unit package configuration.

Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

Stringing. In preparation for installation, distribution (stringing) of pipe and appurtenances shall be as close to the trench as practical and, if possible, on the opposite side from the excavated earth stockpile. Pipe shall be protected from traffic and secured to prevent rolling. Bell ends on pipe should be pointed in the direction of work progress. Caution shall be exercised to minimize the contamination of pipe interiors and joint components.

#### EXCAVATION

General.

Prior to excavation the Contractor shall note all existing surface features and locate all underground services.

#### 5.2 Surface excavation.

Surface material shall be carefully stripped and set aside. Where the material is to be re-used it is to be stacked separately.

#### 5.3 Trenching/ Trench Construction

Trenches shall be excavated to the lines and levels shown on the Drawings with allowance being made for bedding. The dimensions of the trench shall comply with the relevant Standard

**Drawing.** The base of the excavated trench shall be trimmed neat and uniform for its full length. Boulders, roots and any other hard objects in the bottom of the trench shall be removed; soft areas in the bottom of the trench shall be taken out and filled to grade level with approved bedding material and compacted.

**Trench width.** The trench width at the ground surface may vary with the trench depth, the nature of soils encountered, existence of any pavement, and the proximity of adjacent structures. The minimum clear width of an unsupported or supported trench measured at the centerline of the pipe shall be at least 18 in. (450 mm) or the pipe outside diameter plus 16 in.(400 mm), whichever is greater.

**Trench depth.** The trench shall be excavated to the depth that permits pipe to be laid at the elevations shown on the engineering drawings or with the required depth of cover specified by the Client. The depth of cover shall be measured from the finished grade or the surface of the permanent improvement to the top of the pipe barrel.

**Preparation of trench bottom.** The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. Blocking shall not be used to change pipe grade or to intermittently support pipe across excavated sections. Bell holes at each joint shall be provided to permit the joint to be assembled and pipe to be supported properly.

**Rock conditions.** Ledge rock, boulders, cobbles, and large stones shall be removed to provide at least 4 in. (100 mm) of embedment cushion on each side of and below all pipe and appurtenances. The excavation shall be sufficiently wide to enable proper placement of the embedment specified by the Client. When excavation is completed, embedment material shall be placed, leveled, and compacted to provide a proper cushion for the pipe. Such embedment shall be granular material graded in particle size so that the embedment material supporting the pipe shall be retained in place under all conditions, including the rapid movement of water through the pipe embedment and the surrounding material.

**Previous excavations.**

If the trench passes over a sewer or other previous excavation, the trench bottom shall (1) be compacted to provide support equal to that of the undisturbed native soil or (2) conform to specific regulatory requirements that preclude damage to the existing installed facility.

**Blasting.**

Blasting for excavation shall be permitted only when specified by the engineer in charge and when proper precautions have been taken for the protection of persons and property. Hours permitted for blasting shall be in accordance with the direction of engineer in charge specifications. Damage caused by blasting shall be repaired by the constructor at no additional expense to the GIDC, unless otherwise specified. Blasting (if required) procedures shall conform to applicable laws, ordinances, and regulations imposed by federal, state, provincial, or local authorities.

**Unstable sub grade.**

Where an unstable sub grade condition exists that, in the opinion of the Client or the Clients agent, cannot support the pipe, an alternative foundation shall be provided. At the discretion of the Client or the Engineer In Charge, an additional depth shall be excavated and refilled to pipe foundation grade with embedment material or special pipe foundation material in accordance with the direction of engineer in charge & specifications. Any part of the trench excavated below grade shall be backfilled to grade and compacted to the required density. Such embedment material shall have a gradation that inhibits migration of soil particles.

#### Dewatering.

Where running or standing water occurs in the trench bottom or where the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps. The trench shall be kept free from water during installation operations by suitable means, such as well points or pervious under drain bedding, until the pipe has been installed and backfill placed and compacted to a sufficient height to prevent pipe flotation. A cover depth of 1.5 pipe diameters will normally prevent flotation. Soil migration in the pipe zone shall be prevented through the use of geo-textile fabric or embedment material gradation.

#### Excavated material.

Excavated material shall be placed in a manner that will not obstruct work or endanger personnel or the public. Excavated material shall not obstruct sidewalks or driveways for extended periods unless provided for in the contract documents. Hydrants under pressure, valve-pit covers, valve boxes, curb-stop boxes, fire and police call boxes, or other utility controls shall remain unobstructed and accessible. Gutters shall remain clear unless other satisfactory provisions have been made for street drainage. Natural water courses shall not be obstructed. Surplus excavated material shall be disposed of in a suitable manner or as provided in the specifications.

The Contractor will maintain all trenches in a safe condition for protection of people and property and will notify the relevant Government Department or Agency of any excavation over 1.5m deep and be responsible for carrying out the instructions of its officers.

### 6.0 BEDDING AND HAUNCHING

Pipe bedding and Haunching material will depend on the type of pipe installed as shown in the Fig-1. It shall be either clean sharp sand or coarse aggregate, free from organic matter and clay lumps. Pipe bedding material shall also have a sand equivalent of at least 60.

#### 6.1 Bedding.

Bedding shall be compacted bedding material complying with relevant standard drawing.

#### 6.2 Haunching.

Haunching shall be material complying with the relevant Standard Drawing else where in the tender document. Material shall be well tamped to the satisfaction of Engineer-In charge.

#### 6.3 Pipe Embedment

Selection of the required laying condition and the method of embedment shall be made in accordance with the requirements specified by the engineer in charge. Common embedment types are shown in Figure 1, with the bedding constant (K) and typical soil modulus (E1) values

associated with each. These values, along with other embedment design parameters specified by the Client/Consultant, should be used to calculate pipe deflection per the design information provided in ANSI/AWWA C900, ANSI/AWWA C905, and AWWA Manual M23. Embedment types other than those shown in Figure I may also be specified by the engineer in charge. The type of pipe embedment should be selected so as to prevent a vertical cross-section deflection of more than 5 percent. Embedment shall be selected and placed to prevent gouges, crimping, or puncture of pipe, joints, or appurtenances.

## PIPE LAYING AND JOINTING

### Material Inspection

Pipe and appurtenances shall be inspected for defects prior to installation in the trench. Unless otherwise specified by the engineer in charge, any defective, damaged, or unsound material shall be marked and held for inspection by the engineer in charge, who may prescribe corrective repairs or reject the material.

### 7.2 Precautions

Proper equipment, tools, and facilities shall be provided and used by the constructor for the safe execution of work. All pipe and appurtenances shall be lowered carefully into the trench using suitable equipment and methods to prevent material damage or personnel injury. Under no circumstances shall pipe or appurtenances be rolled, dropped, or dumped into the trench.

### 7.3 Trench foundation.

The trench foundation will be finished to the approval of Engineer-In charge prior to placing of the bedding material.

### 7.4 Pipe Laying

**7.4.1 Pipe cleaning.** Before lowering the pipe into position in the trench, all dirt and foreign matter that cannot be removed by normal flushing shall be cleaned by mechanical means. The Client or Engineer - In charge shall determine when such mechanical cleaning is required. During laying operations, no debris, hand tools, clothing, or other materials shall be placed in the pipe. Pipe shall be kept clean during and after laying.

**Pipe placement** As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to required line and grade within tolerances specified in the specification. The pipe and joint shall be uniformly supported and secured in place with the specified embedment material. The pipe shall be laid with the bell end pointing in the direction of work progress.

**Interrupted operations.** When laying operations are interrupted or terminated at the end of a day, pipe ends shall be sealed temporarily to prevent the entry of water, debris, small animals, and similar types of contamination. Precautions shall be taken to prevent flotation of the sealed pipe during work stoppages.

### 7.5 Cutting and Jointing

7.5.1 Field cuts. Circular saws, handsaws, or similar equipment may be used for cutting PVC pipe. When pipe is cut in the field, the cut shall provide a smooth end at a right angle to the longitudinal axis of the pipe. Pipe spigot ends shall be deburred, beveled, and remarked with insertion line. For optimal performance, the length and angle of field bevels should match the factory bevels. To ensure the proper engagement of the sealing gasket with the PVC pipe spigot when connecting to certain shallow-depth bells, such as those on some cast-iron fittings and valves, the factory bevel shall be cut off to form a deburred, square-cut end with only a slight outer bevel.

7.5.2 Joint preparation. The sealing surface of the pipe spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets shall be cleaned immediately assembly. Factory-installed gaskets should not be removed for cleaning. The joint shall be free of dirt, sand, grit, grease, or any foreign material. When assembling asketed joints, an approved lubricant shall be applied as specified by the pipe manufacturer. Damage to the gasket(s) may result from the use of improper lubricants. If joints are to be assembled in cold-weather conditions, factory installed gaskets may be removed and taken to a heated truck cab or shelter to restore the gasket's flexibility prior to joint assembly. Not all factory-installed gaskets are field removable. Gasket removal shall only be permitted with the consent of the pipe manufacturer.

7.5.3 Types of gasketed joints. Unless specified otherwise by the engineer in charge, all gasket joints shall be the push-on type. PVC pressure pipe shall be assembled using the following types of joints:

7.5.3.1 Gasketed bell joint Integral with the pipe or fitting shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, and ANSI/AWWA C907.

7.5.3.2 Gasketed coupling. A double-gasketed coupling shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, ANSI/AWWA C907, and ANSI/AWWA C219.

7.5.3.3 Mechanical joint Any of several joint designs that have gaskets and bolts shall be manufactured in accordance with ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, and ANSI/AWWA C153/A21.53.

7.5.3.4 Joint assembly. Joints shall be assembled under conditions that ensure clean mating and sealing surfaces by using proper equipment, materials, and procedures in accordance with recommendations published by the manufacturer.

The integral bell gasketed joint and the gasketed coupling joint shall be assembled by positioning the elastomeric gasket in the annular groove of the bell or coupling (if the gasket is not preinstalled at the factory) and inserting the spigot end of the pipe into the bell or coupling. To assure compatibility, only gaskets supplied by the particular pipe and fittings manufacturer(s) shall be used in the pipes and fittings respectively. Gaskets and sealing surfaces shall be cleaned prior to lubrication and assembly. An approved lubricant shall be applied in accordance with the pipe manufacturer's published recommendations. Application of a non-approved lubricant or too much lubricant can result in a pipeline that is difficult to disinfect and may cause temporary taste or odor problems.



The mechanical joint shall be assembled in accordance with the fittings manufacturer's published recommendations. Pipe spigot bevels may require shortening for use with mechanical joints or fitting joints.

#### 7.5.6 Cutting of pipes - Requirements

Where pipes are cut the ends shall be left neat and regular.

### 8.0 BACK FILLING.

Trench backfill above the pipe shall conform to the specifications. If specified, tracing wire or tape shall be placed immediately above the initial backfill material, directly over the pipe.

#### Material.

The initial backfill material immediately above the top of the pipe shall be free of refuse, cobbles, boulders, large rocks or stones, frozen soil, or other similarly unsuitable material. Sands or gravels or sand and gravel mixtures with fines of low plasticity obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75 mm.

When imported or special backfill material is not defined in the specifications or on the drawings, the excavated native soil may be used, provided that such material consists of loam, sand, clay, or other material that is considered suitable by the Engineer-In charge.

Placement After the embedment material has been placed in accordance with Figure 1, initial backfill material shall be placed to a depth of 6 to 12 in. (150 to 300mm) over the top of the pipe in a manner that will fill the remaining voids and avoid damage to the pipe.

8.4 The balance of the backfill shall contain no stones or rocks larger than 8 in. (200 mm), frozen material, or debris. Backfilling shall follow pipe-laying as closely as possible. In general, backfilling should be no further than 100 ft (30 m) behind pipe-laying. Backfill shall be mounded in unpaved areas to allow for future settlement.

Compaction. Unless otherwise specified, trenches under pavement, sidewalks, or roads shall be backfilled and compacted in layers to the density specified by the Client or to the density required by the appropriate government jurisdiction.

Unless otherwise specified by the Client, trenches in locations other than surfaced areas shall be backfilled to the density of the adjacent soils.

Additional backfill material shall be supplied by the constructor if needed to backfill trenches completely or to fill depressions caused by subsequent settlement.

#### Partial backfilling during testing:

Newly installed pipelines are normally tested after backfilling. When Client specifications require that pressure and leakage testing be accomplished before completion of backfilling or with pipe joints exposed for examination, sufficient backfill material shall be placed over the pipe barrel between the joints to prevent movement, and due consideration shall be given to restraining thrust forces. In particular, pipes

### 9.0 CONNECTION TO EXISTING FACILITIES.

Connections to existing pipes and access chambers will be undertaken by the Local Authority at the contractor's cost unless otherwise noted on the Drawings. The Contractor shall be responsible for notifying Engineer-In Charge of the requirements for the connection to the existing service fourteen (14) days prior to the need for that connection.

#### 10.0 Pipe Bending

If permitted in the specifications, PVC pressure pipe may accommodate longitudinal bending with the following limitations. The constructor shall block or brace pipe joints to ensure that bending of PVC pressure pipe does not result in axial deflection in the gasketed or mechanical joints that exceed the manufacturer's published limits. Excessive axial joint deflection may result in damaging stresses or leakage. The longitudinal bending in the PVC pipe barrel shall not result in a bending radius less than the minimum limits established in Table 1.

The bending of PVC pipe barrels larger than 12 in. (300 mm) nominal diameter is not recommended due to the forces required. The curved alignment of pipelines larger than nominal 12 in. (300 mm) in diameter shall be determined by the pipe manufacturer's published axial-joint-deflection limits or as otherwise specified by the engineer in charge.

Table 1 Allowable bending for PVC pressure pipe

Nominal Size In.(mm)	Minimum Bending Radius	
	ft	(M)
4(100)	100	(30.5)
6(150)	144	(43.9)
8 (200)	189	(57.6)
10(250)	231	(70.4)
12(300)	275	(83.8)

\*ANSI/AWWA C900 PVC pipe with cast iron (CI) outside diameters

#### 11.0 Storage and disposal of material.

Excavated material is to be stored in a safe manner and in a location approved by Engineer-In charge. No excavated material will be placed against any fence or wall without the written consent of the owner and the approval of Engineer-In charge. Material will be placed a minimum of 1.0 m clear of the edge of the trench. Surplus material will be disposed of in locations approved by Engineer-In Charge.

#### INSPECTIONS.

Inspection of materials will be carried out at factory site by Inspecting agency to be fixed and authorized by Client/Consultant. The supplier on receipt of supply order from Client shall intimate inspecting agency to carry out inspection as soon as material is ready.

12.2 The inspection call for Air valve should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batches with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled.

Inspection note issued by the inspection agency to supplier as well as consignee (Concerned Executive Engineer) of materials with inspection mark will be dispatched in stipulated in supply order and on receipt at site the verification will be carried out by concerned Deputy Executive Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Deputy Executive Engineer after verifying and satisfying the above requirements.

The Contractor shall ensure that inspections, by Engineer-In Charge, of the various stages of work are requested. Engineer-In charge may require the following inspections:

Inspection of the site prior to commencing work.

Completion of trench excavation prior to placement of bedding material.

Completion of pipe laying prior to any backfilling.

Stages of backfilling.

Completion of excavation for access chamber bases.

Completion of access chamber bases prior to rendering.

Completion of access chambers.

Twenty-four (24) hours notice is required for any of the above inspections. Work shall not proceed unless each stage of work has been inspected and passed by Engineer-In Charge.

#### TESTING:-

Cost of testing: All tests required by Engineer-In charge shall be at the Contractors cost.

#### 13.2 Testing of Bedding, Haunching and Backfill Material.

Engineer-In Charge may request a sample of bedding or backfill material to be taken and tested by a registered testing laboratory in order to determine whether the material complies with this specification. Any material which is found not to comply with the requirements shall not be used for bedding or backfill.

#### 13.3 Pipeline Inspection

The pipelines shall be inspected by means of a mirror and lamp to ensure there are no obstructions in the barrel and to ensure that pipes are laid straight.

#### 13.4 Access Chamber Testing.

Access chamber leakage tests may be required by Engineer-In charge at the Contractors cost. The access chamber entries and outlets shall be temporarily sealed and the access chamber filled with water. Any visible leakage or leakage which exceeds five liters in 24 hours will not be accepted.

## Hydrostatic Testing

### General.

To prevent pipe movement, sufficient backfill shall be placed prior to filling the pipe with water and field testing. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed but before placement of permanent surfacing. The contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

### Cross-connection control.

When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the Client. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

### Procedure:

The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired. If separate tests are made, the pressure test shall be performed first. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of all air. The specified test pressure shall be applied by means of and approved pumping assembly connected to the pipe in a manner satisfactory to the engineer in charge. The test pressure shall not exceed pipe or thrust-restraint design pressures. If necessary, the test pressure shall be maintained by additional pumping for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All visible leaks shall be stopped. All defective elements shall be repaired or removed and replaced and the test repeated until the allowable leakage requirements have been met.

### 14.4 Test method.

The contractor may perform simultaneous pressure and leakage tests or perform separate pressure and leakage tests on the installed system at test durations and pressures specified in Table 2. Tests shall be witnessed by the Client or the Engineer-In charge, and the equipment used for the test shall be subject to the approval of the Engineer-In charge.

