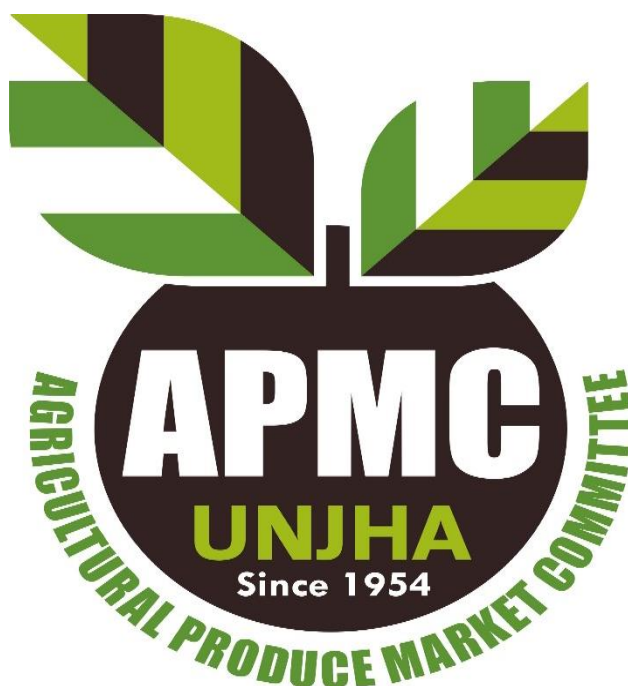


# **The Agricultural Produce Market Committee UNJHA**



## **UG & ESR SPECIFICATION**

### **NAME OF WORK:**

**Construction of New Sub Market yard at  
Brahmanwada R.S. NO-613 of A.P.M.C. Unjha. Under  
the scheme of AMI sub scheme of ISAM  
ESTIMATED COST PUT TO TENDER ₹. 627789022.10**

Chairman  
APMC  
Unjha

## 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 Chief Officer. 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 :

I.S. 456 Code of Practice for plain and reinforced concrete

I.S. 875 Code of Practice for design loads for buildings and structures  
(Part 1 to 5)

I.S. 3370 Code of Practice for concrete structures for the storage of liquids (Part I to IV)

I.S. 1893 Criteria for earthquake resistant design of structures

I.S. 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:

I.S. 800: Code of Practice for general construction in steel

I.S. 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 c	25.00 kN/m <sup>3</sup>
Weight of brickwork (exclusive of plaster)	22.00 N/m <sup>2</sup> per mm thickness Of

Weight of plaster to masonry surface	brickwork 18.00 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) : 1.50 kN/m<sup>2</sup>  
(Non-accessible) : 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 CHIEF OFFICER 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 Load

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.

#### 1.4.5 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 Design Conditions for Underground or Partly Underground Liquid Retaining Structures

All underground or partly underground liquid containing structures shall be designed for the following conditions :

- (i) liquid depth to be considered up to full height of wall and no relief due to soil pressure from other side to be considered.
- (ii) structure empty condition (i.e., empty of liquid, any material, etc.) : full earth pressure with saturation and surcharge pressure wherever applicable, to be considered.
- (iii) partition wall between dry sump and wet sump : to be designed for full liquid depth up to full height of wall.
- (iv) partition wall between two compartments : to be designed as one compartment empty and other full for both the directions.
- (v) structures shall be designed for uplift in empty conditions with no live load with the appropriate water table.
- (vi) walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilisation and dynamic water loads.
- (vii) Under ground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.

(viii) Soil bearing capacity is to be considered as per Actual SBC done by bidder with his own cost. However the same is to be ascertain by the agency by taking actual S.B.C at site & the design of SUMP etc. shall be designed accordingly.

### **1.7 Foundations**

(i) The minimum depth of foundations for all structures, equipment, buildings and frame foundations and load bearing walls shall be as per IS 1904.

(ii) Maximum safe bearing capacity of soil strata shall be taken as indicated in geotechnical reports.

(iii) Care shall be taken to avoid the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this Contract. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. No extra claims for such adjustments shall be accepted by Nagar Sevasadan.

(iv) Special attention is drawn to danger of uplift being caused by the ground water table. All underground structural slab wherever applicable shall be designed for uplift forces due to ground water pressure.

(v) Where there is level difference between the natural ground level & the foundations of structure or floor slabs, this difference shall be filled up in the following ways:

- In case of non-liquid retaining structures the natural top soil shall be removed till a firm strata is reached (minimum depth of soil removed shall be 500 mm.) and the level difference shall be made up by compacted backfill as per specifications. However the thickness of each layer shall not exceed 150 mm. The area of backfilling for floor slabs shall be confined to prevent soil from slipping out during compaction. The safe bearing capacity of this well compacted backfilled soil shall not exceed 100 kN/sq.m.

- In case of liquid retaining structures, the natural top soil shall be removed as described above and the level difference shall be made up with Plain Cement Concrete (1:5:10)

### **1.8 Design Requirements**

The following are the design requirements for all reinforced or plain concrete structures:

a) All binding and leveling concrete shall be a minimum 100 mm thick in concrete grade 1 : 3 : 6 .

b) All structural reinforced concrete for water retaining structures shall be of a minimum M30 grade with a maximum 20 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural members. For non water retaining structures the concrete shall be of M 25 grade. The structures shall have to be designed as per IS : 3370 (Part I-IV).

c) The reinforced concrete for water retaining structures shall have a minimum cement content of 360 kg/m<sup>3</sup> with a maximum 20 mm size aggregate and 330 kg/m<sup>3</sup> with a maximum 40 mm size aggregate as per IS : 3370 (Part I-IV).

d) The minimum reinforcement for water retaining structures in each direction should be 0.30% of cross section. (or actual as per design)The minimum clear cover to all reinforcement including stirrups and links shall be 25 mm for all water retaining structures.

e) All buildings shall have a minimum 1 metre wide, 100 mm thick plinth protection paving in M15 grade concrete or stone slabs/tiles. All plinth protection shall be supported on well compacted strata.

f) Any structure or pipeline crossing below roads shall be designed for Class A of IRC loading.

g) The bridges & bridge supporting structures shall be designed to safely withstand the loading.

h) All pipes & conduits laid below the structural plinth & road works shall be embedded in reinforced concrete of grade M15 of minimum thickness 150 mm.

i) Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure in the proportions specified by manufacturer or 2 % by weight of cement whichever is higher.

- The wall and floor panels shall be poured in sequential order with a minimum time gap of 4 days.

The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness:

Roof slab	100 mm
Bottom slab	200 mm
Roof Dome	100 mm
Container Dome	150 mm
Vertical wall including shaft wall	150 mm
Inclined wall or shall requiring shuttering of one side	170 mm
(i) Slope with horizontal more than 30°	150 mm
(ii) Do less than 30°	150 mm

### **1.9 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 CHIEF OFFICER, 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 CHIEF OFFICER

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

IS : 383 Specification for coarse and fine aggregates from

natural sources for concrete

IS : 428 Specification for distemper, oil emulsion, colour 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)

IS : 2645 Specification for integral cement water proofing compounds

IS : 2750 Specification for steel scaffoldings

IS : 2835 Specification for flat transparent sheet glass

IS : 3384 Specification for bitumen primer for use in waterproofing and damp roofing

IS : 3502 Specification for steel chequered plates

IS : 4021 Specification for timber door, window and ventilator frames

IS : 4350 Specification for concrete porous pipes for under drainage

IS : 4351 Specification for steel door frames

IS : 4990 Specification for plywood for concrete shuttering work

IS : 8112 Specification for 43 grade ordinary Portland cement

IS : 9862 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting

IS : 10262 Recommended guidelines for concrete mix design

IS : 12269 Specification for 53 grade ordinary Portland cement

IS : 12330 Specification for sulphate resisting Portland cement

IS : 12709 Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

**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 : 7318 Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)

**c) 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 (Parts1 & 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 penetrant 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

IS: 4326 Code of practice for Earthquake Resistant Design and Construction of Buildings

IS : 4353 Recommendations for submerged arc welding of mild steel and low alloy steels

IS : 5329 Code of practice for sanitary pipe work above ground for buildings

IS : 5334 Code of practice for magnetic particle flaw detection of welds

- IS : 5822 Code of practice for laying of welded steel pipes for water supply  
 IS : 7215 Tolerances for fabrication of steel structures  
 IS : 9595 Recommendations for metal arc welding of carbon and carbon manganese steels  
 IS : 10005 SI units and recommendations for the use of their multiples and of certain other units

**d) Construction Safety**

- IS : 3696 Safety code for scaffolds and ladder (Parts 1 & 2)  
 IS : 3764 Safety code for Excavation work  
 IS : 7205 Safety code for erection of structural steel work

**1.10 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 Chief Officer, be relocated by the Contractor.

**1.11 Buildings and Structures**

1.13.1 All the building and structure works shall generally comply with the following Chief Officer requirements unless otherwise specified elsewhere

1.13.2 All building works shall be of reinforced concrete framework.

1.13.3 All external walls shall be in 230 mm thick brick masonry built cement mortar in 1:6.

1.13.4 All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:6.

1.13.5 All internal masonry surfaces finish shall have 13 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.

1.13.6 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.

1.13.7 Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.

For pumping station foundation and plinth will be in Brick masonry in C.M. 1:4 and 600 mm wide where as all external wall for super structure will be 230 mm thick in Brick masonry in C.M. 1:6.

1.13.8 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.

1.13.9 The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.

1.13.10 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.

1.13.11 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 as per the drawing attached

1.13.12 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.

1.13.13 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 Chief Officer to access areas not frequently visited.

1.13.14 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).

1.13.15 All staircases shall be provided with 32 NB (M) galvanised M.S. pipe hand railing for protection.

1.13.16 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.

1.13.17 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.

1.13.18 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.

1.13.19 Building plinth shall be minimum 1000 mm above average finished ground level around building.

1.13.20 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.

1.13.21 All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)

1.13.22 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.

1.13.23 Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act.

1.13.24 All rooms in the buildings shall be provided with appropriate sign boards indicating the function of the rooms involved.

1.13.25 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.

1.13.26 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.

1.13.27 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.

1.13.28 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.

1.13.29 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.

## **1.12 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 metres 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.

## **1.13 Site Drainage**

The contractor shall provide a site drainage system which shall comprise of the Storm Water Drainage and Foul Drainage.

### **1.13.1 Storm Water Drainage**

Storm water drains adjacent to the existing and proposed roads (under this Contract) shall be sized for a rainfall intensity of 80 mm/hr, allowing for 100% runoff. Drains adjacent to roads shall be in brick masonry (1:5) of appropriate thickness, topped with 75 mm thick M 15 pre-cast concrete covers and plastered internally in cement mortar (1:4), 20 mm thick.

The storm water drainage system shall be designed to cater for the run-off from the structures, if necessary.

### **1.13.2 Foul Drainage**

The foul drainage system shall accept discharge from toilets, washrooms, offices and shall discharge to separate septic tank and further to a soak pit, both of appropriate volumes for individual buildings.

## **1.14 Cable and Pipe work Trenches**

Cable and pipe work trenches shall generally be constructed in reinforced concrete. However, 500 mm x 500 mm size or smaller trenches, not on fill may be constructed in 230 mm thick brick masonry (1:4). The trenches will be plastered internally with cement mortar (1:4) and externally in cement mortar (1:3).

Trenches within the buildings or Plant areas shall be covered with M.S chequered plates, suitably painted and those outside the buildings shall be covered with M20 precast R.C.C covers. The trenches



shall be suitably sloped to drain rainwater.

Layout of trenches outside the buildings shall allow space for construction of future trenches where necessary with due consideration for planning for future developments. This aspect shall be brought to the notice of Chief Officer while planning the works.

#### **GENERAL**

In the specifications, "as directed" / "Approved" shall be taken to mean 'as directed' / 'approved' by the Engineer-in-Charge.

Wherever a reference to any Indian Standard appears in the specifications, it shall be taken to mean as a reference to the latest edition of the same in force on the date of agreement.

Approval to the samples of various materials given by the Engineer-in-charge shall not absolve the contractor from the, responsibility of replacing defective material brought on site of materials used in the work found defective at a later date. The contractor shall have no claim to any payment of compensation whatsoever on account of any such materials being rejected by the Engineer-in-charge. The contract rate of the item of work shall be for the work completed in all respects.

No collection of materials shall be made before it is got approved from the Engineer-in-charge.

Collection of approved materials shall be done at site of work in a systematic manner. Materials shall be stored in such a manner as to prevent damage, deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work.

Materials, if and when rejected by the Engineer-in-charge, shall be immediately removed from the site of work.

No materials shall be stored before, during and after execution of structures in such a way as to cause or lead to damage of overloading of the various components of the structure.

All tools, templates, machinery and equipment for correct execution of the work as well as for checking lines, levels, alignment of the works during execution shall be kept in sufficient numbers and in good working condition on the site of the work.

The mode, procedure and manner of execution shall be such that it does not cause damage or over loading of the various components of the structure during execution of after completion of the structure.

Special modes of construction not adopted in general Engineering practice, if proposed to be adopted by the Contractor shall be considered only if the contractor provides satisfactory evidence that such special mode of construction is safe, sound and helps in speedy construction and completion of work to the required strength and quality.

Acceptance of the same by the Engineer-in-charge shall not, however, absolve the contractor of the responsibility of any adverse effects and consequences of adopting the same in the course of execution of completion of the work.

All installations pertaining to water supply and fixtures thereof as well as drainage lines and sanitary fittings shall be deemed to be completed only after giving satisfactory tests by the Contractor.

The contractor shall be responsible for observing the rules and regulation imposed under "Minor Minerals Act", and such other laws and rules prescribed by Government from time to time.

All necessary safety measures and precaution (including those laid down in the various relevant India Standards) shall be taken to ensure the safety of men, materials and machinery on the works as also of the work itself.

The testing charges of all materials shall be borne by the Contractor.

Approval to any of the executed items for the work does not in any way relieve the contractor of his responsibility for the correctness, soundness and strength of the structure as per the drawings and specification.

#### **T.S.I. CLEARING OF SITE:**

Before starting the work the site shall be cleared of all shrubs, grass and other vegetation including large and small bushes, all stumps removal of roots cutting and disposal of small trees upto 300mm girth etc. (The girth shall be measured at a height of 1.5 meters above ground level).

The site to be cleared shall consist of the entire area required to be cut down to accommodate the reservoir.

The bidder shall make themselves familiar with the local rules and regulation and/ or those governing the land clearance, industry special requirements of forest areas wherever applicable and the work shall be carried out in strict accordance there with.

#### **T.S.2 EXCAVATION:**

The side slopes of the cutting shall generally have the following slopes for stability:

- (A) 1:1 slope for excavation in earth, murrum boulders etc.
- (B) 0.5:1 slope for excavation in hard murrum and soft rock.

(C) 0.25: 1 slope for excavation in hard rock. If however, the strata met with can sustain safely steeper slopes than those mentioned above, such steeper slopes may be permitted with the prior written permission of the Engineer in charge of the work

#### **Dewatering or pumping:**

If pumping or draining of water is required to be done at any time during excavation, the bidder shall arrange for such draining by excavating channels, pumping or otherwise and shall maintain such arrangements to the satisfaction of the dewatering pumps shall be conveyed. The discharge of the dewatering pumps shall be conveyed either to drains and shall not be allowed to be spread in the vicinity of work site. All cost for such arrangements including pumping shall be borne by the bidder and no extra payment shall be admissible for such operation.

#### **Shoring:**

Open cuttings shall be suitable shored sheeted and braced. If required by the Engineer or by site conditions or to meet local laws for protecting life property of the work. Adequate shoring and strutting shall be provided by the bidder at their own cost. Wrapped or deformed timber shall not be used. The shoring shall project at least 150mm above ground level and shall extend to a suitable depth below the bottom. Wherever necessary the planks or struts shall be driven by compressed air pile drivers. The planks shall be fixed close enough to avoid any running in of sand or earth through the joints.

The shoring materials shall not be of sizes less than those specified below unless steel sheet piling is used or unless approved by the Engineer in writing.

- (A) Planks 5 cm thick
- (B) Walling pieces 10 cm × 20 cm
- (C) Struts 15 cm × 20 cm

For walling pieces round timber shall not be allowed. In a vertical plane, there shall be at least three struts or more as directed by the Engineer. They shall rest on walling pieces. The spacing of the struts shall be as per the requirements. At the bottom extra struts shall have to be provided if ordered by the Engineer.

The excavated material shall be transported by the contractors and stacked and / or spreaded at suitable places **within the lead of 500m** as directed by the Engineer. The stacks shall be made outside the area of excavation and shall not endanger the work in any way and shall avoid the obstruction to footpaths, road, driveways, hydrants access, the properties and work sites. gutter shall be kept clear, natural water course shall not be obstructed. Separate stacks shall be formed for (a) rubble considered suitable for masonry work or road work (b) rubble of inferior quality and boulders (c) soft rock, earth murrum (d) rock spoils up to 150mm size.

#### **T.S.3. CONCRETE: -**

##### **Cement :**

Cement shall be in respect of the sulfate, chloride, salinity met with soil and required quality of cement shall be supplied and used by the bidder. The cement shall be stored in weatherproof godown in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter. The weather proof go-down shall have a solid impervious floor raised 300mm above the general ground level so that the cement stored there on shall not come in direct contact with subsoil moisture. The passages and the general construction shall be such that it affords full protection from weather effects.

##### **Aggregates :**

All the aggregates shall confirm to the latest I.S. 383 – 1970 coarse and fine aggregate from natural sources for concrete or I.S. 5159-1959 natural and manufactured aggregates shall consist of naturally occurring sand and gravel or stones crushed or uncrushed or combination thereof. They are classified broadly under two-category Vis.

- (1) Sand or fine aggregates and
  - (2) Coarse aggregate depending upon their sizes. The fine aggregates are those which pass through I.S. sieve No. 480 and the coarse aggregates are those which are retained on I.S. Sieve No. 480. The aggregate both fine and coarse shall be hard strong durable clean free from veins and adherent coatings. The use of flaky and elongated pieces of aggregates shall be prohibited.
- The aggregates shall not contain deleterious materials such as iron pyrite, coal, alkali, soft fragments sea shells organic impurities etc. in such quantity as to effect the strength or durability of concrete or the reinforcement embedded in such reinforced concrete.

The maximum quantities of deleterious materials that may be permitted shall confirm to the following limits by weight.

Deleterious	Fine Aggregates Substances. By weight (Max).	Coarse Aggregate (%) (%) by weight
(1)	(2) (3)	(4) (5)

(1) Coal and lignite	1.00	1.00	1.00	1.00
(2) Clay lumps.	1.00	1.00	1.00	1.00
(3) Soft fragments		-	3.00	-
(4) Material passing Through 75 micron sieve	3.00	3.00	3.00	3.00
(5) Shale	1.00	-	-	-

The total of various deleterious materials occurring in any sample, in no case exceed 5%.

Sampling and testing of aggregates shall be carried out in accordance with the requirement of the appropriate section of I.S. 2386. Methods of test for aggregate for concrete. The tenderers shall satisfy the Engineer that the aggregate to be supplied shall not give rise to an alkali reaction with the cement. If the aggregate supplied is not clean, it shall be washed. It is not properly graded, it shall be various sizes proportioned to get the required grading. Storing of aggregates on dusty, muddy, and grassy spots shall be avoided. They shall be stored on the works in such manner as to prevent intrusion of foreign matter, and shall be protected from exposure to dust. They shall be placed in stock piles in individual units of suitable sizes and in suitable layers to prevent aggregation. They shall not be allowed to run down slopes.

**(1) Sand or fine aggregates:**

All fine aggregates shall consist of clean, hard, strong, durable uncoated, siliceous gritty material well graded particles obtained from the rock fragment, it shall be free from clay, clumps injurious amount of dust, mica shell, soft or flaky particles, shale alkali organic matter, loam or other deleterious substances.

The sand shall be taken from a source approved by the Engineer. The sand or fine aggregate shall confirm to the latest I.S. No. 388-1970. "Coarse and fine aggregate from natural sources for concrete". If the Engineer considers it necessary it shall be washed and/or screened before use at the expenses of the contractors. The sand shall have a fineness modulus of not less than 2.5 and not more than 3.00 and the grading shall conform as far as possible to the following analysis

I.S Sieve No.	Percent Natural Sand or crushed Gravel	Passing crushed stone
4.75mm	95-100	90-100
2.36mm	70-95	60-90
1.18mm	45-85	40-80
600micron	25-60	20-50
300micron	5-30	5-30
250micron	0-10	0-15

The specific gravity of sand shall not be less than 2.6. In no case shall fine aggregate be accepted containing more than 2% by dry weight not more than 3.5% by dry volume, not more than 5% by wet volume of clay, loam or silt. If any samples of fine aggregate shows, more than 5% of clay, loam silt in one hour's settlement after shaking in an excess of water the material represented by the sample shall be rejected.

The following two fields tests are recommended for ascertaining the percentage of clay lumps and impervious organic material, and the contractors shall carry out the same, of the Engineer deems fit.

**Test for determining silt in sand:**

Fill a calibrated tumbler with sand to be tested to half its volume and added water there to until the tumbler is three quarter full. Shake up the mixture vigorously and allow it to settle for about an hour. The volume of silt visible on top of the sand shall be measured. If the volume of the silt standing over the sand exceeds 5% of total volume of sand the sand shall be rejected.

**(2) Calorimetric test for organic impurities:**

The sample of sand shall be mixed with equal volume of 3% solution (about 30gms in a liter of water) of caustic soda sodium hydroxide taken in a plain glass and the mixture shall be allowed to stand for 24 hours.

The liquid standing above the sand shall not be darker than light shade (Pale yellow) color is marked yellow or brown the test would indicate presence of organic material in excessive amount.

In case suitable sand is not available in adequate quantities with in a reasonable and economical limit the contractors may be allowed to use of crushed or pulverized stone or gravel either alone or mixed with natural sand in parts. The stone or gravel shall be clean sharp and free from dust etc. and shall confirm to the latest I.S. 383. The percentage of crushed stone to be mixed with sand shall be such as

to obtain the fineness modulus of the blended sand within the limit specified above, and / or as approved by the Engineer after laboratory tests.

**(ii) Coarse Aggregates:**

All coarse aggregates used in concrete works shall consist of crushed rock, gravel or other approved inert material. Broken or crushed rock from sound blue basalt or black trap free from zeolite or other common impurities shall be used in the concrete as coarse aggregate. The particles of aggregates shall be clean, hard, tough, and durable free from deleterious substances and shall not contain soft, flat or elongated pieces. The coarse aggregate shall have specific gravity not less than 2.6 and the water absorption measured after being immersed for 24 hours in water shall not be more than 5% by weight. The maximum of deleterious materials in the coarse aggregate shall not exceed 5% by weight in the aggregate when tested in conformity with I.S. No.383. 1970. Coarse fine aggregate from natural sources for concrete.

