

**GUJARAT WATERSUPPLY & SEWERAGE BOARD
GANDHINAGAR**

(A WHOLLY OWNED GOVERNMENT OF GUJARAT UNDERTAKING)



Name of Work:- “Demolition of Existing old RCC ESR ,RCC U/G Sump, Pump House, Staff Quarter at Kalyanpar HW, Shiyani HW,Panshina Village, Janshali HW, Kanpara HW, Chokdi HW, Bagodara Store/HW, Limbdi Store Under M&R to S2 S3 RWSS Year-2026-27.”

Estimated Cost: Rs. 11,91,301.09/-

VOLUME - II

DATA SHEET & TECHNICAL SPECIFICATION

Gujarat Water Supply & Sewerage Board

Zone –III,Rajkot

DATA SHEET

GENERAL TECHNICAL
SPECIFICATIONS

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1.0 CIVIL AND BUILDING WORKS

1.1 Design Submissions

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted to GWSSB. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by GWSSB.

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 GWSSB. 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)

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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 :

- | | | | |
|-------|---|---|--|
| (i) | Weight of water | : | 9.81 kN/m ³ |
| (ii) | 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 ³ |
| (iii) | Weight of plain concrete | : | 24.00 kN/m ³ |
| (iv) | Weight of reinforced concrete | : | 25.00 kN/m ³ |
| (v) | Weight of brickwork (exclusive of plaster) | : | 22.00 N/m ² per mm thickness of brickwork |
| (vi) | Weight of plaster to masonry surface | : | 18.00 N/m ² per mm thickness |
| (vii) | Weight of granolithic terrazzo finish or rendering screed, etc. | : | 24.00 N/m ² 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 ² |
| | (Non-accessible) | : | 0.75 kN/m ² |
| (ii) | Live load on floors supporting | | |

equipment such as pumps, blowers, compressors, valves, etc.	:	10.00 kN/m ²
(iii) Live load on all other floors walkways, stairways and platforms.	:	5.00 kN/m ²

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 GWSSB 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, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

1.4.6 The design of RCC Sumps/ Intake well 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.

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 waterstops of 150 mm width shall be used for walls and 230 mm width for base slabs.

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) structures shall be designed for uplift in empty conditions with no live load with the appropriate water table.
- (iv) walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilisation and dynamic water loads.
- (v) underground 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.

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 Data Sheet.
- (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 GWSSB.
- (iv) Special attention is drawn to danger of uplift being caused by the ground water table. All underground structural slab 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 blinding and leveling concrete shall be a minimum 75 mm thick in concrete grade 1 : 4 : 8 for non water retaining structures and 1 : 3 : 6 for water retaining structures.
 - 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 20 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/m³ with a maximum 20 mm size aggregate and 330 kg/m³ 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 0.35% of cross section. The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all water retaining structures.
 - e) All buildings shall have a minimum 1 meter 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) 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:

(i) Walls for liquid retaining structures	:	250 mm
(ii) Roof slabs for liquid retaining structures (other than flat slabs)	:	150 mm
(iii) Bottom slabs for liquid retaining structures	:	200 mm
(iv) Floor slabs including roof slabs, walkways, canopy slabs	:	100 mm
(v) Walls of cables / pipe trenches, underground pits etc.	:	125 mm
(vi) Column footings	:	300 mm

(vii) Parapets, chajja	:	100 mm
(viii) Precast trench cover	:	75 mm

1.9 Materials in General

The term "materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the Works.

Except as may be otherwise specified for particular parts of the works the provision of clauses in "Materials and Workmanship" shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

As soon as practicable after receiving the order to commence the Works, the Contractor shall inform GWSSB of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of GWSSB which may be withheld until samples have been submitted and satisfactorily tested. The Contractor shall thereafter keep GWSSB informed of orders for and delivery dates of all materials.

Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

1.10 Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by GWSSB and shall carry out the specified tests directed by GWSSB at the Site, at the supplier's premises or at a laboratory approved by GWSSB. GWSSB 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.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by GWSSB.

The Contractor shall give GWSSB seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by GWSSB. Representative of GWSSB shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by GWSSB to carry out such a test on a

mutually agreed date in his presence. The Contractor shall in any case submit to GWSSB's Representative within seven days of every test such number of certified copies (minimum six) of the test results as GWSSB may require.

Approval by GWSSB as to the placing of orders for materials or as to samples or tests shall not prejudice any of GWSSB's powers under the Contract.

The provisions of this clause shall also apply fully to materials supplied under any nominated sub-contract.

1.11 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 GWSSB, 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 GWSSB.

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)

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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 aluminium 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)

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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

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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

1.12 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 GWSSB, be relocated by the Contractor.

1.13 Buildings and Structures

All the building and structure works shall generally comply with the following GWSSB's requirements unless otherwise specified elsewhere.

1. All building works shall be of reinforced concrete framework.
2. All external walls shall be in 230 mm thick brick masonry built cement mortar in 1:4. Transoms and mullions of 115 mm x 230 mm size with four numbers 6 mm bars and 6 mm links at 150 mm c/c shall be provided to form panels not exceeding 3500 mm x 3500 mm in size.

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3. All internal partition walls except for toilets and Residential units shall be in 230 mm thick brick masonry built in cement mortar 1:4 with transoms and mullions as in (2) above. Toilet partition walls shall be in 115 mm thick brick masonry built in cement mortar 1:4 and shall have transoms and mullions as in (2) above and shall form panels not exceeding 1200 mm x 1200 mm in size.
4. (a) Finishes to concrete liquid retaining structures (for details, refer clause 3.16 of this volume) shall be :

F1	-	External surfaces, buried
F2	-	External surfaces exposed and up to 300 mm below ground level
F2	-	Internal surfaces

(b) Finishes to other concrete structures (for details, refer clause 3.16 of this volume) shall be :

F1	-	Buried
F1	-	Exposed, where plastering is specified
F2	-	Exposed
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.
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.
7. 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.
8. The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.
14. 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.
15. Building plinth shall be minimum 1000 mm above average finished ground level around building.
16. 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.
17. All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)

1.14 Valve Chambers

- a) All valve chambers are to be of an adequate size to facilitate maintenance and operation. The base slab of valve chambers shall slope towards a sump pit from which water can be pumped to keep the chamber dry. All valve chambers shall be constructed in M20 grade reinforced concrete. Chambers shall have removable cast iron / reinforced concrete covers, as appropriate, approach ladders and valve supports.

2.0 EARTHWORKS

2.1 *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 cohesion less 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).

2.2 *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.

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Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and levelling the same so as to provide natural drainage. Rock/soil 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.

2.3 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.

2.4 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, upto 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.

2.5 Rock

2.5.1 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 1m³ or 0.25m³ 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.

2.5.2 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 metres 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 overbreak 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.

2.6 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.

2.7 Fill, Backfilling and Site Grading

2.7.1 General

- (a) 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.

2.7.2 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. Top soil 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.

2.7.3 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.

2.7.4 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. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours,

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allowed to dry and then the surface again compacted as specified above to avoid settlement at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

Compaction of the plinth fill shall be carried out by means of 12 ton rollers smooth wheeled, sheep-foot or wobbly wheeled rollers. In case of compaction of granular material such as sands and gravel, vibratory rollers shall be used. A smaller weight roller may be used only if permitted by the Employer's Representative. As rolling proceeds, water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fills.

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.

Rolling shall commence from the outer edge and progress towards the centre and continue until compaction is to the satisfaction of Employer's Representative, but in no case less than 10 passes of the roller will be accepted for each layer.

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.

At some locations/areas, it may not be possible to use rollers because of space restrictions, etc. The Contractor shall then be permitted to use pneumatic tampers, rammers, etc. and he shall ensure proper compaction.

2.7.5 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.

2.7.6 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 by watering and ramming, 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 centre 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 centre 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, murum, etc. The filling up to the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the

centre line 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.

2.8 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 levelling 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.

2.9 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.

2.10 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 metre spacings, 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.

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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 spacings 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.

2.11 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 insanitary 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.

2.12 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.

3.0 CONCRETE

3.1 Applicable Codes

3.1.1 Materials

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| 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 and 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. |

3.1.2 Material Testing

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| 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 1 to 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. |

3.1.3 Material Storage

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| 1) IS:4082 | Recommendations on stacking and storing of construction materials at site. |
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3.1.4 Concrete Mix Design

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

3.1.5 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.

3.1.6 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 weigh batchers for concrete (single and double bucket type).
- 14) IS:2750 Specification for steel scaffoldings.

3.1.7 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.

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- 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 insitu cement concrete flooring.
- 16) IS:7861 Code of practice for extreme weather concreting : Part 1 Recommended practice for hot weather concreting.

3.1.8 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.

3.2 General

The GWSSB 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 GWSSB'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 GWSSB and after establishing their performance suitability based on previous data, experience or tests.

3.3 Materials

3.3.1 Cement

Unless otherwise called for by the GWSSB, 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 GWSSB.

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

3.3.2 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.

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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 GWSSB.

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.

3.3.3 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.

3.3.4 Reinforcement

All reinforcement steel shall be of CRS Fe-500 grade and welded wire fabric to IS:1566 as shown or specified on the drawing.

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.

3.3.5 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 GWSSB. 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 embedment's.

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.

3.4 Samples and Tests

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

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Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the GWSSB samples shall also be got tested by the Contractor in a laboratory approved by the GWSSB at no extra cost to Employer. GWSSB 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 GWSSB.

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.

3.5 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 GWSSB. 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.

3.6 Concrete

3.6.1 General

Concrete grade shall be as designated on drawings. In concrete grade M15, M20, M25 & M30 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.

3.6.2 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

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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 water tight 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.

Grade of Concrete	Minimum Cement Content in Kg/Cu.m of Concrete
M15	240
M20	300
M30	320

The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The CONTRACTOR's quoted rates for concrete shall provide for the above 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 GWSSB at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456.

Grade of Concrete	Minimum Compressive Strength N/sq.mm at 7 days	Specified Characteristic Compressive Strength N/sq.mm at 28 days
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

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

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

Heavy mass construction	50	25
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(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 GWSSB 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 GWSSB. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456, IS 3370.

3.6.3 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.

3.7 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 GWSSB, the drawings and calculations for the design of the formwork shall be submitted to the GWSSB 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 finish within the specified tolerance limits.**
- (d) **Capable of withstanding without deflection the worst combination of selfweight, 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 GWSSB. 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 GWSSB. 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 GWSSB, 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 GWSSB, than that required as per drawing to compensate for irregularities in excavation.

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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 GWSSB. The Contractor shall temporarily and securely fix items to be cast (embedment's/ 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 GWSSB. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the GWSSB. 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.

3.8 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 GWSSB.

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

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 GWSSB 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 GWSSB's approval.

3.9 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 :

(a) Deviation from specified dimensions of cross section of columns and beams	- 6 mm + 12 mm
(b) Deviations from dimensions of footings (Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels	
1) Dimension in plan	- 12 mm + 50 mm
2) Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm
3) Thickness	± 0.05 times the specified thickness

3.10 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 GWSSB. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

3.11 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 concrete 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 GWSSB. 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 GWSSB. Concrete shall be protected against damage until final acceptance.