### Allowable leakage.

The contractor shall furnish the gauges and measuring device for the leakage test, pump, pipe, connections, and all other necessary apparatus, unless otherwise specified, and shall furnish the necessary assistance to conduct the test. The duration of each leakage test shall be 2 hours, unless otherwise specified. During the test, the pipeline shall be subjected to the pressure listed in Table 2. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi (34 kPa) of the specified leakage-test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if the leakage is greater than that determined by the formula:

L = NDSP 7400

Where:

L Allowable leakage, in gallons per hour

N Number of joints in the length of pipeline tested

D Nominal diameter of the pipe, in inches

P Average test pressure during the leakage test, in pounds per square inch (gauge) In metric units,

$$L_m = 130,400$$

Where;

$L_m$  allowable leakage, in litres per hour

Number of joints in the length of pipeline tested

D = nominal diameter of the pipe, in millimeters

P = average test pressure during the leakage test, in kilovolts per ampere 15.0

#### DEWATERING:

During the progress of drainage works, the Contractor shall provide for effective diversion and disposal of surface water and shall be responsible for all damage to any portion of the works or surrounding properties due to inadequate drainage diversion or de-watering equipment.

#### 16.0 LOCATION OF PIPES, PITS AND ACCESS CHAMBERS

All pipes, pits and access chambers shall be located as shown on the Drawings unless otherwise as per the instruction of Engineer-In charge.

TABLE – 2 System Test Methods

Procedure	Pressure	Duration of Test
Simultaneous Pressure and leakage Tests	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation!	2h
Separate Pressure Test	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation!	1h
Separate Leakage Test	150% of working pressure* of segment tested!	2h

\*Working pressure is defined as maximum anticipated sustained operating pressure.

In no case shall the test pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.

**17.0 Mode of Measurement: This item shall be measured for completed no. basis for 1 Lakh litre ESR with 12m staging height.**

Sr. No	Stage of work Amount admissible	payment
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1	S.B.C Testing and On approval designs	3%
2	On completion of work up to excavation and Raft Concreting with steel	9%
3	On completion of work upto Full shaft and/or column/beam/ braces up to bottom slab	17%
4	Completion of work up to bottom slab / bottom dome vertical wall or slant wall of container without top slab or dome	21%
5	Completion of work up to Top slab or including staircase, dome staircase with RCC cabin and door with inside water proof plaster and RCC finishing to out side surface and Dome with inside epoxy paint.	10%
6	Procurement and fixing of inlet, outlet, washout, overflow pipe valves specials at site.	15%
7	Fixing of inlet, outlet, washout, overflow pipe valves specials pipes, specials as directed	5%
8	Painting with exterior acrylic paint , letters, Supplying & Fixing of M .H. cover, C. I. Cowl type ventilator ,M. S ladder, pipe railing , all valves , lighting arrestor, water level indicator, and all miscellaneous items like connection with outlet, inlet pipes and any other items required for proper functioning of ESR Completed with all respect including water tightness test	20%
	TOTAL	100%

The rate shall be for a unit of one Number

<b>On completion of each item As above</b>	<b>80%</b>
<b>Amount of bill to be recovered and kept in deposit till successful completion of defect and liability period.</b>	<b>20%</b>

#### **Part 4 – GSR**

**Preparing structural design of RCC Under Ground Reservoir of 5.5 Lac Ltrs. capacity as per relevant I.S.s and constructing the same, including excavation in all types of soil strata (including rock) including shoring strutting if required, for loose soil / to protect from collapse due to nearby traffic load, casting 100 mm thick P.C.C. levelling course in M-10, Refilling the pit with proper soil and disposing of the surplus stuff within a lead of 50 meters. Including cement plaster in CM 1:2 with approved water proofing compound to inside water touching surface to container. Including all types of labour and material charges of lowering, laying, erecting / hosting and jointing of pipe assembly to inlet, outlet overflow, washout and bye pass arrangement as per hydraulic design.**

**Providing and fixing accessories like MS / GI Ladder, CI Manhole frame and cover, water level indicator, adequate cowl type ventilators or lantern type ventilator with stainless steel jail.**

**B.B. Masonry chambers for valves. Providing and applying three coats of cement paint / snowcem to the outside face of structure. It also includes satisfactory water tightness test as per relevant I.S. code and painting name of scheme and capacity on the tank as per direction of engineer in charge.**

**NOTE:**

1. The structural design of GSR shall be in accordance with provisions relevant I.Ss.
  - (1) I.S. 3370, Part – 1 to 4, 1965 or latest revised.
  - (2) I.S. 456 – 2000 or latest revised.
  - (3) I.S. 1893 – 2000 – 1984 or latest revised.
  - (4) I.S. 875, Part – 1 to 3, 1987 or latest revised.
2. Shape of container (in plan) specified by in data shall be adopted in absence circular shape shall be adopted.
3. Size shall be fixed as per availability of space (land area) at site / acceptable engineer in charge.
4. Effect of overlapping of pressure bulbs on soil due near by structure and proposed sump should be considered.
5. Care shall be taken that no damage should occur to nearby existing structure. Compensation shall be paid for the same by agency.
6. The minimum concrete grade for RCC shall be M-25.
7. HYSD Fe 415 / 500 grade reinforcing bars confirming to I.S. 1786 / 1139 shall be considered in design. CRS / TMT bars shall be provided. In saline atmosphere corrosion resistance stainless steel / HCR rebar shall be provided. Any other steel can be used with approval of EIC/ in situation of non -availability in market without extra cost.
8. Minimum size (or thickness) of various components shall be provided as per tender criteria / specifications in absence as per I.S./ Std. practice of G.W.S.S.B. Minimum dimensions specified for various components in tender data / specifications shall be provided without fail.
9. The safe bearing capacity (SBC) shall be referred from SBC test report. In absence of report it shall be referred from data sheet. If poor soil is found / water table is met with during excavation SBC shall be scientifically ascertained and design shall be revise. No extra shall be paid for increase in quantity.
10. DI pipes and special shall only be used if type is not specified in tender.
11. The rate shall include cost of dewatering during excavation making all arrangement when water table meets within depth.
12. The structure shall be designed properly to resist uplift due to ground water table specified in data or actual ground water table meets with during excavation. No extra shall be paid. If GWT / Uplift is mentioned in tender and during excavation it does not meet 7.5% rate shall be reduced.

13. GI pipes railing shall be provided when sump is more than 2 meter above ground level.
14. Appearance of structure should be aesthetically good looking acceptable to authority.
15. Any charge in size, shape, depth below GL, height above GL, water depth, F.B., size of member etc can be permitted in exceptional case due to site condition or hydraulic design requirement by C.E. No extra shall be paid for change.
16. Any charge in data, dimensions, shape, water depth, reduction in size if permitted by competent authority and if it reduces quantity then payment shall be reduced prorate.
17. When capacity of GSR / Sump is > 20 lakh liters two or suitable compartments acceptable to executive engineer shall be designed and provided.
18. Agency shall engage qualified (at least graduate) consulting engineer for designing the structure and he / she shall visit the site for guidance of work.
19. 75% part rate shall be payable for concrete, reinforcement and plastering items of container until satisfactory hydraulic testing for water tightness is performed as per tender condition. Till the work shall be treated as incomplete.

## **1.0 SCOPE OF WORK**

This section includes the supply of materials, equipment, labour and services necessary for the construction of 5,50,000 liters capacity RCC Ground Service Reservoir / Sump. This standard covers supply, construction, installation and hydrostatic testing procedures for Sump. It may be necessary to supplement this standard with provisions for special requirements not included.

Here in Such special requirements should be incorporated into the EMPLOYER specifications.

## **2.0 DETAILED SPECIFICATIONS**

### **ORDINARY BRICKWORK:**

#### **BRICKS:**

Bricks shall conform to IS: 3102 (latest revision).

■ The bricks shall be local best quality and of regular & uniform size, shape & colour, uniformly well burnt throughout but not over burnt. They shall have plain rectangular parallel sides & sharp, straight & right angled edges. They shall be free from cracks or other flaws. They shall have a frog of 10 mm. depth on one of the flat faces. They shall give a ringing sound when struck with each other.

■ The bricks shall show a fine grained, uniform, homogeneous & dense texture on fracture and shall be free from lumps of lime, laminations, cracks, air holes, soluble salts causing efflorescence or other defects which may in any way impair their strength, durability, appearance or usefulness for the purpose intended. They shall not break when thrown; on the ground on their flat face in a saturated condition from a height of 600mm.

■ The size of brick shall be 230 x 115 x 76 mm (or locally available sizes) only bricks of one standard size shall be used on one work unless specially permitted by the Architects.

■ After 24 hours immersion in water, absorption by weight shall not exceed 20 percent of the dry weight of the bricks, when tested according to IS: 1077 -1976.



- Unless otherwise specified, crushing strength of brick shall not be less than 50 Kg./Sq.cm.

- Bricks rejected by the Engineer shall be removed from the site of work within 24 hours.

**MORTAR:**

The mortar, which is used, shall be mixed in proper proportion as specified in tender item, it shall be thoroughly mixed on an impervious platform by being turned over at least twice dry and twice wet; water in required quantity shall be added gradually. Mortar shall not be ground. Cement mortar shall be prepared in required quantity and not with more than one bag of cement at a time and this quantity shall be consumed within half of an hour after mixing.

**CONSTRUCTION DETAILS:****SOAKING:**

All bricks shall be immersed in water for two hours before being put into works so that they will be saturated and will not absorb water from the mortar. Alternatively the bricks shall be well soaked with watering so that they will not absorb water from the mortar.

**BATS:**

No bats or cut bricks shall be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different courses and for closer in which case, full bricks shall be laid at corners, the bats being placed in the middle of courses.

**LAYING:**

The bricks shall be laid in mortar to line, level and shapes shown on the plans slightly pressed and thoroughly bedded in mortar and all joints shall be properly flushed and packed with mortar so that they will be completely filled with mortar and no hollows are left anywhere. Bricks shall be handled carefully so as not to damage their edge. They should not be thrown from any height to the ground; these should be put down gently.

Bricks shall be laid with frogs up and every 4th course shall be grouted. Seven courses should not exceed 600 mm. in height and in no case brick work shall be raised more than 14 courses per day.

All courses shall be laid truly horizontal and all vertical joints made truly vertical. Vertical joints in one course and the course below shall not come over one another and shall not normally be nearer than quarter of a brick length. For battered faces, bedding shall be at right angles to the face, care shall be taken during construction to see that edges of bricks at quoin, sills head etc. are not damaged. The verticality of the wall and horizontally of the courses shall be checked very often with plumb and spirit level respectively.

All uneven, irregular and bad brickwork shall be demolished, if deemed necessary by Engineer-in-Charge and rebuilt at contractor's expenses.

Pipes or fitting shall be fixed during the progress of brick work or all chases or holes shall be neatly cut in the brick work later or shall be formed as the work proceeds and shall be filled with (1:2:4) P.C.C. and made good after pipes or fittings have been fixed.

Wherever possible bricks shall be bedded in sand instead of cutting and this method is to be used particularly for the fixing of lugs and holdfasts to doors and windows and to rakes of staircases. The bricks shall then be removed only when the fixings are to be made.

**BOND:**

Brickwork shall be done in English bond unless directed otherwise by the Engineer- in-Charge.

**JOINT:**

- Joints shall not exceed 12mm in thickness and this shall be uniform through out. The Joints shall be raked out not less than 12 mm deep when the mortar is green where pointing is to be done.
- When the brick surface is to be plastered, the joints shall be raked to a depth of 6 mm. when the mortar is still green, so as to provide key to plaster.

**SCAFFOLDING:**

Scaffolding will be double or single as warranted for the particular work and as approved by The Engineer-in-Charge. Holes shall be made good by bricks to match the work when scaffolding is removed.

**CURING:**

All brickwork shall be kept well watered for at least 10 days.

**EXPOSED BRICK WORK:**

Where exposed brick work is specified, the usual specification for Exposed Brick shall be Applicable and in addition, selected brick shall be used for facing, ensuring regular and clean faces of uniform colour. No bricks, which are broken, chipped, wrinkled, or which have irregular edges or corners, shall be used. Depending on the quality of bricks and if instructed by Engineer-in-Charge, the exposed face of every brick shall be rubbed before laying without any extra charge. Wooden fillets 12 mm thick and 12 mm. wide shall be placed at the edge of joints so that no mortar come on the surface of the bricks and a regular thickness of joint is maintained. The surface shall be rubbed down with brushes or bricks if necessary, and thoroughly washed. No mortar shall be allowed to stick to the surface, which shall be left clean with all joints even and true to straight line. Double scaffolding shall be used in exposed brickwork.

As specified in the tender, pointing (1:1) shall be done to brick joints. Before pointing, the joints shall be raked out to a depth 15 mm. and the surface of the wall shall be cleaned, washed and well watered at least for two days.

The mortar shall be prepared by mixing cement and sand in proportions as specified in Bills of Quantities. The material shall be thoroughly mixed in dry condition before water is added to them. The mixing shall be done on a water tight platform and mortar of one cement bag only shall be prepared at a time which shall be consumed within 30 minutes after adding water. The mortar shall be placed in the joints in the best workman like manner. The extra mortar shall be removed so that the edges of bricks shall be clearly defined. The finished work shall be kept well watered at least for 10 days.

**RATES TO INCLUDE:**

**ORDINARY BRICK WORK:**

The rate shall include the cost of materials, labour required for all the operations described above. This shall include the following:

- (i) All raking or false cutting and wastage,
- (ii) Chamfering all external angles if instructed.
- (iii) Extra cutting and wastage for forming rebated, reveals or squint or birds mouth

angles.

- (iv) Cutting and fitting brick work to steel.
- (v) Wedging and pinning up brick work to ceiling.
- (vi) Bedding and pointing to wood frames.
- (vii) Cutting and pinning ends of timbers, lintels, steps etc.
- (viii) Leaving small holes as necessary for pipes, conduits etc.
- (ix) Scaffolding double or single for the brick wall, as directed.
- (x) Necessary tools, plant etc. required for this work.
- (xi) Leaving teeth or steps for proper bond with future masonry work.
- (xii) Soaking of bricks in water and curing of work done.

**EXPOSED BRICK WORK:**

Rate includes the following, in addition to those included for ordinary brick work and all the cost of materials, labour required for all the operations described above.

Rubbing the bricks with bricks or on girder,

Pointing the exposed brick work.

Raking out the bricks up to 15 mm.

**CONCRETE:**

**CEMENT CONCRETE:**

- Placing of concrete shall start after the bottom of foundation is well dressed, watered and rammed by means of rammers. After laying and consolidation is completed, watering twice a day for a week from the next day shall be done.

The measurements shall be exact to length, breadth and depth as per drawing.

If cement concrete is to be used, mixing shall be done either in a mixer machine or as required by Engineer-in-Charge of works in grades of M-10 / M-15 / M-20 / M-25 or as specified in the tender item. Concrete shall be laid in layer of maximum 150 mm. thickness with sufficient water and well consolidated with rammer and shall be roughened, in order to have proper bond before the next layer is laid. Placing of concrete, by curing and measurements shall be done as per lime concrete.

**MATERIALS - CEMENT AND AGGREGATES: CEMENT:**

The Cement used shall be only of the following with prior approval of the Engineer-in-Charge.

- a) Ordinary Portland Cement conforming to IS: 269 (For 33 Grade) IS: 8112 (For 43 Grade) and IS: 12269 (For 53 Grade).
- b) Rapid Hardening Portland Cement conforming to IS: 8041.
- c) Portland Pozzolana Cement conforming to IS: 1489.
- d) Portland slag Cement conforming to IS: 455.
- e) Hydrophobic cement conforming to IS: 8043.
- f) Low Heat Portland Cement conforming to IS: 12600
- g) Sulphate Resisting Portland cement conforming to IS: 12330  
the cement shall satisfy the physical requirements given in Table 2.1

**AGGREGATE:**

Aggregate shall conform to IS: 383. Aggregate shall consist of naturally occurring sand and gravel or stone, crushed or uncrushed or a combination thereof from source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, dense, durable against weathering. It shall have limited porosity and shall be free from veins and adhering coatings, iron pyrites, coal, mica, shale or similar laminated material, sea shells, alkali, clay lumps, coal residues, clinkers, slag, organic and other impurities that may cause corrosion of the reinforcements or may impair the strength and/or durability of the concrete. The grading shall be arranged by the contractor that will produce dense concrete of the specified proportions and consistency that will work readily into position without segregation and without the use of excessive water. The contractor shall submit to the Engineer for approval, a representative sample and sieve analysis of the aggregate at the site. Coarse and fine aggregates shall be delivered at the site separately. The size of the aggregate and sieve analysis furnished below are for the guidance only. The grading of the aggregate shall be based on the mix design and preliminary tests on concrete specified later in this Specification.

**TABLE 2.1**

PHYSICAL REQUIREMENTS (TEST TO BE DONE AS PER IS: 4031)

	Ordinary Portland Cement	Low Heat Portland Cement	Portland Pozzolana Cement	Hydrophobic Portland Cement
Fineness (Blaine's Air Permeability) Specific Surface cm <sup>2</sup> /gm	Not less than 2250	Not less than 3200	Not less than 3000	Not less than 3500
Soundness (Le Chatelier method) Expansion	Not more than 10mm	Not more than 10mm	—	Not more than 10 mm
Setting Time (Vicat Apparatus) Initial	30 minutes	60 minutes	30 minutes	60 minutes
Final Setting Time - Not more than	600 minutes	600 minutes	600 minutes	600 minutes
Compressive Strength (Avg. of 3 Mortar Cubes)	(Not less than)	(Not less than)	(Not less than)	(Not less than)
72 + 1 hour	160 kg/cm <sup>2</sup>	100 kg/cm <sup>2</sup>	~	160 kg/cm <sup>2</sup>
168+ 2 hour	220 kg/cm <sup>2</sup>	160 kg/cm <sup>2</sup>	220 kg/cm <sup>2</sup>	220 kg/cm <sup>2</sup>
672 + 4 hours	—	350 kg/cm <sup>2</sup>	310 kg/cm	310 kg/cm
Heat of Hydration 7 days 28 days	•-	Not more than 65 cal/gm 75	o	

SAMPLING AND TESTING AGGREGATES:

Samples of the aggregate for mix design and determination of suitability shall be taken under the supervision of the Engineer-in-Charge and delivered to the laboratory well in advance of the scheduled placing of concrete. Records of the tests, which have been made on proposed aggregate and on concrete, made from the source of aggregate, shall be furnished to the Engineer in advance of the work of use in determining aggregate suitability.