The nominal size of the coarse aggregate for reinforced concrete work shall be 20mm. Larger coarse aggregate upto 40mm. size may be used if approved by the Engineer in plain concrete work. The maximum size of coarse aggregate shall be as large as possible within the limits specified but in no case shall be greater than one quarter of the minimum thickness of the member, provided that the concrete can be placed in the form work without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form work. The minimum size of coarse aggregate shall be as mentioned (90%-95% maximum) on I.S. Sieve No. 480.

The aggregate shall be screened and, if necessary blended to give the required grading when testing in the laboratory at contractors cost by means of standard mesh Sieves, the grading shall fall within the following limits.

Sieve Size	Percentage Plain C.C	Retained by wt. R.C.C.
40mm	-----	-----
25mm	10 to 15	-----
20mm	35 to 40	5 to 10
10mm	75 to 80	100 to 80
4.75mm	90 to 100	100 to 95

The percentage given above are only for guidance and the Engineer reserves the right to modify the same to any other lower or higher value if considered necessary by him, in consonance with the requirements of the work.

In the event of the undesirable segregation occurring in coarse aggregates in two or more suitable fractions as directed by the Engineer who shall set up such as to give a dense, water-tight concrete of specified proportion and strength and required consistency.

The Engineer shall have the right and authority to carry out routine control tests and analysis of the broken rock at any stage of the work processing and / or concreting operations and the contractors shall give all necessary facilities in respect of such testing. The sampling and testing shall be carried out as per standard I.S practices at the entire cost of the contractor.

**3.3 Water**

The water used for the preparation of concrete, for washing sand etc. and for curing shall be clean and free from objectionable quantities of silt, organic material, acid, alkali, salts, oil and other deleterious impurities and it shall be obtained from the sources approved by the Engineer. Potable water shall be generally be acceptable. The quantity of water to be added for making concrete shall be properly measured and controlled. Suitable water cement ratio for the different mixes and uses shall be determined in consultation with Engineer and shall generally not be exceeding 0.5 the exact value being fixed after taking account all relevant factors such as strength required, weather condition, water absorbed by material, workability and slump required consistent with the work requirements, methods of compacting etc. 0.5% of the tender cost will be charged for supplying water to use in construction shall be charged and also Rupees 5 per 1000 litres will be charged for the water to be used for testing of water retaining structures.

**3.4. Cement Concrete (Plain or reinforce) (ordinary):**

All cement concrete whether used in R.C.C work or plain concrete work shall be designated in grades (by the strength it acquires at the age of 28 days M. 100M – 150, M – 200 and M-250 where refers to the mix and the number 100, 150, 200 and 250 represent the specified 28 days workable compressive strength of the mix under reference, expressed in Kg./Sq. cm. The cement concrete to be used in the construction of works covered under this specification can be broadly classified as

(i) Ordinary concrete and (ii) controlled concrete.

The concrete to be used in the structural work of the reservoir or any part of water retaining structures viz. the roof slab, side walls and divide wall, columns, column footings and the top layer of the reservoir floor and partition walls in each compartment, control room substation shall be controlled concrete while that used in the structural work of appurtenant structures, viz. the stair cases outside the reservoir, etc. mass concrete working anchor blocks, thrust blocks, concrete to be used in the leveling courses or foundation concrete etc. shall be ordinary concrete. All cement concrete to be used in the work shall confirm to be used in the leveling courses or foundations concrete etc. shall be ordinary concrete.

All cement concrete to be used in the work shall confirm to the requirements of latest I.S. 456-1978 code of practice for plain and reinforced concrete, Cement concrete used in any water retaining structure shall in addition to I.S 456 – confirm to I.S. 3370 – code of practice for concrete structures for storage of liquids.

(Part I & II (1963) or latest

(Part III&IV (1967) or latest

Though the use of controlled concrete is specified for the construction of the reservoir proper control room and substation it may be extended to other parts of the work covered by this contract if so directed by the Engineer.

In the concrete used in water retaining structure, the minimum quantity of cement used be 330 / Kg./M<sup>3</sup> of the concrete produced.

**(i) Ordinary cement concrete:**

Ordinary cement concrete is that cement concrete which is not required to be designed by preliminary test and is produced by mixing the various ingredients of concrete designated below shall generally consist of quantities as given in the table below per bag of cement.

3.4.1 Table 1 : Concrete mix proportions for ordinary concrete

Grade of (fine and coarse)	Total quantity of dry aggregate by volume per 50Kg. cement	Quantity of water / Concrete
	(Max. in liters)	(Max. in liters)
M. 100	300	34
M. 150	220	32
M. 200	160	30
M. 250	100	27

The proportion of fine aggregate to coarse aggregate for the various mixers listed above shall generally be 1:2 by volume but variation from 1:1.5 to 1:3 depending upon the grading of the aggregates may be permitted by the Engineer, the total quantity of fine and coarse aggregates, however shall not in any case exceed the quantity in the above table 1. For the purpose of this tender the ordinary concrete specified by strengths as m100, m150, m200, shall be considered to be equivalent to nominal mixes specified as 1:3:6, 1:2:4 and 1:1.5:3 respectively, and any mention to these mixes under one system of nomenclature the strength requirements for 28 days and 7 days test under both the system of nomenclature shall be in conformity with those in table (2) & (3) given here in after. The cement concrete shall be tested for compressive strength at the age of 28 days on 15 cm. cubes in accordance with the latest I.S. 516 – 1959.

Methods of test for strength of concrete and the strengths developed for all types of concrete shall not be less than those given in table – 2.

3.4.2 Table 2 : Strength requirement of concrete :

Grade of concrete	Minimum compressive strength of 15cm. Cubes at 28 days, in 1 Kgs/cm <sup>2</sup> .	
	Preliminary test:	Works test
M 100	135	100
M 150	200	150
M 200	260	200

For quick results, the contractors shall carry out compression tests on representative 15cm cubes cast in accordance with relevant I.S. at 7 days in addition to the normal 28 days compressive strength. The 7 days strength of the various concrete mixes shall not be less than the values given in the Table No.3 below.

However the 28 days compressive strength along shall be the criterion for acceptance or rejection of the concrete, unless the Engineer is satisfied of the relation between the 7 days compressive strength and the 28days compressive strength, established by carrying out a number of tests in which case he may relax the test frequency of 28 days compressive strength specified here in after.

3.4.3 Table 3 : Optional works test requirements of concrete:

Grade of concrete	Minimum compressive strength of 15cm. Cubes at 7 days, in kgs/cm <sup>2</sup> .
M 100	70
M 150	100
M 200	135
M 250	170

All test strength specified above are exclusively for 15cm. size cubes & they shall be adequately modified to suit the requirement of 15cm. dia. and 30cm. long cylinder, the strength values obtained should be multiplied by 1.25 to obtain the equivalent cube strength.

### 3.5. Controlled concrete :

Controlled concrete when used in plain and reinforced concrete structure shall be in grades M100, M150, M200, M250, M300 and M400. In controlled concrete the determination of the proportions of cement, aggregate and water to attain the required strength shall be made with the preliminary test by designing the concrete mix.

The concrete mix shall be designed to have an average strength corresponding to the values specified for preliminary tests in Table – 4. 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 50kg of cement shall not exceed 450kg except where otherwise specifically permitted by the Engineer.

Except where it can be shown to the satisfaction of the Engineer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate in different sizes and blending them in the right proportions 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 material should of coarse and fine aggregate should be checked as frequently as possible, the frequency for a given job of being determined by the Engineer, to ensure that the suppliers are maintaining the grading uniform with that of the samples used in the preliminary tests.

In proportioning concrete, the quantity of both cement and aggregate should be determined by weights. Where the weight of cement is determined by accepting the maker's weight per bag, reasonable number of bags should be weighted separately to check the net weight where the cement is weighed on

The site and not in the bags it should be weighed separately from the aggregate. Water should be either measured by volume in calibrated tanks or weighed. All measuring equipment should be maintained in a clean serviceable condition, 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 according to weather conditions. The amount of the added water should be adjusted to compensate for any observed variation in the aggregate, IS:2386 – (Part.III) 1963 Methods of tests for aggregates 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 moisture content, suitable adjustment in the weight of aggregate should also be made.

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

Workability of the concrete should be checked at frequent intervals. The slump test, or where facilities exist, the compacting factor test in accordance with I.S. : 1199 –1959 Method of sampling and analysis of concrete may be adopted for this purpose.

A competent person should be employed whose first duty will be to supervise all stages in the preparation and placing of the concrete. All works test specimens should be made and site test carried out under his direct supervision in order to get a relatively quicker idea of the quality of concrete or compressive strength test at 7 days may be carried out in addition to 28 days compressive strength test. In all cases the 28 days compressive strength specified in table –4 should alone be the criterion for the acceptance or rejection of the concrete. If however, from tests carried in a particular job over a reasonably long period it has been established to the satisfaction of the Engineer that a suitable ratio between 28 days compressive strength and compressive strength at 7 days may be accepted, the Engineer may suitably relax the frequency of 28 days compressive strength test specified in table – 8, provided the expected strength values at the specified early age are consistently met. For this purpose the value given in table – 5 may taken for general guidance in the case of concrete made of ordinary

cement. For detailed specification regarding preliminary and work test relevant paragraphs are reproduced from I.S: 1199 – 1959. Method of tests for strength of concrete and I.S. 516 – 1959 Methods as sampling and analysis of concrete as given below.

Table – 4 :Strength requirements of concrete :(All values in kg./cm<sup>2</sup>)

Grade of concrete	Compressive strength of 15 cm cubes at 28 days	
	After mixing in accordance with	
	I.S. : 516 – 1959	
	Preliminary Test	Works test
	Min.	Min.
M 100	135	100
M 150	200	150
M 200	260	200
M 250	320	250
M 300	380	300
M 350	440	350
M 400	500	400

**Note:**

**1(A) Preliminary test:**

A test conducted in a laboratory on the trial mix concrete produced in the laboratory with the object of:

- (1) Designing a concrete mix before the actual concreting operation start.
- (2) Determining the adjustment required in the design mix when there is a change in the materials used during the execution of work or
- (3) Verifying the strength of concrete mix.

**(B) Work Test:**

A test conducted either in the field or in a laboratory on the specimens made on the works out of the concrete being used on the works.

**Note:**

**(A) size of cubes :**

In the works test with the approval of the Engineer 10cm cubes may be used in place of 15cm cubes provided the maximum nominal size of aggregate does not exceed 20mm. Even the use of 15cm cubes should normally be restricted to concrete having a maximum nominal size of aggregate not exceeding 40mm where concrete with aggregate larger than 40mm is required to be tested, the size of cubes should be specified by the Engineer keeping in view that generally the length of side of the cubes should be about four times the maximum nominal size of aggregate in the concrete constituting the cube specimen.

**(B) strength in relation to size of the cubes :**

Where 10cm cubes are used the values obtained from tests on 10cm cube shall be reduced to the extent established by comparative preliminary tests, with 10 & 15 cm cubes in the absence of such comparative tests by 10% of the value determined from the test, in order to give the equivalent strength for 15 cm cubes where cubes larger than 15 cm are adopted, generally no modification is necessary unless otherwise specified by the Engineer.

**Note 3 : Cylinder Strength Test**

Comparative strength tests may, with the approval of the Engineer be conducted on 15cm diameter and 30cm high cylinders in accordance with I.S 516-1959 instead on cubes. Where cylinder strength modified according to the formula.

Minimum cylinder compressive strength required = 0.8 compressive strength specified for 15 cm cubes.

The central Road Research Institute, New Delhi has carried tests with a view to establishing a relation between water – cement ratio and the compressive strength of concrete using ordinary Portland cements manufactured in the country in accordance with I.S.: 269-1976 ordinary and Low Heat Portland cement.

As a result of these, it has been considered advisable to give graphs showing the relationships between the compressive strength of the concrete mixes with different water cement ratios and the seven days compressive strength of cement tested in accordance with I.S.:269 – 1976. The Road Research Institute graphs (design curves) may be referred. As they would be of some assistance in obtaining the water-cement ratio for trial mixes of concrete.

**3.5.2 Table–5 optional works test requirements of concrete:**

(All values in kg/cm<sup>2</sup>)

(All test conducted in accordance with I.S. 516-1959)

Grade of Concrete	Compressive strength on 15 cm cubes Min at 7 days	Module of rupture by beams test Min. at 72 + 2 Hr.                      At 7 days.	
(1)	(2)	(3)	(4)
M 100	70	12	17
M 150	100	15	21
M 200	135	17	24
M 250	170	19	27
M 300	200	21	30
M 350	235	23	32
M 400	270	25	34

Note : Notes 2 & 3 under Table – 4 are also applicable to Table 5

**Table 6 Concrete Mix proportions:**

Grade of concrete	Total quantity of dry aggregates by volumes per 50kg. of cement to be taken as the sum of the individual volumes of fine and coarse aggregates Max.	Proportion of fine aggregate to coarse aggregates	Quality of water per 50kg of cement max.
	Liters		Liters
M 100	300	Generally 1:2 for fine aggregate to coarse aggregate by volume but subjected to a upper limit or 1:1:5 and a lower limit of 1:3	34
M 150	220		32
M 200	160		30
M 250	100		27

Note:

1. The proportion of the aggregates should be adjusted from upper limit to lower limit progressively as the grading of fine aggregate becomes larger. Example: for an average grading of fine aggregate (that is, zone II of I.S: 383-1963) the proportion shall be 1:1:5, 1:2 & 1:3 for maximum size of aggregate 10mm and 40mm respectively.

2. it may be noted for general guidance that m 100 and m 250 of ordinary concrete correspond approximately to 1:3:6, 1:2:4, 1:1:5:3 and 1:1:2 nominal mixes of ordinary concrete currently used in the country.

#### 3.5.4 Table 7. Surface water carried by average aggregate

3.5.5

#### AGGREGATE                      APPROXIMATE QUANTITY OF SURFACE WATER

Very wet sand	120
Moderately wet sand	80
Moist sand	40
*Moist gravel or crushed rock	20 & 40

\*Coarse aggregate, less the water it will carry

#### Control and testing of concrete

The work of controlled concrete shall be carried out under the strict supervision of the Engineer the contractors shall employ qualified competent persons for executing this work following tests shall be carried out at site whenever required by the engineer in accordance with I.S : 516-1956.

Methods of test for strength of concrete (latest)

- (1) Preliminary tests – 7 days and 28 days compressive strength test
- (2) Works test - 7 days and 28 days compressive strength test
- (3) Consistency test
- (4) Moisture contents in aggregates
- (5) Unit weight of concrete
- (6) Procedure and Guidance for testing for concrete

#### Preliminary Test :

Preliminary test cubes or cylinders for controlled concrete shall be made in the laboratory prior to the commencement of the work in the manner and at frequencies laid down in the latest I.S.:456 – 1978. Code of practice for Plain and Reinforced Concrete. The testing shall be carried out at the GERI laboratory at Baroda or at any other approved laboratory at contractor's cost.

#### Work Test :

During concreting operations, samples of concrete as placed in the work shall be taken every day and a set of 6 cubes or cylinders their compressive strength. The consistency (slump) test shall also be made and the slump recorded.



All concrete cubes or cylinders shall be tested for compressive strengths as specified in I.S 456 and 516 at the field testing laboratory or at any approved material testing laboratory. The above specifications cover concrete mixes of grades M100 and above, ordinarily it is not necessary to test the compressive strengths of mix grade M 100 as it is generally used for nonstructural purposes. However where this mix (M 100) is used extensively on works (i.e. more than 75 m<sup>3</sup> in one work) it shall be tested in the same manner as other grades of concrete used for structural purpose. The minimum strengths of various grades of concrete both at the age of 7 days and 28 days are given in Table 2 & 3.

In the case of concrete of mix m 150 and above the Engineer may not insist on the testing of concrete, if the quantity of concrete to be paid on any particularly day is less than 10cm, if however the quantity exceeds 10cm. test specimens must be taken and sent to the field testing laboratory or at any approved laboratory for testing.

6 specimens are made for every sample and three of them tested for 7 days strengths as mentioned earlier the 28 days strengths of concrete shall along form the criterion for acceptance or rejection of the concrete.

With this point in view the concrete samples shall be tested both for 7 days strength as well as 28 days strength at the start of the work and continued till the Engineer is satisfied that a proper relation between the 7 days compressive and the 28 days compressive strength is established in which case he may decide to relax the frequency of testing the concrete cubes for the 28 days compressive strength.

If the average strength of specimen tested at the age of 7 days 28 days is not less than the strength specified in Table 2 & 3, then the test shall be considered that only out of 3 consecutive tests may give value less than specified strength but not less than 90% of the specified strength.

If the tests are unsatisfactory, the contractors shall take immediate steps and carry out remedial measures as may be directed by the Engineer in their own modules. The contractors shall pay usual testing fees carried out in the approved laboratory. These fees may vary if arrange to bring their own moulds for taking samples.

#### **Consistency and slump test:**

The workability of concrete shall be checked at frequent intervals. The slump test shall be carried out in accordance with the standard method given under. I.S. specification mentioned above. The slump shall be as less as practicable consistent with the efficient working and compacting of concrete. The slump shall not exceed 64mm but the Engineer may, under exceptional conditions, permit greater slump upto a limit of 150mm. The standard consistency test shall be applied at least once in a day while the concreting is in progress.

#### **Moisture contents in the Aggregates:**

The moisture contents in the aggregates shall be determined in the field in accordance with the latest I.S. No. 2386 – 1963 (Part-3). In methods of tests for aggregates for concrete. Method of test for aggregates for concrete.

#### **Unit weight of concrete**

It shall be determined by placing representative samples of concrete in a unit measure capacity and vibrating it externally by small vibrator or hand compacting to represent actual placing condition. The top of the concrete shall then be made truly flush with the top of the mould and the weight of concrete per cum determined after curing and drying. The weight of dry concrete shall not be less than 2.4 tones per cum. A complete record regarding various tests carried out at site and in the laboratory shall be kept by the Engineer. The contractors shall provide at their own cost all facilities for labor, material, transport etc. required for the proper execution of the above tests.

Any concrete which does not comply with the above requirements shall be liable for rejection by the Engineer.

#### **Procedure and guidance for testing of concrete**

Making and curing compression test specimens in the laboratory.

The procedure for making and curing compression test specimens of concrete in the laboratory where accurate control of the quantities of materials and test conditions are possible and where the maximum nominal size of aggregate does not exceed 38mm. The method is especially applicable to the making of preliminary compression test to ascertain the suitability of the available materials or to determine suitable mix proportions.

#### **Sampling of materials:**

Representative samples of the materials of concrete for use in the particular concrete construction work shall be made of a small portion taken from each of a number of bags on the site. Test samples of aggregate shall be taken from larger lots of quartering.

#### **Preparation of materials:**

All materials shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material. Care being taken to avoid the intrusion of foreign matter. The cement shall then be stored in dry place, preferably in air tight metal

containers, samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air dried condition. In general, the aggregate shall be separated into fine & coarse fractions and recombined for each concrete batch in such a manner as to produce the desired grading. I.S. sieve 48 shall be normally used for separating the fine and coarse fractions, but where special grading is being investigated both fine and coarse fractions shall be further separated into different sizes.

**Proportioning:**

The proportions of the materials, including water in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work, where the proportions of the ingredients of the concrete as used on the site are to be specified by volume, they shall be calculated from the proportion by weight used in the test cubes and the weights of the materials.

**Weighting:**

The quantities of cement, each size of aggregate and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of batch.

**Mixing concrete:**

The concrete shall be mixed by hand, or preferably, in a laboratory batch mixer, in such a manner as to avoid loss of water or either materials, each batch of concrete shall be such a size as to leave about 10 percent excess after modeling the desired number of test specimens.

**Machine mixing:**

When the mixing drum is charged by powder loader, all the mixing water shall be introduced into the drum before the soiled materials; the coarse aggregate, then with the fine aggregate then with the cement and finally with the remaining coarse aggregate on top (If all fine aggregate then is used the skip aggregated on to top), however all fine aggregates will not be normally permitted.

Where the mixing drum is hand-loaded it shall be charged with the dry materials in a similar manner and the water shall be added immediately before the rotation of the drum is started. The period of mixing shall be not less than 2 minutes after all the materials are in the drum and shall continue till the resulting concrete shall be heaped together before sampling.

**Hand – Mixing:**

The concrete batch shall be mixed in a water light, non-absorbent platform with a shovel, trowel or similar suitable implement, using the following procedure:

- (a) The cement and fine aggregate shall be mixed dry until the mixture is thoroughly blended & is uniform in colour.
- (b) The coarse aggregate shall then be added & mixed with the cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch and
- (c) The water shall then be added and the entire batch mixed the concrete appears to be homogeneous and has the desired consistency. If repeated mixing is necessary, because of the addition of water in increments while adjusting the consistency, the batch shall be discarded and a fresh batch made without interrupting the mixing to make trial consistency tests.

**Workability:**

Each batch of concrete shall be tested for consistency immediately after mixing, by one of methods described in I.S: 1199 – 1956. Method of sampling and analysis of concrete. Provided that care is taken to ensure that no water or other material is lost, the concrete used for the consistency test may be mixed with the remainder of batch before making the test specimens. The period of re-mixing shall be as short as possible yet sufficient to produce a homogeneous mass.

**Size of test specimens:**

Test specimens cubical in shape shall be 15 X 15 cm. if the largest nominal size of the aggregate does not exceed 2cm. 10cm. Cubes may be used, as an alternative cylindrical test specimen shall have a length equal to twice the diameter. They shall be 15cm in diameter and 30cm. Long smaller test specimens shall have a ratio of diameter of specimen to maximum size of aggregate of not less than 3 to 1. Except that the diameter of the specimen shall be not less than 7.5cm for mixtures containing aggregate more than 5 percent of which is retained on IS sieve 480.

**Moulds:**

**(1) cube moulds :**

The moulds: shall be metal, preferably steel or cast iron, 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 & shall be so machined that when it is assembled ready for use the dimensions and internal faces shall be accurate within the following limits; the height of the mould and the distance between opposite faces shall be specified size  $\pm 0.2\text{mm}$ . The angle between adjacent internal faces and between internal faces and top and bottom planes of the mould shall be  $90^\circ \pm 0.5^\circ$ . The interior faces of the mould shall be plane surface with a permissible variation  $0.03\text{mm}$  each mould shall be specified size  $\pm 0.2\text{mm}$ . The angle between adjacent internal faces and between internal faces and top and bottom planes

of the mould shall be  $90 \pm 0.5$ . The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03mm each mould shall be provided with a metal base plate having a plane surface. The base plate shall be of such dimensions as to support the mould during the filling without leakage and it shall be preferably attached to the mould by springs of screws.

The parts of the mould when assembled shall be positively and rigidly held together, and suitable methods of ensuring this both during the filling and on subsequent handling of the filled mould shall be provided in assembling the mould for use the joints between the section of moulds shall be thinly coated with 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 the filling. The interior surfaces of the assembled mould shall be thinly coated with oil to prevent adhesion the concrete the contractor shall have at least 6 cube moulds at time site to enable test cubes to be taken at any time. The cube moulds shall be of standard make by reputed manufactures (like Lawrence & Mayo etc.)