3.12 Mass Concrete Works

Sequence of pouring for mass concrete works shall be as approved by the GWSSB. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

3.13 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 GWSSB, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessain 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 GWSSB, 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 GWSSB 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.

3.14 Construction Joints and Keys

Construction joints will be as shown on the drawing or as approved by the GWSSB. 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 GWSSB.

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 GWSSB.

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.

3.15 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 GWSSB. 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.

3.16 Finishes

3.16.1 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.

3.16.2 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.

3.16.3 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.

3.16.4 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, arises, 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.

3.16.5 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 GWSSB shall be supplied and used as recommended by the manufacturer.

3.17 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 GWSSB 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 GWSSB.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the GWSSB 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 GWSSB.

3.18 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 troweling as per equipment manufacturers recommendation. The equipment to be used shall be subject to the GWSSB's approval.

3.19 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 GWSSB, 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 upto 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.

3.20 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 GWSSB. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the GWSSB at no extra cost to the EMPLOYER.

3.21 Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the GWSSB, 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 GWSSB 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.

3.22 Optional Tests

If the GWSSB 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 GWSSB, 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 GWSSB 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 GWSSB also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Employer. Alternately GWSSB also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

3.23 Grouting

3.23.1 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 GWSSB. The grout proportions shall be limited as follows :

Use	Grout Thickness	Mix Proportions	W/C (max)	Ratio
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	

3.23.2 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 GWSSB. Materials rejected by GWSSB 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 GWSSB'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 GWSSB may review and decide whether remedial measures are feasible so as to render the work acceptable. The GWSSB 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.

3.24 Water stops

3.24.1 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/mm² minimum
- b) Ultimate elongation : 300% minimum
- c) Tear resistance : 4.9 N/mm² minimum
- d) Stiffness in flexure : 2.46 N/mm² minimum
- e) Accelerated extraction
 - i) Tensile strength : 10.50 N/mm² 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 : ± 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 GWSSB before procurement for incorporation in the works.

3.24.2 Workmanship

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

Waterstops 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 waterstops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions.

Waterstops 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 waterstops embedded in concrete shall be thoroughly cleaned of all mortar/concrete coating before resuming further concreting operations. The projecting waterstop 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.

3.25 *Preformed Fillers and Joint Sealing Compound*

3.25.1 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.

3.25.2 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.

CONCRETE POUR CARD					
POUR NO. :		DATE :			
DRG. NO. :		STRUCTURE :			
CONCRETE GRADE/QUANTITY/ :		MAX. AGGREGATE SIZE /			
SLUMP :		START / COMPLETION TIME :			
SL. NO.	ITEM				Remarks If Any
1.	BEFORE CONCRETING	CENTRE LINES CHECKED	YES/NO		
2.	FORMWORK AND STAGING CHECKED FOR ACCURACY, STRENGTH & FINISH		YES/NO		
3.	REINFORCEMENT CHECKED		YES/NO		
4.	COVER TO REINFORCEMENT CHECKED		YES/NO		
5.	VERIFIED TEST CERTIFICATE FOR CEMENT/STEEL		YES / NO		
6.	ADEQUACY OF MATERIALS / EQUIPMENT FOR POUR		YES / NO		
7.	EMBEDDED PARTS (LOCATION & PLUMB) CHECKED	CIVIL	YES/NO		
MECH.		YES/NO			
ELEC.		YES/NO			
8.	SOFFIT(S) & POUR TOP(T) LEVELS CHECKED BEFORE (B) & AFTER (A) FORM REMOVAL (ONLY OF BEAMS OF OVER 10 M SPAN & IMPORTANT STRUCTURE LIKE T.G. ETC.)		S(B) T(B) S(B) T(B)		
9.	CONSTRUCTION JOINTS LOCATION & TIME (IF NOT AS PER DRAWING)				
10.	CEMENT CONSUMPTION IN KGS.				
11.	NUMBER OF CUBES AND IDENTIFICATION MARKS				
12.	TEST CUBE RESULTS (7 DAYS / 28 DAYS)				
13.	CONCRETE CONDITION ON FORM REMOVAL		V.GOOD/GOOD/FAIR/POOR		

Contractor's Representative

GWSSB's Representative

NOTES: 1. EACH POUR TO HAVE SEPARATE CARDS, IN TRIPLICATE ONE EACH FOR CLIENT, CONTRACTOR & SITE OFFICE.

UNDER REMARKS INDICATE DEVIATIONS FROM DWGS. & SPECIFICATIONS, CONGESTION IN REINFORCEMENT IF ANY, UNUSUAL OCCURRENCES SUCH AS FAILURE OF EQUIPMENTS, SINKING OF SUPPORTS / PROPS. HEAVY RAINS AFFECTING CONCRETING, POOR COMPACTION, IMPROPER CURING, OTHER DEFICIENCIES, OBSERVATIONS ETC.

4.0 BUILDING DETAILS

4.1 *Applicable Codes and Specifications*

The following codes and standards are included in this section, as part of these specifications. However, respective IS codes for the works not mentioned here shall also be applicable for those particular items of work.

IS:110	-	Ready mixed paint, brushing, grey filler, for enamels for use over primers
IS:269	-	Specification for 33 grade ordinary portland cement
IS:280	-	Specification for mild steel wire for general engineering purposes
IS:287	-	Recommendations for maximum permissible moisture content of timber used for different purposes
IS:304	-	High Tensile Brass Ingots and Castings.
IS:337	-	Varnish, finishing interior
IS:348	-	French polish
IS:383	-	Specification for coarse and fine aggregates from natural sources for concrete
IS:412	-	Expanded metal steel sheets for general purposes
IS:419	-	Specification for putty for use on window frames
IS:428	-	Distemper, oil emulsion, colour as required
IS:459	-	Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets
IS:702	-	Specification for industrial bitumen
IS:710	-	Specification for marine plywood
IS:712	-	Specification for building limes
IS:730	-	Specification for hook bolts for corrugated sheet roofing
IS:733	-	Wrought aluminium and aluminium alloys, bars, rods and sections for general engineering purposes
IS:777	-	Specification for glazed earthenware tiles
IS:1003	-	Specification for timber panelled 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:1081	-	Code of practice for fixing and glazing of metal (steel & aluminium) doors, windows and ventilators
IS:1124	-	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS:1237	-	Specification for cement concrete flooring tiles
IS:1322	-	Bitumen felts for water proofing and damp proofing
IS:1346	-	Code of practice for water proofing of roofs with bitumen felts
IS:1361	-	Specification for steel windows for industrial buildings

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- IS:1397 - Specification for kraft paper
- IS:1443 - Code of practice for laying and finishing of cement concrete flooring tiles
- IS:1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
- IS:1542 - Specification for sand for plaster
- IS:1580 - Specification for bituminous compounds for water-proofing and caulking purposes
- IS:1597 - Code of practice for construction of stone masonry : Part 1 Rubble stone masonry
- IS:1659 - Specification for block boards
- IS:1661 - Code of practice for application of cement and cement-lime plaster finishes
- IS:1834 - Specification for hot applied sealing compound for joint in concrete
- IS:1838 - Specification for preformed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type) : Part 1 Bitumen impregnated fibre
- IS:1948 - Specification for aluminium doors, windows and ventilators
- IS:1949 - Specification for aluminium windows for industrial buildings
- IS:2074 - Ready mixed paint, air drying, red oxide- zinc chrome, priming
- IS:2098 - Asbestos cement building boards
- IS:2114 - Code of practice for laying in-situ terrazzo floor finish
- IS:2116 - Specification for sand for masonry mortars
- IS:2185 - Specification for concrete masonry units (Parts 1,2 & 3)
- IS:2202 - Specification for wooden flush door shutters (Solid core type) : Parts 1 & 2
- IS:2212 - Code of practice for brickwork
- IS:2250 - Code of practice for preparation and use of masonry mortars
- IS:2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
- IS:2339 - Aluminium paint for general purposes, in dual container
- IS:2395 - Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)

- IS:2402 - Code of practice for external rendered finishes
- IS:2571 - Code of practice for laying in-situ cement concrete flooring
- IS:2572 - Code of practice for construction of hollow concrete block masonry
- IS:2645 - Specification of integral cement waterproofing compounds
- IS:2690 - Specification for burnt clay flat terracing tiles : Part 1 Machine made
- IS:2691 - Specification for burnt clay facing bricks

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- IS:2750 - Specification for steel scaffoldings
- IS:2835 - Flat transparent sheet glass
- IS:2932 - Specification for enamel, synthetic, exterior type (a) undercoating, (b) finishing
- IS:3007 - Code of practice for laying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets
- IS:3036 - Code of practice for laying lime concrete for a water-proofed roof finish
- IS:3067 - Code of practice of general design details and preparatory work for damp-proofing and water- proofing of buildings
- IS:3068 - Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete
- IS:3384 - Specification for bitumen primer for use in water-proofing and damp-proofing
- IS:3461 - Specification for PVC-asbestos floor tiles
- IS:3462 - Specification for unbacked flexible PVC flooring
- IS:3495 - Method of test for burnt clay building bricks: Part 1 to 4
- IS:3536 - Specification for ready mixed paint, brushing, wood primer, pink
- IS:3564 - Specification for door closures (hydraulically regulated)
- IS: 3614 (Part – 1) Specification for fire checks doors : Part –I Plate metal covered and rolling type
- IS: 3614 (Part – 2) Specification for metallic and non-metallic fire check doors : Part-2 Resistance test and performance criteria
- IS:3696 - Safety code of scaffolds and ladders (Parts 1 & 2)
- IS:4020 - Methods of test for wooden flush door : Type test
- IS:4021 - Specification for timber door, window and ventilator frames
- IS:4351 - Specification for steel door frames
- IS:4443 - Code of practice for use of resin type chemical resistant mortars
- IS:4457 - Specification for ceramic unglazed vitreous acid resisting tile
- IS:4631 - Code of practice for laying epoxy resin floor toppings
- IS:4832 - Specification for chemical resistant mortars (Part II)
- IS:4860 - Specification for acid resistant bricks
- IS:4948 - Specification for welded steel wire fabric for general use
- IS:5318 - Code of practice for laying of flexible PVC sheet and tile flooring
- IS:5410 - Cement paint, colour as required
- IS:5411 - Specification for plastic emulsion paint (Parts 1 & 2)
- IS:5437 - Wired and figured glass

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- IS:5491 - Code of practice for laying of in-situ granolithic concrete floor topping
- IS:6041 - Code of practice construction of autoclaved cellular concrete block masonry
- IS:6042 - Code of practice for construction of light weight concrete block masonry
- IS:6248 - Specification for metal rolling shutters and rolling grilles
- IS:7193 - Specification for glass fibre base coal tar pitch and bitumen felts
- IS:7452 - Specification for hot rolled steel sections for doors, windows and ventilators
- IS:8042 - Specification for white portland cement
- IS:8543 - Methods of testing plastics
- IS:8869 - Specification for washers for corrugated sheet roofing
- IS:9197 - Specification for epoxy resin, hardeners and epoxy resin composites for floor topping
- IS:9862 - Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting
- IS:12200 - Code of practice for provision of waterstops at transverse contraction joints in masonry and concrete dams
- BS : 476 (Part – 20) - Methods for determination of the fire resistance of elements of construction (General Principles)
- BS : 476 (Part – 21) - Methods for determination of the fire resistance of load bearing elements of construction
- BS : 476 (Part – 22) - Methods for determination of the fire resistance of non-load bearing elements of construction
- Part – IV
Fire
Protection - National Building code of India

4.2 Brickwork

4.2.1 Materials

Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work prepared by the Contractor.