#### CHEMICAL REQUIREMENTS:

The chemical requirement as given in relevant codes shall be satisfied when tested in accordance with IS: 4032.

#### FINE AGGREGATE:

Fine aggregate shall consist of natural sand and/or manufactured sand. The sand shall be sharp, hard, strong, durable and free from organic materials and other deleterious substances.

#### MACHINE MADE SAND:

Machine made sand will be acceptable upon approval by the Engineer, provided that the base rock composition shall be sound, hard, dense, non-organic, uncoated and durable against weathering.

#### SCREENING AND WASHING:

Sand shall be prepared for use by such screening or washing or both as necessary to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

#### FOREIGN MATERIAL LIMITATIONS:

Sand shall be free from all vegetable and injurious substances, dust, clay lumps, soft or elongated or flaky particles, shale, alkali, organic matter, loam mica and other deleterious substances. The percentages of deleterious substances in sand delivered to the mixer shall not exceed the following: Percentage by weight

Material passing IS: 460 - 75 Micron sieve

Shale

Coal and lignite

Clay lumps

Total of all above substances

Not to exceed five percent

#### GRADATION:

The sand shall be so graded that concrete of the required quality, workability, density and strength can be produced using the specified water cement ratio. Unless otherwise directed, sand shall be graded as indicated in Table -2.2.

**TABLE -2.2 FINE AGGREGATE**

IS Sieve Designation	Percentage			
	Grading Zone-I	Grading Zone-II	Grading Zone-III	Grading Zone-IV
10 mm	100	100	100	100

4.74 mm	50-100	90-100	90-100	95-10
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-95	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-10

Note: For crushed stone sands permissible limit on 150 micron IS Sieve is increased to 20 percent (in addition to 5 percent tolerance allowed).

Where concrete of high strength and good quality is required, fine aggregate conforming to any one of the four grading zones may be used; however the concrete mix should be properly designed. As the fine aggregate grading becomes progressively finer, that is, from grading zones I to IV, the ratio of fine aggregate to coarse aggregate should be progressively reduced. The most suitable fine aggregate to coarse aggregate ratio to be used for any particular mix will, however, depend upon the actual grading, particle shape and surface texture of both fine and coarse aggregates.

- It is recommended that the fine aggregates conforming to grading zone IV should not be used in reinforced concrete unless tests have been made to ascertain the suitability of proposed mix proportions. Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron I.S. sieve by total amount not exceeding 5 percent, it shall be regarded as falling within the grading zone. This\* tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve on the coarser limit of grading zone I or the finer limit of grading zone II.

#### FINENESS MODULUS:

The sand shall have fineness modulus of not less than 2.8 nor more than 3.2. The fineness Modulus shall be determined by adding cumulative percentages retained on the five IS: 460 sieve designations viz 2 mm, 1 mm, 500 micron, 300 micron and 150 micron and dividing it by 100. The sieves generally adopted are 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron.

#### SPECIFIC GRAVITY:

Sand having specific gravity below 2.60 (saturated surface - dry basis) shall not be used without special permission of the Engineer.

**TABLE - 2.3**

#### GRADING LIMITS FOR COARSE AGGREGATES

IS Sieve Designation	Percentage Passing for Single Sized Aggregate of Normal Size						Percentage Passing for Graded Aggregate of Nominal Size			
	60 mm	60 mm	40 mm	20 mm	16 mm	10 mm	40 mm	40 mm	15 mm	12.5m m
		40	20 mm	16 mm	12.5 mm			20 mm		

80mm	100	-	-	-	-	-	100	-	-	-
53mm	85-100	100	-	-	-	-	-	-	-	-
40mm	0-80	85-100	100	-	-	-	95-100	100	-	-
20mm	0-5	0-20	85-100	100	-	-	30-70	95-100	100	100
16mm	-	-	-	85-100	100	-	-	-	90-100	-
12.5mm	-	-	-	-	85-100	100	-	-	-	90-100
10mm	-	0-5	0-20	0-30	0-45	85-100	10-35	25-55	30-70	40-85
4.75mm	-	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36mm	-	-	-	-	-	0-5	-	-	-	-

#### COARSE AGGREGATE STONE:

This shall consist of broken trap, granite or any suitable rock from a source to be approved by the Engineer. It shall be machine crushed, hard, strong, durable, free from clay films or loamy admixture, vegetable or organic matter.

#### SCREENING & WASHING:

Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by the Engineer.

The pieces shall be regular in shape, shall have granular or crystal like shape. Friable, flaking and laminated pieces, mica, shale shall be present only in such quantities that will not, in the opinion of the Engineer, effect adversely the strength and/or durability of concrete.

The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1% determined by laboratory sedimentation tests, after 24 hours immersion in water. A previously dried sample shall not have gained more than 10% of the weight

#### GRADING:

The aggregate shall be well graded. The grading limits for coarse aggregates shall be as given in Table-2.3.

#### SPECIFIC GRAVITY:

No coarse aggregate of less than 2.6 specific gravity (saturated surface - dry basis) shall be used without written approval of the Engineer.

#### FOREIGN MATERIAL LIMITATIONS:

The percentage of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the following:

Percentage by Weight 1 1

Clay Materials passing IS 460-75 Micron sieve lumps \_\_\_\_ /\_\_

Total of all Coal and lignite the above substances 3

ALL-IN- AGGREGATES:

If combined aggregates are available, they need not be separated into fine and coarse, but necessary adjustments may be made in the grading by the addition of single-sized aggregate. The grading of All in Aggregate shall be as given in

**TABLE-2.4**

**GRADING OF ALL-IN-AGGREGATE**

IS Sieve Designation	Percentage passing for All in Aggregate of	
	40 mm nominal size	20 mm nominal size
80mm	100	—
40mm	95-100	100
20mm	45-75	95-100
4.75mm	25-75	30-50
600 micron	8-30	10-35
150 micron	0-6	0-6

**MECHANICAL PROPERTIES OF AGGREGATES:**

The aggregates shall have flooring mechanical properties:

Aggregate Crushing Value	-	45 percent for concretes other than for wearing surfaces
		30 percent for concrete for wearing surface
Aggregate Abrasion Value		12 percent
Aggregate Impact Value (Alternative to Aggregate Crushing Value) c	-	45 percent by weight for concretes other than for wearing surfaces 30 percent by weight for concrete for wearing surface

**COARSE AGGREGATE - SLAG:**

Aggregate shall conform to the following in addition to para 2.4.2 to 2.4.8 above, which are applicable in this case also.

Approval for Use	Blast furnace slag as aggregate may be used for concrete work if such use is permitted by the Engineer
Separating and Grading	Slag shall be crushed as required and over Magnetic Separators to remove stray bits of iron and then graded as required
Sulphur Content	Sulphur contents shall be controlled as per laboratory tests and as required by the Engineer



Specific Gravity	No aggregate of less than 2.1 specific and Weight gravity shall be used. Weight of dry compact graded material (6-40 mm) shall range between 1300 -1450 kg. Per cu. m.
Weight of slag Concrete	The weight of concrete made from slag aggregate should be 2170 to 2245 kg. per cum.
Test for approval	In addition to the tests mentioned for coarse aggregate stone, contractor shall perform tests for sulphur and iron contents and any other test required by the Engineer. The Test results shall be approved by the Engineer before the material is used for work.

#### WATER:

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to steel or concrete. Potable Water is generally considered satisfactory for mixing concrete. pH value of water shall generally be not less than 6. Mixing or curing of concrete with seawater is not recommended because of presence of harmful salts in seawater. Under unavoidable circumstances, seawater may be used for mixing or curing in plain concrete or such reinforced concrete constructions, which are permanently under seawater.

#### ADMIXTURES:

Admixtures may be used in concrete, only with the approval of the Engineer-in-Charge based upon evidence that, with the passage of time, neither the compressive strength of concrete is reduced by more than 10 percent nor are other requisite qualities of concrete and steel impaired by the use of such admixtures. Calcium chloride should not be used. Admixtures, if used shall comply with IS: 9103.

#### STORAGE OF MATERIALS:

##### CEMENT:

Cement shall be stored in weather-tight buildings, bins, or silos, which exclude moisture and contaminants. Storage of cement at site shall be at contractor's expense and risk. In The event of any damage occurring to cement due to faulty storage in contractor's shed or on Account of negligence on his part, such damages shall be the liability of Contractor. In case cement is stored and stacked in bags, storing shall be done in weather tight and properly ventilated structures to prevent absorption of moisture. The bags shall be stacked at least 100 - 200 mm clear above the floor. A space of 600 mm all around shall be kept between exterior walls and stacks. Cement bags shall be placed close together in the stack to reduce circulation of air as much as possible. Cement bags should not be stacked more than 10 bags high to avoid lumping under pressure. If the stack is more than 7 bags high, arrange the bags in header and stretcher fashion, that is, alternatively length-wise and cross-wise so as to tie them together and lessen the danger to toppling over. For extra safety during the monsoon or when it is expected to store the cement for an unusually long period, enclose the stack completely in polythene sheets or any other suitable water proofing materials (covering). The flap will close on the top of stack. Care should be taken that the polythene sheet is not damaged any time during use. When removing bags from storage some bags should be removed from two or three tiers back rather than all from one tier. If the rows are thus stepped back, there is less chance of over turning. When

removing cement bags for use, apply "first in, first out" rule, that is, take the oldest cement out first. Each consignment of cement shall be stacked separately to permit easy access for inspection and to facilitate removal.

#### AGGREGATES:

The aggregate shall be stored in such a way as to prevent mixing of and with foreign materials. The heaps of fine and coarse aggregates shall be kept separately. When different sizes of fine or coarse aggregate are procured separately, they shall be stored in separate stockpiles sufficiently away from each other to prevent the material at the edges of the piles from getting intermixed.

#### WORKMANSHIP - CONCRETE:

##### Note:

In the designation of a concrete mix letter M refers to the mix and the number to the specified characteristic compressive strength of 150 mm. cube at 28 days expressed in N/mm<sup>2</sup>.

IS: 516 and IS: 1199 shall be followed for sample sizes, sampling and testing of all samples.

#### STRENGTH REQUIREMENTS OF CONCRETE:

Where Ordinary and Low Heat Portland Cement conforming to IS: 269, Portland Pozzolana Cement conforming to IS: 1489 or Portland Blast Furnace Slag Cement conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given in Table 2.7. Where Rapid Hardening Portland Cement (IS: 8041) is used, the 28 days compressive strength requirements specified in Table 2.7 shall be met at 7 days.

The strength requirements specified in Table 2.7 shall apply to both Controlled Concrete i.e. Design Mix Concrete and Ordinary Concrete i.e. Nominal Mix Concrete.

In order to get a relatively quicker idea of the quality of concrete, optional works tests on beams for modulus of rupture at 72 ± 2 hours or 7 days or compressive strength at 7 days may be carried out in addition to 28 days compressive strength test. The Engineer-in-Charge may suitably relax the frequency of 28 days compressive strength test specified in Table 2.7 of IS: 456 - 2000 provided the expected strength values at the specified early age are consistently met. For this purpose, the values given in Table 2.8 may be taken for general guidance in the case of concrete made with Ordinary Portland Cement.

Where the strength of a concrete mix, as indicated by tests lies in between the strength for any two grades specified in Table 2.7, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

**TABLE-2.7**

#### STRENGTH REQUIREMENTS OF CONCRETE

Group	Grade of Compressive Strength of 150mm Cubes at 28 days after mixing, conducted in accordance with IS: 516		N/mm <sup>2</sup>
Concrete	Ordinary concrete	M-10	10
		M-15	15
		M-20	20
Standard Concrete		M-25	25

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The concrete mix shall be designed to have an average strength corresponding to the values specified for preliminary tests in Table - 2.7. The proportions chosen should be such that the concrete is of adequate workability for the conditions prevailing on the work in question, and can be properly compacted with the means available. The maximum total quantity of aggregate by weight per 50 kg. of cement shall not exceed 450 kg. except where otherwise specially permitted by the Engineer-in-Charge.

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

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

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

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

#### WORKABILITY OF CONCRETE:

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

**TABLE - 2.9 WORKABILITY OF CONCRETE**

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

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

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

#### 2.10.5 NOMINAL MIX CONCRETE:

Nominal mix concrete may be used for concretes of grades M-5, M-7.5, M-10Q, M-15, and M-20.

**The proportions of materials for nominal mix concrete shall be as specified in Table**

#### 2.10.

**TABLE-10****PROPORTIONS OF NOMINAL MIX CONCRETE**

Grades of Concrete	Total Quantity of Dry Aggregate by Mass per 50 kg. of Cement. Sum of Masses of Fine and Coarse Aggregates	Proportion of Fine Aggregate to Coarse Aggregate (by Mass)	Quantity of Water for 50 kg. of Cement (Max.) Lit.
M-5 M-7.5	800 kg 635 kg	Generally 1:2 but subject to upper limit of 1:1.5 and a lower limit of 1:2.5	60 45

M-10 M-15 M-20	480 kg 350 kg 250 kg	Adjust from upper to lower limit as grading fine aggregates becomes finer and maximum sizes of coarse aggregate	34 32 30
The maximum water cement ratio shall be maintained as per Table 2.12			

NOTE:

The Contractor will be required to prepare his own mix design and establish from preliminary tests as per Indian Standards that the mix design is according to that specified for each concrete. The same shall be adopted only after the Consulting Engineer/Architect approves it.

Workability of the concrete should be controlled by direct measurement of water content, making allowance for any surface water in the fine and coarse aggregates. The slump test in accordance with IS: 1199 may be used as a guide. Allowances should be made for surface water present in the aggregate when computing water content. Surface water shall be determined by one of the field methods described in IS: 2386 (Part III). In the absence of exact data, the amount of surface water may be estimated from the values given in Table -2.11.

**TABLE-2.11**

**SURFACE WATER CARRIED BY AGGREGATE**

Aggregate	Percent by Mass	Approximate Qty. of Surface Water Lit/Cum
Water wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist gravel or crushed rock	1.25-2.5	20 to 40

**2.10.6 REQUIREMENT FOR DURABILITY:**

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

**TABLE-2.12**

**Minimum Cement Content, Maximum Water Cement Ratio And Minimum Grade Of Concrete For Different Exposures With Normal Weight Aggregates Of 20mm Nominal Maximum Size**

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

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

**TABLE 2.13**  
**ENVIRONMENTAL EXPOSURE CONDITIONS**

Sr. No.	Environment	Exposure Conditions
1.	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
2	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet. Concrete exposed to condensation and rain Concrete continuously under water Concrete in contact or buried under non-aggressive soil/ground water Concrete surfaces sheltered from saturated salt air in coastal

Sr. No.	Environment	Exposure Conditions
		area
3.	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation. Concrete completely immersed in seawater Concrete exposed to coastal environment
4.	Very Severe	Concrete surfaces exposed to seawater spray, corrosive fumes or severe freezing conditions whilst wet. Concrete in contact with or buried under aggressive sub-soil/ground water
5.	Extreme	Surface of members in tidal zone Members in direct contact with liquid/solid aggressive chemicals

PRELIMINARY TESTS:

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

**Mixing:**

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

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

**Note:**

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

**CONCRETE CUBES:**

**Size of test specimen & moulds:**

Test specimens cubical in shape shall be 150 x 150 x 150 mm. If the largest nominal size of the aggregate does not exceed 200mm, 100 mm cubes may be used as an alternative. A cube mould should be of metal and stout enough to prevent distortion. It shall be constructed in such a manner as to facilitate the removal of the moulded specimen without damage, and shall be so machined that, when it is assembled ready for use, the dimensions and internal faces shall be accurate within the following limits:

Height of mould and distance between opposite faces:

Specified size + 0.2 mm.

Angle between adjacent faces:  $90 \pm 0.5$  degree

Each mould shall have a plane face metal base plate of such size as to support the mould during the filling without leakage and shall be attached to the moulds; when assembled shall be positively and rigidly held together and suitable methods of ensuring this, both during filling and

on subsequent handling of the filled mould, shall be provided. In assembling the mould for use, the joints between the sections of mould shall be thinly

- coated with mould oil and a similar coating of mould oil shall be applied between the contact surfaces of the bottom of the mould and the base plate in order to ensure that no water escapes during filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete. The tamping bar shall be a steel bar 16 mm. in diameter, 0.6 m. long and bullet pointed at the lower end.

#### Compacting:

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

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

#### Curing:

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

#### Tests for Cube Specimen:

The concrete cubes shall be tested in standard testing machines by skilled personnel. Tests shall be made at recognized ages of the test specimen, the most usual being 7 and 28 days. Tests may be made at 24 hours + 1/2 hour and 72 hours + 2 hours if early strengths are needed. The age shall be calculated from the time of the addition of water to the dry ingredients.



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

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

The bearing surface of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen, which are to be in contact with the compression platens. The specimen shall be so placed in the machine that the load shall be applied to the opposite sides of the cubes as cast, that is, not to the top and bottom. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing plates shall be used between specimen and platens of the machine. Once the uniform seating is obtained, load shall be applied without shock and increased continuously at a rate of approximately 14.0 N/mm<sup>2</sup> /Min. until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

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

#### Frequency of Sampling of Concrete Cubes:

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

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

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

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

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

Reference to specific structural member receiving the batch of concrete from which the cubes were cast.

Mark on cubes. Mix of concrete.

Data and time of casting.

Water cement ratio by weight and slump.

Crushing strength as obtained at the end of 7 days for 3 cubes out of a set of 6 cubes and the end of 28 days for the remaining 3 cubes.

Laboratory in which tested and reference to test certificates.

The quantity of concrete, incorporated in work, that is represented by the quantity of concrete of the set of the cubes.