## **(II) Tamping bar:**

The tamping bar shall be steel bar 16mm in diameter 0.6m 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 in to the mould in layers approx. 5 cm deep. In placing each scoopfull of concrete, the scoop shall be moved around the top edge of the mould as the concrete within the mould. Each layer shall be compacted either by hand or by vibration 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.

(I) When compacting by hand, the 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 the strokes per layer required to produce specified conditions will vary according to the type of concrete. For cubical specimens in no case shall concrete be subjected to less than 35 strokes per layer for 15cm cubes or 25 strokes per layer for 10cm cubes. For cylindrical specimens the no. of strokes shall penetrate in to the under laying and the bottom layer shall be robbed throughout its depths where voids are left by the tamping bar. The side of the mould shall be tapped to close the voids.

### **(II) Compacting by vibration: -**

When compacting by vibration each layer shall be vibrated by means of an electric or pneumatic hammer or vibrator or by means of suitable vibrating table until the specified condition is attained.

### **Note :**

The mould and quantum of vibration of the laboratory specimen shall be as nearly the same as those adopted in actual concreting operations.

### **Capping specimens:**

The ends of all cylindrical test specimens that are not plane within 0.05mm shall be capped. Capped surfaces shall not depart from a plane by more than 0.05 and shall be approx. at right angles to the axis of the specimens. Caps shall be made thin as practicable and shall not flow or fracture when the specimen is tested. Capping shall be carried out according to one of the following methods.

### **(I) Neat cement:**

Test cylinders may be capped with a thin layer of stiff, neat Portland cement paste after the concrete has ceased setting in the moulds, generally for two to four hours or more after moulding. The cap shall be formed by means of glass plate not less than 6.5mm. in thickness or a machined metal plate not less than 13mm. in thickness and having a maximum surface dimensions atleast 25mm larger than the diameter of the mould, it shall be worked on the cement paste until its lower surface rests on the top of the mould. The cement coping shall be mixed to a stiff paste for about two to four hours before it is to be used in order to avoid the tendency of the cap to shrink. Adhesion of late paste to the capping may be avoided by coating the plate with a thin coat oil or grease.

### **(II) Sulphur:**

Just prior to testing, the cylindrical specimens may be capped with a sulphur mixture consisting of 1 part sulphur 2 to 3 parts of inert filler, such as finely. The specimens shall be securely held in a special jig so that the caps formed have true plane surfaces. Care shall be taken to ensure that the Sulphur compound is not over heated, as it will not then develop the required compressive strength. Sulphur caps shall be allowed to harden for atleast 2 hours before applying the load.

### **(III) Hard Plaster:**

Just prior to testing, specimens may be capped with hard plaster having a compressive strength of atleast 420 kg/sq. cm. in one hour. Such plasters are generally available as proprietary material. The cap shall be formed by means of a glass plate not less than 13mm. in thickness, having a minimum

surface dimensions at least 25mm. larger than the diameter of the mould. The glass plate shall be lightly coated with oil to avoid sticking.

**Note :**

Ordinary plaster will not serve the purpose of the capping materials due to its low compressive strength.

(IV) As soon as possible after the concrete is mixed, a mortar shall be gauged using a cement similar to that used in the concrete and sand which passes IS Sieve 30 but is retained on IS Sieve 15. The mortar shall have a water cement ratio not higher than that of the concrete of which the specimen is made, and shall be of a stiff consistencies. If an excessively wet mix of concrete is being tested, any free water which has collected on the surface of the specimen shall be removed with a sponge, blotting paper or other suitable absorbent material before the cap is formed. The mortar shall then be applied firmly and compacted with a trowel to a slightly convex surface above the edges of the mould, after which the capping plate shall be pressed down on the cap with a rotary motion until it makes complete contact with the rim of the mould. The plate shall be left in position until the specimen is removed from the mould.

**(V) Curing:**

(a) The test specimens shall be stored in a place free from vibration, in moist air at a temperature of  $27^{\circ} \pm 20^{\circ} \text{C}$  for 24 hours  $\pm \frac{1}{2}$  from the time of addition of water to the dry ingredients. After this period, the specimens shall be marked and removed from the mould and, unless required for test within 24 hours, immediately submerged in clean, fresh water or saturated lime solution in which the specimens are submerged shall be renewed every day and shall be maintained at a temperature of  $27^{\circ} \text{C} \pm 20^{\circ} \text{C}$ . The specimens shall not be allowed to become dry at any time until they have been tested.

**(b) Making and curing compression test specimen in the field.**

The procedure for making and curing compression test specimens of concrete sample during the progress of construction where the nominal maximum size of the aggregate does not exceed 38mm. Size of test specimen, apparatus to be used and procedure to prepare specimens shall be the same as specified earlier.

**Curing:**

Test specimens shall be stored on the site a place free from vibration, under damp matting sacks or other similar material for 24 hours  $\pm \frac{1}{2}$  hour from the time of adding the water to the other ingredients. The temperature of the place of storage shall be within the range of  $22^{\circ}$  to  $32^{\circ} \text{C}$ . After the period of 24 hours, they shall be marked for later identification, removed from the moulds and unless required for testing within 24 hours, stored in a clean water at a temperature of  $24^{\circ}$  to  $30^{\circ} \text{C}$  until they are transported to the testing laboratory. They shall be sent to the testing laboratory well packed in damp sand, damp 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 specimens shall be stored in water at a temperature of  $27^{\circ} \pm 20^{\circ} \text{C}$  until the time of test. Records of daily maximum and minimum temperature shall be kept both during the period of the specimens remain on the site and in the laboratory.

**Test for compressive strength of specimen:**

It will be desirable if the contractor sets up a field laboratory consisting of a compression testing machine set of Sieves, balance, compaction factor apparatus, work tables, tamper lab, vibrator, slump cone etc. In case this is not possible services of a nearby test house (preferably Engineering college should be availed).

**Apparatus:**

**Testing Machine:**

The testing machine may be any reliable type of sufficient capacity for the tests and capable of applying the load at the rate specified in 5.5. The permissible error shall be not greater than +2 percent of the maximum load. The testing machine shall be equipped with two steel bearing plates (preferably the one that normally will bear on the upper surface of the specimen) shall be fitted with a ball seating in the form of portion of a sphere, the center of which coincides with the central points of the face of the plate. The other compression plate shall be plain rigid bearing block.

The bearing faces of both plates shall be at least as large as and preferably larger than the nominal size of the specimen to which the load is applied. The bearing surface of the plates, when new, shall not depart from a plane by more than 0.01mm at any point, and they shall be maintained with a permissible variation limit of 0.02mm. The movable portion of the spherically seated compression plate shall be held on the spherical seat, but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction.

**Age test:**

Tests shall be made at recognized ages of the test specimens, the most usual being 7 and 28 days. Ages of 13 weeks and one year are recommended if tests at greater ages are required. Where necessary to obtain the early strengths, tests may be made at the ages 24 hours  $\pm$  ½ hour and 72 hours  $\pm$  2 hours. The ages shall be calculated from the time of addition of water to the dry ingredients.

**Number of specimens:**

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

**Note:**

When a full investigation is being carried out it is advisable for three separate batches to be made for given variable. An equal number of specimens for each variable should be made.

**Procedure:**

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 projecting fins removed. Specimens when received dry shall be kept in water for 24 hours before they are taken for testing. The dimensions of the specimens to the nearest 0.2mm and their weight shall be noted before testing.

**Placing the specimens in the Testing Machine:**

The bearing surface of the testing machine shall be wiped clean and loose sand or other material removed from the surface of the specimen which are to be in contact with the load shall be applied to opposite sides of the cubes as cast, that is not to the top & bottom, the axis of the specimen shall be carefully aligned with the center of thrust of the spherically seated plate. No packing shall be used between the faces of the test specimen and steel plate of the testing machine. As the spherically seated block is brought to bear on the specimen, the load shall be applied without shock and increased continuously at a rate of approximately 140 kg/sq.cm/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 then be recorded and appearance of the concrete and any unusual features in the type of failure shall be noted.

**Calculation:**

The measured compressive strength of the specimen shall be calculated by dividing the maximum load to the specimen during the test by the sections (see also 4.5.1 of IS 1199-1959) methods of sampling and analysis of concrete and shall be expressed to the nearest Kg./sq.cm. Average of three values shall be taken as per the representative of the batch provided the individual variation is not more than the  $\pm$  15% of the average. A correct factor according to the height / diameter ratio of the specimen after copping shall be obtained from the curve. The product of this correction factor and the measured compressive strength shall be known as corrected compressive strength. This being the equivalent cube strength of the concrete shall be determined by multiplying the corrected strength by 5 / 4.

**Report:**

The following information shall be included in the report on each test specimen.

- (A) Identification mark
- (B) Date of test
- (C) Age of specimen
- (D) Curing condition, including date of manufacture of specimen in the field.
- (E) Weight of specimen
- (F) Dimensions of specimen
- (G) Cross-sectional area
- (H) Maximum load
- (I) Compressive strength
- (J) Appearance of fractured faces of concrete and type of fracture if these are unusual.
- (K) Sampling of Fresh concrete in the Field.

This method specifies the procedure to be followed in the field for obtaining representative samples of fresh concrete directly from the mixer or from concrete at the time and place of deposition.

**Sample:**

The composite sample shall be truly representative of the batch and shall not less than 0.02mm in volume. It shall be composed of a mixture of portions taken from different points in the batch. When continuous mixers used a batch shall be regarded as the discharge from the mixture during the minute.

**Procedure:**

**From Mixers:**

At least three approximately equal sample increments totaling (2cu.m shall be taken from a batch during its discharge and each sample increment shall be collected by passing a clean and dry receptacle across the stream of concrete. This receptacle shall be constructed of non-absorbent material, preferably of metal and shall be such that the sample retained is not segregated. A flat

surface without retaining sides will not fulfill this purpose. Where there sample increments are taken they shall be taken at about the time when one-quarter on half and there quarters of the concrete have been discharged from the mixer and if marathon three are taken they shall be at corresponding shorter, but equally spaced, intervals.

**From concrete at the Time and place of Deposition:**

The sample shall be taken while a batch of concrete is being or immediately after it has been, discharged on the site. The sample shall be collected from not less than five well distributed positions, avoiding the edges of the mass where segregation may have occurred.

**Mixing the composite sample:**

The composite sample obtained by either of the methods described above, shall be mixed on a non-absorbent base either in such a manner as to ensure uniformity. The sample thus obtained shall be used immediately for the purpose of carrying tests. Care shall be taken to protect the sample from the weather.

**Recording of samples:**

The following information regarding the sample shall be recorded:

- (A) Date and time of sampling
- (B) Method of sampling
- (C) Mix proportions (Proportion of ingredients including water, admixtures, etc.
- (D) Mixtures from which delivered (if more than one issued)
- (E) The location of the sampled batch after placing, and
- (F) Temperature and weather conditions

**Slump Test:**

The method of test specified the procedure to be assorted, either in the laboratory or during the progress of work in the field, for determining, by the slump test, the consistency, of concrete where the nominal maximum size of the aggregate does not exceed 38mm.

**(A) Mould:**

The mould for the test specimen shall be in the form of the frustum of a cone having the following internal dimensions:

Dimensions	Cm
Bottom diameter	20
Top diameter	10
Height	30

The mould shall be constructed of metal (brass or aluminum shall not be used) of at least 1.6mm.(or16 BC) thickness and the top and bottom shall be open and at right angle to the axis of the cone. The mould shall have a smooth internal surface. It shall be provided with suitable foot pieces and also handles to facilitate lifting it from the moulded concrete test specimen in vertical direction as required by the test. A mould provide with a suitable guide attachment may be used.

**(B) Tempering rod:**

The tamping rod shall be of steel or other suitable material, 16mm in diameter, 0.6m long and rounded at one end.

**Note:**

To facilitate the lifting of the mould in a vertical direction. It is recommended that suitable guide attachment be provided any rivets used in the construction of the mould shall be countersunk flush on the inside of the cone. Attachments should preferably be welded to the mould.

**Sampling:**

If this test is being carried out in the field, the sample of freshly mixed concrete shall be obtained as described in 3. In the case of concrete containing aggregate of maximum size more than 38mm. the concrete shall be wet-sieved through 1.5 in screen to exclude aggregate particles bigger than 38mm

**Procedure:**

The internal surface of the mould shall be thoroughly cleaned and free from superfluous moisture and set concrete before commencing the test. The mould shall be placed as a carefully leveled metal plate, the mould being firmly held in place while it is being filled.

The mould shall be filled in four layers, each approximately one-quarter of the height of the height of the mould. Each layer shall be temped with twenty-five strokes of the rounded end of the tempering rod. The strokes shall be distributed in uniform manner over the cross-section of the Mould and for the second and subsequent layers shall penetrate into the underlying layer. The bottom layer shall be temped throughout its depth. After the top layer has been rodded, the concrete shall be shrunk off level out between with a trowel or the tempering rod, so that the mould is exactly filled. Any mortar which may be leaked out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately by raising it slowly

And carefully in a vertical direction. This allows the concrete to subside and the slump shall be measured immediately by determining the difference between the height of the mould that of the highest point of the specimen being tested. The above operations shall be carried out at a plate free from vibration or shock and within a period of two minutes after sampling.

**Slump:**

The slump measured shall be recorded in terms of millimeters of subsidence of the specimen during the test. Any slump specimen which collapses or shears off laterally gives incorrect result and if this occurs the test shall be repeated with another sample. If in the repeat test also, the specimen should shear, the slump be measured and the fact that the specimen sheared, shall be recorded.

**Note:**

Some indication of the cohesiveness and workability of the mix can be obtained, if after the slump measurement has been completed, the side of the concrete is tapped gently with the tamping rod, a well proportioned concrete which has an appreciable slump will gradually slump further but if the mix has been badly proportioned, it is likely to fall apart.

**Gauge Boxes:**

Gauge boxes of approved type shall be used for measuring sand and coarse aggregates in required proportion whenever concrete is allowed to be prepared by mixing the aggregates on volumetric basis. Such boxes shall be of seasoned timber or steel and shall be of such size as and shape and shall be used in such a manner as to enable the proportion of the material to be checked readily. The cement used in concrete however, shall not be used by measuring it in gauge boxes but it shall be measured by weight whatever may be the type of concrete.

**Storage of materials:**

Cement, fine and coarse aggregates shall be stored separately at the site of work in such manner as to prevent any deterioration or contamination or admixture of foreign materials. Any material which has been damaged or is considered defective by the Engineer shall not be used on the works and shall be removed immediately from the site of work.

**Manufacture and placement if concert**

**(1) Batching**

Whether controlled concrete or ordinary concrete is to be mixed the quantity of cement shall be determined by weight if the makers weight per bag is to be used the same shall be certified by weighing separately a reasonable number of bags.

Whenever direct use of bagged cement is allowed, one jute bag of cement shall be considered to contain 50kg. of net weight of cement. This shall, however be verified at site by weighting. For which the contractors shall provide an accurate weighing apparatus on work site.

Having once designed the mix, the Engineer may permit further mixing of the aggregate to be used done on volumetric basis for a particular batch stock of aggregates which has been used in the design of the mix.

The water shall be either measured by the volume in calibrated tanks or weighed, in controlled concrete, the quantity of fine and coarse aggregates shall be determined by weight. While in ordinary concrete, they may be determined by volume. For volumetric measurements gauge boxes used for approved type as described earlier shall be used for measuring the fine and coarse aggregates in required proportion.

**(ii) Mixing of concrete:**

The concrete shall be mixed in a mechanical and/or weight mixer of adequate capacity. The ingredients shall be added to each batch of mix by weight, volume or both as the case may be so as to ensure accurate proportioning, water for each batch of concrete shall be measured in a standard container so as to ensure the same amount of water being used each time and shall be added prior to during and following mixer charging operation. The mixing of each batch shall be done for a period of not less than two minutes or shall continue until there is a uniform distribution of material, having the mass uniform in color and consistency. Every care shall be taken to ensure that there is no segregation while unloading the mixer.

Mixing shall be done as near the place of placement as possible and adequate shed shall be constructed over the mixer to protect the discharged concrete from the effect of direct sun rays small additional amount of water, if necessary, shall be allowed to be added to the mixer to compensate for any anticipated evaporation losses during transport. The quantity of water to be added shall be sufficient to allow a workable mix being made tamped and vibrated into all parts of the mould and between the reinforcement.

**Permission for starting the concrete work:**

The contractors shall get the surface whether concrete of rock or formwork etc. previously approved by the Engineer, who shall, then issue the permission for starting the work. Any concrete work done without such permission shall be cut and removed at the cost of contractors.

No concreting shall be started unless the surface of the foundation is inspected and approved by the Engineer as stated above. If concreting is to be done on concrete shall clean with wire brushed and all laitance removed to expose the original surface of metal and sand particles etc. It shall, then be covered with a 7mm. thick layer of cement mortar (1:2) before laying fresh concrete.

**Transporting and depositing concrete:**

Concrete shall be placed within 30 minutes after mixing and shall be transported from the mixer to its final placement as rapidly as practicable, taking care to see that no segregation or loss of ingredients takes place. In case segregation occurs the concrete shall be remixed. Dropping of concrete from an excessive height or running or working it along forms will not be permitted. Any concrete, which before placement has begun to set has become stiff shall be rejected.

Concrete shall be properly compacted by use of vibrators or by roting and spading as directed by the Engineer. Tamping as above shall be continued until all the entrained air is removed and the concrete has become compacted and completely fills the form. The sides of the formwork shall be gently tapped by spades during concreting.

All controlled concrete shall be invariably compacted by mechanical vibrators irrespective of the positions. It shall be compacted by needle vibrator or screed vibrator as the case may be and the work of vibrating the concrete by mechanical means shall be paid for under the relevant item. Compacting by roting or spading however shall not be paid for separately and the rates for concrete shall be demeaned to cover the cost thereof.

Internal type vibrators when used shall be inserted into the uncomplicated concrete vertically and at regular intervals. Where the uncomplicated concrete is in a layer above freshly compacted concrete. The vibrator shall be allowed to penetrate vertically for a few cms in to the previous layer. In no circumstances shall the reinforcement or form work nor shall they be withdrawn quickly from the mass of concrete but shall be drawn back slowly so as to leave no voids. Internal type vibrators shall not be placed in the concrete in a random or haphazard manner not shall concrete from one part of the work to another by means of the vibrator. The duration of vibration shall be limited to that required to produce satisfactory compaction without causing segregation. Vibration shall on no account be continued after water or excess grout has appeared on the surface face.

**Curing of concrete :**

All concrete work shall be protected from direct rays of the sun. The exposed surface shall be kept wet for a minimum period of 10 days or such longer periods as may be directed by the Engineer. All concrete laid shall not be distributed and shall be suitably protected from any injury, until completely set: particular care shall be taken at all corners and edges of the members. All horizontal concrete surfaces shall be kept constantly wet pounding or otherwise in the manner approved by the Engineer, till the time of next pouring regardless of time. Concrete surfaces shall be cured either by sprinkling or by spraying water or by adopting any other method to keep the areas moist. Flat or vertical surfaces may be covered with damp gunny bags and watered frequently. Water used for curing shall be clean and free from any excessive amount of silt, coloring matter or other impurities, which may stain the finished work. In order to ensure adequate quantities of water for curing, the contractors shall make necessary arrangements such as providing sufficient lengths of temporary pipelines of suitable sizes, storage of water in tanks and / or use of bhistis at their cost.

**Defective concrete:**

The defective concrete shall be cut out and the work reconstructed with fresh concrete of required quality in the presence of the Engineer. The concrete thus cut out shall not be re-used under any circumstances, should any concrete become permanently damaged due to cracking or is broken or damaged from whatever cause, or should any concrete be found defective in quality due to honey combing or bad workmanship, it shall be removed forthwith and replaced by concrete of required quality at the cost of the contractors to the satisfaction of the Engineer.

The authority reserves the right to carry out any further test like electronic ultrasonic tests and such other non-destructive test to verify. The quality of concrete done by the contractor should it become to notice at that time that some work is required to be redone, the same shall be attended to by the contractor at his own cost, irrespective of the fact that the same has been passed and paid for.

**T.S.4 FORMWORK :**

**Formwork fixing and general :**

All formwork shall be constructed of timber, sheet metal or other approved material. For work which are of respective nature such as roof slab, column capital, floors, etc. for reservoir, the formwork shall be fabricated out of steel plates and structures to obtain uniform finish throughout the work. All formwork shall be firmly supported, adequately struted, braced and tied to withstand the placing and vibrating of concrete and the effect of weather. The tolerance on line and level shall not exceed 3mm. The tenderers/contractors shall be responsible for the calculations and designs for the formwork, and, if required, shall submit them to the Engineer for approval before any construction. In all case the



formwork shall be inspected and approved by the Engineer before any concreting is started. On formwork to external faces, which will be permanently exposed all horizontals and vertical formwork joints shall be so arranged that joint lines will form a uniform pattern on the face of the concrete.

Where the tenderers / contractors propose to make up to formwork from standard sized manufactured formwork panels, the size of such panels, shall be approved by the Engineer before they are used in the construction of the works. The finished appearance of the entire elevation of the structure and adjoining shall be considered when planning the pattern of joint lines caused by formwork and by construction of horizontal and vertical lines.

Face of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits or other defects and all formwork shall be clean and free from standing water, dirt shavings chipping or other foreign matter. Joints shall be sufficiently watertight to prevent the escape of mortar or the formation of line or other blemishes on the face of the concrete.

Opening for inspection of the inside of the formwork and for the removal of water used for washing down shall be provided and so formed as to be easily closed before placing concrete. Before placing concrete all bolts, pipes or conduits or any other fixtures which are to be built in shall be fixed in their correct positions, and cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without the approval of the Engineer.

No ties or bolts or other device shall be built into the concrete for the purpose of supporting formwork without the prior approval of the engineer. The whole or part of any such supports shall be capable of removal so that no part remaining embedded in the concrete shall be nearer than 50mm from the surface in the case of reinforced concrete & 150mm in case of reinforced concrete. Holes left after removal of such supports shall be neatly filled with well rammed dry-pack cement sand mortar in proportion of 1:3 at tenderers / contractors cost.

Formwork in contact with the concrete shall be treated with a suitable non-standing mould oil to prevent adherence of the concrete except where the surface is subsequently to be rendered. Care shall be taken to prevent the oil from coming in contact with concrete at construction joints.

#### **Defects in formed surfaces:**

Workmanship in formwork and concreting shall be such that concrete shall normally requires no making good surfaces, being perfectly compacted and smooth.

If any blemishes are revealed after removal of formwork the Engineer's decisions concerning remedial measures shall be obtained immediately.

These measures may include, but shall not be limited to the following: fins, pinhole bubbles, surface discoloration and minor defects may be rubbed down with sacking immediately after the formwork is removed. Abrupt and gradual irregularities may be rubbed with carborandum and water after the concrete has been fully cured. These and any other defects shall be remedied by methods approved by the Engineer which may include using a suitable epoxy resin or where necessary, cutting out to a regular dovetailed shape atleast 75mm deep and refilling with concrete over steel mesh reinforcement strung into the dovetail. No extra payment for rectification work will be made.