The nominal size of the modular brick shall be 200mmx100mmx100mm with the permissible tolerances over the actual size of 190mmx90mmx90mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mmx115mmx75mm with tolerance upto ± 3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear

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ringing sound when struck and shall have a minimum crushing strength of 5N/sq.mm unless otherwise specified in the Items of work prepared by the Contractor.

The average water absorption shall not be more than 20 percent by weight upto class 12.5 and 15 percent by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works.

Sample bricks shall be submitted to the GWSSB for approval and bricks supplied shall conform to approved samples. If demanded by GWSSB, brick samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by GWSSB shall be removed from the site of works within 24 hours.

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work prepared by the Contractor. Sand for masonry mortar shall conform to IS:218. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by GWSSB. If so directed by the GWSSB, sand shall be screened and washed till it satisfies the limits of deleterious materials.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the GWSSB. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. In case, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances. The Contractor shall arrange for test on mortar samples if so directed by the GWSSB.

4.2.2 Workmanship

Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work prepared by the Contractor. Brick work 200mm/230mm thick and over shall be laid in English Bond unless otherwise specified.

100mm/115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only as closers to make up required wall length or for bonding. Bricks shall be laid with frogs on top.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, atleast one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 deg. But in no case the level difference between adjoining walls shall exceed one meter. Brick work shall not be raised more than one metre per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum

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depth of 10mm/15mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/ pointing respectively to be done later. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the GWSSB.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the GWSSB. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/pointing.

In the event of usage of traditional bricks of size 230 mm x115mm x75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor slabs and at the top of the parapet shall be laid with bricks on edge.

All brickwork shall be built tightly against columns, floor slabs or other structural members.

To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.

For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

RCC/ steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 50 mm thickness, projecting 50mm on either sides of the beam, duly finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

Steel wire fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work.

Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a deshuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

Reinforced cement concrete transoms and mullions of dimensions as indicated in the construction Drawings to be prepared by the Contractor are generally required to be provided in the half brick partition walls.

Where the drawings prepared by the Contractor indicate that structural steel sections are to be encased in brickwork, the brickwork masonry shall be built closely against the steel section, ensuring a minimum of 20mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

Facing bricks of the type specified conforming to IS:2691 shall be laid in the positions indicated on the Drawings prepared by the Contractor and all facing brickwork shall be well bonded to the

backing bricks/RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.

Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of pointing to be carried out shall be as specified in the item of works prepared by the Contractor. The pattern of laying the bricks shall be as specifically indicated in the Drawings prepared by the Contractor. For facing brickwork, double scaffolding shall be used. Faced works shall be kept clean and free from damage, discoloration etc., at all times.

4.3 *Uncoursed Random Rubble Masonry, in Foundation, Plinth and Superstructure*

4.3.1 Materials

Stones for the works shall be of the specified variety which are hard, durable, fine grained and uniform in colour (for superstructure work) free from veins, flaws and other defects. Quality and work shall conform to the requirements specified in IS:1597 (Part-I). The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS:1124. The Contractor shall supply sample stones to the GWSSB for approval. Stones shall be laid with its grains horizontal so that the load transmitted is always perpendicular to the natural bed.

Cement-sand mortar for stone masonry works shall be in the proportion of 1:6. Materials and preparation of mortar shall be as specified in clause 7.2.1.

4.3.2 Workmanship

For All Works below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for the hearting and selected quarry dressed stones for the facing.

For all works above ground level and in superstructure the masonry shall be random rubble uncoursed, well bonded, faced with hammer dressed stones with squared quoins at corners. The bushings on the face shall not be more than 40 mm on an exposed face and on the face to be plastered it shall not project by more than 12 mm nor shall it have depressions more than 10 mm from the average wall surface.

Face stones shall extend back sufficiently and bond well with the masonry. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourths the thickness of wall nor less than 150 mm. The height of stone may be upto a maximum of 300 mm. Face stones or hearting stones shall not be less than 150 mm in any direction.

Chips and spalls shall be used wherever necessary to avoid thick mortar joints and to ensure that no hollow spaces are left in the masonry. The use of chips and spalls in the hearting shall not exceed 20 percent of the quantity of stone masonry. Spalls and chips shall not be used on the face of the wall and below hearting stones to bring them to the level of face stones.

The maximum thickness of joints shall not exceed 20 mm. All joints shall be completely filled with mortar. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of the work while the mortar is still green.

Through or bond stones shall be provided in walls upto 600 mm thick and in case of walls above 600 mm thickness, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous lime stone and sand stone, etc.) the bond stone shall extend about two-thirds into the wall and a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. Each bond stone or a set of bond stones shall be provided for every 0.5 sq.m of wall surface.

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All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. All connected walls in a structure shall be normally raised uniformly and regularly. However if any part of the masonry is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45deg. Masonry work shall not be raised by more than one metre per day.

Green work shall be protected from rain by suitable covering. Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days for proper curing of the joints.

Type of scaffolding to be used shall be as specified in clause 7.2.2.

4.4 *Coursed Rubble Masonry (First Sort) for Superstructure*

4.4.1 Materials

The Material specification for the work shall be as per clause 7.3.1.

4.4.2 Workmanship

All Courses shall be laid truly horizontal and shall be of the same height in any course. The height of course shall not be less than 150 mm and not more than 300 mm. The width of stone shall not be less than its height.

Face stones shall tail into the work for not less than their height and atleast 1/3rd the number of stones shall tail into the work for a length not less than twice their height but not more than three-fourths the thickness of the wall whichever is smaller. These should be laid as headers and stretchers alternately to break joints by atleast 75 mm.

The face stones shall be squared on all joints and beds; the bed joints being hammer or chisel dressed true and square for at least 80 mm back from the face and the side joints for atleast 40 mm. The face of the stone shall be hammer dressed so that the bushing shall not be more than 40 mm on an exposed face and 10 mm on a face to be plastered. No portion of the dressed surface shall show a depth of gap more than 6 mm from a straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints.

No spalls or pinning's shall be allowed on the face. All bed joints shall be horizontal and side joints shall be vertical and no joints shall be more than 10 mm in thickness. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool, during the progress of the work while the mortar is still green.

Hearting shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of the stone masonry. Care shall be taken so that no hollow spaces are left anywhere in the masonry.

The requirement regarding through or bond stones shall be as specified in clause 7.3.2 with the further stipulation that these shall be provided at 1.5 m to 1.8m apart clear in every course but staggered at alternate courses.

The quoins which shall be of the same height as the course in which they occur, shall not be less than 450 mm in any direction. Quoin stones shall be laid as stretchers and headers alternately. They shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm from the face. These stones shall have a minimum uniform chisel drafts of 25mm width at four edges, all the edges being in the same plane.

Type of scaffolding to be used shall be as per Clause 7.2.2. Requirements of execution of the work and curing shall be as stipulated in clause 7.3.2 .

4.5 Concrete Block Masonry

4.5.1 Materials

Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS : 2185 (Part I).

Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS : 2185 (Part 3).

Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS:2185 (Part 3).

The height of the concrete masonry units shall not exceed either its length or six times its width.

The nominal dimensions of concrete block shall be as under.

Length 400, 500 or 600 mm

Height 100 or 200 mm

Width 100 to 300 mm in 50 mm increments

Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full length blocks.

Actual dimensions shall be 10mm short of the nominal dimensions.

The maximum variation in the length of the units shall not be more than ± 5 mm and maximum variation in height or width of the units shall not be more than ± 3 mm.

Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks.

Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall as specified. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square.

The bedding surfaces shall be at right angles to the faces of the block.

The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume.

Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of GWSSB.

4.5.2 Workmanship

The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified. The minimum nominal thickness of non-load bearing internal walls shall be 100mm. The minimum nominal thickness of external panel walls in framed construction shall be 200 mm.

The workmanship shall generally conform to the requirements of IS:2572 for concrete block masonry, IS:6042 for light weight concrete block masonry and IS:6041 for autoclaved cellular concrete block masonry works.

From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.

Concrete blocks shall be embedded with a mortar which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar of proportion 1:6 shall be used for the works. Preparation of mortar shall be as specified in clause 7.2.1.

The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, levelled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal

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(bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cell blocks with slight depression on the vertical sides these shall also be filled up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity. Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.

As per the design requirements and to effectively control cracks in the masonry, RCC bound beams/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS:280 or welded wire fabric/high strength deformed basis.

For jambs of doors, windows and openings, should concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

At intersection of walls, the courses shall laid up at the same time with a true masonry bond between at least 50% of the concrete blocks. The sequence for construction of partition walls and treatment at the top of load bearing walls for the RCC slab shall be as detailed under clause 7.2 for the brick work.

Curing of the mortar joints shall be carried out for atleast 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet.

Double scaffolding as per clause 7.2.2 shall be adopted for execution of block masonry work.

Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows etc.

Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

4.6 Damp - Proof Course

4.6.1 Materials and Workmanship

Where Specified, all the walls in a building shall be provided with damp-proof course cover plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10 mm down graded coarse aggregates.

The surface of brick work/stone masonry work shall be levelled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.

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Damp-proof course shall be cured properly for atleast seven days after which it shall be allowed to dry for taking up further work.

4.7 *Miscellaneous Inserts, Bolts etc.*

All the miscellaneous inserts such as bolts, pipes, plate embedments etc., shall be accurately installed in the building works at the correct location and levels, all as detailed in the construction Drawings to be prepared by the Contractor prepared by the Contractor. Contractor shall prepare and use templates for this purpose, if so directed by the GWSSB. In the event, of any of the inserts are improperly installed, Contractor shall make necessary arrangements to remove and reinstall at the correct locations/levels, all as directed by the GWSSB.

4.8 *Wood Work In Doors, Windows, Ventilators & Partitions*

4.8.1 *Materials*

Timber To be used shall be first class Teak wood as per IS:4021. Timber shall be of the best quality and well seasoned by a suitable process before being planed to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 8 to 14 percent of timber less than 50mm in thickness for different regions of the country as stipulated in IS:287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits and cracks.

Flush door shutters of the solid core type with plywood face panels shall conform to IS:2202 (Part 1) and with particle board/hard board face panels shall conform to IS:2202 (Part 2).

Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.

Builder's hardware for fittings and fixtures shall be of the best quality from approved manufacturers.

4.8.2 *Workmanship*

The workmanship and finish of wood work in doors, windows, ventilators and partitions shall be of a very high order. Contractor shall ensure that work is executed in a professional manner by skilled carpenters for good appearance, efficient and smooth operation of the shutters.