Any other information required by Architects. Consistency:

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

Record of Temperature:

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

#### OPTIONAL TESTS:

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

Tests on cement shall include:

- Fineness Test,
- Test for Normal Consistency,
- Test for Setting Time,
- Test for Soundness,
- Test for Tensile Strength,

Test for Heat of Hydration (by experiment and by calculations) in accordance with BIS or any other approved standard for cements.

Test on sand shall include:

- Sieve Test
- Test for Organic Impurities
- Decantation Test for Determining Clay
- Specific Gravity Test
- Test for Sieve Analysis and Fineness Modulus.
- Tests on coarse aggregate shall include:
- Sieve Analysis

- Specific Gravity and Unit Weight of Dry Loose and Rodded Aggregate (Bulk Density Test)
- Determination of Yield of a Dry Mixture
- Petrographic Examination of Deleterious Minerals in Aggregates. Test for Aggregate Crushing Value and 10% Fine Value Test.
- Aggregate Impact Value
- Toughness Test
- Soundness Test
- Hardness Test
- Alkali Aggregate Reaction
- Deleterious Material

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

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

#### LOAD TEST ON MEMBERS OR ANY OTHER TEST:

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

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

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

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

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

#### TESTING CONCRETE OF TANKS FOR LEAKAGE:

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

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

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

Costs of Tests:

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

Unsatisfactory Test:

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

PLACING:

The procedure for placing of concrete shall be as follows: Preparation before placing of concrete shall be as given below. Engineer's Approval of Equipment & Method:

- Before any concrete is placed, the entire placing programme, consisting of equipment, layout, proposed procedure and methods shall be submitted to the Engineer for approval if so demanded by the Engineer and no concrete shall be placed until the Engineer's approval has been received.
- Hardened concrete and foreign materials should be removed from the inner surface of the conveying equipments.
- Form work shall have been completed; snow, ice and water shall have been removed. Reinforcement shall have been secured in place, expansion joint material, anchors and other embedded items shall have been positioned and the entire preparation shall have been approved.
- No concrete shall be placed on watered surface.
- Rain or Wash Water:

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

position on the surface of the newly placed concrete and shall be removed by approved means and no further concrete shall be placed thereon.

Time interval between mixing and placing:

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

Concrete placing by manual labour:

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

Avoiding segregation:

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

Concrete placing by Mechanical Equipment:

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

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

Type of Buckets:

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

Operation of Bucket:

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

Placement in Restricted Forms:

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

Chuting:

Where it is necessary to use transfer chutes between mixer, containers or hoppers, and point of deposit in the forms, specific approval of the Engineer must be obtained as regards the type, length, slopes, baffles and vertical terminals. Concrete shall not be permitted to fall from the end of the chutes or tube more than 1.00 M. Chutes, when approved for use shall have slope not flatter than 1to3 and not steeper than 1tp2.

#### Placing by Pumping:

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

#### Bonding Mortar:

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

#### Thickness of Layers:

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

#### Bedding of layers:

Bedding planes shall be approximately horizontal unless otherwise instructed.

#### Compaction:

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

#### TYPE OF VIBRATORS:

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

- Use of Vibrators:

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

- **Successive Batches:**

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

- **Vibrator Penetration of under layer:**

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

- **Vibrating Against Reinforcement**

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

- **Use of form attached Vibrators:**

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

- **Use of Surface Vibrators:**

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

- **Stone pockets and Mortar Pondages:**

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

### **CONSTRUCTION JOINTS AND KEYS:**

**Concrete shall be placed continuously unless otherwise specified.**

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

### **CURING, PROTECTING, REPAIRING AND FINISHING:**

All concrete shall be cured by keeping it damp for the period of time required for complete hydration and hardening to take place. Certain types of finish, or preparation for overlaying, concreting must be done at certain stages of the process and special treatment may be required for specific concrete surface finish.

Curing with water:

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

Continuous Spraying:

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

Alternate Curing Methods:

Whenever, in the judgment of the Engineer, it may be necessary, the continuous spray method may be omitted and a covering of sand, or other approved mulching such as wet gunny bags,

which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which should strain or damage the concrete during or after curing period. Covering shall be kept continuously wet during the curing period.

Curing compounds:

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

Ponding:

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

Curing Equipments:

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

Protection of Fresh Concrete:

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

Repair and Replacement of Unsatisfactory Concrete:

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

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

CURING OF DIFFERENT ITEMS:



For all the time during construction, curing shall be carried out especially from 7.00 AM to 7.00 PM even on holidays with proper manpower, necessary pumps and pipe lines, connections, etc. Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering **with** a layer of sacking, canvas, hessian or similar material and kept constantly wet for at least seven days from the date of placing concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 (days for concrete exposed to dry and hot weather conditions. In the case of concrete where mineral admixtures or blended cements are used it is recommended that above minimum periods may be extended to 14 days. For the concretes containing PPC or Portland Slag Cements, period of curing may be increased.

For other items the curing shall be done as follows or as directed by the Engineer-in-Charge.

- |     |                                  |                       |
|-----|----------------------------------|-----------------------|
| (a) | Brickwork                        | At least for 10 days. |
| (b) | Plaster work                     | At least for 7 days.  |
| (c) | Sand faced plaster               | At least for 15 days. |
| (d) | Tiles or stone flooring and dado | At least for 10 days. |

#### FORM WORK:

##### General:

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

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

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

##### Materials:

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

Chamfer strips shall be placed in corner of forms to produce bevelled edges on permanent exposed surface, if specified.

Temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.

##### Mould Oil:

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

Chamfers and fillets:

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

Vertical construction joint chamfers:

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

Reuse of Forms:

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

The contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from. Striking of forms in the case of sides of beams, columns and slabs can be carried out after 24 hours of concreting. Striking shall be done with utmost care without shock or vibration by gently easing the wedges. If, after removing the formwork, it is found that the timber is embedded in the concrete, it has to be cut out and made good with fine concrete. Due care shall be given to the provision of correct form work for holes and openings in the slabs, inserts, grounding cables, conduits and pipe sleeves, foundation or anchor bolts etc. as per approved drawings or as directed by the Engineer.

**CLEANING AND TREATMENT OF FORMS:**

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

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

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

In columns of any forms where access to the interior is not available otherwise, a sufficient area of one side shall be left loose so that it may be removed for cleaning out all chips, dirt, sawdust and other extra materials.

Where the shoring bores on the ground, the Contractor shall spread the load from shores by suitable brick platforms in order to prevent settlement.

#### ARCHITECTURAL EXPOSED REINFORCED CEMENT CONCRETE:

##### General:

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

##### Materials:

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

##### Aggregate:

##### Fine Aggregates:

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

##### Coarse Aggregate:

The colour of the aggregate shall be maintained the same through out. Unless otherwise specified, exposed concrete in walls, fences and parapets which are nonload bearing and are less than 120 mm. in thickness the maximum size of coarse aggregate shall be limited to 12 mm for which nothing extra shall be admissible. Flat and flaky pieces shall not be allowed.

**Reinforcement & Cover of the Concrete:** Correct placing of the reinforcement with proper cover is important in all exposed work to avoid discolouration by rusting. The minimum cover specified in the Specification shall be D maintained throughout. Concrete blocks or spacers shall be sparingly used at exposed surfaces. When used, such blocks shall preferably be cast on vibrating tables or in some other similar manner so that it may match the concrete surface in texture and colour. Cove/ blocks of materials other than precast blocks shall not be allowed to be used.

##### Construction of shuttering:

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

##### Timber Shuttering:

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

##### Plywood Shuttering:

The contractor shall provide shuttering quality plywood not less than 12 mm thickness as per IS.4990 (type-I) of approved make or equivalent approved by the Architect in place of timber

plank shuttering mentioned above for such location as called for by the Architects. The joints in plywood shuttering shall be located as directed by the Architects. Shuttering, centering and form work for all exposed concrete work like exposed columns, beams, ribs, slabs, chajjas, facias, walls etc. shall be of such finish and rigidity as to produce all faces fair and smooth, true to line level and plumb. No rendering or touching shall be permitted on these faces.

#### Steel shuttering:

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

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

Any holes for the supports, which the contractor may need, shall be permitted only if approved by the Architects. All such holes shall be subsequently filled in carefully as to match with the other surface. Walls, columns etc. shall generally be cast to the full height in one operation and the formwork shall be provided accordingly. If permitted by the Architects, these may be completed in two or more heights when the formwork shall be carefully and correctly raised for further height so as to ensure a neat joint without disturbing the pattern. Any groove desired by the Architect at the joint shall be provided by the Contractor at no extra cost.

#### Coating for shuttering:

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

#### Measurements and proportioning of concrete materials:

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

#### Preparation for placing concrete:

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

#### Mechanical vibration:

All concrete for exposed concrete work shall be vibrated, using needle vibrators -30/32 mm. Surface or trough vibrators may be permitted to be used for thin slabs. External vibrators for walls may be allowed but this shall be done carefully to safeguard the displacement of the shuttering. Vibrators shall only be operated by skilled labour; over or under vibration shall not be permitted. Any spillage, or leakage, which is unavoidable and which flows down the exposed

concrete surfaces, shall be immediately washed away with clean water and brush. Exposed concrete members shall be finished to desired surface while the concrete is still green.

Curing and protection of concrete:

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

Removal of shuttering:

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

Finishing:

Finishing of exposed concrete surface shall be as specified.

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

STRIPPING TIME:

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

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

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

However, this period may be increased or decreased at the discretion of Architects. In case when the cube strengths at seven days are found to be low or in the cases when other cements are used, the curing period and stripping time for forms and removal of props may have to be extended. This shall be decided by the Architect and the contractor shall not claim any extra costs for such increased periods of curing and stripping of forms etc. Special care shall be taken while

removing the centering of cantilever slab, canopies, portal frames, folded plates construction etc. Stripping time for such special structure as shell roofs etc. shall be determined from tests of stripping cubes taken specially for the purpose. These cubes shall give strength of 75% of the 28 days strength.

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

Note:

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

#### PROCEDURE WHEN REMOVING THE FORMWORK:

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

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

#### TOLERANCES:

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

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

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

#### FOUNDATION BEDDING, BONDING AND JOINING:

All surfaces upon or against which concrete will be placed shall be suitably prepared by thoroughly cleaning, washing and dewatering as may be indicated in the drawing, or as the Engineer may direct to meet various situations encountered in the work.

#### SPACE OF CROSS SECTION:

No line on the cross section of unit shall deviate from its correct position by an angle exceeding one degree. Contractor shall not make any change in the cross section of the units in any case.

#### PREPARATION OF EARTH FOUNDATION:

All earth surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft yielding soil shall be removed and replaced. Where specified, lean concrete shall be provided on earth for receiving the concrete. The surface of absorbing types of soils against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn from the freshly placed concrete.

#### PREPARATION OF CONCRETE SURFACES:

The preparation of concrete surfaces upon which additional concrete is to be placed shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting of the surface with picks and stiff brooms and by use of an approved combination of air and water\* jet, as directed by the Engineer. Great care shall be taken in performing this work to avoid removal of too much of mortar and weakening of the surface by loosening of aggregate.

When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt; unsound concrete, laitance and glazed mortar have been removed.

#### BONDING TREATMENT (MORTAR):

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, they shall receive a bonding treatment, immediately before placement of the concrete.

The bonding medium shall be a coat of cement sand mortar. The mortar shall have the same cement-sand content as the concrete, which will be placed on it. The water-cement ratio shall be determined by conditions and as approved by the Engineer.

Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 12.5 mm thick for rock surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions, and shall be brushed out to a satisfactory degree, as determined by the Engineer.

Mortar shall be placed at a rate that it can be brushed over the foundation just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar take place. The amount of mortar that will be permitted to be placed at any one time, or the area which it is to cover, shall be in accordance with the Engineer's direction.

#### CLEANING AND BONDING FORMED CONSTRUCTION JOINTS:

Vertical construction joints shall be cleaned as specified above or by other methods approved by the Engineer. In placing concrete against formed construction joints, the surface shall be coated thoroughly with the specified bed joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by careful puddling and spading with aid of suitable tools.

When re-shoring is permitted or required, the operation shall be planned in advance and shall be subject to approval of Architect. When re-shoring is underway, no live load shall be permitted on the construction.

In no case during re-shoring shall concrete in beam, slab, column or any other structural member be subjected to combined dead and construction loads in excess of the loads permitted by Architect/Engineer for the concrete strength developed at the time of re-shoring. Re-shore shall be tightened to carry their required load without overstressing the construction.

Floors supporting shores under newly placed concrete shall have their original supporting shores left in places or shall be re-shored. The re-shoring system shall have capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one half of the capacity of the shoring system above.

The re-shores shall be located directly under a shore position above unless other location is permitted.

#### EXPANSION AND CONSTRUCTION:

Provision will be made for expansion joints and construction joints in concrete by use of special types of joints located as shown on the drawings. Construction joint surfaces are to be treated as shown on the drawings or as directed by the Engineer.

#### ADVERSE WEATHER CONDITIONS:

When concrete is to be placed under adverse weather conditions special provisions shall be made in the handling and placing methods and in protection during the curing period to ensure that concrete of full strength and free from damage will be obtained.

Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. The use of calcium chloride in mass concrete of footings and similar occasions will be permitted only upon written approval of the Engineer. When calcium chloride is used, it shall be liquefied and added to the mixing water in an amount not exceeding 2 % of the weight of the cement in each batch of concrete. If calcium chloride added is:

1% of weight of cement, it serves the purpose of acceleration. But if the quantity exceeds 2% it causes delay in the initial setting time; it acts as retarder.

8% of weight of cement, it causes slash-set. Calcium Chloride should not be used in the pre-stressed concrete works at all and more amount of it reduces the resistance of the cement to the sulphur attacks.

#### OPENINGS, INSERTS ETC.

Slots, openings or holes, pockets, etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by the Engineer. Any deviation from the approved drawings shall be made good by the contractor without damaging any other work. Sleeves, bolts, inserts etc. shall also be provided in concrete work, where so specified.

#### RATES ALL INCLUSIVE:

The unit rate for concrete work under various categories shall be inclusive of and no claims for extra payment on account of such items as leaving holes, pockets, embedding inserts etc. shall be entertained. No extra claim shall also be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift



or scaffolding etc. All these factors should be taken into consideration while quoting the unit rates. The rates shall also include fixing inserts in all concrete work, whenever required.

#### PAYMENT FOR CONCRETE WORK:

Payments for concrete will be made on the unit rates quoted for the respective items in the Bills of Quantities. No deduction in the concrete quantity would be made for reinforcements, inserts, etc. and opening less than one twentieth of the square meter and 1/150 Cmt. Where concrete is measured in cubic meters. It shall be very clearly understood that payment for "concrete work formwork" is inclusive formwork, shuttering shoring, propping, scaffolding, etc.

Rate for all concrete work shall be based on 20 mm maximum size aggregate. Contractor shall also quote the reduction offered for using 40 mm maximum size aggregate, if permitted by the Engineer.

#### TESTS AND INSPECTIONS: Rejection of work:

The Engineer-in-Charge reserves the right to condemn any work, which appears unsatisfactory or does not comply with the specifications or working drawings. The contractor shall at his own expense cut out the condemned work and replace it with new work to the satisfaction of the Engineer-in-Charge. REINFORCEMENT

1.1 T.M.T. BARS shall conform to IS 1786-FE415 Mild steel binding wires shall conform to relevant IS.

#### 2.0 Workmanship:

The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed.

Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting

Reinforcing steel shall conform accurately to the given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed using a proper bar bender operated by hand or power to attain proper radius of bends, Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending. Unless otherwise specified a 'IT type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be at least four times the diameter of the round bar and the length of straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In case of bars which are not found and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

All the reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using stay blocks or metal chair spacers metal hangers supporting wires or other approved devices at sufficiently close intervals. Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. AH devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete except where shown

on drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces or broken stone, brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, pre-cast mortar blocks or other approved devices. Reinforcement after being placed shall be maintained in a condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All the bars protruding from concrete and to which other bars are to be spliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

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

2.6 As far as possible bars of full length shall be used. In case this is not possible, overlapping of bars shall not touch each other but be kept apart by 25 mm. Or 1.25 times the maximum size of the coarse aggregate, whichever is greater, by concrete between them. Where not feasible, overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted light. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending movement is maximum.

2.7 Wherever indicated on the drawings or desired by the Engineer-in-charge, bars shall be joined by couplings, which shall have a cross section sufficient to transmit the full stress of bars. The ends of the bars that are joined by coupling shall be of sufficient length that the effective cross section at the base of threads is not less than normal cross-section of the bar. Threads shall be standard threads. Steel for coupling shall conform to IS 226.

2.8 When permitted or specified on the drawings, joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to IS 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

PLASTER:

PREPARATION OF SURFACE:

Before plastering, masonry joints are to be raked out. Mortar powder and dust shall be brushed out from joints, and the surface shall be washed with clean water and shall be watered well. Cement slurry shall be applied to R.C.C. surface before plastering. The minimum thickness or

mortar to be applied shall be as specified. To ensure proper thickness, gauged patches shall be made at 1.5 to 2 m. apart. Plastering shall be started from top and worked to bottom.

#### PREPARATION OF MORTAR:

The mortar shall be prepared in required proportion as specified in Tender. The mortar shall be thoroughly mixed on an impervious platform by turning over at least twice dry and twice wet. Water shall then be added gradually in required quantity. Mortar shall not be ground.

Cement mortar shall be prepared in required quantity and not with more than one bag of cement at a time. This quantity shall be consumed within 30 minutes after adding water and mixing.

#### SCAFFOLDING:

Scaffolding will be double or single stage as warranted for the particular work and as approved by the Engineer-in-Charge. Holes shall be made good by bricks to match the work when scaffolding is removed.