#### **Holes to be filled:**

Holes formed in concrete surfaces by formwork supports of the like shall be filled with dry-pack mortar made from one part by weight of ordinary cement and three parts fine aggregate passing I.S. sieve 1.18mm. The mortar shall be mixed with only sufficient water to make the materials strike together when being moulded in the hands.

The tenderers / contractors shall thoroughly clean any hole that is to be filled with dry-pack mortar and where the surfaces has been damaged the tenderers / contractor shall break out any loose, broken or cracked concrete or aggregate. The concrete surrounding the hole shall be dried so as to leave a small amount of free water on the surface.

The surface shall then be dusted lightly with ordinary Portland cement by means of small dry brush until the whole surface that will come into contact with the dry-pack mortar has been covered and darkened by absorption of the free water by cement. Any dry cement in the hole shall be removed. The dry-pack material shall then be placed and packed in layers having compacted thickness not greater than 15mm in thickness the compaction shall be carried out by use of a hard-wood stick and a hammer and shall extend over the full area of the layer, particular care being taken to compact the dry-pack against the sides of the hole. After compaction the surface of each layer shall be scratched before further loose material is added. The hole shall not be over filled and the surface shall be finished by laying a hardwood block several times. Steel finishing tools shall not be used and water shall not be added to facilitate finishing.

#### **Removal of formwork:**

In no circumstances, shall forms be struck until the concrete reaches adequate strength has required or without obtaining permission of the Engineer. All formwork shall be removed without any shock or vibration such as would damage the concrete. Before the soffit are removed the concrete, surface shall

be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. The responsibility for the removal of the formwork whether whole or part shall rest entirely with the tenderers/contractors who must nevertheless be guided by the opinion of the Engineer in this regard. The work of striking and the removal of formwork shall be conducted in the presence of the Engineer and under personal supervision of competent foremen in the employment of the contractors.

Normally, the form shall be struck after the expiry of following periods:

1. Vertical surfaces of wall .....1 day
2. Columns and vertical sides of beam .....2 days
3. Slab bottoms with props left under .....2 days
4. Beam bottom and bottoms of column  
strip in a flat with prop left under .....7 days
5. Removal of props under span up to 4.5m .....7 days  
Span up to 4.5m ...14 days
6. Removal of props span up to 6m ... 14 day  
beam and arches.

#### **Surface treatment and finish:**

When the formwork is struck, all the faces of concrete shall be smooth and sound, free from voids and air holes. Any roughness or irregularity on the exposed surface shall be immediately filled up while the concrete is still green, with cement grout, cement wash and / or 1:1.5 cement mortar, properly trowled and finished. Such patching of the concrete face shall be carried only with the permission of the Engineer. If the concrete is found honey combed the portion and whatever surrounding concrete that may be considered unsatisfactory by the Engineer shall be dismantled and fresh concrete of proper quality shall be reinstated at contractors cost.

Faces of concrete which are to be either in contact with water or are exposed to water vapors such as in roof slab, and columns, col. footing, R.C.C floor internal staircase, etc shall be treated as described below immediately after the formwork is struck.

All projecting imperfections shall be first rubbed down flush, with carborandum stone or by any other approved means. The grit and dust resulting this form shall be thoroughly washed off clean water. The surface shall then be given a wash of cement, and Cico solution made upto a consistency of thick milk by mixing Cico (i) and water in proportion 1:10 applied with brush. The treated surface shall be cured with water spray for a period of 10 days minimum. The Engineer may at his discretion, allow the contract to substitute CICO by any other approved material, of equivalent quality. In the case of any other concrete except for the reservoir proper and control room used in the construction on other structure such substation, external stair cases, parapet walls, etc. the concrete surface exposed when the form are struck off shall be finished as specified below : All exposed external R.C.C surfaces, including soffit edges, faces etc. shall be finished with sandfaced plaster 1:3 or medium smooth plaster 1:4 as the case may be consistence with the finish of the adjoining masonry work as per specifications or as directed by the Engineer.

### **T.S. 5. REINFORCEMENT**

#### **General requirements**

Steel Conforming to para 5.1.2 for reinforcement shall be clear and free from loose milscales, dust, loose rust, coats of paints, oil or other coatings which may destroy or reduce bond. It shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oil substance shall be used for removing the rust.

#### **Assembly of Reinforcement :**

Bars shall be bent correctly and accurately to the size and shape as shown in the detailed drawing or as directed by EIC. Preferably bars of full length shall be used. Necessary cutting and straightening is also included. Over lapping of bars, where necessary shall be done as directed by the EIC. The overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25 mm or 1¼ times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted tight. The overlaps/splices shall be staggered as per directions of the EIC. But in no case the over lapping shall be provided in more than 50% of cross sectional area at one section.

#### **Bonds and Hooks Forming End Anchorages :**

Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice for bending and fixing of bars for concrete reinforcement. The details of bends and hooks are shown below for guidance.

#### **U – Type Hook**

In case of mild steel plain bars standard U type hook shall be provided by bending ends of rod into semicircular hooks having clear diameter equal to four times the diameter of the bar.

**Bends**

Bend forming anchorage to a M.S. plain bar shall be bent with an internal radius equal to two times the diameter of the bar with a minimum length beyond the bend equal to four times the diameter of the bar.

**Anchoring Bars in Tension :**

Deformed bars may be used without end anchorages provided, development length requirement is satisfied. Hooks should normally be provided for plain bars in tension. Development length of bars will be determined as per IS : 456 – 2000.

**Anchoring Bars in Compression :**

The anchorage length of straight bar in compression shall be equal to the 'Development length' of bars in compression as specified in IS : 456-2000. The projected length of hooks, bends and straight lengths beyond bend, if provided for a bar in compression, shall be considered for development length.

**Binders, stirrups, links etc :**

In case of binders, stirrups, links etc. the straight portion beyond the curve at the end shall be not less than eight times and nominal size of bar.

**Welding of Bars :**

Wherever facility for electric arc welding is available, welding of bars shall be done in lieu of overlap. The location and type of welding shall be got approved by the EIC. Welding shall be as per IS : 2751 and IS : 9417

**Placing in Position**

Fabricated reinforcement bars shall be placed in position or as directed by the EIC. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to 1.6 mm thickness twisted tight to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during deposition of concrete.

Tack welding in crossing bars shall also be permitted in lieu of binding with steel wire if approved by EIC.

**The bars shall be kept in correct position by the following methods:**

In case of beam and slab construction precast cover blocks in cement mortar 1:2 (1 cement : 2 coarse sand) about 4x4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcement.

In case of cantilevered and doubly reinforced beams or slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 metre or at shorter spacing to avoid sagging.

In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them; or with block of cement mortar 1:2 (1 cement :2 coarse sand) of required size suitably tied to the reinforcement to ensure that they are in correct position during concreting.

In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates shall be used as directed by EIC.

Tolerance on Placing of Reinforcement : Unless otherwise specified by the EIC, reinforcement shall be placed within the following tolerances:

	Tolerance in spacing
(a) For effective depth, 200 mm or less	+ 10 mm
(b) For effective depth, more than 200 mm	+ 15 mm

Minimum cover in structural members shall be maintained as for moderate exposure. However, in slabs (excluding roof slab, chajjas, fins) mild exposure would be permitted. The minimum nominal cover to meet durability requirements shall be as under :

Exposure	Nominal Concrete Cover In mm not Less than
Mild	20
Moderate	30
Severe	45
Very Severe	50
Extreme	75

# Thermo Mechanically Treated Bars (TMT- Bars)

## Standards & Specification Unit

### Correction Slip No- 6

#### Introduction:

Thermo Mechanically Treated (TMT) bars is a recent technological advancement for production of high strength deformed steel bars for concrete reinforcement. In this process higher strength is obtained by thermo mechanical treatment, where in the steel bars get intensive cooling immediately after rolling. Sudden reduction in temperature creates a hardened surface layer with the internal core still being hot. While further cooling in atmosphere, tempering takes place by the heat from the core. This process is expected to improve the properties of strength and ductility of the bars.

#### Advantages:

Generally, the higher strength in steel can be obtained by increasing carbon content, micro alloying, thermo mechanical treatment or cold twisting. So far in india, cold twisting of bars was used extensively for production of high strength bars. These bars can easily be identified by the two main ribs being helical, here as in hot rolled bars these ribs are straight. In the case of TMT bars the higher strength is obtained by thermo mechanical treatment and the carbon content also has been brought down leading to improved ductility.

#### Permission to use:

However, it may be noted that deliberations are going on at the Bureau of Indian Standards (BIS) for making appropriate provisions in relevent BIS codes and it is expected that this will be done shortly. Meanwhile, the properties of these bars have been examined in this office and it has now been decided that these bars may be allowed to be used in CPWD works.

#### Properties:

This steel is currently being produced in various grades by M/S Steel Authority of India Ltd. (SAIL), M/S Tata Steel & M/S Rashtriya Ispat Nigam Ltd. The trade names for these bars are SAIL- TMT-TISCON-TMT and REBARS respectively. The grades, chemical properties and mechanical properties are indicated in below Table:

SL.No	M/S Sail	M/S Tata Steel	M/S Rashtriya Ispat Nigam Ltd.	Yield Stress As per IS : 1786
1	SAIL TMT 415	TISCON TMT 42	REBARS 415	415 N/MMF
2	SAIL TMT 500	TISCON TMT 50	REBARS 500	500 N/MMF
3	SAIL TMT 520			530 N/MMF

Table - II  
CHEMICAL COMPOSITION IN %

IS – 1786 FE 415	Sail TMT All Grades		Tiscon TMT-42		TMT - 50	Vizag Steel (RINL) Rebarsall Grades
<b>Carbon</b>	<b>0.30</b>	<b>0.25</b>	<b>0.17</b>	<b>0.19</b>	<b>0.19</b>	<b>0.20</b>
<b>Sulphur</b>	<b>0.06</b>	<b>0.05</b>	<b>0.045</b>	<b>.045</b>	<b>0.045</b>	<b>0.04</b>
<b>Phosphorus</b>	<b>0.06</b>	<b>0.05</b>	<b>0.045</b>	<b>.05</b>	<b>0.05</b>	<b>0.05</b>
<b>Sulphur/Phosphorus</b>	<b>0.11</b>	<b>0.10</b>	<b>0.90</b>	<b>0.090</b>	<b>0.09</b>	<b>0.09</b>

Table – III  
Mechanical Properties

	IS - 1786	SAIL - TMT			TISCO N		Vizag Steel (RINL) Rebars	
Grade	Fe 415				TMT-42	TMT-50	Fe 415	Fe 500
Yield Strength	415				450	530	460	540
Tensile Strength	485				510	580	520	585
Elongation in %	14.5				20	18	20	18

**Limitations :**

Standard table of Sp – 16 ( Design Aid to Is :456) can be used for utilizing these bars in the design process. However, there are limitations when it comes to using the strengths higher than 415 Mpa in Earthquake prone area IS : 13920 forbids using strengths higher than 415 Mpa under following situations.

The structure is located in seismic zone IV & V.

- i. The structure is located in seismic zone – III and has the importance factor (I) greater than 1.0.
- ii. The structure is located in seismic zone – III and is an industrial structure.
- iii. The structure is located in seismic zone – III and is more than 5 story high.

While every care shall be taken to avoid mixing different types and grades of bars in the same structure members as main reinforcement to satisfy clause to IS : 456, the technical circular No.9 issued by CDO vide EE(D) III/IJS/80/199-298 dated 8.4.82 can be used as a guide under exigencies where two grades type of bars are to be used in the same building.

This circular does not cover use of corrosion resistant steels (CRS) bars.

**Identification:**

Care shall also be taken to properly identify these bars at site. The staff shall be specially trained for looking for identification marks on these bars. While TISCON bars are available with embossed marks on their bars, SAIL – TMT are yet to do so. Currently SAIL is providing Bundled bars which are colour coded yellow for TMT 500 and Green for TMT 550 ( No colour code for TMT 415) at the cut face at ends along with a tally indicating the grade with each bundle Rashtriya Ispat Nigams's rebar can be identified with in-Signia which is embossed on every rebar can be identified by means of colour coding. Grade Fe 415 is coded with Blue colour and Fe 500 is coded with Blue Green colour. Hence, it will be advised to see that only one grade/type of bars are brought to site and used in the project after conducting tests for each lot.

**T.S. 6. PLASTER WORK****Inside plaster :**

Cement plaster shall be of 15mm thick with cement mortar 1 : 3  
(1 cement : 3 fine sand )

**Scaffolding -**

wooden ballies, bamboos, planks, treaties and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

**Preparation of Background –**

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface be roughened by wire brushing it is not hard and hacking if it is hard. In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retards is left on the surface. Trimming of projections on brick/concrete surfaces where necessary shall be carried out to get an even surface. Raking of joints in case of masonry work where necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry, such areas shall be moistened again.

**Outside plaster :**

Providing and applying 20mm thick sand faced cement plaster walls upto height 10 meters above ground level consisting of 12 mm thick backing coat of C.M. 1 : 3 [1 cement : 3 sand] and 8mm thick finishing coat in C.M. 1 : 1 [1 cement : 1 sand] etc. comp.

**Materials :**

Water shall conform to M-1 cement mortar shall conform to M-8

**Workmanship :**

The work shall be carried out in two coats. The backing coat [basecoat] shall be 12mm thick in C.M. 1 : 3 . The specifications of shall be followed except that the thickness of back coat shall be 12mm average and the proportion shall be of cement mortar 1 : 3 [1 cement : 3 sand]

Before the first coat hardens its surface shall be beaten up by edges of wooden tapers and close dents shall be made on the surface subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days, depending upon the weather conditions. The surface shall not be allowed to dry during this period.

The second coat shall be completed to 8mm thickness in C.M. 1 : 1 as described above, including raising sand facing by bushing. The sample of sand face shall be got approved before the work is started. The whole work shall be carried out uniformly as per sample approved.

For external plaster, the plastering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are reedit and the temporary supports of the ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

#### **Application of Plaster**

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

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

In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically. When recommending the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and nearer that 15 cms. to any corners or arises. It shall not be closed on the body of features such as plaster bands and cornices not at the corners or arises. Horizontal points in plaster work shall not also occur on parapet tops and copings as those invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

Each coat shall be kept damp continuously till the next coat is applied for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking or walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air to dry weather shall be prevented by hanging mattings or gunny bags on the outside of the plaster and keeping them wet.

#### **Water proof plaster :**

The relevant specifications of Item No.12 shall be followed except that the water proofing materials as cement or approved make as per I.S. 9130-1979 shall be added to the cement at the rate specified or as directed by the Engineer-in-charge. The proportion of water proofing materials to be by the manufacturer of the water proofing materials.

#### **I.P.S flooring :**

I.P.S flooring shall be 40mm thick in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20mm. nominal size ) with a floating coat of neat cement.

The cement concrete flooring of 40mm thick (average) is to be laid as per the site conditions. The concrete shall be mixed in a mechanical mixer at the work. Hand mixing may be allowed for smaller quantities of work and in case of failure of machineries or as permitted by the Engineer-in-charge. It shall be carried out on a watertight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mechanical mixing shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce dense concrete of required workability for the purpose. Flooring of specified thickness shall be laid in accordance with the approved pattern or as directed. Finishing operation shall start shortly after the cessation or beating and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be left for some time till moisture mixed with water to form thick slurry and spread over the surface while the concrete is still green. Use of dry cement or cement and sand mixture sprinkled on this surface to stiffen the concrete or absorb excessive moisture shall not be permitted. The cement slurry shall then be properly pressed twice by means of iron floats, once when the slurry is applied and the second time when cement starts setting and finished floated smooth. The surface shall be marked with string or B.R.C fabric jali to make the surface non-slippery as and when directed. The junction of floors with wall plaster, dado or skirting shall be rounded off where so required upto 25mm radius flooring in lavatories and bath rooms shall be laid after fixing of water closet and squatting pans and floor traps which shall be plugged while

laying the floors and opened after the floors are completed. Any damage done to the water supply or sanitary fittings during execution of work shall be made good.

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

The formwork shall be provided if necessary as directed by the Engineer-in-charge. Concreting shall be done as per alternate bay method with necessary centering either by mastic or cement mortar as directed.

**Filling with excavated earth :**

The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats, mortar dropping etc. and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the but ends of crowbars, where rammer cannot be used.

The side slopes of reservoir shall be similarly filled with earth in layers not exceeding 20 cms. adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finishing level, the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

The finished level of filling shall be kept to shape intended to be given to floor.

The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth.

Under no circumstances black cotton soil be used for filling the side slopes and trenches.

**Snowcem, Distemper, Oil paint :**

**General :**

Preparation of surface & priming coat :

The surface shall be thoroughly brushed free from mortar dropping and other foreign matter and sand papered smooth.

A priming coat of whiting shall be applied over the prepared surface in case of water-bound distempering and distemper primer or cement primer shall be applied in the case of oil bound distemper. No white washing coat shall be used as a priming coat for distemper.

**Application :**

After the primer coat has dried for at least 48 hours, the entire surface shall be coated uniformly with proper distemper brushes in horizontal strokes, immediately followed by vertical ones which together shall constitute one coat.

**Scaffolding :**

Where scaffolding is necessary it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white or colour washed. A properly secured strong and well-tied suspended platform (zoola) may be used for white washing. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary.

**Snowcem :**

Finishing wall with water proofing cement paint (snowcem) on undecorated wall surface) three coats) to give and approved brand and manufacture and required shape even shade after thoroughly brushing to surface to remove all dirt and remains of loose powdered materials.

The surface shall be thoroughly scrapped clean, finishing walls shall be completely cleaned before applying snowcem or water proof cement paint. The shade and quality must be approved by Engineer-in-charge of the work before starting the work. The snowcem shall be applied with the fine brush and allowed to set before second coat is applied. The rate shall include necessary scaffolding, tools and plants and sufficient watering etc. complete.

The work shall be carried out to the entire satisfaction of the Engineer-in-charge of the work and in best workmanship like manner as per specification of manufacturer or as directed.

**Oil paint :**

All doors, windows, ventilators, shutters, railing, all fabricated items, motors, pumps, all interconnecting piping above ground level etc. shall be colored with two coats of approved make oil paint strictly as directed by Engineer-in-charge.

**Distempering :**

Distempering shall be of the oil or water bound type as specified.

Material :

Dry distemper or oil bound washable distemper of approved brand and manufacture for water bound and oil bound respectively conforming to IS:428 shall be used. The proportions of the mix shall be as per the approved manufacturer's instructions.

The dry distemper shall be stirred slowly in clean warm water using 0.6 liter of water per kg. of distemper or as specified by the approved makers. The mixture shall be well stirred before and during use to maintain an even consistency.

Thinner as stipulated by approved manufacturer shall be used in case of distemper for oil bound type. Dry distemper shall not be mixed in larger quantity than is actually required for one day's work.

**G.I Railing :**

The railing shall be fabricated from G.I pipes generally conforming to IS. They shall consist of horizontal pipes welded at a spacing of not more than 450mm to vertical balustrade pipes of 40mm dia. The vertical pipes shall be spaced at 1m c/c. The fabricated railing shall be installed using 6 mm thick MS base plate and 12mm dia MS 'J' bolts. The exposed faces shall be painted with 3 coats of enamel paint of approved quality with a basecoat.

**M.S. Ladder :**

The M.S ladder shall be used where access to elevated area is essential for operation and maintenance. It shall be fabricated from M.S angles and channel section. The span of the ladder shall be not less than 60 cms. The angles used shall not be less than ISA 25 × 25 × 6 mm. A checkered plate of thickness 6mm shall be provided for every step. For ease in climbing the pitch of ladder shall be restricted to 60 degree. The rise of the steps shall be restricted to 25 cm. All M.S surfaces shall be coated with epoxy to prevent the corrosion. The railing for the ladder shall be fabricated from 25mm GI pipes.

## **PREAMBLE TO DATA SHEET**

1. The Agency should confirm both the levels and layout of the Head Works as per the requirement of the inter-related Structures and design accordingly. No Extra payment shall be made by the Department to the Agency for the extra excavation or for the raised structure above Ground Level.
2. In case of shifting of the Head Works is to be carried out due to any reason, the Agency shall be bound to carry out all the Structures of the Head Works at the new site and the design is to be carried out accordingly without any extra claims.
3. All the Sumps should be designed together for positive Suction only. Generally Department considers 3 meters Residual Head on Ground Level near Sump. The Depth of Excavation can be considered accordingly except in case of HGLR.



## Design Requirement

### (A) Design requirements of RCC U.G. Sump

Sr. No.	Parameters	Details
	<b>Location</b>	<b>Location BHRAHAMWADA</b>
	<b>Capacity of sump ( in litre)</b>	<b>Capacity</b> Race-Course No. 305 10.00 lacs
1	<b>Average ground level of pumping station plot</b>	As per Site
2	<b>Bottom level of the Sump</b>	As per Site, minimum 3mt below GL
3	<b>Minimum water level in the sump (m) suction pit</b>	4.00 meter & Above(site situation as per design)
4	<b>Maximum water level in the sump (m) RL</b>	As per Site
5	<b>Water depth minimum</b>	4.0 meter & Above(site situation as per design)
6	<b>Free board</b>	0.30 meter minimum (below beam bottom)
7	<b>Inlet size of Pumping Main &amp; Type</b>	AS per requirement
	<b>Size of over flow pipe</b>	AS per requirement
	<b>Size of Washout pipe</b>	AS per requirement
8	<b>Length of pipes</b>	From container to GI (vertically) up to Duck foot Bend, and minimum 5.0 meter along ground after edge of shaft (Horizontally)
9	<b>Type of structure</b>	RCC Rectangular type with Top Flat slab As per design/plan
10	<b>Grade of Concrete</b>	RCC –M300
11	<b>Steel</b>	FE 500/415 TMT Steel Confirming to Relevant IS
12	<b>SBC</b>	As per actual SBC received on site.
13	<b>Shape of Sump</b>	Rectangular with Top Flat slab
14	<b>IS</b>	The design of RCC Sumps shall be in accordance with IS-1893-(Part-I) “Criteria for Earth quake Resistant Design of Structures” Part –I General provisions and Buildings and IS-1893-(Part-II (2002) “Liquid Retaining Tanks (Elevated and Ground supported “and IS 875 Part-III, IS13920, IS 4326.