All works shall be executed as per the detailed Drawings prepared by the Contractor and/or as directed by the GWSSB.

All members of the door, window, and ventilator shall be straight without any warp or bow and shall have smooth well planed faces. The right angle shall be checked from the inside surfaces of the respective members of the frame. Frames shall have mortice and tenon joints which shall be treated with an approved adhesive and provided with metal or wood pins. The vertical members of the door frame shall project 50 mm below the finished floor level. The finished dimension of frames shall be rebated on the solid for keying with the plaster and for receiving the shutters. The depth of rebate for housing the shutter shall be 15 mm. The size of the frames shall be as specified in the respective items of work prepared by the Contractor. The workmanship shall generally conform to the requirements specified in IS:4021.

The face of the frames abutting the masonry or concrete shall be provided with a coat of coal tar.

Three hold fasts using 25 mm x 6 mm mild steel flats 225 mm long with split ends shall be fixed on each side of door and window frames, one at the centre and the other two at 300 mm from the top and bottom of the frame. For window and ventilator frames less than 1 m in height, two hold fasts on each side shall be fixed at quarter points.

Timber paneled shutters for doors, windows and ventilators shall be constructed in the form of framework of stiles and rails with panel insertion. The panels shall be fixed by either providing grooves in the stiles and rails or by beading. Glazing bars shall be as detailed in the Drawings

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prepared by the Contractor. The stiles and rails shall be joined by mortise and ten on joints at right angles. All members of the shutter shall be straight without any warp or bow and shall have smooth, well planed faces at right angles to each other. The right angle for the shutter shall be checked by measuring the diagonals and the difference shall not be more than ± 3 mm. Timber panels made from more than one piece shall be jointed with a continuous tongued and grooved joint, glued together and reinforced with metal dowels. The workmanship shall generally conform to the requirements specified in IS:1003 (Parts 1 & 2). The thickness of the shutter, width/thickness of the stiles/rails/panel type shall be as specified. Marine plywood panels conforming to IS:710 shall be used for doors where specified.

Details of the wooden flush door shutters, solid core type with specific requirement of the thickness, core, face panels, viewing glazed panel, venetian louver opening, teak wood lipping etc. shall be as specified. Panels of shutter shall be of marine plywood conforming to IS:710. Flush door shutters shall be from reputed manufacturers and Contractor shall submit test results as per IS:4020, if so desired by the GWSSB.

Glazing of door, window, ventilator and partitions shall be with either flat transparent sheet glass, wired or figured glass. Transparent sheet glass shall be of 'B' quality as per IS:2835. The thickness and type of glazing to be provided shall be as specified.

The material of the fittings and fixtures either of chromium plated steel, cast brass, copper oxidized or anodized aluminum shall be as specified. The number, size and type of the fittings and fixtures shall be as specified.

Woodwork shall not be provided with the finishes of painting/varnishing etc. unless it has been approved by the GWSSB. The type of finish and the number of coats shall be as stipulated in the respective items of work prepared by the Contractor. Preparation of the wood surfaces and application of the finishes shall be in accordance with clause 7.32.

Wooden hand railing and architrave's shall be of the size and shape with the fixing arrangement as indicated in the Drawings prepared by the Contractor.

The framework of the partitions with mullions and transoms shall be with the sections of dimensions as specified. Panels of double/single glazing/plywood shall be fixed as per details specified. Partitions shall be fixed rigidly between the floor and structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings prepared by the Contractor.

Any carpentry work which show defects due to inadequate seasoning of the timber or bad workmanship shall be removed and replaced by Contractor with work as per Specifications.

4.9 Steel Doors, Windows and Ventilators

4.9.1 Materials

Hot rolled steel sections for the fabrication of steel doors, windows and ventilators shall conform to IS: 7452, which are suitable for, single glazing.

Pressed steel door frames for steel flush doors shall be out of 1.25mm thick mild steel sheets of profiles as per IS : 4351.

Transparent sheet glass shall conform to the requirements of IS : 2835. Wired and figured glass shall be as per IS : 5437.

Builder's hardware of fittings and fixtures shall be of the best quality from the approved manufacturers.

4.9.2 Workmanship

All steel doors, windows and ventilators shall be of the type as specified in the respective items of work prepared by the Contractor and of sizes as indicated in the Drawings prepared by the Contractor prepared by the Contractor. Steel doors, windows and ventilators shall conform to

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the requirements as stipulated in IS : 1038. Steel windows shall conform to IS : 1361, if so specified.

Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the unit shall be with rolled section, cut to correct lengths and metered. Corners shall be welded to form a solid fused welded joint conforming to the requirements of IS : 1038. Tolerance in overall dimensions shall be within $\pm 1.5\text{mm}$. The frames and shutters shall be free from warp or buckle and shall be square and truly plain. All welds shall be dressed flush on exposed and contact surfaces. Punching of holes, slots and other provisions to install fittings and fixtures later shall be made at the correct locations as per the requirements. Samples of the units shall be got approved by the GWSSB before further manufacture/purchase by the Contractor.

Type and details of shutters, hinges, glazing bar requirement, couplings, locking arrangement, fittings and fixtures shall be as described in the respective items of work and / or as shown in the Drawings prepared by the Contractor for single or composite units.

For windows with fly proof mesh as per the item of work prepared by the Contractor, rotor operator arrangement, for the operation of the glazed shutters from the inside shall be provided.

Pressed steel door frames shall be provided with fixing lugs at each jamb, hinges, lock-strike plate, mortar guards, angle threshold, shock-absorbers of rubber or similar material as per the requirements of IS : 4351. Pressed steel doorframes shall be fixed as 'built-in' as the masonry work proceeds. After placing it plumb at the specified location, masonry walls shall be built up solid on either side and each course grouted with mortar to ensure solid contact with the doorframe, without leaving any voids. Temporary struts across the width shall be fixed, during erection to prevent bow/sag of the frame.

Door shutters of flush welded construction shall be 45mm thick, fabricated with two outer skills of 1.25mm thick steel sheets, 1mm thick steel sheet stiffeners and steel channels on all four edges. Double shutters shall have meeting stile edge beveled or rebated. Provision of glazed viewing panel, louvers shall be made as per the items of works and/or Drawings prepared by the Contractor. Shutters shall be suitably reinforced for lock and other surface hardware and to prevent sagging/twisting. Single sheet steel door shutters shall be fabricated out of 1.25mm thick steel sheets, mild steel angles and stiffeners as per the Drawings prepared by the Contractor.

Doors, windows and ventilators shall be fixed into the prepared openings. They shall not be 'built-in' as the masonry work proceeds, to avoid distortion and damage of the units. The dimensions of the masonry opening shall have 10mm clearance around the overall dimensions of the frame for this purpose. Any support of scaffolding members on the frames/glazing bars is prohibited.

Glazing of the units shall be either with flat transparent glass or wired / figured glass of the thickness as specified in the items of works prepared by the Contractor. All glass panels shall have properly squared corner and straight edges. Glazing shall be provided on the outside of the frames.

Fixing of the glazing shall be either with spring glazing clips and putty conforming to IS:419 or with metal beads. Pre-formed PVC or rubber gaskets shall be provided for fixing the beads with the concealed screws. The type of fixing the glazing shall be as indicated in the items of work and/or in Drawings prepared by the Contractor.

Steel doors, windows and ventilators shall be provided with finish of either painting as specified or shall be hot dip galvanized with thickness of the zinc coating as stipulated all as described in the respective items of works prepared by the Contractor.

The material of the Builders hardware of fittings and fixtures of chromium plated steel, cast brass, brass copper oxidized or anodized aluminum shall be as specified in the items of works prepared by the Contractor. The number, size and type of fittings and fixtures shall be as in the Drawings /items of works prepared by the Contractor.

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Installation of the units with fixing lugs, screws, mastic caulking compound at the specified locations shall generally conform to the requirements of IS:1081. Necessary holes etc required for fixing shall be made by the Contractor and made good after installation. Workmanship expected is of a high order for efficient and smooth operation of the units.

4.10 Aluminum Doors, Windows, Ventilators & Partitions

4.10.1 Materials

Aluminum alloy used in the manufacture of extruded sections for the fabrication of doors, windows, ventilators shall conform to designation HE9-WP of IS:733.

Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.

Builder's hardware of fittings & fixtures shall be of the best quality from approved manufacturers.

4.10.2 Workmanship

All aluminum doors, windows, ventilators and partitions shall be of the type and size as specified. The doors, windows, ventilators shall conform to the requirements of IS:1948. Aluminum windows, shall conform to IS:1949, if so specified.

All aluminum units shall be supplied with anodized finish. The minimum anodic film thickness shall be 0.015 mm.

Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the units shall be with the extruded sections, cut to correct lengths, mitered and welded at the corners to a true right angle conforming to the requirements of IS:1948. Tolerance in overall dimensions shall be within $\pm 1.5\text{mm}$. The frames and shutters shall be free from warp or buckle and shall be square and truly plane. Punching of holes, slots and other provisions to install fittings or fixtures later shall be made at the correct locations, as per the requirements.

Aluminium swing type doors, aluminum sliding windows, partitions shall be as specified.

IS:1948 and IS:1949 referred to incorporates the sizes, shapes, thicknesses and weight per running metre of extruded sections for the various components of the units. However, new sizes, shapes, thicknesses with modifications to suit snap-fit glazing clips etc. are being continuously being added by various leading manufacturers of extruded sections, which are available in the market. As such, the sections of the various components of the unit proposed by the Contractor, will be reviewed by the GWSSB and will be accepted only if they are equal to or marginally more than that given in the codes/as specified.

The framework of the partitions with mullions and transoms shall be with anodized aluminum box sections. Anodized aluminum box sections shall be in-filled with timber of class 3 (silver oak or any other equivalent) as per IS:4021. Panels of double/single glazing/plywood shall be fixed as per details indicated in the Drawings to be prepared by the Contractor. Partitions shall be fixed rigidly between the floor and the structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings to be prepared by the Contractor.

Specific provisions as stipulated for steel doors, windows, ventilators under clause 7.9.2 shall also be applicable for this item work. Glazing beads shall be of the snap-fit type suitable for the thickness of glazing proposed as indicated in the items of works prepared by the Contractor. A layer of clear transparent lacquer shall be applied on aluminum sections to protect them from damage during installation. This lacquer coating shall be removed after the installation is completed.

4.11 Steel Rolling Shutters

4.11.1 Materials and Workmanship

Rolling shutters shall be of an approved manufacture, conforming to the requirements specified in IS:6248.

The type of rolling shutter shall be self coiling type (manual) for clear areas upto 12 sq.m, gear operated type (mechanical) for clear areas upto 35 sq.m and electrically operated type for areas up to 50 sq.m. Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.

Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the Drawings prepared by the Contractor.

Shutters shall be built up of interlocking laths 75 mm width between rolling centres formed from cold rolled steel strips. The thickness of the steel strip shall not be less than 0.90 mm for shutters upto 3.50m width and not less than 1.20 mm for shutters above 3.50 m width. Each lath section shall be continuous single piece without any welded joint.

The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built up construction. The channel shall be of size as stipulated in IS:6248 for various clear widths of the shutters.