#### PLASTERING:

##### CEMENT FINISH CEMENT PLASTER:c

Before plastering the surface, gauge marks with cement mortar should be carried out in line level and plants at distances less than the gauge patti. These gauge marks should be prepared one day prior to commencement of plastering work. Mortar shall be uniformly applied all over the surface to a thickness of 13 mm and finished true to level, line and plumb taking special care to finish jambs of windows, doors, junction etc. A thin layer of cement paste with 5% slake lime slurry for easy application shall then be applied initially with wooden gutka and then with MS mala / trowel to avoid air bubbles and rubbed into the surface and finished by means of trowel until the surface is even and smooth. Before applying cement paste, care shall be taken that previous coat of mortar shall not be dried. All corner, angles and junctions shall be truly vertical or horizontal and finished. Any cracks

which appear in the surface and portions which found hollow when tapped or found soft or otherwise defective shall be cut and redone. Curing shall be started after 24 hours and surface kept wet for seven days.

##### NEEROO FINISH CEMENT PLASTER:

General specifications shall be as per cement finish cement plaster, except applying a thin layer of neeroo paste instead of cement paste. In neeroo paste some quantity of cement paste, shall be added. A thin layer of neeroo paste shall then be applied to the under coat and rubbed into the surface and finished by means of trowel until the surface is even and smooth. Surface shall be cured for seven days, after a laps of 24 hours.

##### MALA FINISH PLASTER:

Specification are same as sand face plaster, except in second coat, mortar shall be mixed in proportion as specified in Bills of Quantities and surface shall be finished with Mala only, as directed by Engineer-in-Charge.

#### RATE TO INCLUDE (All Plasters):

The rate shall include the cost of materials and labour required for all the operations, described above. This shall include the following:

- (i) Raking out joints of brickwork, stonework or raking concrete for key.
- (ii) Work done overhead or in confined spaces and in narrow widths.

- (iii) Thoroughly watering surfaces before the plastering.
- (iv) Protection of plaster until handing over.
- (v) Forming coves at Junction.
- (vi) Forming 10 mm to 30 mm wide and 12 mm deep grooves vertically or horizontally as required at junction of ceiling and wall, skirting, dado floors and at joints of concrete and masonry work.
- (vii) Forming drip and weathering where necessary and directed,
- (viii) Scaffolding, single or double stage, as warranted for the particular work and as approved by the Architects.
- (ix) Making sample for respective item for approval if instructed by Engineer-in-Charge, without any extra charges.
- (x) Watering the brick surface and applying cement slurry to R.C.C. surface before plastering.
- (xi) Curing of work executed, (xii) Necessary patta as required.

#### **FILLING EARTH:**

This work shall be consist of laying and compacting embankment of selected soil brought from outside other than GIDC land. The embankment shall constructed in accordance with the requirement of these specifications and in conforming with lines, grades and cross sections shown on the drawing or as directed by Engineer in charge.

#### **MATERIALS**

##### **SOURCE**

The selected soil shall be obtained from outside sources/area other than GIDC land. The contractor will have to make his own arrangement to get sources /area for obtaining the selected soil of approved quality with all lead and lifts at his own cost. The general specifications for collection of road materials attached here with shall also follow.

The source / quarries arranged by the contractor to obtain the selected soil shall got approved from the Executive Engineer prior to use in the work. The ample of selected soil collected from approved quarries shall be got tested at Govt. recognized laboratory as may be directed to the contractor at his own cost. The results shall conform to the standard requirement set down hereunder. The selected soil of the approved quality shall be only permitted for use in the work.

##### **GENERAL REQUIREMENTS:**

The material to be used for the work shall be natural murrum / soil. The selected soil shall be free from logs/stumps, roots, rubbish or any other matter likely to deteriorate or to affect the stability of the embankment / Sub grade.

If inferior quality of selected soil is used in the work, same shall be removed by the -contractor at his own cost.

##### **PHYSICAL REQUIREMENT**

The selected soil shall conform to the physical requirement set forth in table below.

TABLE

Sr. No.	Kind of material	Requirement
1	Selected soil	Maximum laboratory dry unit weight when tested as per IS-2720 (Part-A) value not less than 19.50 KN/ Cubic meter

The Engineer-in-charge may however relax this requirement by taking into account the availability of materials for construction and other relevant factors.

#### **CONSTRUCTION OPERATIONS:**

##### **SITE CLEARANCE:**

Immediately prior to the laying of selected soil, original ground/Sub-grade/ Sub- base shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with one or more pass of 80/100 KN static weight vibratory roller, with plain drum or heavy pneumatic tired roller of minimum 200/300 KN weight having a minimum tyre pressure of 070 MN/m<sup>2</sup>. as directed by the Engineer-in-charge. The relevant specification of M.O.R.T. & H. clause No.201 shall also be followed.

##### **SETTING OUT:**

After clearing the site or preparing the sub-grade/sub-base the alignment of the road shall be properly set out true to lines curves, slopes, grades and sections as shown in the plan or as directed by the Engineer-in-charge. The contractors shall provide all labours and materials such as lime, string, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out, establishing temporary & permanent bench marks center line stones & other marks and giving profiles, alignments and other marks, as long as they are required for the marks and long as opinion of the Engineer-in-charge.

##### **DEWATERING:**

M.O.R.T. & H. Clause No.305.3.2. Shall be followed.

##### **COMPACTING GROUND SUPPORTING EMBANKMENT/SUB-GRADE:**

The original ground shall be levelled to facilitate placement of first layer of embankment mix with water & then compacted by rolling so as to achieve minimum dry density. The specification under paras No. 3.3 of Item No. 1 of Part-A shall be followed.

##### **SPREADING MATERIALS IN LAYERS & BRINGING TO APPROPRIATE MOISTURE**

##### **CONTENT:**

Earth work shall not be proceed until the foundation of embankment have been inspected by the Engineer-in-charge for satisfactory condition and approval. The selected soil shall be spread on the prepared road foundation with the help of a drag spreader, motor graders or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of the each layer after consolidation does not exceed 200 mm or required thickness, shown on the drawing or as directed by the Engineer-in-charge. Successive layers of soil shall not be placed until the layers under construction have been thoroughly compacted to the requirements set down hereunder and accepted by the Engineer in charge. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve specific slope and grade.

The operation of laying the successive layers of selected soil shall have to be suitably synchronized with the consolidation work. Moisture content of the selected soil shall be checked at the site of placement prior to recommencement of compaction, if found to be out of agreed limit, the same shall be made good. Where water is required to be added in such construction, water shall be sprinkled from a water tanker fitted with sprinkle capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding.

The water shall be added uniformly & thoroughly mixed in murrum by blading, discing or harrowing until a unit of moisture content is obtained through out the depth of the layer. If the selected soil delivered to the road bed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Such circumstances arises, where owing to wet weather the moisture content can not be reduced to the required amount by the above procedure, compaction shall be suspended. Moisture content of the each layer of selected soil shall be checked in accordance with IS : 2720 ( Part-2 ) and unless otherwise mentioned, shall be so adjusted, making due allowances for evaporation losses, that at the time of compaction, it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with corresponding to IS : 2720 (Part-7 ) of IS : 2780 ( Part - 8 ). After water has been added the material shall be processed by mechanical or other approved means if so directed by the Engineer-in-charge until the layer is uniformly wet confirming to M.O.R. T.& H. specification clause no. 305.3.5.2

### **COMPACTION**

Only the compaction equipment approved by the Engineer shall be employed to compact the selected soil. The compaction shall be done with the help of vibrator roller of 80 to 100 KN static weight with plain drum or heavy pneumatic tired roller of minimum 200/300 KN weight having a minimum tyre pressure of 0.70 MN/M<sup>2</sup> as approved by the Engineer-in-charge, capable for achieving required compaction. The contractor shall demonstrate the efficiency of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted this site trials shall first be submitted to the Engineer-in-charge for approval. Immediately there after rolling shall be started with approved roller or other approved plant. Rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of roller shall uniformly overlap not less than on third of the track made in the proceeding pass. During rolling the grade and camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding fresh material. Rolling shall be continued till the density achieved is at least 100% of the maximum dry density for the material determined as per IS : 2720 ( Part - 8 ). The surface of any layer of selected soil on completion of compaction shall be well closed free from movement under compaction plant 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.

### **FINISHING OPERATIONS**

The embankment shall be finished in conformity with the alignments, levels, cross sections and dimensions shown on the plans or as directed by the Engineer-in-charge. Finishing operations shall include work of shaping and dressing the sub-base / shoulders and the side slopes to conform to the cross section. When earthwork operations have been subsequently completed, the road way area shall be cleared of all debris and ugly scrubs in the construction area, responsible for objectionable appearance shall be eliminated. The defective portion shall be removed and re-constructed as directed by the Engineer-in-charge.

The surface finish of construction shall conform to the requirement as per general technical specification for quality control on works and materials attached herewith.

M.O.R.T.& H. specification clause no. 305.3.9 shall be also followed.

**ARRANGEMENT OF TRAFFIC:**

M.O.R.T. & H. specification clause no. 112 shall be followed.

**QUALITY CONTROL OF WORK:**

Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with these specifications and general technical specifications for quality control on works and materials attached herewith. The Engineer-in-charge shall have the right to modify the frequencies of testing according to the needs.

**3.0 MATERIALS**

**As per General Technical Specification for relevant material.**

**3.1 For other materials following specifications apply:**

**3.2 VALVES - SLUICE VALVES**

**3.2.1 GENERAL**

The contractor shall be covering manufacturing, supplying and delivery of Sluice valve conforming to IS: 2906-1984 & IS: 780-1984 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification

**3.2.2 STANDARDS**

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

**3.2.3 TEMPERATURE VARIATION**

All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 4° to 45° C.

**3.2.4 MARKING**

The legible and in deliable marking upon each valve shall indicate the following:

- (1) ISI certification mark on each sluice valve only.
- (2) Manufacture's brand name and/or trade mark.
- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch
- (6) Where a valve is tested for "open" condition, it should be marked "O" distinctly & permanently.
- (7) Any other important matter that the manufacturer deems fit to be inscribed/embossed.

**3.2.5 TEST CERTIFICATE**

- (a) The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.
- (b) The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by Engineer for the same purpose. The inspection charges of the authorized person/agency as fixed by GIDC shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor.

### 3.2.6 NOMINAL PRESSURE

(a) Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-H" (Mpa= 10 kgf/m<sup>2</sup> approx)

The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

### 3.2.7 MATERIAL:

(a) The materials for the different component parts of the sluice valve shall conform to requirements given in Table-A.

**Table A**

Materials for components parts of sluice valve

Sr No.	Component	Material	Ref. IS No.	Grade of Designation
1	Body, bonnet wedge stuffing box, gland thrust plate, cap.	Grey cast iron	210-FG 1978(1)	
2	Stem	High tensile brass	320-1962(2)	Alloy 1 of 2
3	Wedge nut	Leaded tin bronze	318-1962(3)	2
4	Body seat ring, wedge facing ring	Leaded tin bronze	318-1962(3)	2
5	Bolts	Carbon steel	1367-1967(4)	Class 4.6
6	Nuts	Carbon steel	1367-1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712-1971(5)	C
8	Gland packing	Jute & hemp	5414-1969(6)	

- (1) Specification for grey iron castings (third revision)
- (2) Specification for high tensile brass rods and sections (revised)
- (3) Specification for leaded tin bronze ingots and casting (revised)
- (4) Technical specification - supply of threaded fasteners
- (5) Specification for compressed asbestos fiber jointing (first revision)

### 3.2.8 MANUFACTURE

Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double-flanged ends connection.

### 3.2.9 FLANGES

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538-1976 (Specification for cast Iron fittings for pressure pipes for water, gas and sewage) or its latest revision.

### AIR VALVES

#### 3.4.1 SCOPE OF CONTRACT:



The contract shall be covering manufacturing, supplying and delivering of Air valves-single ball flanged /screw type, Air valve-double ball flanged, Air isolated valves-double ball flanged, Air cushion valve with C.I. body etc. as per item of tender.

#### **GENERAL**

The air valve shall conform to the I.S.S. as and when published and shall be of approved make and quality. The standard applies to air valves used for water and sewage mains. The details given below briefly cover the requirement for materials, dimensions and test for air valves.

#### **3.4.2 CLASSIFICATION**

Air valve shall be of two types

(a) Single Air valve

Single air valve shall have single small or large orifice for releasing air during pipe filling and ventilating the pipe during emptying. Air valves up to 40 mm dia directly shall be screwed on the main.

(b) Double Air valve

Double air valve shall have two ball chambers, one outlet of large capacity shall be provided for admission and release of bulk volume of air during emptying and filling of the main, another of small outlet type for the escape of smaller quantities of air accumulating under pressure. They shall be of flanged type.

#### **3.4.3 MATERIALS**

> CAST IRON

Cast Iron for bodies pressure covers, splash covers, glands, caps, joints support rings shall be best grey iron of selected grade, 20 of IS-210-1978 specification for grey iron castings.

> GUN METAL

Gunmetal shall be of mixture of 88% copper, 10% tin and 2% Zinc having excellent hard wearing qualities. Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gunmetal.

> FOREGED BROZNE

Nipples, spindles shall be machined from rolled, extruded or forged high tensile brass or aluminium bronze. The produce shall possess much greater strength than ordinary cast product.

> MILD STEEL

Bolts, nuts, flanges etc. shall be of mild steel unless otherwise specified and( shall conform to I.S. 226-1975 specification for structural steel.

> MATERIALS FOR BALLS

The balls shall be of rubber covered and vulcanite covered. The rubber shall have a smooth and hard surface. It shall be as per I.S. 638-1965 specification for rubber and insertion jointing.

> FLANGE JOINTING MATERIALS

The jointing material used between the flanges of components part of the valve shall be compressed fiberboard or rubber of thickness between 1.5 mm to 3 mm. The rubber shall be as per I.S. 683:1965 specifications for rubber and insertion jointing. The fiber board

shall be impregnated with chemically natural mineral oil and shall have a smooth and hard surface.

#### **3.4.4 DIMENSION**

Dimension of the Air valves shall be as per relevant IS code.

#### **3.4.5 CHARACTERISTICS**

- > Small orifice valves shall have rubber-covered balls and nipples of forged bronze or special alloy of brass plug.  
Large orifice valve shall have vulcanite-covered ball closing on rubber sealing backed with leather and gunmetal outlet bushes. They shall be screwed or flanged.  
For sewage mains, the air valves shall be actuated by mild steel floats bronze spindles and shall be fitted with synthetic rubber seals.  
Air valves shall be sound in all respect and uniformly forged so as to have uniform bore. They shall be free from any defects such as unwanted projection, holes or roughness and shall have inner and outer surfaces perfectly smooth.

#### **3.4.6 COATING**

- > Immediately after casting and before machining, all cast iron parts shall be Thoroughly cleaned, and before rusting commences, shall be coated by dipping in a bath containing a composition having a tar base.
- > The coating shall be such that it shall not impose any test of smell to water. The coating shall be smooth glossy and sufficiently hard. It shall not chip when scratched lightly with the point of pen knife.

#### **3.4.7 INSPECTION AND TESTING**

The engineer in charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials which does not conform to the specified requirements.

The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show no sign of leakage under these tests i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

#### **3.4.8 MANUFACTURER'S GUARANTEE**

- > The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch, shall replace any part that prove defective, free of charge at the place of dispatch.

#### **3.4.9 The following information shall be cast on each valve body:**

Manufacturer's name or trademark.

Size of valve

#### **3.4.10 TENDER PRICE:**

The tender price shall include all labour, material and machinery cost necessitated to be utilized for;

- a) Proper manufacturing of the valves.
- b) All tests required to be undertaken at manufacturer's premises.

- c) Transportation of the valves either by Rail and/or Road services with all the covers duly and appropriately insured.
- d) Delivery of specials with proper loading, unloading, stacking at site as indicated by Engineer-in-charge.
- e) The storage of all specials to be manufactured supplied and delivered under the scope of contracts as per Technical specifications.

#### **3.4.11 DELIVERY SCHEDULE:**

The delivery schedule shall be governed by clients' the Executive Engineer.

#### **3.4.12 MARKING**

The methods of marking all the valves 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 valves shall indicate the followings:

- i) Manufactures brand name and/or trademark.
- ii) Purchasers mark as "GIDC" be inscribed.
- iii) Diameter and class of valves.
- iv) Any other important matter that the manufacturer or owner deems fit to be inscribed.

#### **3.4.13 PACKING AND HANDLING:**

- > The materials shall always be packed separately and dispatched from manufacturers works with adequate protective measures to prevent damages/deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.
- > When the materials are transported at railway risk, special packing as per I RCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.
- > The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the site.

#### **3.4.14 MATERIALS AND WORKMANSHIP:**

- > General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process.

All the material shall be new and of high quality.

- > In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacturer.

#### **3.4.15 TEST CERTIFICATE:**

- > The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.
- > The supplier shall also produce in addition to manufacturer's test certificate, the inspection certificate issued by the authorized person/agency appointed by Engineer or Owner for the same purpose.

### **4.0 STORAGE AND HANDLING**

- 4.1** Materials shall be stored and handled in such a manner necessary to prevent their

damage and deterioration. The Contractor shall employ adequate means to safely handle pipes, access chambers and other materials.

**Stacking.** Stored materials shall be kept safe from damage and deterioration. The interior as well as all sealing surfaces of pipe and appurtenances shall be kept free from dirt and foreign matter per ANSI/AWWA C651. Pipe stored outdoors and expected to be exposed to direct sunlight for periods of one year or more after delivery shall be covered with canvas or other opaque material with provision for adequate air circulation. PVC pipe shall not be stored close to heat sources, such as heaters, boilers, steam lines, or engine exhaust.