## **ITEM WISE TECHNICAL SPECIFICATIONS**

### **R.C.C. ESR 3 Lac Liter Capacity**

#### **Item No.1:**

**Providing and erecting RCC elevated reservoir of 3.0 lac capacity compiling provisions of Relevant Indian standards. All types of labour and material charges of lowering, laying, erecting, hosting and joining of pipes assembly of inlet, outlet, overflow, washout and bypass arrangement as per design and drawing. Providing and fixing any accessories CI man hole cover and frame, water table indicator, lighting conductor. GI pipe railing around walking at roof level, RCC spiral staircase with adequate tie beams, staircase footing, RCC chambers for valves, ventilation shaft etc.**

**Minimum concrete grade M:300**

**Steel TMT (FE500) Or higher grade reinforcing bars confirming to IS 1786/1139 Or CRS/TMT bars shall be used as per specification.**

**LSL 17.0 MT from GL in Seismic zone-4**

**ESRS shell type as per design Note: The structural design of ESR shall be in accordance with provisions of relevant Indian Standards**

**(1) I.S. 3370 part I & II 2009 or latest revised**

**(1.1) I.S. 3370 part III & 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**

## **EARTHWORKS**

#### **Applicable Codes**

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

a) IS 783 - 1985 - Code of practice for laying of concrete pipes.

b) IS 3764 - 1992 - Excavation work - Code of Safety.

c) IS 2720 Methods of test for soils:

(Part-1) -1983- Part 1 Preparation of dry soil samples for various tests.

(Part-2) - 1986-Part 2 Determination of Water Content.

(Part-4) - 1985-Part 4 Grain size analysis.

(Part-5) - 1985-Part 5 Determination of liquid and plastic limit.

(Part-7) - 1980 -Part 7 Determination of water content - dry density relation using light compaction.

(Part-9) - 1971 -Part 9 Determination of dry density - moisture content by constant weight of soil method.

(Part-14) – 1983 -Part 14 Determination of density index (relative density) of cohesionless soils.

(Part-22) – 1978 -Part 22 Determination of organic matter.

(Part-26) – 1987 -Part 26 Determination of pH Value.

(Part-27) – 1987-Part 27 Determination of total soluble sulphates

(Part-28) – 1974 -Part 28 Determination of dry density of soils in place, by the sand replacement method.

(Part-33) – 1971 -Part 33 Determination of the density in place by the ring and water replacement method.

(Part-34) – 1972-Part 34 Determination of density of soil in place by rubber balloon method.

(Part-38) – 1976 - Part 38 Compaction control test (Hilf Method ).

#### **General**

The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer's Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches,

pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and leveling the same so as to provide natural drainage. Rock/soil & murrum excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

Topsoil shall be stock piled separately for later re-use.

### **Clearing**

The area to be excavated/filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer's Representative. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

### **Excavation**

All excavation work shall be carried out by mechanical equipment unless, in the opinion of Employer's Representative, the work involved requires it to be carried out by manual methods.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Employer's Representative. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care.

Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer's Representative. The final excavation should be carried out just prior to laying the blinding course.

To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer's Representative. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete of the same class as in the foundation resting thereon, up to the required elevation at no cost to the Employer.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer's Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

### **Rock**

#### **General:**

'Rock' means a natural aggregate of mineral crystals, which for its excavation would normally require the use of heavy pneumatic/hydraulic breaker and/or cutting equipment or explosives. the term shall exclude any material that can be removed by ordinary excavating machinery and which in any individual mass has a volume not exceeding 1m<sup>3</sup> or 0.25m<sup>3</sup> where the net width of excavation is less than 2 m. Ordinary excavating machinery means a hydraulic back hoe with rated output of 50 kW or less.

Before classification of material as rock the Contractor shall demonstrate to the satisfaction of the Employer's Representative his inability to excavate it without resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. Excavation by the use of explosive will not normally be permitted except for pipeline.

Material shall not be classified as rock unless the Employer's Representative has agreed to such classification on the basis of such a demonstration before its excavation. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the Employer's Representative to enable the extent of the rock excavation to be determined.

#### **Excavation by the Use of Explosives**

Unless otherwise stated herein, I.S. Specification " IS:4081: Safety Code for Blasting and related Drilling Operations" shall be followed. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the

rock below and beyond the lines specified for the excavation, in the soundest possible condition. The quantity and strength of explosives used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Employer's Representative, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Employer's Representative at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

The contractor shall obtain a valid Blasting License from the authorities concerned. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as away as possible from the area to be blasted. Employer's Representative's prior approval shall be taken for the location proposed for the magazine.

In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

For blasting operations, the following points shall be observed.

- i) Contractor shall employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.
- ii) Before any blasting is carried out, Contractor shall intimate Employer's Representative and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.
- iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle. The area shall also be given a warning by sounding a distinguishing whistle.
- iv) The blasting of rock near any existing buildings, equipments or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Employer's Representative, a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.
- v) The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.
- vi) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming, which may consist of sand or stone dust or similar inert material.
- vii) Contractor shall preferably detonate the explosives electrically.
- viii) The explosives shall be exploded by means of a primer, which shall be fired by detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.
- ix) In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.
- x) Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.
- xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level.

Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Employer's Representative, with concrete of strength not less than M10. Stopping in rock excavation shall be done by hand trimming.

xii) Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of explosives, or any other Authority duly constituted under the State and / or Union Government as applicable at the place of excavation.

### **Stripping Loose Rock**

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Employer's Representative, to fall or otherwise endanger the workmen, equipment, or the work shall

be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion, which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Employer's Representative, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

**Classification of Strata :**

The decision regarding, classification of strata shall rest with the Engineer in charge and his decision shall be final and binding to the contractor.

All the materials encountered in the excavation shall be classified as under :-

**ORDINARY SOIL AND SOFT MURRUM :**

These will include all materials of an earthy or sandy nature, which can be easily ploughed or small shingle, and gravel, which can be easily removed.

**HARD MURRUM :**

This shall include all kinds of disintegrated rock or shale or inundated clay which can be removed with a shovel without difficulty and which do not require blasting.

**SOFT ROCK :**

This shall include all materials which is rock or hard conglomerate, all decomposed and whether rock, highly fissured rock old masonry and also soft rock boulders bigger than 1/2 cubic meter and other varieties of rock. Which do not require blasting and which can be removed with the pie crowbars wedges and hammer.

**HARD ROCK :**

This shall include rocks, occurring in masses, which could best be removed by chiseling or by blasting.

**Fill, Backfilling and Site Grading**

**General:**

All fill material shall be subject to the Employer's Representative's approval. If any material is rejected by Employer's Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer's Representative after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer's Representative.

**Material**

To the extent available, selected surplus spoil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer's Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Topsoil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer's Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

**Filling in pits and trenches around foundations of structures, walls, etc.**

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Employer's Representative. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Employer's Representative is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Employer's Representative.

**Plinth Filling**

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15cm, watered and compacted with mechanical compaction machines. The Employer's Representative may, however, permit manual compaction by hand tampers where he is satisfied that mechanical compaction is not possible. The finished level of the filling shall be trimmed to the level/slope specified.

The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Employer's Representative obtained prior

to commencing filling.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

#### **Sand Filling in Plinth and Other Places**

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer's Representative has inspected and approved the fill.

#### **Filling in Trenches**

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated taking due care so that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the center line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the center line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling upto a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murrum, etc. The filling up to the level of the centerline of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centerline of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

#### **General Site Grading**

Site grading shall be carried out as indicated in the drawings and as approved by the Employer's Representative. Excavation shall be carried out as specified in the Employer's Requirements. Filling and compaction shall be carried out as specified under Clause 2.7 and elsewhere unless otherwise indicated below.

If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and leveled uniformly and compacted as indicated in Clause 2.7 before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip.

If so specified, the rock as obtained from excavation may be used for filling and leveling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12-ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

#### **Fill Density**

The compaction, under the plant road area and building plinths shall comply with minimum 95% compaction by Standard Proctor at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained. In other areas the soil should be backfilled and compacted suitably as specified by the Engineer.

#### **Timber Shoring**

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Employer's Representative. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by

horizontal walling of strong wood at maximum 1.2 meter spacing, strutted with ballies or as approved by the Employer's Representative. The length of the ballie struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Employer's Representative. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer's Representative.

The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacing shall be subject to the approval of the Employer's Representative. In all other respects, the Employer's Requirements for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

#### **Dewatering**

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Employer's Representative, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Employer's Representative, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

#### **Rain Water Drainage**

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Employer's Representative.

# **CONCRETE**

## **Applicable Codes**

### **Materials**

1. IS.269 Specification for 33 grade ordinary Portland cement.
2. IS.455 Specification for Portland slag cement.
3. IS.1489 Specification for Portland-Pozzolana cement (Part 1&2).
4. IS: 8112 Specification for 43 grade ordinary Portland cement.
5. IS: 12269 Specification for 53 grade ordinary Portland cement.
6. IS: 12330 Specification for sulphate resisting Portland cement.
7. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.
8. IS: 432 Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement. (Part 1&2)
9. IS: 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.
10. IS: 1566 Specification for hard-drawn steel wire fabric for concrete reinforcement.
11. IS: 9103 Specification for admixtures for concrete.
12. IS: 2645 Specification for integral cement water- proofing compounds
13. IS: 4990 Specification for plywood for concrete shuttering work.

### **Material Testing**

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

### **Material Storage**

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

### **Concrete Mix Design**

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

### **Concrete Testing**

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

### **Equipments**

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

### **Codes Of Practice**

- 1) IS: 456 Code of practice for plain and reinforced concrete.
- 2) IS: 457 Code of practice for general construction of plain and reinforced concrete for dams



and other massive structures.

- 3) IS: 3370 Code of practice for concrete structures for storage of liquids (Parts 1 to 4)
- 4) IS: 3935 Code of practice for composite construction.
- 5) IS: 2204 Code of practice for construction of reinforced concrete shell roof.
- 6) IS: 2210 Criteria for the design of reinforced concrete shell structures and folded plates.
- 7) IS: 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
- 8) IS: 5525 Recommendation for detailing of reinforcement in reinforced concrete works.
- 9) IS: 2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
- 10) IS: 9417 Specification for welding cold worked bars for reinforced concrete construction.
- 11) IS: 3558 Code of practice for use of immersion vibrators for consolidating concrete.
- 12) IS: 3414 Code of practice for design and installation of joints in buildings.
- 13) IS: 4326 Code of practice for earthquake resistant design and construction of building.
- 14) IS: 4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)
- 15) IS: 2571 Code of practice for laying inset cement concrete flooring.
- 16) IS: 7861 Code of practice for extreme weather concreting: Part 1  
Recommended practice for hot weather concreting.

#### Construction Safety

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

#### General

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

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

#### Materials

##### Cement:

Unless otherwise called for by the Engineer-in-charge, cement shall be ordinary Portland cement conforming to IS: 269, IS: 8112 or IS: 12269.

Where Portland pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.

Only one type of cement shall be used in any one mix. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from the ENGINEER INCHARGE.

Cement, which is not used within 90 days from its date of manufacture, shall be tested at a laboratory approved by the ENGINEER INCHARGE and until the results of such tests are found satisfactory, it shall not be used in any work.

##### Aggregates (General):

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS: 383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Aggregates shall be washed and screened before use where necessary or if directed by the Engineer-in-charge.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long-term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

Plums 160 mm and above of a reasonable size may be used in mass concrete fill where directed. Plums shall not constitute more than 20% by volume of the concrete.

#### **Water**

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

#### **Reinforcement**

All reinforcement steel shall be TMT steel grade – Fe415 conforming to relevant I.S. for water retaining structure

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

#### **Admixtures**

Accelerating, retarding, water reducing and air entraining admixtures shall conform to IS: 9103 and integral water proofing admixtures to IS: 2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the Engineer-in-charge. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

#### **Wastage**

Wastage allowance for cement and steel shall be considered in the item rate and no extra payment shall become payable to the Contractor on any account.

#### **Samples and Tests**

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

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the Engineer-in-charge samples shall also be got tested by the Contractor in a laboratory approved by the Engineer-in-charge at no extra cost to Employer. Engineer-in-charge may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests. Sampling and testing shall be as per IS: 2386 under the supervision of the Engineer-in-charge.

Water to be used shall be tested to comply with requirements of IS: 456.

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

#### **Storing of Materials**

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

The Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by the Engineer-in-charge. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

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

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

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

#### **Concrete**

##### **General**

Concrete grade shall be as designated on drawings. In concrete grade M15, M25 etc. the number

represents the specified characteristic compressive strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS: 456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of grade M5, M7.5 and M10 shall be NOMINAL MIX CONCRETE whereas all other grades, M15 and above, shall be DESIGN MIX CONCRETE.

### **Design Mix Concrete**

#### **(a) Mix Design & Testing**

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

The minimum cement content for Design Mix Concrete shall be as per Appendix-A of IS: 456 or as given below, whichever is higher.

<b>Grade of Concrete</b>	<b>Minimum Cement Content in Kg/Cu. m of Concrete</b>
M15	260
M20	315
M25	360
M30	400

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

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

<b>Grade of Concrete</b>	<b>Minimum Compressive Strength N/sq.mm at 7 days</b>	<b>Specified Characteristic Compressive Strength N/sq.mm at 28 days</b>
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer-in-charge is given below:

<b>Structure/Member</b>	<b>Slump in millimeters</b>	
	<b>Maximum</b>	<b>Minimum</b>
Reinforced foundation walls and footings	75	25
Plain footings, caissons and substructure walls		
Slabs, Beams and reinforced walls		
Pump & miscellaneous Equipment Foundations	100	25
Building columns	75	25
Pavements	100 50 50 50	25
Heavy mass construction		25
		25
		25

#### **(b) Batching & Mixing of Concrete:**

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

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the Engineer-in-charge shall be maintained. Each

time the work stops, the mixer shall be cleaned out, and while recommencing; the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the Engineer-in-charge. Sampling and testing of strength and workability of concrete shall be as per IS: 1199, IS: 516 and IS: 456, IS 3370.

### **Nominal Mix Concrete**

#### **(a) Mix Design & Testing**

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS: 456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per Table 3 of IS: 456. However it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

#### **(b) Batching & Mixing of Concrete**

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only.

### **Formwork**

Formwork shall be all inclusive and shall consist of but not be limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, false work, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the Engineer-in-charge, the drawings and calculations for the design of the formwork shall be submitted to the Engineer-in-charge for approval.

Formwork shall be designed to fulfill the following requirements:

- (a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
- (b) Made of suitable materials.
- (c) Capable of providing concrete of the correct shape and surface finishes within the specified tolerance limits.
- (d) Capable of withstanding without deflection the worst combination of self weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
- (e) Capable of easy striking out without shock, disturbance or damage to the concrete.
- (f) Soffit forms capable of imparting a camber if required.
- (g) Soffit forms and supports capable of being left in position if required.
- (h) Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of the Engineer-in-charge. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the Engineer-in-charge. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

Where specified all corners and angles exposed in the finished structure shall have chamfers or fillets

of 20 mm x 20 mm size.

Forms for substructure may be omitted when, in the opinion of the Engineer-in-charge, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the Engineer-in-charge, than that required as per drawing to compensate for irregularities in excavation.

The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the Engineer-in-charge. The Contractor shall temporarily and securely fix items to be cast (embedment/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor's cost.

The striking time for formwork shall be determined based on the following requirements:

- (a) Development of adequate concrete strength;
- (b) Permissible deflection at time of striking form work;
- (c) Curing procedure employed - its efficiency and effectiveness;
- (d) Subsequent surface treatment to be done;
- (e) Prevention of thermal cracking at re-entrant angles;
- (f) Ambient temperatures; and
- (g) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

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

### **Reinforcement Workmanship**

Reinforcing bars supplied bent or in coils shall be straightened cold without damage. No bending shall be done when ambient temperature is below 5°C. Local warming may be permitted if steel is kept below 10° C.

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

Re-bending or straightening incorrectly bent bars shall not be done without the approval of the Engineer-in-charge.

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

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

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

### **Tolerances**

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

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

The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances given below:

Deviation from specified dimensions of cross section of columns and beams	- 6 mm + 12 mm
Deviations from dimensions of footings (Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels	

Dimension in plan	- 12 mm + 50 mm
Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm
Thickness	± 0.05 times the specified thickness

### **Preparation Prior to Concrete Placement**

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

All arrangements-formwork, equipment and proposed procedure, shall be approved by the Engineer-in-charge. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

### **Transporting, Placing and Compacting Concrete**

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

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

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

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

- (a) Continuously between construction joints and pre- determined abutments.
- (b) Without disturbance to forms or reinforcement.
- (c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.
- (d) Without dropping in a manner that could cause segregation or shock.
- (e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.
- (f) Do not place if the workability is such that full compaction cannot be achieved.
- (g) Without disturbing the unsupported sides of excavations; prevent contamination of with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.
- (h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
- (i) Ensure that there is no damage or displacement to sheet membranes.
- (j) Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration shall be avoided.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the ENGINEER INCHARGE. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the ENGINEER INCHARGE. Concrete shall be protected against damage until final acceptance.

### **Mass Concrete Works**

Sequence of pouring for mass concrete works shall be as approved by the ENGINEER INCHARGE.

The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

### **Curing**

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

- (a) Premature drying out, particularly by solar radiation and wind;
- (b) Leaching out by rain and flowing water;
- (c) Rapid cooling during the first few days after placing;
- (d) High internal thermal gradients;
- (e) Low temperature or frost;
- (f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.**

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

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

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

### **Construction Joints and Keys**

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

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

Before resuming concreting on a surface, which has hardened all laitance and loose stone, shall be thoroughly removed by wire brushing/hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and horizontal layers.

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

### **Foundation Bedding**

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

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

### **Finishes**

#### **General**

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

#### **Surface Finish Type F1**

The main requirement is that of dense, well-compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade, which will receive waterproofing treatment, the concrete shall be free of surface irregularities, which would interfere with proper and effective application of waterproofing material specified for use.

#### **Surface Finish Type F2**

The appearance shall be that of a smooth dense, well-compacted concrete showing the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

### **Surface Finish Type F3**

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discolouration, blemishes, airholes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by the Contractor.

### **Integral Cement Finish on Concrete Floor**

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

### **Repair and Replacement of Unsatisfactory Concrete**

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the ENGINEER INCHARGE who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the Engineer-in-charge.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the ENGINEER INCHARGE as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the Engineer-in-charge.

### **Vacuum Dewatering of Slabs**

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

### **Hot Weather Requirements**

Concreting during hot weather shall be carried out as per IS: 7861 (Part I).

Adequate provisions shall be made to lower concrete temperatures, which shall not exceed 40° C at the time of placement of fresh concrete.

Where directed by the ENGINEER INCHARGE, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

### **Cold Weather Requirements**

Concreting during cold weather shall be carried out as per IS: 7861 (Part II).

The ambient temperature during placement and up to final set shall not fall below 5 Deg.C. Approved antifreeze/accelerating additives shall be used where directed.

For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

### **Liquid Retaining Structures**

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.

The minimum level of surface finish for liquid retaining structures shall be Type F2. All such structures shall be hydro-tested.

The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

The Contractor shall also make all temporary arrangements that may have to be made to ensure stability of the structures during construction.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the Engineer-in-charge. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the Engineer-in-charge at no extra cost to the EMPLOYER.

### **Testing Concrete Structures for Leakage**

Hydrostatic test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the Engineer-in-charge, as described below:



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

In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. Over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure. The ENGINEER INCHARGE shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

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

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

### **Optional Tests**

If the ENGINEER INCHARGE feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the ENGINEER INCHARGE, as per relevant IS Codes. Contractor shall have to pay for these tests.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the ENGINEER INCHARGE reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. The ENGINEER INCHARGE also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Employer. Alternately ENGINEER INCHARGE also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

### **Grouting**

#### **Standard Grout**

Grout shall be provided as specified on the drawings.

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

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

Non-Shrink Grout: Non –shrink grout where required shall be provided in strict accordance with the manufacturer's instructions / specifications on the drawings

### **General**

#### **Inspection:**

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of Engineer-in-charge. Materials rejected by Engineer-in-charge shall be expressly removed from site and shall be replaced by Contractor immediately.

#### **Clean-Up:**

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

clean.

**Acceptance Criteria:**

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

- a) properties of constituent materials;
- b) characteristic compressive strength;
- c) specified mix proportions;
- d) minimum cement content;
- e) maximum free-water/cement ratio;
- f) workability;
- g) temperature of fresh concrete;
- h) density of fully compacted concrete;
- i) cover to embedded steel;
- j) Curing;
- k) tolerances in dimensions;
- l) tolerances in levels;
- m) durability;
- n) surface finishes;
- o) special requirements such as;
  - i) water tightness
  - ii) resistance to aggressive chemicals
  - iii) resistance to freezing and thawing
  - iv) very high strength
  - v) improved fire resistance
  - vi) wear resistance
  - vii) resistance to early thermal cracking

The Engineer-in-charge 's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

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

**Water stops**

**Material:**

The material for the PVC water stops shall be a plastic compound with the basic resin of polyvinyl chloride and additional resins, plasticizers, inhibitors, which satisfies the performance characteristics specified below as per IS:12200. Testing shall be in accordance with IS:8543.

- a) Tensile strength : 3.6 N/mm<sup>2</sup> minimum
- b) Ultimate elongation : 300% minimum
- c) Tear resistance : 4.9 N/mm<sup>2</sup> minimum
- d) Stiffness in flexure : 2.46 N/mm<sup>2</sup> minimum
- e) Accelerated extraction
- i) Tensile strength : 10.50 N/mm<sup>2</sup> minimum
- ii) Ultimate elongation : 250% minimum
- (f) Effect of Alkali : 7 days
  - i) Weight increase : 0.10% maximum
  - ii) Weight decrease : 0.10% maximum
  - iii) Hardness change :  $\pm 5$  points
- (g) Effect of Alkali : 28 days
  - i) Weight increase: 0.40% maximum
  - ii) Weight decrease : 0.30% maximum
  - iii) Dimension change :  $\pm 1\%$

PVC water stops shall be either of the bar type, serrated with centre bulb and end grips for use within the concrete elements or of the surface (kicker) type for external use.

PVC water stops shall be of approved manufacture. Samples and the test certificate shall be got approved by the ENGINEER INCHARGE before procurement for incorporation in the works. Alternatively G.I. sheet of 18 gage (1.3mm) thick and 200mm wide can be used by the contractor as construction joints.

Alternatively contractors can use G.I sheet 200mm wide and 18 gauge thick as constructions joints

#### **Workmanship**

Water stops shall be cleaned before placing them in position. Oil or grease shall be removed thoroughly using water and suitable detergents.

Water stops shall be procured in long lengths as manufactured to avoid joints as far as possible. Standard L or T type of intersection pieces shall be procured for use depending on their requirement. Any non-standard junctions shall be made by cutting the pieces to profile for jointing. Lapping of water stops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions.

Water stops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the water stops embedded in concrete shall be thoroughly cleaned of all mortar/ concrete coating before resuming further concreting operations. The projecting water stop shall also be suitably supported at intervals with the reinforcement to maintain its intended position during concreting so as to ensure that it does not bend leading to formation of pockets. In addition, smaller size aggregates shall be used for concreting in this region also.

#### **Preformed Fillers and Joint Sealing Compound**

##### **Materials:**

**Preformed filler for expansion/isolation joints shall be non-extruding and resilient type of bitumen impregnated fibres conforming to IS:1838 (Part I).**

Bitumen coat to concrete/masonry surfaces for fixing the preformed bitumen filler strip shall conform to IS:702. Bitumen primer shall conform to IS:3384. Sealing compound for filling the joints above the preformed bitumen filler shall conform to Grade 'A' as per IS:1834.