Hood covers shall be of mild steel sheets not less than 0.90 mm thick and of approved shape.

Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.

All component parts of the steel rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS:2074 at the shop before supply. These surfaces shall be given an additional coat of primer after erection at the site along with the number of coats and type of finish paint as specified in the respective items of works prepared by the Contractor. Painting shall be carried out as per clause 7.33.

In case of galvanized rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanised with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be atleast 610gms/sq.m.

Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation.

6.12 Rubble Sub-Base

4.12.1 Materials

Stones used for rubble packing under floors on grade, foundations etc., shall be clean, hard, durable rock free from veins, flaws, laminations, weathering and other defects. Stones shall generally conform to the requirements stipulated in IS: 1597 (Part I).

Stones shall be as regular as can be obtained from quarries. Stones shall be of height equal to the thickness of the packing proposed with a tolerance of ± 10 mm. Stones shall not have a base area less than 250 sq cm nor more than 500 sq.cm, and the smallest dimension of any stone shall not be less than half the largest dimension. The quality and size of stones shall be subject to the approval of the GWSSB.

4.12.2 Workmanship

Stones shall be hand packed carefully and laid with their largest base downwards resting flat on the prepared sub-grade and with their height equal to the thickness of the packing. Stones shall be laid breaking joints and in close contact with each other. All interstices between the stones shall be wedged-in by small stones of suitable size, well driven in by crow bars and hammers to ensure tight packing and complete filling-in of the interstices. The wedging shall be carried out simultaneously with the placing in position of rubble packing and shall not lag behind. After this, any interstices between the smaller wedged stones shall be infilled with clean hard sand by booming so as to fill the joints completely.

The laid rubble packing shall be sprinkled with water and compacted by using suitable rammers.

4.13 Base Concrete

The thickness and grade of concrete and reinforcement shall be as specified in items of works prepared by the contractor.

Before placing the blinding concrete, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

4.14 Terrazzo and Plain Cement Tiling Work

4.14.1 Materials

Terrazzo tiles and cement tiles shall generally conform in all respects to standards stipulated in IS:1237. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14N/mm².

The type, quality, size, thickness colour etc, of the tiles for flooring/dado/skirting shall be as specified.

The aggregates for terrazzo topping shall consist of marble chips which are hard, sound and dense. Cement to be used shall be either ordinary portland cement or white cement with or without coloring pigment. The binder mix shall be with 3 parts of cement to 1 part of marble powder by weight. The proportion of cement shall be inclusive of any pigments. For every one part of cement-marble powder binder mix, the proportion of aggregates shall be 1.75 parts by volume, if the chips are between 1mm to 6mm and 1.50 parts by volume if the chips are between 6mm to 25mm.

The minimum thickness of wearing layer of terrazzo tiles shall be 5mm for tiles with chips of size varying from 1mm upto 6mm or from 1mm upto 12mm. This shall be 6mm for tiles with chips varying from 1mm upto 25mm. The minimum thickness of wearing layer of cement/colored cement tiles shall be 5mm. This shall be 6mm for heavy duty tiles. Pigment used in the wearing layer shall not exceed 10 percent of the weight of cement used in the mix.

4.14.2 Workmanship

Laying and finishing of tiles shall conform to the requirements of workmanship stipulated in IS:1443.

Tiling work shall be commenced only after the door and window frames are fixed and plastering of the walls/ ceiling is completed. Wall plastering shall not be carried out upto about 50mm above the level of proposed skirting/dado.

The base concrete shall be finished to a reasonably plane surface about 40 to 45mm below the level of finished floor. Before the tiling work is taken up, the base concrete or structural slab

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shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. using steel wire brush and well wetted without allowing any water pools on the surface.

A layer of 25mm average thickness of cement mortar consisting of one part of cement to 6 parts of sand shall be provided as bedding for the tiles over the base concrete. The thickness of bedding mortar shall not be less than 10mm at any place. The quantity of water to be added for the mortar shall be just adequate to obtain the workability for laying. Sand for the mortar shall conform to IS:2116 and shall have minimum fineness modulus of 1.5. The surface shall be left rough to provide a good bond for the tiles. The bedding shall be allowed to harden for a day before laying of the tiles.

Neat cement slurry using 4.4 kg of cement per sq.m of floor area shall be spread over the hardened mortar bedding over such an area at a time as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be in straight lines and shall normally be 1.5mm wide. On completion of laying of the tiles in a room, all the joints shall be cleaned and washed fairly deep with a stiff broom/wire brush to a minimum depth of 5mm. The day after the tiles have been laid, the joints shall be filled with cement grout of the same shade as the color of the matrix of the tile. For this purpose white cement or grey cement with or without pigments shall be used. The flooring should be kept moist and left undisturbed for 7 days for the bedding/joints to set properly. Heavy traffic shall not be allowed on the floor for at least 14 days after fixing of the tiles.

About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles along with any other cracked or broken tiles shall be removed and replaced with new tiles to proper line and level. The same procedure shall be followed again after grinding the tiles and all damaged tiles replaced, properly jointed and finished to match. For the purpose of ensuring that such replaced tiles match with those laid earlier, it is necessary that the Contractor shall procure sufficient quantity of extra tiles to meet this contingency.

Wherever a full tile cannot be provided, tiles shall be cut to size and fixed. Floor tiles adjoining the wall shall go about 10mm under the plaster, skirting or dado.

Tile skirting and dado work shall be executed only after laying tiles on the floor. For dado and skirting work, the vertical wall surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 10mm thick backing of 1:4 cement sand mortar. For this work the tiles as obtained from the factory shall be of the size required and practically full polished. The back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. Fixing shall be done from the bottom of the wall upwards. The joints shall be in straight lines and shall normally be 1.5mm wide. Any difference in the thickness of the tiles shall be evened out in the backing mortar or cement paste so that the tile faces are in conformity & truly plumb. Tiles for use at the corners shall be suitably cut with beveled edges to obtain a neat and true joint. After the work has set, hand polishing with carborundum stones shall be done so that the surface matches with the floor finish.

Wall plastering of the strip left out above the level of skirting/dado shall be taken up after the tiles are fixed.

Chequered terrazzo tiles for flooring and for stair treads shall be delivered to site after the first machine grinding.

Machine grinding and polishing shall be commenced only after a lapse of 14 days of laying. The sequence and three numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pin holes, watering etc. shall be carried out all as specified in IS:1443.

Tiles shall be laid to the levels specified. Where large areas are to be tiled the level of the central portion shall be kept 10mm higher than that at the walls to overcome optical illusion of a

depression in the central portion. Localized deviation of $\pm 3\text{mm}$ in any 3m length is acceptable in a nominally flat floor.

4.15 In-Situ Terrazzo Work

4.15.1 Materials

The requirements of marble aggregates for terrazzo topping shall be as per clause 7.14.1.

Cement shall first be mixed with the marble powder in dry state. The mix thus obtained shall be mixed with the aggregates in the specified proportions. Care shall be taken not to get the materials into a heap which results in the coarsest chips falling to the edges and cement working to the centre at the bottom. Materials shall be kept, as far as possible, in an even layer during mixing. After the materials have been thoroughly mixed in the dry state, water shall be added, just adequate to obtain plastic consistency for the desired workability for laying. The mix shall be used in the works within 30 minutes of the addition of water to the cement.

4.15.2 Workmanship

The thickness, type, quality, size and color of chips etc. for the in-situ terrazzo finish for flooring/dado/ skirting shall be as specified in the respective items of works prepared by the Contractor. Laying and finishing of in-situ work shall conform to the requirements of workmanship stipulated in IS: 2114.

In-situ terrazzo finish shall be laid over hardened concrete base. The finish layer consists of an under layer and terrazzo topping. The under layer shall be of cement concrete of mix 1:2:4 using 10mm downgraded coarse aggregates. The combined thickness of under layer and topping shall not be less than 30 mm for flooring and 20mm for dado/skirting work.

The minimum thickness of topping shall be 6mm if chips used are between 1mm to 4mm, 9mm if chips are between 4mm to 7mm and 12mm if chips are between 7mm to 10mm. If chips larger than 10mm size are used, the minimum thickness shall be one and one third the maximum size of chips.

Both the under layer and later the topping shall be divided into panels not exceeding 2 sq.m for laying so as to reduce the possibility of development of cracks. The longer dimension of any panel shall not exceed 2m. Dividing strips shall be used to separate the panels. When the dividing strips are not provided, the bays shall be laid alternately, allowing an interval of at least 24 hours between laying adjacent bays.

Dividing strips shall be either of aluminum, brass or other material as indicated in the items of works prepared by the Contractor. Aluminum strips should have a protective coating of bitumen. The thickness of the strips shall be not less than 1.5mm and width not less than 25mm for flooring work.

Concrete base shall be finished to a reasonably plane surface to a level below the finished floor elevation equal to the specified thickness of terrazzo finish. Before spreading the under layer, the base concrete surface shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. and well wetted without allowing any water pools on the surface. Dividing strips or screed strips, if dividing strips are not provided shall be fixed on the base and leveled to the correct height to suit the thickness of the finish. Just before spreading the under layer the surface shall be smeared with cement slurry at 2.75 Kg/sq.m. Over this slurry, the under layer shall be spread and leveled with a screeding board. The top surface shall be left rough to provide a good bond for the terrazzo topping.

Terrazzo topping shall be laid while the under layer is still plastic and normally between 18 to 24 hours after the under layer is laid. Cement slurry of the same color as the topping shall be brushed on the surface immediately before laying is commenced. The terrazzo mix shall be laid to a uniform thickness and compacted thoroughly by tamping and with a minimum of toweling. Straight edge and steel floats shall be used to bring the surface true to the required level in

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such a manner that the maximum amount of marble chips come up and spread uniformly all over the surface.

The surface shall be left dry for air-curing for a period of 12 to 18 hours. Thereafter it shall be cured by allowing water to stand in pools for a period of not less than 4 days.

Machine grinding and polishing shall be commenced only after a lapse of 7 days from the time of completion of laying. The sequence and four numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pinholes, wet curing, watering etc shall be carried out all as specified in IS: 2114.

4.16 Shahabad / Tandur/ Kota Stone Slab work

4.16.1 Materials

The slabs shall be of approved selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS : 1124.

The slabs shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100mm shall be $\pm 5\text{mm}$. This shall be $\pm 2\text{mm}$ on dimensions less than 100mm.

Slabs shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs shall have the top surface machine polished (first grinding) before being brought to site. The slabs shall be washed clean before laying.

4.16.2 Workmanship

The type, size, thickness and color/shade etc. of the slabs for flooring/dado/skirting shall be as specified in the respective items of works prepared by the Contractor.

Preparation of the concrete base, laying and curing shall be as per clause 7.14.2.

Dado / skirting work shall be as per clause 7.14.2. The thickness of the slabs for dado/skirting work shall not be more than 25mm. Slabs shall be so placed that the back surface is at a distance of 12mm. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar of proportion 1:3. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed.

Grinding and polishing shall be as per clause 7.14.2 except that first grinding with coarse grade carborundum shall not be done and cement slurry with or without pigment shall not applied before polishing.