When possible, pipe shall be stored in unit packages on flat surfaces to avoid bending. When unit packages are stacked, care shall be exercised to ensure that the weight of the upper units does not cause deformation to pipe in lower units. Unit packages shall be supported by racks to prevent damage or ending of the pipe.

When unit packages are stacked, care shall be exercised to ensure that the height of the stack does not result in instability that could cause stack collapse, pipe damage, or personal injury. Generally, stack height should not exceed 8 ft (2.4 m). Safe stack height will vary by unit package configuration.

Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

**Stringing.** In preparation for installation, distribution (stringing) of pipe and appurtenances shall be as close to the trench as practical and, if possible, on the opposite side from the excavated earth stockpile. Pipe shall be protected from traffic and secured to prevent rolling. Bell ends on pipe should be pointed in the direction of work progress. Caution shall be exercised to minimize the contamination of pipe interiors and joint components.

## **EXCAVATION**

### **General.**

Prior to excavation the Contractor shall note all existing surface features and locate all underground services.

### **5.2 Surface excavation.**

Surface material shall be carefully stripped and set aside. Where the material is to be re-used it is to be stacked separately.

### **5.3 Trenching/ Trench Construction**

Trenches shall be excavated to the lines and levels shown on the Drawings with allowance being made for bedding. The dimensions of the trench shall comply with the relevant Standard Drawing. The base of the excavated trench shall be trimmed neat and uniform for its full length. Boulders, roots and any other hard objects in the bottom of the trench shall be removed; soft areas in the bottom of the trench shall be taken out and filled to grade level with approved bedding material and compacted.

**5.3.1 Trench width.** The trench width at the ground surface may vary with the trench depth, the nature of soils encountered, existence of any pavement, and the proximity of adjacent structures. The minimum clear width of an unsupported or supported trench measured at the centerline of the pipe shall be at least 18 in. (450 mm) or the pipe outside diameter plus 16 in.(400 mm), whichever is greater.

**5.3.2 Trench depth.** The trench shall be excavated to the depth that permits pipe to be laid at the elevations shown on the engineering drawings or with the required depth of cover specified by the Client. The depth of cover shall be measured from the finished grade or the surface of the permanent improvement to the top of the pipe barrel.

**5.3.3 Preparation of trench bottom.** The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. Blocking shall not be used to change pipe grade or to intermittently support pipe across excavated sections. Bell holes at each joint shall be provided to permit the joint to be assembled and pipe to be supported properly.

**5.3.4 Rock conditions.** Ledge rock, boulders, cobbles, and large stones shall be removed to provide at least 4 in. (100 mm) of embedment cushion on each side of and below all pipe and appurtenances. The excavation shall be sufficiently wide to enable proper placement of the embedment specified by the Client. When excavation is completed, embedment material shall be placed, leveled, and compacted to provide a proper cushion for the pipe. Such embedment shall be granular material graded in particle size so that the embedment material supporting the pipe shall be retained in place under all conditions, including the rapid movement of water through the pipe embedment and the surrounding material.

**Previous excavations.** If the trench passes over a sewer or other previous excavation, the trench bottom shall (1) be compacted to provide support equal to that of the undisturbed native soil or (2) conform to specific regulatory requirements that preclude damage to the existing installed facility.

**Blasting.** Blasting for excavation shall be permitted only when specified by the engineer in charge and when proper precautions have been taken for the protection of persons and property. Hours permitted for blasting shall be in accordance with the direction of engineer in charge specifications. Damage caused by blasting shall be repaired by the constructor at no additional expense to the GIDC, unless otherwise specified. Blasting (if required) procedures shall conform to applicable laws, ordinances, and regulations imposed by federal, state, provincial, or local authorities.

**Unstable sub grade.** Where an unstable sub grade condition exists that, in the opinion of the Client or the Clients agent, cannot support the pipe, an alternative foundation shall be provided. At the discretion of the Client or the Engineer In Charge, an additional depth shall be excavated and refilled to pipe foundation grade with embedment material or special pipe foundation material in accordance with the direction of engineer in charge & specifications. Any part of the trench excavated below grade shall be backfilled to grade and compacted to the required density. Such embedment material shall have a gradation that inhibits migration of soil particles.

**Dewatering.** Where running or standing water occurs in the trench bottom or where the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps. The trench shall be kept free from water during installation operations by suitable means, such as well points or pervious under drain bedding, until the pipe has been installed and backfill placed and compacted to a sufficient height to prevent pipe flotation. A cover depth of 1.5 pipe diameters will normally prevent flotation. Soil migration in the pipe zone shall be prevented through the use of geotextile fabric or embedment material gradation.

**Excavated material.** Excavated material shall be placed in a manner that will not obstruct work or endanger personnel or the public. Excavated material shall not obstruct sidewalks or driveways for extended periods unless provided for in the contract documents. Hydrants under pressure, valve-pit covers, valve boxes, curb-stop boxes, fire and police call boxes, or other utility controls shall remain unobstructed and accessible. Gutters shall remain clear unless other satisfactory provisions have been made for street drainage. Natural water courses shall not be obstructed. Surplus excavated material shall be disposed of in a suitable manner or as provided in the specifications.

The Contractor will maintain all trenches in a safe condition for protection of people and property and will notify the relevant Government Department or Agency of any excavation over 1.5m deep and be responsible for carrying out the instructions of its officers.

## **6.0 BEDDING AND HAUNCHING**

Pipe bedding and Haunching material will depend on the type of pipe installed as shown in the Fig-1. It shall be either clean sharp sand or coarse aggregate, free from organic matter and clay lumps. Pipe bedding material shall also have a sand equivalent of at least 60.

### **6.1 Bedding.**

Bedding shall be compacted bedding material complying with relevant standard drawing.

### **6.2 Haunching.**

Haunching shall be material complying with the relevant Standard Drawing else where in the tender document. Material shall be well tamped to the satisfaction of Engineer-In charge.

### **6.3 Pipe Embedment**

Selection of the required laying condition and the method of embedment shall be made in accordance with the requirements specified by the engineer in charge. Common embedment types are shown in Figure 1, with the bedding constant (K) and typical soil modulus (E1) values associated with each. These values, along with other embedment design parameters specified by the Client/Consultant, should be used to calculate pipe deflection per the design information provided in ANSI/AWWA C900, ANSI/AWWA C905, and AWWA Manual M23. Embedment types other than those shown in Figure 1 may also be specified by the engineer in charge. The type of pipe embedment should be selected so as to prevent a vertical cross-section deflection of more than 5 percent. Embedment shall be selected and placed to prevent gouges, crimping, or puncture of pipe, joints, or appurtenances.

## **7.0 PIPE LAYING AND JOINTING**

### **7.1 Material Inspection**

Pipe and appurtenances shall be inspected for defects prior to installation in the trench. Unless otherwise specified by the engineer in charge, any defective, damaged, or unsound material shall be marked and held for inspection by the engineer in charge, who may prescribe corrective repairs or reject the material.

### **7.2 Precautions**

Proper equipment, tools, and facilities shall be provided and used by the constructor for the safe execution of work. All pipe and appurtenances shall be lowered carefully into the trench using suitable equipment and methods to prevent material damage or personnel injury. Under no circumstances shall pipe or appurtenances be rolled, dropped, or dumped into the trench.

### **7.3 Trench foundation.**

The trench foundation will be finished to the approval of Engineer-In charge prior to placing of the bedding material.

### **7.4 Pipe Laying**

**7.4.1 Pipe cleaning.** Before lowering the pipe into position in the trench, all dirt and foreign matter that cannot be removed by normal flushing shall be cleaned by mechanical means. The Client or Engineer - In charge shall determine when such mechanical cleaning is required. During laying operations, no debris, hand tools, clothing, or other materials shall be placed in the pipe. Pipe shall be kept clean during and after laying.

**Pipe placement** As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to required line and grade within tolerances specified in the specification. The pipe and joint shall be uniformly supported and secured in place with the specified embedment material. The pipe shall be laid with the bell end pointing in the direction of work progress.

**Interrupted operations.** When laying operations are interrupted or terminated at the end of a day, pipe ends shall be sealed temporarily to prevent the entry of water, debris, small animals, and similar types of contamination. Precautions shall be taken to prevent flotation of the sealed pipe during work stoppages.

### **7.5 Cutting and Jointing**

**7.5.1 Field cuts.** Circular saws, handsaws, or similar equipment may be used for cutting PVC pipe. When pipe is cut in the field, the cut shall provide a smooth end at a right angle to the longitudinal axis of the pipe. Pipe spigot ends shall be deburred, bevelled, and remarked with insertion line. For optimal performance, the length and angle of field bevels should match the factory bevels. To ensure the proper engagement of the sealing gasket with the PVC pipe spigot when connecting to certain shallow-depth bells, such as those on some cast-iron fittings and valves, the factory bevel shall be cut off to form a deburred, square-cut end with only a slight outer bevel.

**7.5.2 Joint preparation.** The sealing surface of the pipe spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets shall be cleaned immediately assembly. Factory-installed gaskets should not be removed for cleaning. The joint shall be free of dirt, sand, grit, grease, or any foreign material. When assembling gasketed joints, an approved lubricant shall be applied as specified by the pipe manufacturer. Damage to the gasket(s) may result from the use of improper lubricants. If joints are to be assembled in cold-weather conditions, factory installed gaskets may be removed and taken to a heated truck cab or shelter to restore the gasket's flexibility prior to joint assembly. Not all factory-installed gaskets are field removable. Gasket removal shall only be permitted with the consent of the pipe manufacturer.

**7.5.3 Types of gasketed joints.** Unless specified otherwise by the engineer in charge, all gasket joints shall be the push-on type. PVC pressure pipe shall be assembled using the following types of joints:

**7.5.3.1 Gasketed bell joint** Integral with the pipe or fitting shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, and ANSI/AWWA C907.

**7.5.3.2 Gasketed coupling.** A double-gasketed coupling shall be in accordance with ANSI/AWWA C900, ANSI/AWWA C905, ANSI/AWWA C907, and ANSI/AWWA C219.

**7.5.3.3 Mechanical joint** Any of several joint designs that have gaskets and bolts shall be manufactured in accordance with ANSI/AWWA C110/A21.10, ANSI/AWWA C111/A21.11, and ANSI/AWWA C153/A21.53.

**7.5.3.4 Joint assembly.** Joints shall be assembled under conditions that ensure clean mating and sealing surfaces by using proper equipment, materials, and procedures in accordance with recommendations published by the manufacturer.

**7.5.4** The integral bell gasketed joint and the gasketed coupling joint shall be assembled by positioning the elastomeric gasket in the annular groove of the bell or coupling (if the gasket is not preinstalled at the factory) and inserting the spigot end of the pipe into the bell or coupling. To assure compatibility, only gaskets supplied by the particular pipe and fittings manufacturer(s) shall be used in the pipes and fittings respectively. Gaskets and sealing surfaces shall be cleaned prior to lubrication and assembly. An approved lubricant shall be applied in accordance with the pipe manufacturer's published recommendations. Application of a non-approved lubricant or too much lubricant can result in a pipeline that is difficult to disinfect and may cause temporary taste or odor problems.

**7.5.5** The mechanical joint shall be assembled in accordance with the fittings manufacturer's published recommendations. Pipe spigot bevels may require shortening for use with mechanical joints or fitting joints.

#### **7.5.6 Cutting of pipes - Requirements**

Where pipes are cut the ends shall be left neat and regular.

### **8.0 BACK FILLING.**

Trench backfill above the pipe shall conform to the specifications. If specified, tracing wire or tape shall be placed immediately above the initial backfill material, directly over the pipe.

#### **Material.**

The initial backfill material immediately above the top of the pipe shall be free of refuse, cobbles, boulders, large rocks or stones, frozen soil, or other similarly unsuitable material. Sands or gravels or sand and gravel mixtures with fines of low plasticity obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75 mm.

8.1 When **imported or special backfill material** is not defined in the specifications or on the drawings, the excavated native soil may be used, provided that such material consists of loam, sand, clay, or other material that is considered suitable by the Engineer-In charge.

8.2 **Placement** After the embedment material has been placed in accordance with Figure 1, initial backfill material shall be placed to a depth of 6 to 12 in. (150 to 300mm) over the top of the pipe in a manner that will fill the remaining voids and avoid damage to the pipe.

8.4 **The balance of the backfill** shall contain no stones or rocks larger than 8 in. (200 mm), frozen material, or debris. Backfilling shall follow pipe-laying as closely as possible. In general, backfilling should be no further than 100 ft (30 m) behind pipe-laying. Backfill shall be mounded in unpaved areas to allow for future settlement.

8.5 **Compaction.** Unless otherwise specified, trenches under pavement, sidewalks, or roads shall be backfilled and compacted in layers to the density specified by the Client or to the density required by the appropriate government jurisdiction.

8.6 Unless otherwise specified by the Client, trenches in locations other than surfaced areas



shall be backfilled to the density of the adjacent soils.

- 8.7 **Additional backfill material** shall be supplied by the constructor if needed to backfill trenches completely or to fill depressions caused by subsequent settlement.

**8.8 Partial backfilling during testing:**

Newly installed pipelines are normally tested after backfilling. When Client specifications require that pressure and leakage testing be accomplished before completion of backfilling or with pipe joints exposed for examination, sufficient backfill material shall be placed over the pipe barrel between the joints to prevent movement, and due consideration shall be given to restraining thrust forces. In particular, pipes

**9.0 CONNECTION TO EXISTING FACILITIES.**

Connections to existing pipes and access chambers will be undertaken by the Local Authority at the contractor's cost unless otherwise noted on the Drawings. The Contractor shall be responsible for notifying Engineer-In Charge of the requirements for the connection to the existing service fourteen (14) days prior to the need for that connection.

**10.0 Pipe Bending**

If permitted in the specifications, PVC pressure pipe may accommodate longitudinal bending with the following limitations. The constructor shall block or brace pipe joints to ensure that bending of PVC pressure pipe does not result in axial deflection in the gasketed or mechanical joints that exceed the manufacturer's published limits. Excessive axial joint deflection may result in damaging stresses or leakage. The longitudinal bending in the PVC pipe barrel shall not result in a bending radius less than the minimum limits established in Table 1.

The bending of PVC pipe barrels larger than 12 in. (300 mm) nominal diameter is not recommended due to the forces required. The curved alignment of pipelines larger than nominal 12 in. (300 mm) in diameter shall be determined by the pipe manufacturer's published axial-joint-deflection limits or as otherwise specified by the engineer in charge.

Table 1 Allowable bending for PVC pressure pipe

Nominal Size In.(mm)	Minimum Bending Radius	
	ft	(M)
4(100)	100	(30.5)
6(150)	144	(43.9)
8 (200)	189	(57.6)
10(250)	231	(70.4)
12(300)	275	(83.8)

\*ANSI/AWWA C900 PVC pipe with cast iron (CI) outside diameters

**11.0 Storage and disposal of material.**

Excavated material is to be stored in a safe manner and in a location approved by Engineer-In charge. No excavated material will be placed against any fence or wall without the written consent of the owner and the approval of Engineer-In charge. Material will be placed a minimum of 1.0 m clear of the edge of the trench. Surplus material will be disposed of in locations approved by Engineer-In Charge.

**12.0 INSPECTIONS.**

- 12.1 Inspection of materials will be carried out at factory site by Inspecting agency to be fixed and authorized by Client/Consultant. The supplier on receipt of supply order from Client

shall intimate inspecting agency to carry out inspection as soon as material is ready.

- 12.2** The inspection call for Air valve should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.
- 12.3** For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled.
- 12.4** Inspection note issued by the inspection agency to supplier as well as consignee (Concerned Executive Engineer) of materials with inspection mark will be dispatched in stipulated in supply order and on receipt at site the verification will be carried out by concerned Deputy Executive Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Deputy Executive Engineer after verifying and satisfying the above requirements.

The Contractor shall ensure that inspections, by Engineer-In Charge, of the various stages of work are requested. Engineer-In charge may require the following inspections:

- a) Inspection of the site prior to commencing work.
- b) Completion of trench excavation prior to placement of bedding material.
- c) Completion of pipe laying prior to any backfilling.
- d) Stages of backfilling.
- e) Completion of excavation for access chamber bases.
- f) Completion of access chamber bases prior to rendering.
- g) Completion of access chambers.

Twenty-four (24) hours notice is required for any of the above inspections. Work shall not proceed unless each stage of work has been inspected and passed by Engineer-In Charge.

## **TESTING**

### **Cost of testing.**

All tests required by Engineer-In charge shall be at the Contractors cost.

### **13.2 Testing of Bedding, Haunching and Backfill Material.**

Engineer-In Charge may request a sample of bedding or backfill material to be taken and tested by a registered testing laboratory in order to determine whether the material complies with this specification. Any material which is found not to comply with the requirements shall not be used for bedding or backfill.

### **13.3 Pipeline Inspection**

The pipelines shall be inspected by means of a mirror and lamp to ensure there are no obstructions in the barrel and to ensure that pipes are laid straight.

### **13.4 Access Chamber Testing.**

Access chamber leakage tests may be required by Engineer-In charge at the Contractors cost. The access chamber entries and outlets shall be temporarily sealed and the access chamber filled with water. Any visible leakage or leakage which exceeds five liters in 24 hours will not be accepted.

#### **14.0 Hydrostatic Testing**

##### **14.1 General.**

To prevent pipe movement, sufficient backfill shall be placed prior to filling the pipe with water and field testing. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed but before placement of permanent surfacing. The contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

##### **14.2 Cross-connection control.**

When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the Client. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

##### **14.3 Procedure:**

The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired. If separate tests are made, the pressure test shall be performed first. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of all air. The specified test pressure shall be applied by means of and approved pumping assembly connected to the pipe in a manner satisfactory to the engineer in charge. The test pressure shall not exceed pipe or thrust-restraint design pressures. If necessary, the test pressure shall be maintained by additional pumping for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All visible leaks shall be stopped. All defective elements shall be repaired or removed and replaced and the test repeated until the allowable leakage requirements have been met.