##### **Workmanship**

The thickness of the preformed bitumen filler shall be 25mm for expansion joints and 50mm for isolation joints around foundation supporting rotatory equipment's. Contractor shall procure the strips of the desired thickness and width in lengths as manufactured. Assembly of small pieces/thicknesses of strips to make up the specified size shall not be permitted.

The concrete/masonry surface shall be cleaned free from dust and any loose particles. When the surface is dry, one coat of industrial blown type bitumen of grade 85/25 conforming to IS:702 shall be applied hot by brushing at the rate of 1.20 kg/sq.m. When the bitumen is still hot the preformed bitumen filler shall be pressed and held in position till it completely adheres. The surface of the filler against which further concreting/masonry work is to be done shall similarly be applied with one coat of hot bitumen at the rate of 1.20 kg/sq.m.

Sealing compound shall be heated to a pouring consistency for enabling it to run molten in a uniform manner into the joint. Before pouring the sealing compound, the vertical faces of the concrete joint shall be applied hot with a coat of bitumen primer conforming to IS: 3384 in order to improve the adhesive quality of the sealing compound.

Expansion joints between beams/slabs shall be provided with 100mm wide x 4mm thick mild steel plate at the soffit of RCC beams/slabs to support and prevent the preformed joint filler from dislodging. This plate shall be welded to an edge angle of ISA 50 x 50 x 6mm provided at the bottom corner, adjacent to the expansion joint of one of the beams/slabs, by intermittent fillet welding. Steel surfaces shall be provided with 2 coats of red oxide zinc chrome primer and 3 coats of synthetic enamel paint finish.

## **GENERAL**

### **1. Employer's Drawings**

1.1. The drawings listed in the Tender document are the Employer's drawings and are provided by the Employer as illustrative of the Specification.

1.2. All data and information furnished in the drawings by the Employer is given in good faith but the Employer does not accept the responsibility for the completeness and accuracy thereof. The same shall be verified by the Contractor promptly pointing out errors or discrepancies thereof to the Engineer.

### **2. Drawing Sheet Format**

2.1. All drawings provided by the Contractor shall be on standard size sheets, prepared on computer with AutoCAD 14 and shall show the following particulars in a title block located in the lower right hand corner, in addition to the name of Contractor and equipment manufacturer, date, scale, drawing number, revision number (R0 for drawings submitted initially, R1, R2, etc. for drawings submitted subsequently) and title.

### **The Agricultural Produce Market Committee Unjha**

A blank space of 90 mm x 100 mm shall be provided for the Engineer's approval stamp and provision shall be made for details of revisions to be recorded.

2.2. All drawings submitted by the Tenderer/Contractor shall use the English language and SI units. All drawings shall be clearly and fully cross-referenced to the other drawings as relevant.

### **3. Tender / Contract Drawings**

3.1. Drawings submitted by the Tenderer shall show all the essential items of the Plant offered together with sufficient details to enable the general arrangement of the Plant to be determined.

3.2. The drawings and documents to be provided by the Tenderer / Contractor shall be as per the schedules of price but shall not be limited to those listed:

### **4. Submissions and Approval of Drawings**

4.1. The following shall be the procedure for submission and approval of drawings:

4.1.1. The Contractor shall submit 4 copies of the drawings to the Employer. All the drawings are to be signed by the Contractor or his authorized representatives

4.1.2. The Engineer's Representative will review the drawings and, if found fit for approval, the Employer will return 2 copies to the Contractor duly approved.

4.1.3. In case the drawings/documents are not fit for approval but worth for review, the Engineer's Representative will mark the comments on the drawings and return 2 copies to the Contractor. In such case, the Contractor shall resubmit the revised drawings within two weeks as per sub-clause 5.1.1 above and the same shall be repeated till the drawings are finally approved as per sub-clause 5.1.2 above.

4.1.4. If the submitted drawings/documents are not worth for review, the Contractor will be informed accordingly.

4.1.5. On receipt of the approved drawings as per sub-clause 5.1.2 above, the Contractor shall submit floppy and documents to the employer.

4.1.6. After tests on completion, the Contractor shall submit, within 15 days of the conclusion of the tests, floppies of the "As Built Drawings" to the Employer.

4.2. When the drawings are received by the Engineer's Representative after revision by the Contractor, he will only review the revision made and hence the Contractor shall carefully identify all the revised details / dimensions and also describe the revisions in the revision block.

4.3. No drawings, with corrections made after taking the prints, will be accepted.

4.4. Approval of drawings by the Engineer shall not relieve the Contractor of his responsibility in terms of the Contract.

### **5. Delivery, Unloading and Storing at Site**

5.1. The Contractor shall be responsible for checking all materials delivered to Site and shall keep the Engineer's Representative fully informed of the state of deliveries. The Contractor shall carry out, at his cost, all instructions of Engineer or his Representative for proper unloading, preservation, maintenance, storage and security of materials delivered to Site until he fulfills all his obligations under the Contract.

5.2. The Contractor shall erect and maintain on the Site any temporary storage facility as required and approved by the Engineer.

5.3. Multiple handling and movement of materials during storage and retrieval shall be avoided.

### **6. Spare Parts:**

6.1. Spare Parts required after the taking over the Plant shall be filled up by the bidder in the price schedule.

6.2. Spares during pre-commissioning trials, commissioning tests/maintenance, guarantee etc. shall be provided by the Contractor. The necessary spares shall be brought by the Contractor prior to the pre-commissioning test so as to avoid the downtime of equipment due to non-availability of them. All these spares have to be provided as required, by Contractor free of cost.

6.3. All spare parts shall be new, unused and strictly interchangeable with the parts for which they are intended to be replacements and shall be treated and packed for long storage under the climatic conditions prevailing at the Site. Each spare part shall be clearly marked or labeled on the outside of its packing with its description, number and purpose. When more than one spare is packed in a single case or other container, a general description of its contents shall be shown on the outside of such case or container and a detailed list enclosed. All cases, containers and other packages shall be marked and numbered in an approved manner for the purpose of identification. Spares shall be delivered to Site after the completion of erection but before start of commissioning of Plant along with technical leaflets and details. Spare parts shall be indicated in the assembly drawing showing clearly the part numbers.

6.4. All cases, containers or other packages are liable to be opened for such examination as the Engineer's Representative may require and packing shall be designed to facilitate opening and thereafter re-packing. In the event of the some specific spares offered in the Contract being withdrawn from manufacture owing to changes in design of equipment or similar reasons viz., model being obsolete etc., the Contractor shall inform the Employer before such withdrawal so that the Employer can take timely alternative steps.

## **7. Tools:**

7.1. Tools shall be delivered to site just prior to Tests on Completion.

7.2. The specified tools shall not be used for the erection of the Plant being supplied and except that the Engineer may call upon the Contractor to demonstrate their use or effectiveness, they must be handed over to the Employer in a completely new and unused condition. Should the Contractor require any such tools at site for erection, he shall provide his own.

The test equipment shall include special purpose items essential to the testing or re-calibration of related items of Facilities.

# **MATERIALS AND WORKMANSHIP**

## **1. Introduction**

1.1. This part of the Specification sets out the general standards of materials to be supplied and the workmanship required to be ensured by the Contractor. All component parts of the Works shall, unless otherwise specified, comply with the provisions of employer's requirement or be subject to the approval of the Employer. Particular attention shall be paid to a neat, orderly and well-arranged installation carried out in a methodical competent manner.

## **2. Reference Specifications and Standards**

2.1. Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'B.S.') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standard Institution), Manak Bhavan, 9 Bahadur shah Zafar Marg, New Delhi 110 002, or American Society for Testing and materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American national Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or Japanese Industrial Standards (JIS) issued by Japanese Standards Association, 4-1-24, Akasaka, Minato-Ku, Tokyo 107, Japan or to any other equivalent Standard it shall be to the latest revision of that Standard at the Tender opening date.

2.2. The Contractor may propose at no extra cost to the Employer, the use of any relevant authoritative Internationally recognised Reference Standard.

2.3. All details, materials and equipment supplied and workmanship performed shall comply with the specified Standards. If Tenderer offers equipment to other Standards, the equipment/material should be equal or superior to those specified and full details of the difference shall be supplied.

2.4. In the event of conflict between this Specification and the Codes for equipment, provisions of this Specification shall govern. Certain specifications issued by national or other widely recognised bodies are referred to in this Specification. In referring to the Standard Specifications the following abbreviations are used:

IS	:	Indian Standard
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society of Testing and Materials
AWS	:	American Welding Society
AWWA	:	American Water Works Association
ISO	:	International Organization for Standardization
DIN	:	Deutsches Institute fur Normung

BS	:	British Standard
IEC	:	International Electrotechnical Commission
IEE	:	Institution of Electrical Engineers
IEEE	:	Institute of Electrical and Electronic Engineers
NEMA	:	National Electrical Manufacturers Association
AGMA	:	American Gear Manufacturer's Association

### **3. Materials - General**

3.1. All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of reputed make/approved quality, free from imperfections and selected for long life and minimum maintenance. Non-destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the Plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause.

### **4. Workmanship - General**

4.1. Workmanship and general finish shall be of first class quality and in accordance with best workshop practice.

4.2. All similar items of the Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items.

4.3. All parts, which can be worn or damaged by dust, shall be totally enclosed in dust proof housings. All materials incorporated in the Works shall be the most suitable for the duty concerned, free from imperfections and selected for long life and minimum maintenance. All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by the Contractor unless it is specifically excluded from his scope. Suitable provision by means of eyebolts or other means are to be provided to facilitate handling of all items that are too heavy or bulky for lifting and carrying by two men.

### **5. Welding**

5.1. Welding shall comply with the latest revision of the BS 5135 Code.

5.2. Welders shall be qualified in accordance with the requirement of the appropriate section of BS 4871. The Engineer shall have the right to call for further qualification from time to time from any welder who in the opinion of the Engineer does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each weldments shall clearly be identified as to its welder marking the welder's Code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures for which he has qualified, the date of such qualification, the type of defects produced and their frequency. The Engineer shall disqualify the welder whose Work requires a disproportionate amount of repairs. All procedures where required shall be qualified as per BS EN 283-3.

5.3. Inspection and quality of surveillance shall not be limited to the examination of finished welds. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.

5.4. Haphazard striking of the electrodes for establishing an arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed and examined by liquid penetration method.

5.5. Generally, a stringer bead technique shall be used with a slight oscillation of necessary to avoid slag and to minimize the number of beads needed to fill exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For all pipes above 300 mm dia., welding shall be done whenever possible, by 2 welders working simultaneously along both sides of the pipe.

5.6. The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles, burn through and excessive "such back", etc. shall be cause for rejection of welds.

5.7. Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg lengths shall not exceed the specified size by more than 1.5 mm.

5.8. All attachments such as lugs, brackets and other non-pressure parts shall also be done by qualified welders in accordance with the design details and materials specifications. Temporary attachments shall be removed in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods.

5.9. All tack welds shall be made using qualified procedure and welders, the number of size of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouging. Flame gouging may be permitted provided

gouged surfaces are ground at least by 1.0 mm below the deepest indentation.

5.10. All weld repairs shall be carried out using the approved welding procedures and welders. Re-welded areas shall be re-examined by the methods specified for the original welds and the Engineer's Representative shall duly qualify repair procedures.

## **6. Pre-heating and Post-heating Treatment**

6.1. Pre-heating and post heating treatment shall conform to the relevant application Codes. Pre-heating not exceeding 121 deg. C for all carbon steel construction above 25 mm thickness would be mandatory. Such pre-heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches/gas rings with neutral flame. The temperature shall be checked by temperature indicating crayons. However, such pre-heating will not be necessary for welds less than 6 mm size. In large diameter pipe fabricated out of plate materials, production control test plates in accordance with the BS 4870 part 1 Table 6 to represent 30% of the long seams and each welder's performance would be mandatory.

## **7. Electrodes**

7.1. All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in Work areas for drying purposes. Electrodes withdrawn from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

## **8. Examination/NDT/Radiography**

8.1. The various stages of examination and types shall be as stipulated in the respective fabrication Codes. Radiographic examination shall be carried out as per provisions of BS 2600 or BS 2910; Ultrasonic tests where called for shall be carried out as per provisions of BS 3926; magnetic particle tests shall be carried out as per BS 6072. Liquid penetration tests shall be carried out as per BS 6443.

## **9. Stainless Steel Welding**

9.1. All welding consumable such as electrodes, filler weirs, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the Engineer. Weld deposits shall have similar or higher physical properties and similar chemical composition to the members joined.

9.2. All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken in avoiding mixing of electrodes in the oven. The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.

9.3. Argon gas with purity 99.5% shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.

9.4. Non-destructive examination of the welds shall be carried out to ensure quality of weld.

9.5. The electric current for welding shall be direct current, straight polarity (electrode negative). The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

## **10. Castings**

10.1. Cast iron shall be of standard grey close-grained quality. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings, which are not machined, shall be smooth and shall be carefully fettled to remove all foundry irregularities.

10.2. Minor defects in depth not exceeding 12.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer shall be notified of large defects and no repair welding of such defects shall be carried out without prior approval of the Engineer. If the removal of metal for repair should reduce the stress resisting cross section of the casting by more than 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified to check physical, chemical analysis of casting. Major defects on casting are not acceptable. Castings repaired by welding for minor defects shall be stress-relieved after such welding. Non-destructive tests as directed by the Engineer will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine where repair welds have been properly made.

## **11. Forging**

11.1. All major stress-bearing forging shall be made to a Standard Specification. Forging shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect, which will not machine out during the final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indication, which proves to penetrate deeper than 2.5% of the finished thickness of the component, shall be reported to the Engineer giving the details like location, length, width and depth. For the magnetic particle inspection the choice of wet or dry particles shall be at the Contractor's discretion.

11.2. All forging shall be demagnetized after test and shall be heat-treated for the relief of residual stresses.

## **12. Design Life**

12.1. The Works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the Site, and with the minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The Contractor shall be called upon to demonstrate this for any component part either by service records, or evidence of similar equipment already installed elsewhere or relevant type tests. Routine maintenance and repair shall as far as possible not requires the services of highly skilled personnel.

12.2. The Plant shall be designed to provide easy access to and replacement of component parts, which are subject to wear, without the need to replace whole units. No parts in contact with water shall have a life from new to replacement or repair of less than five years.

12.3. Design features shall include the protection of Plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause, which may have a detrimental effect upon the performance or life of the Works.

12.4. Plant located outside lockable areas/building shall have additional features to prevent unauthorized operation.

## **13. Name Plate**

13.1. Each item of the Plant shall have permanently attached to it in a conspicuous position, a nameplate and rating plate. Upon these shall be engraved or stamped, the manufacturer's name, type and serial number of Plant, details of the loading and duty at which the item of Plant has been designed to operate, and such diagrams as may be required by the Engineer. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their function and proper manner of use.

13.2. Nameplates, rating plates and labels shall be of a non-flame propagating materials, either non-hygroscopic or transparent plastic with engraved lettering of a contrasting colour. Fixing shall be by means of non-corrosive screws; drive rivets or adhesives shall not be used.

13.3. Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background.

13.4. Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.

## **14. Nuts, Bolts, Studs and Washers**

14.1. Nuts, bolts, studs and washers for incorporation in the Plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut

14.2. Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.

14.3. Washers, locking devices and anti-vibration arrangements shall be provided where necessary. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.

14.4. Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All bolts, nuts and washers that are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel-bearing stainless steel.

14.5. The Contractor shall supply all holding down, alignment and leveling bolts comp. with anchorages, nuts, washers and packing required to attach the Plant to its foundations, & all bed plates, frames and other structural parts necessary to spread the loads transmitted by the Plant to concrete foundations without exceeding the design stresses.

## **15. Allowances for Wastage**

15.1. The Contractor shall supply reasonable excess quantities to cover wastage of those consumable, which will be normally subject to waste during erection, commissioning and setting to Work.

## **16. Painting – General**

16.1. The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the Plant at the place of manufacture prior to packing.

16.2. Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials



shall be applied in strict accordance with the paint manufacturer's instructions.

16.3. All protective coatings shall be suitable for use in warm humid climates. All primers, under coats and finishes shall be applied by brush or airless spray, except where otherwise specified. Consecutive coats shall be in distinct but appropriate shades. All paints shall be supplied from the store to the painters, ready for application, and addition of thinners or any other material shall be prohibited.

#### **17. Painting at Place of Manufacture**

17.1. Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp covers etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin based coating with at least 75 microns dry film thickness is to be provided. In addition the parts are to be provided with adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

#### **18. Painting at Site**

18.1. Immediately on arrival at the site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

18.2. After erection, such items, which are not finish painted, shall be done so and, items that have been finish painted at the manufacturer's works shall be touched up for any damaged paintwork. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.

18.3. The dry paint film thickness shall be measured by Electrometer or other instruments approved by the Employer. In order to obtain the dry film thickness specified the Contractor should ensure that the coverage rate given by the paint manufacturer would enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm<sup>2</sup>. Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.

#### **19. Galvanizing**

19.1. Wherever galvanizing has been specified the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

a) Fabricated steel

Thickness less than 2 mm but not less than 1.2 mm 340 gms/sq.m

Thickness 2 mm and above 460 gms/sq.m

b) Fasteners

Up to nominal size M10 270 gms/sq.m

Over M10 300 gms/sq.m

19.2 Galvanizing shall be carried out after all drilling; punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanizing. Any Site modification of galvanized parts should be covered well by zinc rich primer and aluminum paint.

#### **20. Support for Pipe work & Valves**

20.1. All necessary supports, saddles, sling, fixing bolts & foundation bolts shall be supplied to support the pipe work. Valve and other facilities mounted in the pipe work shall be supported independent of the pipes to which they connect.

## INSPECTION AND TESTING AT MANUFACTURER'S PREMISES

### 1. Inspection and Tests

#### 1.1. Valve

1.1.1. During testing there shall be no visible evidence of structural damage to any of the valve component.

1.1.2. Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.

1.1.3. The following test shall be carried out for butterfly valves:

- a) Seat leakage test at rated pressure
- b) Body hydrostatic test at 1.5 times the rated pressure
- c) Disc strength test at body test pressure
- d) Valve operation with and without actuator
- e) Crack opening test under tension

1.1.4. The following test shall be carried out for sluice valves:

- a) Seat leakage test at rated pressure
- b) Hydrostatic test at 1.5 times the rated pressure
- c) Valve operation

1.1.5. The following test shall be carried out for non-return valves:

- a) Seat leakage test at rated pressure
- b) Body hydrostatic test at 1.5 times rated pressure
- c) Operation

#### 1.2. Pipe work

1.2.1. Testing of pipes and fitting shall be carried out in accordance with relevant Indian Standard and internationally approved standard. Pipes, fittings and expansion bellows shall be hydrostatically tested for 1.5 times the rated pressure.

#### 1.3. E.O.T. Crane

1.3.1. The cranes shall be completely assembled in the Contractor's or subcontractor's Works and shall be subjected to the tests as specified in IS 807/IS 3177 or relevant internationally approved standard. The Contractor shall provide the test weights.

#### 1.4 Equipment for testing

Equipment required for testing CC cubes and testing of steel bars are installed at main H/W site.

# CRITERIA FOR PREPARATION OF DESIGNS OF RCC ESR BY PRIVATE AGENCY

## 1.0 GENERAL:

1.1.0 Capacity of the container of the tank shall be the volume of the water it can store between the designed full supply level (F.S.L) and lowest supply level (L.S.L) i.e. the level of the lip of the outlet pipe. Due allowance shall be made for 20 mm. thick plastering the tank from inside, while calculating the capacity of the tank.

1.2.0 Freeboard is the vertical distance between F.S.L. and Soffit of covering slab or dome or beam supporting the cover. In any case the free board shall not be less than 300 mm from bottom of beam.

1.3.0 Height of the staging or height of the tower shall be the vertical difference between L.S.L. of the tank and the average ground level at the site of tank.

1.4.0 Dead storage shall be the storage capacity of water below L.S.L. depth of dead storage shall be the vertical distance between the top outlet level and wash out level. The washout pipe level shall be at the lowest portion of the container.

1.4.1 Minimum depth of water for dead storage shall be 100 mm even for flat bottom slab and not more than 300 mm for inlet i.e. bottom dome slab type tank.

1.5.0 Water depth in the tank shall be the vertical distance between L.S.L. and F.S.L. of tank.

1.6.0 The allowable bearing pressure or the safe bearing pressure on the strata as specified in the table of IS 1004-1978 or its latest revision, whichever is less shall be considered and design of foundation shall be based on this unit pressure unless specified.

1.6.1 Not with standing anything mentioned above regarding S.B.C. whenever the Engineer-in-charge of design directs that bearing capacity shall be determined by carrying out actual soil exploration and tests due to conditions as mentioned in para 2.0 of IS 1992-1969. The same shall be carried out by a Government laboratory or any other approved laboratory and allowable bearing capacity so arrived shall be taken as the basis of design. The factor of safety adopted in case of actual test shall be as per clause 6.1 (A) of IS 6403-1971.

1.6.2 IS:1893 (Part-I and Part-II) :2002 , IS 875 Part-III 2002 , IS 13920 and IS 4326 shall be followed.

1.6.3 As per IS:11682 - 1985 page 25 Typical reinforcement details of shaft "The" Ties or "Links" jointing to vertical bars of shaft is highly needed.

## 2.0 GENERAL REQUIREMENTS:

2.1.0 Cement concrete shall be in accordance with IS 456-2000 fine and coarse aggregates shall be confirming to IS 383-1963 or its latest revision. The selection of the type of fine and coarse aggregate to be actually used shall be as directed by the Engineer-in-charge.

2.2.0 For parts of the tank in contact with stored water and closing vapour above FSL shall be in concrete grade M300 or in richer grade.

2.3.0 Inlet, Outlet, Overflow and Washout pipe:

Materials:

DI/Cast iron flanged pipe of appropriate class shall only be used.

2.3.1 Inlet Pipe:

The size of inlet pipe 300mm diameter – 1Nos. shall be Rising main to ESR.

2.3.2 Outlet Pipe:

The outlet pipe shall be 350mm diameter of inlet pipe.

2.3.3 Overflow pipe:

The size of overflow pipe shall be 300mm diameter.

2.3.4 Washout Pipes:

The size of Washout Pipes shall be 300mm diameter.

**Note:** Pipe of inlet & outlet connection to Existing Sump Pumping machinery & existing distribution pipeline and complete water supply for APMC Unjha as per direction of Engineer in charge without any extra cost job connection to existing pipeline approximately 30mt length each for Pumping & Distribution network, Rate quoted including job connection & require pipeline to joint existing network no extra payment for pipeline & job connection.

Detailed drawing showing all the pipes, duck foot bends, chamber, sluice valves and other necessary connection shall be furnished in the plan. Plain concrete block in M-150 for duck foot bands shall be of minimum depth of 600 mm. The width of the block shall have an offset minimum of 150 mm.