4.17 Carborundum Tile Finish

4.17.1 Materials

Carborundum tiles shall generally conform in all respects to the standards stipulated in IS:1237 for heavy duty tiles. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14 N/mm^2 .

The topping shall be uniform and of thickness not less than 6mm. The quantity of carborundum grit shall be not less than 1.35 kg/sq.m used with cement with or without pigment. The carborundum grit shall pass through 1.18mm mesh and shall be retained on 0.60 mm mesh.

4.17.2 Workmanship

Requirements as detailed for terrazzo/cement tile finish under clause 7.14.2 shall be applicable for carborundum tile flooring.

4.18 Glazed Tile Finish

4.18.1 Materials

Glazed earthenware tiles shall conform to the requirements of IS: 777. Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 777.

4.18.2 Workmanship

The total thickness of glazed tile finish including the bedding mortar shall be 20 mm in flooring/dado/skirting. The minimum thickness of bedding mortar shall be 12mm for flooring and 10mm for dado/skirting work.

The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5.

Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.

Coloured tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.

Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings etc well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good bond for the tiles. For skirting and dado work, the backing mortar shall be roughened using a wire brush.

Neat cement slurry using 3.3 kg cement per sq.m of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. For skirting and dado work, the back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than 1mm wide. The surface shall be checked frequently to ensure correct level/required slope. Floor tiles near the walls shall enter skirting/dado to a minimum depth of 10mm. Tiles shall not sound hollow when tapped.

All the joints shall be cleaned of grey cement with wire brush to a depth of atleast 3mm and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.

Specials consisting of coves, internal and external angles, cornices, beads and their corner pieces shall be of thickness not less than the tiles with which they are used.

4.19 In-Situ Cement Concrete Floor Topping

4.19.1 Materials

The mix proportion for the in-situ concrete floor topping shall be 1:2.5:3.5 (one part cement : two and half parts sand : three and half parts coarse aggregates) by volume unless otherwise specified.

The aggregates shall conform for the requirements of IS:383.

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Coarse aggregates shall have high hardness surface texture and shall consist of crushed rock of granite, basalt, trap or quartzite. The aggregate crushing value shall not exceed 30 percent. The grading of the aggregates of size 12.5mm and below shall be as per IS:2571.

Grading of the sand shall be within the limits indicated in IS:2571.

4.19.2 Workmanship

The thickness of the floor topping shall be as specified in the items of work prepared by the Contractor. The minimum thickness of the floor topping shall be 25mm.

Preparation of base concrete/structural slab before laying the topping shall be as per clause 7.13. The surface shall be rough to provide adequate bond for the topping.

Mixing of concrete shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the GWSSB. The concrete shall be as stiff as possible and the amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and compacting. The mix shall be used in the work within 30 minutes of the addition of water for its preparation.

Floor finish shall be laid in suitable panels to reduce the risk of cracking. No dimension of a panel shall exceed 2 meters and the length of a panel shall not exceed one and a half times its breadth. Topping shall be laid in alternate panels, the intermediate panels being cast after a gap of at least one day. Construction joints shall be plain vertical butt joints.

Screed strips shall be fixed dividing the area into suitable panels. Immediately before depositing the concrete topping, neat cement slurry at 2.75 kg/sq.m of area shall be thoroughly brushed into the prepared surface. Topping shall then be laid, very thoroughly tamped, struck off level and floated with wooden float. The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities and these shall be made good immediately.

Finishing of the surface by toweling shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled 3 times at intervals so as to produce a smooth uniform and hard surface. Immediately after laying, the first toweling just sufficient to give a level surface shall be carried out avoiding excessive trowelling at this stage. The surface shall be re-trowelled after sometime to close any pores and to scrap off excess water or laitance, which shall not be trowelled back into the topping. Final trowelling shall be done well before the concrete has become too hard but at a time when considerable pressure is required to make any impression on the surface. Sprinkling of dry cement or cement-sand mixture for absorbing moisture shall not be permitted.

Immediately after the surface is finished, it shall be protected suitably from rapid drying due to wind/ sunlight. After the surface has hardened sufficiently to prevent any damage to it, the topping shall be kept continuously moist for a minimum period of 10 days.

It is preferable to lay the topping on hardened base concrete, as against being laid monolithically with a lesser thickness, since proper levels and slopes with close surface tolerances is achievable in practice, owing to its greater thickness. Further, as this would be laid after all other building operations are over, there will be no risk of any damages or discoloration to the floor finish which are difficult to repair satisfactorily.

4.20 In-Situ Granolithic Concrete Floor Topping

4.20.1 Materials and Workmanship

The Requirements of materials and workmanship shall be all as per clause 7.19 for in-situ cement concrete floor topping except that the mix proportion of the concrete shall be 1:1:2 (cement:sand:coarse aggregates) by volume.

The minimum thickness of granolithic floor topping on hardened concrete base shall be 40mm.

4.21 Floor Hardener Topping

4.21.1 Materials & Workmanship

Floor Hardener topping shall be provided either as integrally finished over the structural slab/grade slab or laid monolithically with the concrete/granolithic floor finish on top of hardened concrete base.

Floor hardener of the metallic or non-metallic type suitable for the performance of normal / medium/ heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work prepared by the Contractor.

For monolithic application with the floor finish/slab the thickness of the layer shall be 15mm. The topping shall be laid within 2 to 3 hours after concrete is laid when it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface of the concrete layer shall be kept rough for providing adequate bond for the topping. Laitance shall be removed before placing the topping. The topping shall be screeded and thoroughly compacted to the finished level. Trowelling to a smooth finish shall be carried out as per clause 7.19.2. After the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days.

The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.

Surface shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand.

4.22 Water-Proofing

4.22.1 General

The work shall include waterproofing for the building roofs, terraces, toilets, floor slabs, walls, planters, chajjas, sills and any other areas and at any other locations and situations as directed by the Employers Representative.

The waterproofing treatment shall be carried out on top of lime concrete (brick bat coba) laid to slope on roof surfaces. The brick bat coba shall be covered as specified below.

The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the GWSSB.

4.22.2 Modified Bituminous Membrane

Modified Bituminous Membrane shall be "SUPER THERMOLAY" 4 mm thick weighing 4 Kg/sqm, manufactured using APP Polymer modified bitumen with a central core of non-woven polyester reinforcement (200 gms/sqm) and with top and bottom layers of thermofusible film (top layer could also be sand finished) made by STP Limited in collaboration with Bitumat Company Limited. "PLYFLEX" of Bitumat Company Limited, Saudi Arabia supplied by STP Limited shall also be acceptable or other equivalent specification.

4.22.3 Waterproofing of Roofs with Lime Concrete

(a) Materials

Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25mm and shall generally conform to IS:3068.

Lime shall be class C lime (fat lime) or factory made hydrated lime conforming to IS:712.

(b) Workmanship

Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 1/2 (two and a half)

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parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying. Washing soap and alum shall be dissolved in the water to be used. The quantity of these materials required per cum of lime concrete shall be 12kg of washing soap and 4kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. Lime concrete shall be used in the works within 24 hours after mixing.

The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS:3067.

The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer.

The average thickness of lime concrete, slope and the finish on top of machine made burnt clay flat terracing tiles conforming to IS:2690 (part I) shall be as specified in the items of work to be prepared by the Contractor. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the items of work prepared by the Contractor, duly considering the traffic the terrace will be subjected to.

The minimum compacted thickness of lime concrete layer shall be 75mm and average thickness shall not be less than 100mm. In case, the thickness is more than 100mm, it shall be laid in layers not exceeding 100mm to 125mm.

Laying of lime concrete shall be commenced from a corner of the roof and proceeded diagonally towards centre and other sides duly considering the slopes specified for effectively draining the rain-water towards the down take points.

Lime concrete fillet for a minimum height of 150mm shall be provided all along the junction of the roof surface with the brick masonry wall/parapet/column projections. These shall then be finished on top with provision of clay terracing tiles/cement concrete tiles.

After the lime concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried on for at least seven days until the THAPI makes no impression on the surface and rebounds readily from it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or column projections.

During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be smoothened with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugar solution may be prepared in any one of the following ways as directed by the GWSSB.

- a) By mixing about 3 Kg of Jiggery and 1.5 Kg of BAEL fruit to 100 liters of water.
- b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jiggery and 40 liters of water for 10 sq.m of work. This solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.

The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of straw or hessian which shall be kept wet continuously.

Machine made flat terracing tiles shall be of the size and thickness as specified. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12mm thick in cement mortar 1:3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally

at right angles to the direction of run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by atleast 50 mm. The joints shall be completely filled and flush pointed with cement mortar 1:2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days.

Finishing on top with cement concrete tiles or in-situ cement concrete floor topping shall be carried out in similar fashion as described for clay tiles in above paragraph. Tiles to be used shall be supplied after the first machine grinding of the surface.

4.22.4 Waterproofing of Roofs/Terraces etc.

(a) Water proofing of Horizontal Surfaces

The waterproofing shall be applied as follows :

A coat of Blown Bitumen 85/25 shall be applied at the rate of 1.45 kg/sq.km

A roll of Modified Bituminous Membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller. Torching shall be done, where recommended by the manufacturer and where directed by the GWSSB, as the unrolling progresses.

The side overlaps shall be minimum 100 mm whereas the end overlaps shall be minimum 150 mm; both shall be bonded and sealed by flame torching.

Care shall be taken that the membrane is lapped with the treatment along the vertical surface and roof gutter treatment for at least 500 mm.

The membrane shall be properly overlapped/terminated at all openings, rainwater down takes etc. to ensure that such junctions do not become sources of leakage.

Top of membrane finally shall be painted with antiglouse reflective paint.

(b) Waterproofing of Vertical Surfaces at Roof Level and Gutters

The Water proofing shall be applied as described in (a) above.

Modified Bituminous membrane shall be unrolled and bonded to the substrate after applying a coat of bitumen and by pressing down evenly for the full width of the roll. Light torching shall be done to ensure complete bonding.

The membrane shall be overlapped with treatment for the horizontal surface by at least 500 mm.

The membrane shall be taken up to a pre-cut chase anchored and sealed.

4.22.5 Khurras and Rainwater Down Pipes

Down pipes shall be isolated from RCC work with 6 mm polyethylene foam fixed with adhesive (Araldite) and sealed with silicone sealant prior to laying membrane. A water proofing flashing composed of one layer of Hessian based self finished felt Type 3 Grade 1 and two layers of aluminum foil of 0.075 mm thickness shall be provided. This flashing shall be carried into the down take pipes for at least 150 mm and sealed with hot bitumen. The Contractor shall closely coordinate the work with the agency providing and fixing the rainwater down take pipes.

4.22.6 Testing

The treated area (flat and horizontal only) shall be tested by allowed water to stand on the treated areas to a depth of 150 mm for a minimum period of 72 hours.

The treated area (flat and horizontal) shall have continuous slope towards the rainwater outlets and no water shall pond anywhere on the surface.