##### **14.4 Test method.**

The contractor may perform simultaneous pressure and leakage tests or perform separate pressure and leakage tests on the installed system at test durations and pressures specified in Table 2. Tests shall be witnessed by the Client or the Engineer-In charge, and the equipment used for the test shall be subject to the approval of the Engineer-In charge.

##### **14.5 Allowable leakage.**

The contractor shall furnish the gauges and measuring device for the leakage test, pump, pipe, connections, and all other necessary apparatus, unless otherwise specified, and shall furnish the necessary assistance to conduct the test. The duration of each leakage test shall be 2 hours, unless otherwise specified. During the test, the pipeline shall be subjected to the pressure listed in Table 2. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi (34 kPa) of the specified leakage-test

pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if the leakage is greater than that determined by the formula:

$$L = NDSP 7400$$

Where:

L Allowable leakage, in gallons per hour

N Number of joints in the length of pipeline tested

D Nominal diameter of the pipe, in inches

P Average test pressure during the leakage test, in pounds per square inch (gauge) In metric units,

$$L_m = 130,400$$

Where;

$L_m$  allowable leakage, in litres per hour

N Number of joints in the length of pipeline tested

D = nominal diameter of the pipe, in millimeters

P = average test pressure during the leakage test, in kilovolts per ampere

#### 15.0 DEWATERING:

During the progress of drainage works, the Contractor shall provide for effective diversion and disposal of surface water and shall be responsible for all damage to any portion of the works or surrounding properties due to inadequate drainage diversion or de-watering equipment.

#### 16.0 LOCATION OF PIPES, PITS AND ACCESS CHAMBERS

All pipes, pits and access chambers shall be located as shown on the Drawings unless otherwise as per the instruction of Engineer-In charge.

TABLE - 2

System Test Methods

Procedure	Pressure	Duration of Test
Simultaneous Pressure and leakage Tests	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation!	2h
Separate Pressure Test	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation!	1h
Separate Leakage Test	150% of working pressure* of segment tested!	2h

\*Working pressure is defined as maximum anticipated sustained operating pressure.

In no case shall the test pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.

**17.0 Mode of Measurement and Payment: This item shall be measured for completed GSR number for 5,50,000 Litres capacity.**

#### PAYMENT SCHEDULE

(FOR RCC UNDERGROUND SUMP)			
Sr. No.	Description of Item	% of total cost to be paid on completion of these works	
		For raw water sump without top slab	For raw / pure water sump with top cover
1	On approval of the design	2%	2%
2	On completion of the excavation	3%	3%
3	On completion of the levelling course	10%	3%
4	On completion of the base slab	20%	15%
5	Vertical wall:		
5.1	Up to 1.5 mt height	15%	10%
5.2	Up to bottom of the roof slab	15%	10%
6	Supporting column		
6.1	Upto 1.5 mt height -	--	05%
6.2	Upto bottom of the roof slab	--	05%
7	Roof slab with beams	--	25%
8	Inside outside and ceiling plaster	10%	05%
9	Inside outside stair case & air vent	10%	02%
10	Hydraulic test	10%	10%
11	Miscellaneous item	05%	05%

Note:

% Total cost means cost quoted in Schedule-B

10% amount of bill to be recovered and kept in deposit till successful completion of defect and liability period.

I / We agree to abide by the above conditions fully.

#### Part 5: Pump Room

**Designing (Aesthetically) and constructing pump room with positive suction / negative Suction , without Gantry structure (upto 3.6m)**

**Note:-**

- 1. Minimum 15 % opening for ventilation should be provided**
- 2. pumping room rolling shutter, door and windows of aluminium section and window grill of iron should be provided ( including cost )**
- 3. Plinth level of pump house should be min 1 meter above GL**
- 4. Cost should not include foundation for Pumping machinery.**

The pump house and panel room shall have to be constructed above top slab of U/G Sump OR adjacent to U/G sump as directed and as per approved detailed drawing along with reinforcement as per drawing using TMT epoxy coated bars having Fe-500 grade and of having IS mark of approved brand, concrete grade M-250 (mix design to be carried out by agency and to be approved by the Engineer in charge), Minimum cement consumption should be 400 kg /cu.mt.

All materials as per standards of materials enclosed in the tender documents. Windows shall be of standard aluminum sections with sliding pattern and doors shall be flush door with standard make aluminum hinges, aldrops, handle, proper locking arrangement etc. as approved and directed by engineer in charge. The walls of pump house shall be plastered with 15 mm single coat for inside walls and with sand faced plaster in two coats for outside walls and painted in three coats with approved quality plastic emulsion paint for inside walls and with approved quality whether proof paint like Apex or equivalent for outside walls. Flooring of pump house shall be of avg. 25 mm thick polished quota stone of approved quality and laid on the cement mortar bed of avg. 20 mm thick in proper line, level and slope, as directed by engineer in charge. All necessary testing of soil for SBC / ABC shall have to be carried by the bidder and GIDC may cross check the same before approval of structural design.

All necessary arrangements, openings, gantry etc. for pumping machineries and pipes ( inlets & outlets), arrangement for panel boards, all required electric points, plugs incl. cost of concealed electric wiring etc. shall have to be provided as directed by engineer in charge based on requirements of M/E branch.

#### DESIGN CRITERIA & PARAMETERS

##### 1.1 Design Submissions

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted to Executive Engineer, GIDC, Mehsana. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

##### 1.2 Design Standards

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by Competent Authorities. In case of any variation or contradiction between the provisions of the I.S. Standards or Codes and the specifications given along with the submitted tender document, the provision given in this Specification shall be followed.

All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution:

IS:456 Code of Practice for plain and reinforced concrete

IS:875 Code of Practice for design loads for buildings and structures (Part 1 to 5)

IS:3370 Code of Practice for concrete structures for the storage of Liquids (Part I to IV)  
 IS:1893 Criteria for earthquake resistant design of structures  
 IS:2974 Code of Practice for design and construction of machine Foundations (Part 1 to 4)

All structural steel design shall generally conform to the following publications of the Indian Standards Institution:

IS : 800            Code of Practice for general construction in steel  
 IS : 806            Code of Practice for use of steel tubes in general building construction

### 1.3 Design Life

The design life of all structures and buildings shall be 60 years.

### 1.4 Design Loading

All buildings and structures shall be designed to resist the worst combination of the following loads / stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

#### 1.4.1 Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery.

The following minimum loads shall be considered in design of structures:

Weight of water	9.81 kN/m <sup>3</sup>
Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered.	20.00 kN/m <sup>3</sup>
Weight of plain concrete	24.00 kN/m <sup>3</sup>
Weight of reinforced concrete	25.00 kN/m <sup>3</sup>
Weight of brickwork (exclusive of plaster)	22.00 N/m <sup>2</sup> per mm thickness of brickwork
Weight of plaster to masonry surface	1 8.00 N/m <sup>2</sup> per mm thickness
Weight of granolithic terrazzo finish or rendering screed, etc.	24.00 N/m <sup>2</sup> per mm thickness

#### 1.4.2 Live Load

Live loads shall be in general as per I.S. 875. However, the following minimum loads shall be considered in the design of structures:

i)	Live load on roofs (accessible) (Non-accessible)	:	1.50 kN/m <sup>2</sup>  0.75 kN/m <sup>2</sup>
ii)	Live load on floors supporting Equipment such as pumps, blowers, Compressors, valves, etc.	:	10.00 kN/m <sup>2</sup>
iii)	Live load on all other floors  Walkways, stairways and platforms.	:	5.00 kN/m <sup>2</sup>

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of EXECUTIVE ENGINEER, GIDC, Mehsana prior to starting the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection / construction shall be considered and shall be partial or full whichever causes the most critical condition.

#### 1.4.3 Wind Load

Wind loads shall be as per I.S. 875.

#### 1.4.4 Earthquake Factor

This shall be computed as per I.S. 1893. An importance factor appropriate to the type of structure shall be considered for design of all the structures.

#### 1.4.4 Dynamic Load

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, traveling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

#### 1.5 Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in all walls, floors and roof slabs of water retaining structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2-m height. PVC water stops of 150 mm width shall be used for walls and 230 mm width for base slabs. Alternatively contractor can use G.I. Sheets of 18 gauge and 200 mm wide.

Expansion joints for non liquid retaining structures shall be provided as per IS 3414.

#### 1.6 Standards



Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender.

Where the relevant standard provides for the furnishing of a certificate to EXECUTIVE ENGINEER, GIDC, Mehsana at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to EXECUTIVE ENGINEER, GIDC,

Mehsana

The specifications, standards and codes listed below are considered to be part of this Bid specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between the Bid Specification and the Standards referred to herein, the Bid Specification shall govern.

a) Materials

IS : 269	Specification for 33 grade ordinary Portland cement Specification for coarse and fine aggregates from natural sources for
IS : 383	concrete
IS : 428	Specification for distemper, oil emulsion, color as required
IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2 )
IS : 455	Specification for Portland slag cement
IS : 458	Specification for precast concrete pipes(with and without reinforcement)
IS : 650	Specification for standard sand for testing of cement
IS : 651	Specification for salt glazed stoneware pipes and fittings
IS : 777	Specification for glazed earthenware tiles
IS : 808	Specification for dimensions for hot rolled steel beam, column, channel and angle sections
IS : 814	Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel
IS : 1003	Specification for timber paneled and glazed shutters(Parts 1 & 2)
IS : 1038	Specification for steel doors, windows and ventilators

IS : 1077	Specification for common burnt clay building bricks
IS : 1398	Specification for packing paper, water proof, bitumen laminated
IS : 1489	Specification for Portland pozzolana cement (Parts 1&2)
IS : 1566	Specification for hard drawn steel wire fabric for concrete Reinforcement
IS :1580	Specification for bituminous compounds for water proofing and caulking purposes
IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS : 1852	Specification for rolling and cutting tolerances for hot rolled steel Products
IS : 1948	Specification for aluminum doors, windows and ventilators
IS : 1977	Specification for structural steel (ordinary quality)
IS : 2062	Specification for steel for general structural purposes
IS : 2185	Specification for concrete masonry units (Parts 1 & 2)
IS : 2202	Specification for wooden flush door shutters (Parts 1 & 2)

b) Tests

IS : 516	Method of test for strength of concrete
IS : 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS: 1199	Methods of sampling and analysis of concrete
IS: 2386	Methods of test for aggregates for concrete(Parts 1 to 8)
IS: 2720	Methods of test for soils (Parts 1 to 39)
IS: 3025	Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 44)

IS:

3495 Method of test for burnt clay building bricks(Parts 1 to 4)

IS:

3613 Acceptance tests for wire flux combination for submerged arc

Welding

IS:

4020 Methods of tests for wooden flush doors Type tests

IS:

4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)

IS:

5807 Method of test for clear finishes for wooden furniture (Parts 1 to 6)

IS: Approval tests for welders when welding procedure approval is not 7318 required (Parts 1 and 2)

#### Codes of Practice

IS: 456 Code of practice for plain and reinforced concrete

IS: 783 Code of practice for laying of concrete pipes

IS: 800 Code of practice for general construction in steel

IS: 806 Code of practice for use of steel tubes in general building Construction

IS: 816 Code of practice for use of metal arc welding for general construction in mild steel

IS: 817 Code of practice for training and testing of metal arc welders

IS: 875 Code of practice for design loads (other than earthquake) for building structures (Parts 1 to 5)

IS: 1081 Code of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators

IS: 1172 Code of practice for basic requirements for water supply, drainage and sanitation

IS: 1477	Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
IS: 1597	Code of practice for construction of stone masonry (Parts 1 & 2)
IS: 1742	Code of practice for building drainage
IS: 1893	Criteria for earthquake resistant design of structures
IS: 2065	Code of practice for water supply in buildings
IS: 2212	Code of practice for brickwork
IS: 2338	Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
IS: 2394	Code of practice for application of lime plaster finish
IS: 2395	Code of practice for painting, concrete, masonry and plaster surfaces (Parts 1 & 2)
IS: 2470	Code of practice for installation of septic tanks (Parts 1 & 2)
IS: 2502	Code of practice for bending and fixing of bars for concrete Reinforcement
IS: 2571	Code of practice for laying in situ cement concrete flooring
IS: 2595	Code of practice for radiographic testing
IS: 2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
IS: 2974	Code of practice for design and construction of machine foundations (Parts 1 to 4)
IS: 3114	Code of practice for laying of Cast Iron pipes
IS: 3370	Code of practice for concrete structures for the storage of liquids (Parts 1 to 4)
IS: 3414	Code of practice for design and installation of joints in buildings
IS: 3558	Code of practice for use of immersion vibrators for consolidating Concrete
IS: 3658	Code of practice for liquid penetrate flaw detection
IS: 3935	Code of practice for composite construction

IS: 4000	Code of practice for High strength bolts in steel structures
IS: 4014	Code of practice for steel tubular scaffolding (Parts 1 & 2)
IS: 4111	Code of practice for ancillary structures in sewerage system (Parts 1 to 4)

IS: 13920	Code of practice for laying of glazed stoneware pipes
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IS: 4326	Code of practice for Earthquake Resistant Design and Construction of Buildings
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IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels
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IS: 5329	Code of practice for sanitary pipe work above ground for buildings
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IS: 5334	Code of practice for magnetic particle flaw detection of welds
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IS: 5822	Code of practice for laying of welded steel pipes for water supply
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IS: 7215	Tolerances for fabrication of steel structures
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Recommendations for metal arc welding of carbon and carbon IS: 9595 manganese steels

SI units and recommendations for the use of their multiples and of certain IS: 10005 other units

#### d) Construction Safety

IS : 3696	Safety code for scaffolds and ladder (Parts 1 & 2)
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IS : 3764	Safety code for Excavation work
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IS : 7205	Safety code for erection of structural steel work
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### 1.7 Orientation

The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipe work Underground services requiring to be relocated in order to accommodate the proposed site layout shall, with the approval of ENGINEER, be relocated by the Contractor.

### 1.8 Buildings and Structures

1.8.1 All the building and structure works shall generally comply with the following EXECUTIVE ENGINEER, GIDC, Mehsana requirements unless otherwise specified elsewhere.

1.8.2 All building works shall be of reinforced concrete framework.

1.8.3 All external walls shall be in 230 mm thick brick masonry built cement mortar in 1:4.

1.8.4 All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:4.

1.8.5 All internal masonry surfaces finish shall have 12 mm thick plain faced cement plaster in cement mortar (1:4) with neat lime or neeru finish on top. Over this, one coat of primer and two coats of plastic emulsion paint of approved quality and shade shall be provided.

1.8.6 All external masonry surfaces shall have 20 mm thick sand faced cement plaster in cement mortar (1:3) in two coats. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.

All external surfaces above ground level shall have one coat of primer and two coats of waterproof cement based paint of approved quality and shade. A coat of silicone water repellent paint shall also be applied thereon.

1.8.7 Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.

1.8.8 Toilet floor slab shall be filled with brickbat coba (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.

1.8.9 The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.

1.8.10 The flooring in all areas shall be in 600 mm x 450 mm x 20-mm thick polished kota stone placed in C.M. to give overall thickness of 50mm.

1.8.11 Toilet areas shall have 450 mm x 450 mm x 25 mm thick polished marble Kota stone tiles placed in cement mortar or lime mortar to give an overall thickness of 50 mm. 2200 mm high ceramic tile (size 200 mm x 200 mm x 6 mm thick) dado placed in cement mortar shall also be provided in these areas. In W.C. areas, the flooring and 2200 mm high dado shall be provided with 200 mm x 200 mm x 6 mm thick coloured ceramic tiles.

(i) The toilet facilities for pump house complex shall be separate.

1.8.12 All staircases shall have 25 mm thick chequered mosaic tiles for treads and 25 mm thick plain mosaic tiles of approved shade for risers set in cement mortar or lime mortar to give an overall thickness of 50 mm.

1.8.13 Stairways shall be provided to permit access between different levels within buildings. All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical ladders fitted with landing point extensions will be permitted where considered appropriate by the EXECUTIVE ENGINEER, GIDC, Mehsana to access areas not frequently visited.

1.8.14 All floor cut outs and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoor areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with M.S. hand railing of 32 NB (M).

1.8.15 All staircases shall be provided with 32 NB (M) galvanized M.S. pipe hand railing for protection.

1.8.16 The reinforced concrete roofs shall be made waterproof by application of an approved roof polythene / bitumen membrane. The finished roof surface shall have adequate slope to drain quickly the rainwater to R.W down take inlet points.

1.8.17 For roofing drainage, cast iron rainwater down takes with C.I. bell mouth and C.I. grating at top shall be provided. For roof areas up to 100 sq.m minimum two nos. 100 mm diameter down take pipes shall be provided. For every additional area of 100 sq.m or part thereof, at least one no. 100 mm dia. down take pipe shall be provided.

1.8.18 Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rain water. Chajjas, canopies and roof projections shall have drip moulds.

1.8.19 Building plinth shall be minimum 1000 mm above average finished ground level around building.

1.8.20 All doors, windows, rolling shutters shall have lintels above. Chajja protection to lintels on external walls shall be such as to prevent the rain water splashing into the building.

All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)

1.8.21 All concrete channels and ducts used for conveying liquid shall have inside finish of type F2. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with hand railings.

1.8.22 Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act.

1.8.23 All rooms in the buildings shall be provided with appropriate sign boards indicating the function of the rooms involved.

1.8.24 Wherever equipment and machinery are to be moved for inspection, servicing, replacement etc., suitable movable gantry in the form of EOT crane shall be provided. Minimum capacity of 5 tonnes or more as required shall be provided for monorail.

1.8.25 The design of buildings shall be suitable for the climatic conditions existing on site. Buildings shall as far as is possible permit the entry of natural light.