2.4.0 Water Level Indicator:

A water level indicator shall be provided for the tank reading depth of water in meters with least count of 10 cm. The system shall consist of uncorrodable material and shall be simple and easy to maintain. The water level indicator shall be provided and fixed as approved and directed by the Engineer-in-charge.

2.4.1 Access to roof for an entry to the inside of the tanks shall be provided. At roof level of the tank the access to roof manhole from the ladder or stair shall be properly provided with parapet or railing. At

ground level or at walkway level the access forgoing up shall be provided with a door and locking arrangement. Railing at roof level and at gallery level shall be provided.

2.4.2 At least two manhole with frame and cover of CI medium type shall be provided with ladder for entering into the container for maintenance purpose. The size of manhole frame shall be 0.9 x 0.6 meter 75 kg.

2.5.0 Lightning Arrestor:

Lightening arrestors shall be provided on the roof of the tank as per IS 2309-1969. Position and height of lighting arrestors shall be such that the whole structure shall be enclosed within dome having its apex at top and of the arrestors and generated by a line inclines at  $60^{\circ}$  to the vertical. The arrestors shall be suitably earthed. Copper strip shall be covered with GI pipe 25-mm dia up to 4-meter height from GL.

2.6.0 The roof of the tank shall be ventilated by providing cowls or ventilators with mosquito proof met for ventilators. They shall be fixed with proper framing. Ventilation area shall not be less than of (A) 0.04% of the free water surface when cowl type ventilators are provided. (B) Cross sectional area of the inlet pipe. (C) Cross sectional area of the outlet pipe.

2.7.1 All tanks shall be checked for seismic forces confirming to IS 1893-1975 or its latest revision and wind forces also.

2.7.2 Water tank in vicinity of mines, galleries and blasting sites or in areas which may be subjected to blasting sites or in areas which may be subjected to blast or shock, shall be designed for the dynamic forces developed due to blast equipment.

2.7.3 Members of towers, which are primarily subjected to dynamic stresses, shall be checked for ductility of the members at the joint.

2.7.4 Staircase and all columns shall be tied together just above foundation level by structural members such as a braced or a tie ring beam.

2.8 Following shall be the minimum thickness of various members of the tank container.

Roof slab	100 mm
Bottom slab	200 mm
Roof Dome	100 mm
Container Dome	150 mm
Vertical wall including shaft wall	150 mm
Inclined wall or shall requiring shuttering of one side	170 mm
(i) Slope with horizontal more than $30^{\circ}$	150 mm
(ii) -Do less than $30^{\circ}$	150 mm

2.9.0 Error up to 2 % in weights, forces, moments etc. in the design calculations may be neglected.

### 3.0 LOADS:

3.1.0 For all RCC and PCC component unit weight shall be taken as  $25000 \text{ N/m}^3$ ,  $24000 \text{ N/m}^3$  respectively, allowance of plaster up to 20 mm. Inside surface of container shall be taken in to consideration of in normal circumstances.

3.2.0 Water load shall be taken as  $10000 \text{ N/m}^3$ .

3.3.0 Live load and snow load shall be taken as per IS: 875-1964 or its latest revision.

3.3.1 No live load may be assumed while designing the staging (or tower) and foundation for seismic loads.

3.3.2 Live load on gallery all round the elevated tank shall be considered as  $1500 \text{ N/m}^2$ .

3.4.0 Wind load as per Fig. i.e. basis maximum wind pressure or Indian including winds of short duration as per IS 875 Part-III 2002 shall be considered.

3.5.0 Seismic forces on the tower shall be as IS:1893 (Part-I and Part-II) :2002 or its latest revision.

Wind and seismic forces shall not be assumed to act simultaneously.

### INCREASES IN PERMISSIBLE STRESSES:

Where stresses due to wind or earth quack temperature & shrinkage effects are combined with those due to dead, live and impact loads the stresses specified in table 13, 16 & 17 of 456-1978 may be increased up to a limit of 33.50%.

### 4.0 DESIGN:

4.1.0 General:

4.1.1 Shape of the structure shall be as directed by Engineer-in-charge and shall be selected depending upon site condition from the standard shape.

4.1.2 General description and salient feature as mentioned below of the design shall be not allowed by the Engineer-in-charge and shall be mentioned in the design before detail design calculations starts.

4.2 Sketch showing dimensional section, elevation with plan shall be given.

4.3.1 The safety against over turning of structure shall be computed quite accurately.

4.3.2 Design shall be based on the worst possible combination of various loads, moments, shears and resultant stress in the tank for the following two cases.

- (i) Tank Full 'A'
- (ii) Tank Empty

Tank full means depth of water inside the container up to full height of the container without consideration of free board.

Or safe bearing capacity of soil based on actual soil investigation report of the laboratory.

Position of sub soil water level.

Chemical analysis if sub soil water and soil where possibility of brakish/saline water is ascertained.

Location of site on index plan with respect to latitude and longitude.

4.3.3 Design shall be based on accepted basis and methods of design as well as the provision of IS 3370-1965, IS 456-1978, IS 1343-1960, IS 2210-1962, IS 2204-1962 etc. and their latest revision. However methods based on experimental investigation as mentioned in para 18.2 % "C" in IS 456-1978 shall not be entertained.

4.4.0 The parts of the structure neither in contact with the liquid on any face more enclosing the space above the liquid as in the case of stages of a tower shall be designed on working stress method on accordance with the requirement of IS 456-1978. Staging may be designed on limit method as per IS 456-1978.

4.5.0 Design of members other than these excluded by above (i.e. roof, walls, floor etc. of the container) shall be based on consolidation of adequate resistance of cracking as well as adequate strength calculation of stresses shall be para s per 3.2.2 of IS 3370 (part-II) 1965 or its latest revision.

4.5.1 PERMISSIBLE STRESS IN CONCRETE FOR RESISTANCE TO CRACKING:

For calculations relating to the resistance of members to cracking the permissible stresses in tension (direct and due to bending) and shear shall confirm the values specified in Table-I of IS 3370 (part-II 1965)

The permissible tensile stresses due to bending apply to the fact of the member in contact with the liquid. In members less than 225 mm thick and in contact with the liquid on one side, these permissible stress in bending apply to the face remote from liquid.

4.5.2 FOR STRENGTH CALCULATION:

In strength calculation, the permissible concrete stresses shall be in accordance with para-44 of IS 456-1978. Where the calculated shear stress in concrete alone exceeds the permissible value reinforcement acting in conjunction with diagonal compression in the concrete shall be provided to take the whole of the shear.

4.5.3 Permissible compressive stress (Directly only) insheels (i.e. Top Dome, Conical Wall and shall be reduced by 43% for 10 cm thick walls. For thickness more than 30 cm, the compressive stress shall be reduced by 50% and for inter media thickness 10 cm. to 30 cm. linear interpolation shall be done.

4.6 PERMISSIBLE STRESSES IN STEEL:

4.6.1 For resistance to cracking the steel and the concrete are assumed to act together. For checking the tensile stresses in un cracked concrete for avoidance of cracks, the tensile stress in the steel shall be the product of the modular ratio and the corresponding allowable tensile stress in concrete as per IS 3370(part-II) 1965 or its latest revision. Modular ratio "M" for different concrete mix shall be taken as under:

Grade of Concrete	Modular Ratio "M"
M-200	19
M-250	13
M-300	11

4.6.2 For strength calculation (concrete assumed to be cracked), the permissible stresses in reinforcement shall be as per Table -2 of IS 3370(part-II) 1965 or its latest revision. For steel, the stresses shall be as per IS 1966 or its latest revision.

4.7.1 The analysis of staging of the tank shall be done by using any established method such as portal method etc. The staging shall be analyzed from combination of dead, dead live loads and wind seismic loads. The effect of continuity of beams of the junction shall be properly accounted and column reaction worked out, for different condition of loading, axial force, shear force, bending moments.

4.8.1 Modules of elasticity of concrete MEC shall be taken as 5700/FC where equal to characteristic cube strength of concrete in N/m<sup>2</sup> as per IS 456-1976.

4.8.2 Columns shall be checked for tensile stress for both the conditions as mentioned in para 4.3.2 in combination with axial tension and bending due to wind or seismic loads, and shall be checked for bond for maximum tensile stress arrived.

4.8.3 Columns may be assumed to be fixed at the top of footing.

4.8.4 Water Tower in seismic zone (V) of IS 1393-1975 twin diagonal (crossed) backing of steel in vertical plane in addition to the horizontal braking may be provided.

4.9 COLUMNS:

4.9.2 Reinforcement shall be provided on both faces of the load-bearing shaft. Minimum vertical reinforcement in the shaft shall be of 0.4% of the gross concrete area required, Minimum horizontal reinforcement shall be 0.3% of the gross concrete area. Required in ease, for tower in high seismic zone (IV & V) minimum horizontal reinforced shall be 0.4% of the gross concrete area; for before bars of medium tensile or height tensile steel the above steel requirements may be reduced by 20 %.

4.9.3 Shaft shall be checked for combined axial load and bending the to wind or seismic loads and shall satisfy the provision of IS 456-1978 in tank full and tank empty condition.

4.9.4 Horizontal construction joints in shaft shall be as minimum as possible. On account of minor in accordance in construction shaft the allowable direct compressive stress shall be reduced by multiplying with 0.8% factor. On account of buckling reduction factor, if any, shall be multiplied to the value 0.85. For the calculation of direct compressive stress the contribution of steel shall be neglected.

4.9.5 Age factor for increasing strength shall not be considered.

4.9.6 Shaft shall be checked for tensile stress for worst condition in combination with axial tension on bending due to wind or seismic load.

## **5.0 FOUNDATION:**

5.1 The permissible increase in bearing pressure for different types of foundation shall be as per table -I of IS 1893-1965 or its latest revision. When seismic forces are considered and for wind forces it shall be as per IS 1904-1966 or its latest revision.

5.2 For the purpose of the design of foundation the loading data shall be given the magnitude of vertical load, lateral load and moments at top of footing (Foundation) level. The data shall be made available, for both the cases as per para 4.3.2.

5.4.1 The foundation area, door, individual column footings, combined footings, angular rafts and solid rafts shall be worked out on the basis of lower most value of the safe bearing capacity or allowable bearing pressure values as derived from IS 1904-1978, IS 9403-1971, IS 8009-1976 or their latest revision.

5.4.2 In case of purely cohesive and CI pipe of soil particulars attention should be given to IS 1903-1978 clause 6 & 7. Settlement shall be calculated as per IS 8009 (part I) 1976 for foundation.

5.4.3 In case of purely cohesion less soil, foundation shall be design for safe bearing capacity and shall be checked for permissible total as well as differential settlement values as given in relevant IS.

5.4.4 If the foundation consists of individual columns footing, minimum clear distance between center of column shall be equal to twice the width of footing and clear distance between the edge of footing shall be not less than width of footings.

5.4.5 In case of soil beneath the footings are not of the same characteristics the footing shall be designed for the soil having lowest SNC or ANP as the case may be. In such conditions the permissible limits of total as well as differential settlement shall be limited to 75% of the permissible limit given in ISS.

5.4.6 For special type of foundations like well foundation under beam pipe foundation etc., decision of Superintending Engineer, Public health Design Circle shall be final and binding to the designer.

5.4.7 Classification of soil and all characteristics of soil relevance to BSBC and APB shall be as per the soil in irrigation reports of Government stipulation. Government approved investigators.

5.5 For the design of foundation angular or solid raft type, the "PLACE THEORY" shall be adopted.

5.6 In normal circumstances minimum 100-mm thick plain cement concrete with 100 mm projection around in Grade M 100 with coarse aggregate as metal shall be provided as leveling course. Where injurious soil progressive water is expected the leveling course shall be grade not weaker than M 15 and if necessary Sulphate resisting or the special cement shall be used. The ground level within the foundation area of the structure shall be consolidated properly with a suitable slope to drain out rainwater outside the foundation.

## **6.0 DETAILING:**

### **6.1 MINIMUM REINFORCEMENT FOR WATER RETAINING MEMBER:**

6.1.1 The minimum reinforcement in walls, floors, roofs, in each of two directions at right angle shall have an area of 0.3% of the concrete section in that direction for sections up to 100.00 mm thick. For section for thickness greater than 100 mm and less than 450 mm thick, minimum reinforcement each of two directions shall be nearly deducted from at 0.3% for 100 mm thick sections or greater two layers of reinforcing steel shall be place one near each face of the section to make up to minimum reinforcement specified in this clause.

6.1.1 The minimum reinforcement specified in this 6.1 above may be decrease by 20 % in case of high yield strength bars confirming to IS 1786-1976 or IS 139-1966.

6.2.1 Minimum clear cover to reinforcement under normal conditions shall be as per para 25.4 of IS 456-1978.

6.2.2 For liquid faces of parts of members either in contact with the liquid or enclosing the space above the liquid shall be as per para 7.2 IS 3370 (part-I 1965).

6.2.3 In case of Raft Foundation, the cover to reinforcement shall be as per 4.6.2 of IS 295 (part-I) 1973.

6.2.4 In case of "shaft" the cover to reinforcement shall be as under;

Vertical 25 mm

Horizontal 15 mm

6.3 For members of structure in contact with water, effective cover shall not be more than 60 mm. Even bars subjected to bending stress, or bars subjected to tension due pure tension in the member the effective cover shall not more than 75 mm.

6.4.1 Spacing of reinforcement shall be as per para 25.3 IS 456-1978.

6.4.2 Spacing of lateral ties for column shall satisfying provision of para 25.3.2 'C' of IS 456-1978.

6.4.3 The additional suggested criteria for reinforcing steel which accounts for existing moments, tension etc. i.e. other than temperature or binding steel shall comprise of minimum 8 mm for deformed or 10 mm mild steel bars.

6.4.4 The spacing between two para in main reinforcement shall distribution steel, stirrups, links etc. shall not exceed 30 cm.

6.5 For members of the container, the maximum diameter of reinforcement in tension shall not exceed as given below depending upon the geometrical percentage of reinforcement. (Ratio of tensile steel to gross is concrete.)

Up to 1.0%	16 mm dia
Up to 1.5%	22 mm dia
Up to 2.0%	25 mm dia

**Note:**

1.0 In case of dispute regarding interpretation any above clause, the decision of the Superintending Engineer, Public Health Circle, Concerned will be binding to the Designer.

2.0 In case of any clauses not included in the above criteria the decision of the Superintending Engineer, Public Health Design Circle will be final and binding to the Designer.

## **INSTRUCTION FOR PREPARATION OF DESIGN OF RCC ESR (ONLY FOR SELF DESIGN BY CONTRACTOR)**

1.0 The design of RCC ESR shall be in accordance with IS-1893-(Part-I) “ Criteria for Earthquake Resistant Design of Structures” Part –I General provisions and Buildings and IS-1893-( Part-II (2002) “ Liquid Retaining Tanks ( Elevated and Ground supported “ and IS 875 Part-III, IS13920, IS 4326. IS 11682-1985 page-25 Typical Reinforcement details of Shaft

2.0 The design of RCC ESR shall be got prepared by the any consultants, who have experience to design water retaining structures. The design prepared accordingly shall be got approved by the Panel of Structure Consultant/Public Health Design Circle, GWSSB, Gandhinagar without any extra cost..

3.0 PAYMENT AS PER PAYMENT SCHEDULE

### **4.0 COMMON CONDITIONS:**

4.1 All petty items occurring if the work shall be carried out in workman like manner as per specification published by G.W.S. & S. Board and as per general specification current in the Division and as per instruction of the Engineer-in-charge from time to time.

4.2 Extra charge of claims in respect of extra work shall not be allowed unless such works are ordered in written by the Engineer-in-charge and are claimed for in specified manner before the work is taken in Hand.

4.3 The contractor shall engage on in experience and qualified supervisor as his authorized agent for the work. He shall be responsible to take from time to time such orders as may be given by the Engineer-in-charge to carry them.

4.4 As order book shall be maintained on the work site and the contractor shall sign the orders given by the Engineer-in-charge and he shall carry out them promptly. The order books shall be surrendered to the Department on completion of Work.

4.5 The contractor shall have to clear the site of work before it commences and after the work is completed for which separate claim shall not be entertained.

4.6 In addition in the required stores the contractor shall provide at his own cost the suitable temporary office shed with a covered area of about 20 sq mt. with necessary furniture for the use of Government staff while in works. The shed and furniture on completion of the work shall be removed by the contractor at his own cost.

4.7 The contractor shall provide at his own cost all labour charges setting out the as may be required for lining and setting out the as may be required for lining and setting up the works satisfactory and adequate facilities site scaffolding etc. for facility of checking his work or taking measurements etc.

4.8 Department shall give reasonable facilities to the contractor to enable him to obtain controlled materials at controlled rates as may be fixed from time to time. The contractor shall however not be entitled to time. The contractor shall however not be entitled to claim any compensation extra time limit to account of non-supply at controlled rates. The materials obtained shall be only used for the work in question. Any materials remaining surplus shall be neither disposed nor removed by the contractor without obtaining written permission of Department to that effect. Government shall have the right to take delivery of the surplus materials at the original purchase price of the receipt contractor shall be sue of such materials to the satisfaction of Engineer-in-charge and submit in monthly statement thereof.

4.9.1 The contractor at his own cost expense shall provide necessary housing accommodation and the sanitary

4.9.2 Arrangement for his staff and labour and shall pay direct of the authorities concerned all rates. Taxes royalties and other charges.

The contractor shall also comply with the requirement of the Health Department as regards anti malarial measures etc.

4.10 Water require for the execution of work and for the water tightness test of the reservoir shall be supplied by the contractor at his own cost in manner satisfactory to the Engineer-in-charge of work.

4.11 The contractor shall not be entitled to claim compensation from the Government. For works suffered on account of delay where such delay is caused either by (i) Difficulties relating to the supply of Railway Wagons, (ii) Force majeure, (iii) Acts of the God, (iv) Any other reasonable caused beyond the control of the Department. In case of delay Govt. shall however grant such extension of time limit for the completion as may appear reasonable to the Engineer-in-charge and his decision shall be final.

4.12 The contractor shall be responsible to pay complete compensation to his staff and to his labours according to the labour compensation rules, on account of accidents and loss of life or loss of the life due to accident.

**5.0 DECLARATION:**

The contractor shall make declaration as under:-

"I have made myself thoroughly conversant with conditions as regards the availabilities or otherwise of all construction materials skilled and unskilled labour on which. I have quoted my rates for this work. The specifications, drawing and design of this work have been carefully studied and are understood by me before the submission of this tender. "



## DETAILED SPECIFICATION

Detailed specification given here shall be treated as extension or partial modifications to the specifications of respective items given in the volume of specification published by Gujarat Water Supply and Sewerage Board.

### **1.0 EXCAVATION FOR FOUNDATION:**

1.0 When the rates are to be quoted for a work based on "contractors own design" the word excavation for foundation shall mean excavation for foundation in all types strata such as soil soft murrum as well as hard rocks up to the designed depth at which foundation is to rest. No extra payment will be given for any change in strata at the same place. The rate shall also include dewatering and shoring strengthen if and where found necessary.

1.1 Excavation shall be carried out as per approved drawing. The excavation made deeper or wider than that required as per drawing shall not paid, but such deeper excavation if carried out shall have to be filled up using C.C. 1:3:6 by the contractor without extra cost. If the type of strata require wider excavation at top (GL) Then contractor shall excavate the trench accordingly but no extra payment for such wider excavation shall be made.

1.2 The rate shall include providing cured warnings lights during night time providing barricading consisting of metal ropes and bamboo for which no extra payment will be made.

1.3 The contractor shall make his own arrangements to obtain prior permission directly from relevant authorities for staking of excavated stuff near work side. If he fails to obtain such permission, then he will have to make his own arrangement without claiming extra cost to transport and stack the excavated stuff at a suitable place approved by the Engineer-in-charge of work.

1.4 The excavated stuff shall be stacked at least 3.0 meter away from the edge of excavated trench, If enough space is not available at work site then the excavated stuff shall be stacked at suitable place situated away from site. Similarly the surplus stuff shall have to be disposed off at a suitable place for which contractor shall have to obtain permission directly from relevant authorities. No extra payment for transportation of excavated stuff or surplus stuff shall be made.

1.5 No excavated stuff shall be disposed off or used for any purpose other than refilling without prior permission of Engineer-in-charge of work.

1.6 Details shown in the data sheet regarding water table are approximate. The contractor should make his own arrangements for taking trial pots at his own cost more quoting his rates for as certain type of strata water table, quantity of seepage water etc.

1.7 Work at nighttime shall be carried out only with written permission of Engineer-in-charge.

1.8 Bottom of the excavated foundation trench shall be sprinkles with water ( If water table is not above foundation level) and wall rammed to obtain a reasonably firm and level bedding.

1.9 The rates shall include continuous dewatering of seepage water or rainwater from, trenches to keep the trench dry particularly during casting of base concrete. Concrete for footing and columns of shaft etc. till concrete fully cures etc.

1.10 Whenever collapsible types of strata are encountered pucca shoring and strutting shall be invariably claim shall be entertained.

### **2.0 C.C.M. 100 BASE CONCRETE FOR LEVELLING COARSE:**

2.1 For all practical purpose and in absence of proportioning of concrete on base of preliminarily tests, C.C. 1:3:6 may be provided as a leveling course i.e. one part of cement three parts of sand and six parts of black trap kapachi. Specification for various ingredients of concrete such as sand, cement, kapachi, water shall be as these given in specification for C.C.M. 15.

2.2 While laying base concrete for leveling course the concrete shall not be dumped from above but shall be carried out to the bottom and gently placed from a height not exceeding 1.5 meter. If concrete is transported by chutes, then the same shall be remixed at bottom of chutes to overcome any segregation that might have occurred.

### **3.0 C.C.M. 150:**

3.1 As far as possible the preparation of various ingredients of concrete shall be determined on the bases of preliminary tests as per ISS using the actual materials to be used on site. However in absence of such preliminary tests the volumetric proportion of 1:2:4 may be adopted i.e. one part of cement, two parts of sand and four parts of kapachi, water just sufficient to attain desired workability may be added. However the aim while proportioning should be to fix the proportion of aggregation and water cement ratio shall be always sufficiently low enough to get desired strength.

3.2 Materials:

3.2.1 Coarse aggregate shall consist of tough angular black trap kapachi. The kapachi shall be obtained from approved source only. Normally at least two stock piles of different size of 12 to 20 mm and 25 mm to 40 mm shall be maintained. It will however, be preferably to maintain third stock pile of 6 mm to 12 mm also for better control on mix of concrete.

3.2.2 The maximum size of coarse aggregate to be used shall be as large as possible within the limits of requirements, based on size of member and spacing of reinforcement. But aggregate exceeding 40 mm shall not be used in concrete for ESR and Sumps.

3.2.3 Depending up on the size of member, spacing of reinforcement and degree of workability desired, the coarse aggregates from different stockpiles may be mixed in a suitable proportion to get a uniform mix that does not segregate.