4.23 Cement Plastering Work

4.23.1 Materials

The proportions of the cement mortar for plastering shall be 1:3 (one part of cement to three parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the GWSSB. If so desired by the GWSSB sand shall be screened and washed to meet the Specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

4.23.2 Workmanship

Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS:1661 and IS:2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior plain faced plaster - This plaster shall be laid in a single coat of 13mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the GWSSB.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mm thickness. Application of mortar shall be as stipulated in above paragraph.

Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph.

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Exterior Sand Faced Plaster- This plaster shall be applied in 2 coats. The first coat shall be approximately 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the GWSSB duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the GWSSB..

Where specified in the Drawings to be prepared by the Contractor prepared by the Contractor, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the Drawings to be prepared by the Contractor prepared by the Contractor.

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

For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturer's instruction while preparing the cement mortar.

For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.

Double scaffolding to be used shall be as specified in clause 7.2.2.

The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2m length placed against the surface.

To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.

- a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.
- b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement.
- c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

4.24 Cement Pointing

4.24.1 Materials

The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by GWSSB and if so directed it shall be washed/screened to meet specification requirements.

4.24.2 Workmanship

Where pointing of joints in masonry work is specified, the joints shall be raked at least 15mm/20mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.

Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

The work shall be kept moist for at least 7 days after the pointing is completed. Whenever colored pointing has to be done, the coloring pigment of the color required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the GWSSB.

4.25 Water-Proofing Admixtures

Water-proofing admixture shall conform to the requirements of IS:2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the GWSSB.

4.26 Painting of Concrete, Masonry & Plastered Surfaces

4.26.1 Materials

Oil bound distemper shall conform to IS:428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Cement paint shall conform to IS:5410. The primer shall be a thinned coat of cement paint.

Lead free acid, alkali and chlorine resisting paint shall conform to IS: 9862.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the GWSSB.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the GWSSB for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

4.26.2 Workmanship

Contractor shall obtain the approval of the GWSSB regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS: 2395.

Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

4.26.3 White Wash

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from

top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

4.26.4 Color Wash

Color wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

4.26.5 Cement Paint

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/sq.m. A minimum of 2 coats of the same color shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

4.26.6 Oil bound Distemper

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

4.26.7 Acid, Alkali Resisting Paint

A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

4.26.8 Plastic Emulsion Paint

The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same color shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

4.26.9 Acrylic Emulsion Paint

Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

4.27 Painting & Polishing of Wood Work

4.27.1 Materials

Wood primer shall conform to IS: 3536.

Filler shall conform to IS: 110.

Varnish shall conform to IS: 337.

French polish shall conform to IS: 348.

Synthetic enamel paint shall conform to IS: 2932.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the GWSSB for the brand of manufacture and the color/shade. All materials shall be brought to the site of works in sealed containers.

4.27.2 Workmanship

The type of finish to be provided for woodwork of either painting or polishing, the number of coats, etc. shall be as specified in the respective items of work to be prepared by the Contractor.

Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

Painting shall be either by brushing or spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of IS: 2338 (Part I).

All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work to be prepared by the Contractor. Any slight irregularities of the surface shall then be made up by applying an optimum coat of filler conforming to IS:110 and rubbed down with an abrasive paper for obtaining a smooth surface for the undercoat of synthetic enamel paint conforming to IS:2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat is applied. At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the GWSSB. The number of coats of paint to be applied shall be as specified in the item of work to be prepared by the Contractor.

All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it in the direction of the grains and dusted off. Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler and rubbed down with an abrasive paper for obtaining a smooth surface. All dust and dirt shall be thoroughly removed. Over this prepared surface, varnish conforming to IS:337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the GWSSB. When two coats of varnish is specified, the first coat should be a hard-drying undercoat or flattening varnish which shall be allowed to dry hard before applying the finishing coat. The number of coats to be applied shall be as specified. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish using a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed

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hard on the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with ethylated spirit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as specified.

4.28 Painting of Steel Work

4.28.1 Materials

Red-oxide – zinc chrome primer shall conform to IS:2074.

Synthetic enamel paint shall conform to IS : 2932.

Aluminum paint shall conform to IS:2339.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the GWSSB for the brand of manufacture and the color/shade. All the materials shall be brought to the site in sealed containers.

4.28.2 Workmanship

Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS: 1477 (Part 2).

The type of paint, number of coats etc. shall be as specified in the respective items of work.

Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS: 1477 (Part – I) and as indicated in the item of work.

It is essential to ensure that immediately after preparation of the surfaces, the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from 'holidays'.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

Atleast 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the GWSSB.

4.29 Flashing

4.29.1 Materials

Anodized Aluminums sheets shall be 1.00mm thick with anodic film thickness of 0.025 mm.

Galvanized mild steel sheets shall be 1.00mm thick with zinc coating of 800 gms/sq.m.

Bitumen felt shall be either Hessian base self finished bitumen felt Type-3 Grade I conforming to IS:1322 or glass fiber base self finished felt Type-2 Grade 1 conforming to IS:7193.

4.29.2 Workmanship

The type of the flashing and method of fixing shall be as specified.

Flashing shall be of the correct shape and size as indicated in the construction Drawings to be prepared by the Contractor and they shall be properly fixed to ensure their effectiveness.

Flashing shall be of long lengths so as to provide minimum number of joints. The minimum overlap at joints shall be 100mm.

Fixing of the flashing shall be either by bolting with bitumen washers or by tucking into the groove 75 mm wide x 65 mm deep in masonry/concrete along with cement mortar 1:4 filleting as indicated in the Drawings to be prepared by the Contractor. Curing of the mortar shall be carried out for a minimum period of 4 days.

Bitumen felt flashing of the type as specified shall be provided with 2 coats of bituminous paint at the rate of 0.10 litre/sq.m after the installation.

4.30 Thermal Insulation For Ceiling

Thermal insulation shall be "Thermocole" TF type or similar approved or Resin bonded fiber glass boards.

4.30.1 Fixing

4.30.2 "Thermocole" Boards

Soffit of R.C.C. Slab shall be thoroughly cleaned with wire brush and 85/25 industrial grade hot bitumen conforming to IS:702 shall be applied uniformly over the surface at the rate of 1.5 Kg/m².

Thermocole boards (T.F. variety) of 50mm thickness shall be stuck by means of the same grade of hot bitumen.

The boards shall be further secured with screws, washers and plugs.

The joints of the boards shall be sealed with bitumen.

4.30.3 Fiber Glass Boards

Timber pegs 50mm x 50mm x 50mm shall be fixed to the slab at 600mm centers with 6mm x 65mm long wood screws. 20 gauge G.I. lacing wire shall be tied to the pegs.

'Crown' 200 fiberglass boards 50mm thick shall be stuck to the pegs with CPRX compound or any other suitable adhesive and be held in position by the 20 gauge G.I. lacing wires.

The insulation boards shall be covered with 20mm – 24 gauge hexagonal G.I. chicken wire mesh, nailed to the timber pegs and 30 gauge aluminum sheets shall be fixed over the chicken wire mesh with 50mm overlap and secured to the timber pegs by screws.

If the insulation is specified to rest on top of the false ceiling, it shall be properly installed and anchored to the framework. In case additional battens are required for proper installation, Contractor shall include its cost in the rate for insulation.

4.31 Plaster of Paris Board False Ceiling

4.31.1 Materials

(a) Plaster of Paris Boards

The plaster of Paris boards to be used in the false ceiling shall be of an approved manufacture or manufactured at site by methods and materials approved by GWSSB.

The plaster of Paris shall be of the calcium-sulphate hemi-hydrate variety and shall contain not less than 35 percent sulphur trioxide and other requirements as per IS:2547 (Part I) However, its fineness shall be such that the residue, after drying, and sieving on I.S. sieve designation

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3.35mm for 5 minutes shall not be more than 1 percent by weight. Initial setting time shall not be less than 13 minutes. The average compressive strength of plaster determined by testing 5 cm cubes 24 hours after removal from moulds and drying in an oven at 40 Deg. C till the weight of the cubes is constant, shall not be less than 84 Kg per sq.cm.

The plaster of Paris boards reinforced with hessian cloth or coir shall be prepared in suitable sizes as shown on the drawings or as directed by GWSSB. Wooden forms of height equal to the thickness of boards shall be placed on truly level and smooth surface such as a glass sheet. The edges of the boards shall be truly square. The glass sheet or surface on which form is kept and the form sides shall be given a thin coat of non-staining oil to facilitate the easy removal of the board. Plaster of Paris shall be evenly spread into the form up to about half the depth and hessian cloth or coir shall be pressed over the plaster of paris layer. The weight of hessian cloth or coir in the board shall be 250 gm per sq.m. The ends of the hessian/coir reinforcement shall be turned over at all edges to form a double layer for a width of 50mm. The hessian cloth shall be of an open web texture so as to allow the plaster below and above to intermix with each other and form an integral board. The form shall then be filled with plaster of Paris which shall be uniform pressed and then wire cut to an even and smooth surface. The board shall then be allowed to set initially for an hour or so and then removed from the form and allowed to dry and harden for about a week. The board after drying and hardening shall give a ringing sound when struck. The boards shall be true and exact to shape and size and the exposed face shall be truly plane and smooth.

The size of boards shall generally be 600mm x 600 mm x 12 mm thick. Boards shall be kept dry in transit and stored flat in a clean dry place and shall not be exposed to moisture. The boards shall always be carried on edges.

4.31.2 Timber Frame Work

Timber for frame work of false ceiling grid and hangers shall be of good quality and well seasoned. It shall have uniform color, reasonably straight and close grains and shall be free from knots, cracks and sapwood. It shall be treated with approved anti-termite preservative as directed by the GWSSB. Extreme care shall be taken so that the preservative treatment does not stain the ceiling boards. In case metal hangers are used, these shall be M.S. flats or bars, having two coats of red oxide zinc chromate paint primer, as shown on drawings or as approved by GWSSB.

4.31.3 Metal Framework

The metal frame work may be made of sections of light metal, such as anodized aluminum, mild steel or as shown on the drawings. The shape of cross-section shall be such as to facilitate proper suspension and proper fixing of the ceiling boards covering them and shall be structurally sound and rigid.

4.32 Construction

Contractor shall ensure that the frame to support the ceiling is designed for structural strength and the sizes, weight and strength of ceiling boards to be fixed and other loads due to live load, air-conditioning ducts, grills, electrical wiring and lighting fixtures, thermal insulation, etc. as shown on the drawings. Contractor shall also submit a detailed drawing to show the grid work, sizes of grid members, method of suspension, position of openings for air-conditioning and lighting, access doors, etc.

Structural design of timber member for the frame shall be in accordance with IS: 883, and metal sections shall be of appropriate size and thickness and shall be of approved manufacture, all as approved by GWSSB.

The false ceiling grid work shall be carried out as per the approved drawings or as directed by GWSSB. In case of timber grid work, the grid work shall consist of teak wood runners of minimum size 60mm deep x 40mm wide along one direction at 1.2m centre to centre and

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secondary runners of size 50mm deep x 40 mm wide at 60mm centre to centre perpendicular to the main runners.