1.8.26 Emergency exit doorways with Signboards shall be provided from all buildings in order to comply with local and international regulations. Stairways and paved areas shall be provided at the exit points.

1.8.27 Toilet blocks in pump house buildings shall be provided with a sink with one drinking water taps of 15 mm size with adequate inlet and outlet connections.

The side walls of buildings shall, comprise at least 15% ventilated brickwork or louvers. Ventilated brickwork or louvers shall not be used where the ingress of driven rain could affect equipment or stored materials.

## 1.9 Roadways, & Pathways

A comprehensive network of roadways shall be provided around the structures to link in with the existing road network and permit access to the units for necessary maintenance, delivery of consumables and personnel access. All roads shall be of asphalt macadam and minimum 5 meters wide. Vehicular access shall be provided for all Plant structures and buildings. All roads shall be provided with drainage and shall be constructed to prevent standing water.

## 2. MODE OF MEASUREMENT & PAYMENT:

The contract rate shall be for a unit of one square meter.

### **Part 6 : Rising main pipe From Bore To GSR**

#### **Item No.01 :-**

**Excavation of pipe line trenches for water supply, sewerage line, manhole etc, all with shoring and strutting it required as per required gradient and line including safety provision using site rails and stacking excavated stuff up to all required lead cleaning the site etc complete for lifts and strata as specified**

#### **a) In all sorts of soil and soft murram**

**1 General:** Excavation for pipe line trenches to be carried out as per approved layout.

#### **2 Clearing the site**

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

2.2 The rate of site clearance is deemed to be included in the rate of earth work for which no extra will be paid.

#### **3 Setting out**

3.1 After clearing the site, the center lines will be given by the Engineer-in-charge. The



contractor shall assume full responsibility for alignment elevation and dimension of each and all parts of the tractor shall assume full responsibility for alignment elevation and dimension of each and all parts of the work. Contractor shall supply laborers materials etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

#### **4 Excavation**

4.1 The excavation in foundation shall be carried out in true line and level and shall have

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

#### **5 Disposal of excavated stuff:**

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

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

#### **6 Mode of measurement and payment:**

6.1 The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by Engineer-in-charge. No payment shall be made for surplus excavations made in excess of above requirements or due to slopping and sloping back as found necessary on account of conditions of soil and requirement of safety.

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

#### **Item No.02 :-**

**Providing and supplying D.I. K-7 grade pipes for following nominal bore diameters with internal cement mortar lining including all taxes , insurances , transportation, freight charges, octrol inspection charges, loading, unloading , conveyance to site , stacking etc. complete (IS - 8329/2000)**

[A] DUCTILE IRON PIPES:

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 Note: Wherever International Standards or Indian standards / specifications are mentioned, their equivalent or higher standards / specifications are also acceptable

##### **1.1 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.

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

#### **1.2 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.

#### **1.3 Length:**

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

#### **1.4 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

#### **1.5 EPDM Rubber Gasket:**

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

he 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

##### **1.5.1 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

#### 1.6 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	118	+1	-2.8
125	144	+1	-2.8
150	170	+1	-2.9
200	222	+1	-3
250	274	+1	-3.1
300 326 +1 -3.3	326	+1	-3.3

#### 1.7 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 in mm	Allowable Difference Between Minor Axis and DE in mm
80 to 300	1

#### 1.8 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
Wall thickness (e)	- (1.3 + 0.001 DN )1)
Flange thickness (b)	+ (2+0.05b) & - (2+0.05b)

#### 1.9 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. This is given below.

Nominal Pipe Size (mm )	Nominal lining thickness (mm)
Up to 300	3

#### 1.10 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 manufactures. 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 from every lot shall carry with them manufacturers test certificate for the following mechanical properties.

1. Hardness
2. Tensile strength
3. Compression set
4. Accelerated ageing 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.

#### 1.11 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 fail to pass the test, the lot shall be liable for rejection.

[d] For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in the standard for a period of minimum 15 seconds during which the pipes shall be struck moderately with a 700 g hammer for confirmation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

#### 1.12 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.

**INSPECTION:**

Inspection of pipes & specials will be carried out by Executive Engineer or his representative agency appointed by GIDC. All the expenditure for inspection shall be born by the Contractor except inspection charges if any, in case of inspection agency appointed by GIDC, shall be paid by GIDC. Make of pipe shall be as approved by engineer incharge.

**2.0 Payment:**

The Payment shall be paid on RMT basis. Item rate includes cost of DI socketed specials for the same like bends, tees, reducers or any other specials as per relevant IS suitable for use with DI Pipes.

**Item No.03 :-**

**Lowering/ Laying and jointing of D.I pipe of various classes with specials following diameters in proper position, grade and alignment as directed by Engineer In Charge including hydraulic testing etc.**

**GENERAL:**

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 levelled 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-incharge or mentioned in item of schedule B. The specification for titan joints i.e. Rubber Rings shall be as per details specification material section Item No-37.

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 levelled as required on the line, without any claim for extra cost whether it is required. 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 accumulated.

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.

DI specials shall be conforming to IS 9523-2000 and flanges shall be of PN-10 class.

#### **1.2 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 exceed the working pressure by 1.50 time of the highest pressure in the section hold for 24 hours. 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.

GIDC 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 opened 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.

#### **2.0 Payment:**

The Payment shall be paid on RMT basis. Item rate includes cost of DI socketed specials for the same like bends, tees, reducers or any other specials as per relevant IS suitable for use with DI Pipes.

**Item No.04 :-**

**Refilling the pipeline trenches including ramming, watering, consolidating disposing of surplus stuff as directed within the radius of 3 Km.**

**1.0 GENERAL**

The refilling will generally refer to refilling of trenches up to GL with excavated stuff or selected soil brought from outside if required.

**2.0 FILLING MATERIAL**

Filling materials may be either excavated stuff on the selected soil, if required, if excavated stuff in any section of pipe line is not suitable for refilling in the trenches as per the opinion of Engineer-in-charge, the contractor shall have to bring the material from outside without any extra cost.

**3.0 REFILLING**

The contractor shall do refilling in a systematic manner. Each layer of 15 cms thickness shall be well watered and compacted before the upper layer is laid, till the final level is reached to form a thoroughly compacted base. Trenches for line shall be back filled after the pipe line is laid and engineer in charge has permitted for filling. The refilling shall be done up to 30 cm above the pipe except the joint portion. The remaining portion of trench to be refilled after completion the hydraulic testing of pipe line. Refilling on top of pipe shall be carried out carefully with the excavated soft stuff. The filling shall be raised 250 mm above G.L for settlement. The contractor shall be fully responsible for any settlement after passing of time or during monsoon and the same shall be refilled with soil brought from outside if necessary without any extra cost. The process of refilling in 15 cm. Layers including watering, ramming etc. shall be carried out in such a way as not to damage the pipe line or foundation, footing, masonry already laid or built up. Surplus excavated stuff shall be disposed of within the estate. As directed by Engineer in charge.

**4.0 MODE OF MEASUREMENT AND PAYMENT:**

The rate shall be paid per cum. of refilled volume to original ground level. The measurement shall be worked out on the basis of quantity of excavation as per item of this tender less the volume of pipe line. The rate includes the loading, carting, unloading loads, ramming watering, consolidating, bringing selected materials brought from

outside if required. Payment of refilling shall be made on cu.m. basis after satisfactory testing of pipe line is given by contractor.

**Item No.05 :-**

**Providing & Supplying ISI mark CI D/F sluice valves as per IS 14846( Latest Edition) for following class and diameters including all taxes , insurances , transportation, freight charges, octrol inspection charges, loading, unloading , conveyance to site , stacking etc. complete PN-1 with hand wheel/ cap operated (PD type short body).**



## **SLUICE VALVE**

Sluice valve as per I.S: 780 & 2906/1984

### **1.0 GENERAL**

The contractor shall be covering manufacturing, supplying and delivery of:

Sluice valve conforming to IS: 2906-1984 & IS: 780-1984 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification

### **2.0 STANDARDS**

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

### **3.0 TEMPERATURE VARIATION**

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

### **4.0 MARKING**

The legible and in deniable marking upon each valve shall indicate the following:

- (1) ISI certification mark on each sluice valve only.
- (2) Manufacture's brand name and/or trade mark.
- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch
- (6) Where a valve has been tested for only open and test, it should be marked 'O' distinctly and permanently.
- (7) Any other important matter that the manufacturer deems fit to be inscribed embossed.

### **5.0 TEST CERTIFICATE**

5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

5.2 The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by EIC for the same purpose. The inspection charges of the authorized person/agency as fixed by EIC shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of EIC.

### **1.0 NOMINAL PRESSURE**

1.1 Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as “PN-II” ( Mpa= 10 kgf/m<sup>2</sup> approx)

1.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

**2.0 MATERIAL:**

2.1 The materials for the different component parts of the sluice valve shall confirm to requirements given in Table

Sr.No	Component	Material	Ref.to	Grade o f designatio
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				n
1	Body, bonnet wedge stuffing box, gland thrust plate, cap.	Grey cast iron	210-FG 1978(1)	
2	Steam	High tensile brass	320- 1962(2)	Ally 1 of 2
3	Wedge nut	Leadedt in bronze	318- 1962(3)	2
4	Body seat ring, wedge facing ring	Leadedt in bronze	318- 1962(3)	2
5	Bolts	Carbon steel	1367- 1967(4)	Class 4.6
6	Nuts	Carbon steel	1367- 1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712- 1971(5)	C
8	Gland packing	Jute & hemp	5414- 1969(6)	--

(1) Specification for grey iron castings (third revision).

(2) Specification for high tensile brass roads and sections (revised).

(3) Specification for leaded tin bronze ingots and casting (revised).

(4) Specification for technical supply condition threaded fasteners (first revision)

(5) Specification for compressed asbestos fiber jointing (first revision)

(6) Specification for glen packing, jute and hemp.

### **3.0 MANUFACTURE**

Sluice valve bodies for 150 mm size valves shall be provided with double flanged ends connection.

#### **4.0 FLANGES**

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538 (Part I to XXII) 1976 (Specification for cast Iron fittings for pressure pipes for water gas and sewage) or its latest revision.

### **3.0 MATERIALS**

#### **3.1 CAST IRON**

Cast Iron for bodies' pressure covers, splash covers, glands, caps, and joints support rings shall be best gray iron of selected grade, 20 of I-S-210-1978 specification for grey iron castings.

#### **3.2 GUN METAL**

Gunmetal shall be of mixture of 88% copper, 10% tin 2% Zinc having excellent hard wearing qualities, Ball guides of small orifice units and outlet bushes of large orifice valves shall be of gunmetal.

#### **3.3 FOREGED BROZNE**

Nipples, spindles shall be machined from rolled, extruded or forged high tensile brass or aluminum bronze. The produce shall possess much greater strength than ordinary cast product.

#### **3.4 MILD STEEL**

Bolts, nuts, flanges etc. shall be of mild steel unless otherwise specified and shall confirm to I.S. 226-1975 specification for structural steel.

#### **3.5 MATERIALS FOR BALLS**

The balls shall be of rubber covered and vulcanite covered. The rubber shall have a smooth and hard surface. It shall be as per I.S. 638-1965 specification for rubber and insertion jointing.

### **3.6 FLANGE JOINTING MATERIALS**

- The jointing material used between the flanges of components part of the valve shall be compressed fiberboard or rubber of thickness between 1.5 mm to 3 mm. The rubber shall be as per I.S. 683:1965 specifications for rubber and Insertion jointing. The fiberboard shall be impregnated with chemically natural mineral oil and shall have a smooth and hard surface.

### **4.0 DIMENSION**

Dimension of the Air valves shall be as per relative item mentioned in schedule B of the tender.

### **5.0 CHARACTERISTICS**

5.1 Small orifice valves shall have rubber covered balls and nipples of forged bronze or special alloy in to brass plug.

5.2 Large orifice valve shall have vulcanite-covered ball closing on rubber sealing backed with leather and gunmetal outlet bushes. They shall be screwed or flanged. The flanged shall be faces and drilled to I.S.S.

5.3 For sewage mains, the air valves shall be actuated by mild steel floats bronze spindles and shall be fitted with synthetic rubber seals.

5.4 Air valves shall be sound in all respect and uniformly forged so as to have uniform bore. They shall be free from any defects such as unwanted projection, holes or roughness and shall have inner and outer surface perfectly smooth.

### **6.0 COATING**

6.1 Immediately after casting and before machining, all cast iron parts shall be thoroughly cleaned and before rusting commences shall be coated by dipping in a bath containing a composition having a tar base.

6.2 The coating shall be such that it shall not impose any test of small to water. The coating shall be smoothing glossy and sufficiently hard. It shall not chip when scratched lightly with the point of penknife.

### **7.0 INSPECTION AND TESTING**

7.1 The engineer in charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials, which does not confirm to the specified requirements.

7.2 The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show to sign of leakage under these tests i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

### **8.0 MANUFACTURERS GUARANTEE**

8.1 The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

### **9.0 The following information shall be cast on each valve body:**

(a) Manufacturer's name or trademark.

(b) Size of valve

### **10.0 TENDER PRICE:**

The tender price shall include all labour, material and machinery cost necessitated to be utilized for;

- a) Proper manufacturing of the valves.
- b) All tests required to be undertaken at manufacturer's premises.
- c) Transportation of the valves either by Rail and/or Road services with all the covers duly and appropriately insured.
- d) Delivery of specials with proper loading, unloading, stacking at site as indicated by Engineer-in-charge.
  - Further towards proper discharge of all contractual obligations. The storage of all specials to be manufactured, supplied and delivered under the scope of contracts shall be in general be made as described in Technical specification document.
  - Cost of Required GI /CI air raises Flanged pipe (3.0 meter above GL) Foundation block and Column in CC M-150.

#### **11.0 DELIVERY SCHEDULE:**

The delivery schedule shall be governed by EIC

#### **12.0 MARKING**

The methods of marking all the valves 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 valves shall indicate the followings:

- i) Manufactures brand name and/or trademark.
- ii) Purchasers mark as "GIDC" is inscribed.
- iii) Diameter and class of valves.
- iv) Any other important matter that the manufacturer or purchase or deems fit to be inscribed.

#### **13.0 PACKING AND HANDLING:**

13.1 The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.

13.2 When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.

13.3 The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

#### **14.0 MATERIALS AND WORKMANSHIP:**

14.1 General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.

14.2 All the material shall be new and of high quality.

14.3 In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacturer.

#### **15.0 TEST CERTIFICATE:**

15.1 The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

15.2 The supplier shall also produce in addition to manufacturer's test certificate as mentioned in Para

7.1 above, the inspection certificate issued by the authorized person/agency appointed by Chief Officer for the same purpose.

## **16.0 INSPECTION**

This clause is applicable in general to all materials such as all types of valves, Pre-cast chambers, other specials and materials etc. which are to be supplied by the contractor. Inspection of materials will be carried out at factory site by Inspecting agency to be fixed and authorized by EIC. The supplier on receipt of supply order from EIC shall intimate inspecting agency to carry out inspection as soon as material is ready.

The inspection call for Air valve should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled. Manufacturer does not load material after sunset to avoid inadvertent dispatch of wrong material.

Inspection note issued by the inspection agency to supplier as well as consignee (EIC) materials with inspection mark will be dispatched to stores stipulated in supply order and on receipt at stores the verification will be carried out by concerned Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Engineer after verifying and satisfying the above requirements.

### **16.1 MODE OF MEASUREMENT AND PAYMENT**

Measurement shall be paid on number basis.

#### **Item No.06 :-**

**Providing & Supplying C.I temper proof Air Valve with SS 304 float gun metal-nozzle of approved make and quality fo class and diameter including all taxes, insurance, transportation, freight chages , octrol, inspection charges, loading, unloading, conveyancy , stacking etc. complete without isolating sluice valve (PN-1)**

This item shall be executed as per directions of Engineer incharge.

#### **Mode of Measurements & Payment:-**

This item shall be measured and paid in Number basis.

#### **Item No.07 :-**

**Providing & Supplying ISI mark CI D/F scour valve for diameters with internal cement mortar lining including all taxes , insurances , transportation, freight charges, octrol inspection charges, loading, unloading , conveyance to site , stacking etc. complete PN-1 with hand wheel/ cap operated (PD type short body)**

[A] SLUICE VALVES, BUTTERFLY VALVES, REFLUX VALVE, AIR VALVE, SCOUR VALVE

### **1.0 SUPPLY OF MATERIAL**

1.1 Cast iron double-flanged sluice valve/butterfly valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.

1.2 The sluice valve/butterfly valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.

1.3 The sluice valves/butterfly valves shall be operated before laying.

1.4 All grits and foreign materials shall be removed from the inside of the valves before placing.

1.5 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.

1.6 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

### **2.0 JOINTING MATERIAL**

2.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool etc.

2.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.

2.3 All jointing materials shall be not approved from the engineer-in-charge before use

2.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.

2.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.

### **3.0 INSTALLATION**

3.1 The sluice valve/butterfly valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.

3.2 If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.

3.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice/butterfly valve bore. It shall be even at both the inner and outer edges.

3.4 The flange faces thoroughly greased.

3.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.

3.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.

3.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.

3.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.

3.9 The sluice valve/butterfly valve shall be installed in such a way that its Spindle shall remain in truly vertical position.

3.10 The other end of tailpiece shall be fitted with pipes so that continuous lines can work.

3.11 Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

### **4.0 TESTING**

4.1 After installation of sluice valve/butterfly valve the same is tested to  $1\frac{1}{2}$  times of its test pressure.

4.2 The joints sluice valve/butterfly valve shall withstand the test pressure of pipelines.

4.3 Defects noticed during test and operation of sluice valve shall be rectified by the contractor at

his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

#### 5.0 MODE OF MEASUREMENT AND PAYMENT

The payment will be made on Number basis.