3.2.4 The coarse aggregate shall not contain dust, clay or other such harmful material. If directed by the Engineer the same shall be washed with water and dried before being used.

3.3.0 Fine Aggregates:

Fine aggregates shall consist of coarse, angular river sand free dirt and other harmful organic materials. If directed the same shall be screened and washed before being used. Sand brought from approved source shall only be used.

3.4.0 Cement:

Contractor shall provide a temporary store with double lock arrangement for storage of this cement on work site without extra cost. Cement shall be stored in such a way that it is not affected by moisture.

3.5.0 Water:

Water to be used in concrete work shall be potable, free from injurious elements such as chloride or sulphate etc. and shall be obtained from approved source only. Contractor shall make his own arrangements to obtain and store sufficient quantity of water at all times.

#### **4.0 FORM WORK:**

Form work shall consist of steel plates or smooth timber planks to be joined by nuts, bolts, nails or pegs so as to have a reasonably water tight joints. Sufficient number of vertical and horizontal supports shall be provide when completed. Formwork shall be sufficiently sturdy & strong to absorb all stresses and movements. Before concrete is placed in position the formwork and steel shall be got checked through Engineer-in-charge of work. Advance intimation shall be given to the Engineer-in-charge for this purpose. The ultimate responsibility for safety and of lives of workmen and that of forms etc. from beginning of work till its completions shall always rest with the contractor proper ladders and plant forms for easy access shall be provided by the contractor without extra cost.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the Engineer In charge. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing swelling, rust staining or allowing the passage of moisture.

For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

The striking time for formwork shall be determined based on the following requirements:

- (h) Development of adequate concrete strength;
- (i) Permissible deflection at time of striking form work;
- (j) Curing procedure employed - its efficiency and effectiveness;
- (k) Subsequent surface treatment to be done;
- (l) Prevention of thermal cracking at re-entrant angles;
- (m) Ambient temperatures; and
- (n) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

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

#### **5.0 MIXING, TRANSPORTATION AND LAYING:**

5.1 For important works like ESR and sumps mixing of concrete shall be invariably done in approved machine mixer only. The mix obtained from the mixer shall be a uniform mass consisting of all aggregates coated with cement paste.

5.2 Fresh concrete shall be transported horizontally in ghamellas or wheelbarrows. Vertical transportation shall be done either by manual labour or using mechanical vertical lifts. When chutes are used for transportation, care should be exercised to avoid segregation and concrete may be remixed at bottom of chutes to get uniform mix. Before any concrete is placed in position all loose materials such as dirt, chips of stones, wood, steel etc. should be removed. Inner side of forms should be coated with thin layer of oil to get a good finished surface.

Concrete should not be dumped from above in which case aggregate will segregates, but placed gently from a height not exceeding 1.5 meter. Compaction of concrete shall be done by vibrators till cream appears at top. Over vibration shall be avoided to avoid segregation.

#### **6.0 CURING:**

After concrete is set in position it shall be kept continuously wet with water for 7 days either by using gunny bags(column and walls) by ponding (slab) or as directed by spraying of water.

Unless otherwise specified the rate shall include finishing the exposed surface to get good finished surface.

The forms shall be kept in position for period given below:-

1)	Vertical sides of walls, beams, columns	2	Days
2)	Slabs (props left under.)	4	"
3)	Bottom of beam (props left under)	7	"
4)	Removal of prop to slab spanning up to 4.5 superious over 4.5 m.	7	"
5)	Removal of props to fearus spanning up to 6.0 m.	14	"
6)	Spanning over 6.0 m.	21	"

#### **C.C.M. 300:**

**All concrete work ESR must be on M:300 Grade concrete.**

Specification for C.C.M. 300 shall be same as those except that grade of concrete to be produced shall be M300. If arbitrary volumetric proportioning is to be followed then the proportion of cement, sand and kapachi shall be 1:1:2 respectively. Since M - 300 mix is normally used in water retaining parts of container where the aim is not to get dense, strong and watertight concrete, special care shall be exercised in controlling proportion of aggregate, water cement ratio, compaction and curing.

#### **7.0 PROVIDING AND PLACING IN POSITION STEEL REINFORCEMENT:**

7.1 Reinforcement bars to be used in RCC work shall have to be supplied by the contractor. The rates include providing, cutting, bending, binding, hooking and placing in position including cost of binding wire. The bars shall be fusion bonded and epoxy coated.

7.2 Depending upon the type of reinforcement steel proposed in design (i.e. M.S. or deformed etc.) the steel shall confirm to relevant ISS codes in practice. Contractor shall produce necessary test certificate in absence of which the steel bars shall be get tested by the Department at the contractor's cost.

7.3 Steel bars shall be cut, bent up, hooked bound with wires and then placed in position as per approved drawing. The steel shall be got checked through Engineer-in-charge. Before any concrete is placed in formwork advance intimation shall be given to the Engineer-in-charge for this purpose. The steel shall be cleared of any dust or rust that might have been deposited on bars.

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

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

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

#### **8.0 RCC STAIRCASE FROM GL. TO TOP OF CONTAINER:**

RCC Staircase shall be provided for easy access necessary to the top of ESR or sump. RCC staircase shall be either spiral with triangular steps fixed around RCC column rectangular steps along the periphery of circular shaft. Rise and trade of suitable dimension shall be provided to have a comfortable access. Width of staircase shall not be less than 90 cm. Separate RCC foundation shall be provided when RCC spiral stair with triangular steps is provided when cantilever steps are provided. In case of spiral staircase with triangular steps separate RCC cabin 10 cm. thick walls shall be provided with a steel door for entry of an authorized person to the top of ESR. However no such separate cabin need to be provided when the staircase is located inside hollow supporting shaft, but in that case enough provision for windows shall be made in addition a wooden door. The baluster and hand railing shall be made from 40 x 40 x 6

mm angles and 3/4 dia GI pipes by welding as directed by Engineer-in-charge and colored with three coats of paints.

#### **9.0 WOODEN WATER LEVEL INDICATOR:**

9.1 A wooden water level indicator of approved size and type shall be provided and fixed by the contractor. It shall consist of wooden plank of 250 mm x 40 mm.

9.2 The divisions on water level indicators shall show distance of 10 cm. clearly. A copper or PVC float of 500-mm dia and 50 mm height shall be provided along with steel wires pulleys etc. The entire arrangement shall be first got approved by the Engineer-in-charge of work. Letter and marking shall be painted with approved enamel paint.

#### **10.0 COPPER LIGHTENING CONDUCTOR:**

Copper lighting conductor with size of strip 20 mm x 3 mm with clamps and screw and copper plate of 600 mm x 600 mm x 6 mm and copper red as per specification no. 120 of PWD Hand book Vol I (ISS - 2309) shall be provided and fixed by the contractor. It shall consist of copper arrestor at top, copper conductor from top up to GL and copper Earthing plate shall be 1 m. deep below GL and filled with salt and charcoal to transmit the current to earth, minimum dimension of these part shall confirmed to relevant ISS. Heights of the arrestor shall be such as to enclose the entire structure with imaginary cone generated by a inclined at 60° degrees with vertical at top.

11.0 Providing and fixing CI flanged pipes and special such as duck foot bends, crippling flanges bell mouthpiece etc. for inlet outlet overflow and wash out.

11.1 Diameter and length of above pipes shall be as given in Appendix - A. CI flanged pipes shall be vertically cast double flanges and shall be confirm to relevant ISS. They shall be first get approved by the Engineer-in-charge of work.

11.2 Item shall include providing all specials such as crippling flanges, and duck feet bends etc. as may be required on site.

11.3 The Item shall also include cost of all jointing materials such as nuts, bolts, rubber packing, white zinc or pig lead or lead wool if required.

11.4 Pipes shall be fixed perfectly vertical and straight.

11.5 Before fixing in position pipes shall be coated with two coats of anticorrosive paint.

11.6 The pipes and specials shall be tested hydraulically. Leakage if found shall be repaired without extra cost.

#### **12.0 PROVIDING AND FIXING CI SLUICE VALVE:**

12.1 Diameter of CI sluice valve shall be as shown in Appendix - A. CI sluice valve shall be of class - I confirming to IS - 780-1980.

12.2 The rate includes providing and fixing CI sluice valves with tailpieces including jointing materials such as nuts, bolts, rubber packing zinc etc.

12.3 The rate includes giving hydraulic test to the satisfaction of Engineer-in-charge of work.

12.4 Sluice valve shall be supplied with necessary spindle or wheel for operating the same.

#### **13.0 PROVIDING AND FIXING C I M H FRAME AND COVER:**

One number of C I M H frame and cover shall be provide and fixed in top slab of container. The dimensions and weight shall be as shown in Appendix - A. The C I M H frame and cover shall be first got approved by the Engineer-in-charge. Two coats of anticorrosive paints shall be applied before fixing them in position.

#### **14.0 C I COWL TYPE VENTILATORS:**

The C I Cowl type ventilator should be of 100 mm dia shape with flanged and roughing screen shall be as per Appendix - A. The rate includes providing and fixing C I Cowl type ventilator as per Appendix - A including cost of all jointing materials such as nuts, bolts, white zinc rubber packing etc. Two coats of anticorrosive paints shall be applied to the surface before they are fixed in position. They shall be first for approved by the Engineer-in-charge.

#### **15.0 PROVIDING AND FIXING M.S. LADDER INSIDE CONTAINER:**

Contractor shall have to fabricate and fixed M.S. ladder. The ladder to be fixed shall be fabricated from M.S. flat of 10 mm x 65 mm or M.S. angle having equivalent modular of selection 20 mm dia. Bars shall be fixed at 30 mm c/c. to act as steps. The ladder shall be 45 cm. wide if length of ladder is more than 8.0 m. Three coats of approved anticorrosive paint shall be applied to the ladder. The design of M.S. ladder shall be got approved by the Engineer-in-charge before it is fabricated and fixed in position. Rate includes providing and fabricating, painting and fixing in position of M.S. ladder as above.

#### **16.0 CONSTRUCTION OF VALVE CHAMBER:**

Number and size of valve chamber shall be as per Appendix - A. Specification of various items such as B.B. masonry cement plaster, C.M. (1:3) and C.C. (1:3:6) at bottom. RCC 1:2:4 etc. shall be as these given in column of specification published by G W S & S Board and as those prevailing in Division.

#### **17.0 PAINTING LETTER:**

Following words shall be painted on the container 40,000 liters capacity. The letters shall be 45 cm high and the black ground of suitable color shall be provided. Approved enameled paint shall only be used for painting letters and background. Entire work shall be carried out as per instruction of Engineer-in-charge.

### 18.0 PROVIDING AND FIXING GI PIPE RAILING AROUND TOP SLAB:

Railing shall consist of 3 raw of 25 mm dia GI pipes fixed in M.S. angles of 60 mm x 60 mm x 6 mm 0.9 m. height fixed at 2 m c/c. The materials shall be got approved by Engineer-in-charge before fabrication. Three coats of approved anticorrosive paint shall be applied to M.S. angle before they are fixed in position.

### 19.0 RCC CABIN:

Constructing RCC cabin 2 m dia and 10 cm wall thickness with neat finishing etc. complete. The depth of excavation for foundation of cabin shall be 0.7 m deep and 0.65 m width. RCC (1:3:6) shall be of 15 cm thick. The cabin shall be constructed in C.C. (1:2:4) with 10-cm thick wall and 2.2 m height above GL. The wall shall be constructed with 10 mm dia vertical bar at 30 cm c/c. and 6 mm dia bars circle on temporally 30 cm c/c. A steel door made 4 mm thick and steel plaster and welded with flat and 25 mm x 25 x 5 mm M.S. angle from frame. The necessary iron fixtures and fastening shall be provided by contractor at his own cost. The contractor shall have to plaster the cabin if the cabin has not smooth finishing without any extra claim.

### 20.0 CEMENT PAINT:

The work shall be carried out as per instruction of the Engineer-in-charge. The snowcem paint shall be waterproof cement paint and best quality shall be got approved before use.

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fiber brush or and suitable means and washing the surface. All loose pieces shall be scrapped out and hole shall be stopped with mortar. After cleaning the surface the watering hole surface and applied snowcem paint in three coats.

### 21.0 WATERPROOF CEMENT PLASTER:

The cement mortar shall consist of two parts of fine river sand free from any dust and other organic matter and one part of approved quality of cement. The mortar shall be properly mixed on watertight platform. The mortar shall be used within half an hour after mixing. The water proofing materials weighting 1.5 kg of powder in one bag of cement shall be added.

The plaster shall be applied in uniform thickness of 20 mm and shall be properly smoothened with wooden & finished with cement finishing of required. The curing shall be done at least for week by sprinkling the water over the wall. The wall shall be tested for waterproof ness. The rate includes the cost of waterproofing materials. The test for waterproof ness shall be carried out by the contractor at his own cost by filling the contractor with water and it shall be checked out that there is no percolation of water from the wall. Payment shall be made per sq. m. of plaster done.

### 22.0 BRICK PITCHING:

The brick shall be of proper quality, standard size, uniform in color, well-burnt and free from cracks. The work of brick pitching shall be carried out in C.M. 1:6. It shall be laid as per the drawing and directed by the Engineer-in-charge. The bricks shall properly soak before being using in work. No brickbats shall be use except the bricks. The joint shall be racked out 20mm depth. Every day at the end of the days work the cement pointing in C.M. 1:2 shall be carried out by line as directed by the Engineer-in-charge. The excavation required for brick pitching shall have to be carried out by the contractor as directed including necessary temping consolidation etc. complete.

After completion & testing of work the contractor shall have provide & fix the Marble 'Takti' of required size with necessary writings, as directed by the Engineer-in-charge.

23.0 RCC work of shaft, container and staircase should be of well finished condition if the same is not satisfactory than contractor since have to finish the surface with 12 mm thick plaster C.M. without any extra cost.

24.0 The contractor shall have to make arrangement for testing of steel bars brought on site and concrete cubes, for different mix at different stage like foundation, shaft, column, cube should be cast on site and send Govt. approved laboratory for compressive strength at 28 days. Results must be produced in office before taking payment of work done. Testing charge must bear by contractor.

25.0 Conditions: The paint is supplied in two packs, fine zinc dust mixed with epoxy resin as base and liquid hardener. They are to be mixed in following ratio.

	By Volume	By Weight
	1.5	4.0
<b>Hardener</b>	1.0	1.0

#### 1) Mixed Paint Properties

I)	Viscosity	20+3% seconds by flow
		Cup No.4 @ 30 °C
ii)	Specific Gravity	1.70+3%
iii)	Post life of mixture	6-8 hrs.
iv)	Zinc dust content on DFT basis	92+/-3%
v)	Finish	Smooth and Matt.
vi)	Drying time	
	Surface dry	5 minutes
	Hard Dry	Less than 1 hr.

vii)	Over coating after	Minimum 24 hrs.
		Maximum No limit
viii)	Flash point	Above 23 o C
ix)	D.F.T.	20-25 microns depending on blasting profile
x)	Compatibility	Compatible with all systems of paints like Bituminous, conventional, chlorubber vinyl and epoxy paints.
xi)	Toxicity	Non toxic

3) Application: By Brush/Spray (Air and Airless)

4) Thinner: Epoxy thinner shall be used if required.

5) Coverage: 10 Sq. m./liter at 25 microns.

6) High build black paint.

1)	Dry time	Surface dry not more than 4 hours Hard dry not more than 18 hours Film thickness per coat 75 micron.
2)	Consistency	Thixotropic liquid
3)	Covering Capacity	5 Sq.m./liter
4)	Color	Black/Brown/Black in alternative layer

7) Characteristics:

The coating shall be non-phenolic, non-toxic. It shall afford a highly durable protective air tight coating to prevent corrosion or rusting of iron and steel against air moisture/water and shall be of sufficient elasticity to prevent racing, blistering or peeling. It shall retain its consistency at the ordinary atmospheric temperatures when packed in suitable containers. After application of drying, the coating shall not show any surface cracks due to drying, weathering action or expansion and contraction. Its resistance to water must be perfect. It shall also be resistant to weak acid and alkalis, natural salts and to dry heat up to 150 centigrade. It should have good brush ability.

The primer as well as paint shall have to be applied as per the manufacturer's specification. The paints shall be tested in the laboratory by the owner at the cost of the contractor if found necessary. The manufacturer shall accompany each lot of primer and paint supplied. The entire procedure of applying the coating as specified shall be rigidly inspected right from cleaning stage to application of final coat.

8) Stacking of bars:

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

## Design Requirement (DATA SHEET)

### (A) Design requirements of RCC ESR

Sr. No.	Details	DATA for RCC ESR			
1)	Capacity	3.00 lac liters & 16mt given in above Table			
2)	Location	Location	Capacity	Ht in mt	G.L.
		Brhamwada	3.00	16	
3)	Foundation depth below G.L.	Minimum 7.0 M & Above required as per design.			
4)	Type of foundation	RCC foundation (as per design)			
5)	Free Board	0.30 meter			
6)	Normal Water Table	Water Table not found up to 1.0 mts. Depth			
7)	Dia of pipe CI vertically cast Double flange/spun pipe B class as per IS 1538	Diameter in mm			
		Inlet	Outlet	Overflow	Wash out

Sr. No.	Details	DATA for RCC ESR			
		300	350	300	300
	Main Head Works				
8)	Length of pipes	From container to DI (vertically) up to Duck foot Bend, and <b>Connecting to Existing pipeline length around 30mt from ESR (Horizontally) with connection to existing pipeline</b>			
9)	Size of Butterfly Valves (IS- 13095) & Sluice Valve	Same size for <b>Outlet , Inlet,&amp; Washout pipe Total 3No Valve</b> supply of valves for RCC ESR.			
10)	Size of Valve Chamber	1.30 x 1.30 x 1.50 mts. (3 Nos) for each ESR			
	i) Internal Dimension	1.5 mts. Depth (Average)			
	ii) Thickness of Masonry	23 cm			
	iii) Type of Masonry	Brick Masonry in C.M. 1:6			
	iv) Plaster and pointing	Inside plaster in C.M. 1:3 , 15 cm thick			
	v) Foundation	15 cm thick C.C. 1:3:6 or as per design			
	vi) Manhole Frame and Cover for chamber	As per requirement			
	vii) RCC Slab	C.C. 1:1.5:3 - 10 cm thick			
11)	Cowl type ventilator	100 mm dia. 2 Nos minimum or as per design (Minimum vent should be provided as per design criteria)			
12)	CI MH Frame and cover at top of Container	0.90 x 0.60 m (100 Kg) 3 Nos			
13)	Type of Construction	<b>RCC M-300 Grade Concrete &amp; Above</b>			
14)	Steel	Only FE 500 TMT steel to be used			
15)	Staging	For ESR up to 5 Lacs lit. Capacity, only in Shaft with Staircase Inside & above 5 Lacs lit. Capacity preferably column-beam type.			
16)	Other Requirement	All other Requirement as per Price bid & specifications Including all obligatory requirement of department.			
17)	SBC	As per actual SBC received, design is to be prepared.			
18)	IS	1) The design of RCC ESR/Sumps shall be in accordance with IS-1893-(Part-I) "Criteria for Earthquake Resistant Design of Structures" Part –I General provisions and Buildings and IS-1893-(Part-II (2002) "Liquid Retaining Tanks (Elevated and Ground supported" and IS 875 Part-III, IS13920, IS 4326. 2) As per IS:11682 - 1985 page 25 Typical reinforcement details "The" Ties or "Links" jointing to vertical bars of shaft is highly needed.			

**Name of work:** Construction of New Sub Market yard at Brahmanwada R.S. NO-613 of A.P.M.C. Unjha. Under the scheme of AMI sub scheme of ISAM

## BREAK UP OF SCHEDULE OF PAYMENT

### Construction of Under Ground Sump

Sr.No	Stage of work	Amount admissible payment
<b>1</b>	On approval designs	<b>2 %</b>
<b>2</b>	On completion of excavation and base slab	<b>5 %</b>
<b>3</b>	On completion of vertical wall and braces	<b>23 %</b>
<b>4</b>	Full supporting structure incl, Column, ring beam and completion of top slab	<b>20 %</b>
<b>5</b>	Plastering inside & outside etc. complete	<b>10 %</b>
<b>6</b>	Procurement and fixing manhole & cowl type ventilation etc.	<b>15 %</b>
<b>7</b>	Water level indictor, painting of letters M.S ladder pipe, railing and all miscellaneous items such as snowcem paint in three coats etc ( Completed with all respect ) including water tightness test	<b>25 %</b>
		<b>100 %</b>

### Construction of R.C.C.E.S.R

Sr.No	Stage of work	Amount admissible payment
<b>1</b>	On approval designs	<b>2 %</b>
<b>2</b>	On completion of excavation and Concreting	<b>10 %</b>
<b>3</b>	On completion of Full shaft and braces including staircase up to bottom slab/ dome level	<b>17 %</b>
<b>4</b>	Completion of bottom slab or dome vertical wall or slant wall of container without top slab or dome	<b>21 %</b>
<b>5</b>	Top slab or dome staircase with RCC cabin and door	<b>10 %</b>
<b>6</b>	Procurement and fixing of inlet, outlet, washout, overflow pipe valves specials chambers, lighting arrester conductor and specials at site	<b>15 %</b>
<b>7</b>	Fixing above pipes, specials as directed	<b>5 %</b>
<b>8</b>	Water level indictor, painting of letters M.S ladder pipe, railing and all miscellaneous items such as snowcem paint in three coats etc ( Completed with all respect ) including water tightness test	<b>20 %</b>
	<b>Total</b>	<b>100 %</b>



### **Construction of Bore Room**

Sr No	Stage of work	Amount admissible payment
<b>1</b>	After Completion of each work	<b>80 %</b>
<b>2</b>	After Testing of work	<b>10 %</b>
<b>3</b>	After commissioning of work	<b>10 %</b>
		<b>100 %</b>

#### **APPENDIX**

##### **APPENDIX – I**

**Details of plants and machinery immediately available with the tenderer for use in this work.**

Sr. No.	Name of Equipment	No. of Units	Kind or Name	Capacity	Age And Condition	Present Location	Remark
	<b>To be attached separately</b>						

DATE:  
CONTRACTOR

SIGNATURE OF

##### **APPENDIX - II**

##### **LIST OF WORKS ALREADY COMPLETED BY TENDERER**

Sr.No.	Name of work	Place	Cost On completion	Time taken in months To complete the work	Remarks
	<b>To be attached separately</b>				

\* Necessary certificate from the officer concerned shall be attached with the tender.

SIGNATURE OF CONTRACTOR  
AUTHORITY

### APPENDIX - III

#### DECLARATION REGARDING WORKS ON HAND WITH TENDERER

Sr.No .	Name of Work	Place	Tender cost	Works on Hand		Estimated cost	Date when decision is expected	Stipulated date and period of completion	Remarks
				Cost of remaining to be executed	Anticipated date of completion				
	To be Attach separately								

SIGNATURE OF CONTRACTOR  
AUTHORITY