The timber grid work shall be suspended with the help of wooden hangers or metal hangers at 1.2m centre to centre in both the directions. Wooden hangers shall be adopted for flat R.C. roof slab structures whereas metal hangers for flat R.C. roof or structural steel floors / tresses. Metal hangers shall be fabricated from mild steel / galvanized flats of 35mm x 6mm size or bars of 10mm dia. Threaded at the lower end and anchored securely in the roof concrete or welded to inserts provided on the underside of slabs, beams etc. All M.S. hangers shall be given two coats of red oxide zinc chromate paint primer. In case the roof work is of A.C. sheeting supported on purlins and trusses, hangers shall be suspended from roof steel work. The arrangement of metal hangers shall be such that the level of false ceiling can be adjusted during fixing of the ceiling frame work. The ceiling frame work shall be secured to hangers by means of washers and nuts. The ends of main runners shall preferably be embedded into the masonry work.

The metal frame work when it is anodized aluminum false ceiling grid system shall consist of aluminum main member of special T-Profile of 38mm x 38mm x 1.5mm thick, interlocking with each other to form frames of various sizes, 600mm x 600 mm or as shown on the drawing. The main members shall be suspended from the roof structures by means of steel hangers as described for timber frame work and supported at the walls by means of anodized aluminum wall angles.

In the case of timber frame work, all the edges of the plaster of Paris board shall be fixed to frame members by means of counter sunk and rustles screws of 2.74 mm size, 40mm long at a spacing of 100mm to 150 mm c/c and 12mm from the edge of the board. Holes for screws shall be drilled and screws slightly countersunk into the boards. The boards shall be fixed to wooden framework with a joint clearance of about 3mm. The joints shall always be in perfect line and plane.

In case of aluminum grid system, boards shall be just placed into the frames formed by the main 'T' members and the cross members fitted with the clips for locking boards. Contractor shall take utmost care so as not to force the boards in position and a slight gap shall be provided so as not to make a tight joint. The boards shall be cut with a saw, if required, to any shape and size.

As the work of false ceiling may be inter-connected with the work of air-conditioning ducts and lighting, Contractor shall fully co-operate with the other agencies entrusted with the above work, who may be working simultaneously. Contractor shall provide necessary openings in the false ceiling work for air-conditioning, lighting and other fixtures. Additional framing, if required, for the above opening shall also be provided at no extra cost to Employer. Removable or hinged type inspection or access trap doors shall be provided at locations specified by GWSSB.

4.32.1 Finishing

It is essential that false ceiling work should be firm and in perfect line and level and all boards free from distortion, bulge, and other defects. All defective boards and other material shall be removed from site immediately and replaced, and ceiling restored to original finish to the satisfaction of GWSSB.

The workmanship shall be of highest order and all joinery work for timber work shall be in the best workmanship manner. The joints for aluminum frame work shall be of inter-locking type so that when the cross member is in place, it cannot be lifted out.

The countersunk heads of screws and all joints shall be filled with plaster of paris and finished smooth. After filling the joints, a thick skin of the finishing material shall be spread about 50mm wide on either side of the joint and on to it shall be trowel led dry a reinforcing scrim cloth about 10mm wide. If metal scrim is used, a stiffer plaster will be necessary to enable the trowelling of the scrim down to the board.

4.32.2 Fire Stopping

In case of fire protective ceilings, fire resisting barriers at suitable intervals shall be provided. These shall completely close the gap between the false ceiling and soffit of the structural slab. The material of the barrier shall be as indicated by GWSSB (Reference may be made to the British Standards Institutions CP 290: Code of Practice for suspended ceiling and lining of dry construction using metal fixing system, for guidance).

4.33 False or Cavity Floor

4.33.1 Frame Work

The false floor shall consist of a framework of suitable structural member designed to carry the loads specified. This frame work shall be supported on suitably designed stools placed at 600mm centre to centre in both directions. The stools shall consist of a mild steel base plate with a mild steel stud having adjustable lock nut and coupling at the centre and another mild steel plate at top serving as a prop head. The above framework shall be suitably designed to accommodate 35mm thick, 600mm square panels. The base plate shall be fixed to the reinforced concrete floor with an approved adhesive compound or with 4 Nos. 6mm dia. anchor fasteners. Bedding of 1:2 or richer cement sand mortar shall be provided locally under the base plates of stools to provide a level surface.

The prop head shall be provided with mild steel lugs welded on top and each placed perpendicular to the other for proper positioning and supporting the main and cross members. The stools shall be capable of adjustment to accommodate concrete floor level irregularities upto plus or minus 15mm. The framing members shall be completely removable and shall remain in position without screwing or bolting to the prop heads. All steel framework including steel stools shall be given a coat of zinc chromate primer and two coats of enamel paint of approved colour and shade.

4.33.2 Floor Panels

The floor panels shall be made of 600mm x 600mm x 35 mm thick medium density untendered/non-prelaminated teak wood particle boards having a density of not more than 800 kg/cu.m bonded with boiling water proof phenol formaldehyde synthetic resin and shall be of fire resistant, termite resistant and moisture proof quality, generally conforming to IS:3087-specification for wood particle boards (Medium Density) for general purposes.

The thermal conductivity of the boards shall not exceed 0.12 kCal/hr/sq.m/deg./C/m.

The panel size given above may be suitably modified near electrical panel/equipment and also to suit room dimensions with panel size not more than 600mm under any circumstances. Exposed 2mm thick vinyl edging shall be provided on all edges of individual panels. Each panel shall be given a coat of primer and two coats of approved fire resistant paint from underside.

The particle boards shall be faced with 600mm x 600 mm x 2mm thick approved make flooring tiles conforming to IS:3462 – “Specification for unbaked flexible PVC flooring” and of approved color and shade. The completed panel shall be completely removable and shall remain in position without screwing or bolting to the on the inner side with stickers for easy identification and reassembly whenever required.

Suitable backing material shall be provided on the underside of the particle board to prevent warping and / or to cater to specified loading.

Suitable removable covers shall be provided to serve as outlets for the cables.

4.33.3 Imposed Loading

The finished floor shall be capable of supporting a uniformly distributed loads of 500 to 1000 Kg. per sq. meter of floor area as specified in data sheet. A point load of 450 Kg on 600 sq.mm on any part of the panel or a line load of 725 Kg on 100mm strip across the panel length shall not result in a deflection greater than 2.5mm.

4.33.4 Finish

The finished floor shall be true to lines and levels and present a neat flush surface.

4.33.5 Vendor Drawing

Vendor shall prepare and submit a layout drawing for false floor giving all details including supporting system for approval. If so called for, vendor shall also submit his calculations for the supporting system with all relevant data assumed, to the GWSSB for his approval. Work shall be carried out on approved drawings only.

4.34 Fire Proof Doors

4.34.1 Material and Workmanship

The design of fire proof doors and the materials to be used in their fabrication have to be such that they shall be capable of providing the effective barrier to the spread of fire. The materials, fabrication and erection of fire proof doors shall confirm to IS:3614 (Part – I) . The fire proof doors shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained beforehand. Sample approval shall also be obtained from testing authority as per the standard IS : 3614 (Part – 2) for the specified degree of fire rating in hours. All fire proof doors shall have specified sizes and confirm to the description in the respective items of work.

Fire proof door shutters shall be of zinc coated weldable steel (confirming to BS:6687) or stainless steel (conforming to IS:304) sheet (18G minimum) fixed in a frame work of rolled channel. The shutter shall consist of an insulating material like mineral wool in required thickness to satisfy the specified fire rating. Normally the thickness of door shutter shall not be less than 35mm for two hour fire rating and 46 mm for four hour fire rating.

The shutter with the required insulating material shall be mounted on angle iron frame or the special made frame from zinc coated (16G minimum) weldable steel sheet. The shutter shall be fixed to frame by means of suitable hinges and shall have a three way latching system. All the doors shall be provided with a coat of primer and one coat of synthetic enamel paint to attain the specified fire rating. All other accessories like hinges, door lock, hold fasts, etc. shall be provided as approved by TAC (Tariff Advisory Committee). All these accessories shall be compatible with the material used for door and shutter.

5.0 Sluice Valve

i) mm dia Sluice valve.(PN-1)

(A) SUPPLY OF SLUICE VALVE

Sluice valve as per I.S: 780 & 2906/1984 or its latest revision.

1.0 GENERAL

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

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

2.0 STANDARDS

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

3.0 TEMPERATURE VARIATION

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

4.0 MARKING

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

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

5.0 TEST CERTIFICATE

- 5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.
- 5.2 The contractor shall also produce, in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by Engineer/board for the same purpose. The inspection charges of the authorized person/agency as fixed by G.W.S.S.B shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of G.W.S.S.B.

6.0 NOMINAL PRESSURE

- 6.1 Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-II" (Mpa= 10 kgf/m² approx)
- 6.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

7.0 MATERIAL:

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

Materials for components parts of sluice valve

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

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

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

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

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

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

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

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

8.0 MANUFACTURE

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

9.0 FLANGES

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

(B) Lowering Laying of Sluice Valve

i) mm dia Sluice valve.(PN-1)

1.0 SUPPLY OF MATERIAL

1.1 Cast iron double-flanged sluice valve/butterfly valves/Zero velocity valve with two tailpieces suitable to pipe shall be carted by the contractor. The rate shall include loading, unloading and stacking at site.

1.2 The sluice valve/butterfly valves/zero velocity valve and tailpieces shall be examined before laying for cracks and other flows. They shall be undamaged in all respect.

1.3 The sluice valves/butterfly valves shall be operated before laying.

1.4 All grits and foreign materials shall be removed from the inside of the valves before placing.

1.5 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.

1.6 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

2.0 JOINTING MATERIAL

2.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool etc.

2.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.

2.3 All jointing materials shall be not approved from the engineer-in-charge before use

2.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.

2.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.

3.0 INSTALLATION

3.1 The sluice valve/butterfly valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.

3.2 If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.

3.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice/butterfly valve bore. It shall be even at both the inner and outer edges. 3.4 The flange faces thoroughly greased.

3.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.

3.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.

3.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.

3.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.

3.9 The sluice valve/butterfly valve shall be installed in such a way that its Spindle shall remain in truly vertical position.

3.10 The other end of tailpiece shall be fitted with pipes so that continuous lines can work.

3.11 Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

4.0 TESTING

4.1 After installation of sluice valve/butterfly valve/zero velocity valve the same is tested to 1 1/2 times of its test pressure.

4.2 The joints sluice valve/butterfly valve shall withstand the test pressure of pipelines.

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

The rate shall be paid per No. basis of air valve/butterfly valve/zero velocity valve fitted after satisfactory hydraulic testing.

1.0 Valve Chamber

Additional excavation required to be done shall be carried out as per instruction of engineer in charge. For foundation chamber 15 cm. thick 1:4:8 PCC shall be provided and 23 cm up to 1.50 M depth and beyond 1.50 M depth 35 cm. thick B.B. Masonary walls in C.M. 1:6 shall be constructed.

Second class bricks of standard size shall be brought by the contractor and shall got approval before use in the work from the engineer in charge.

12mm.thick cement plaster in C.M. 1:3 shall be provided on inside and outside of walls up to 20 cm below from G.L. Cement pointing in C.M. 1:3 shall be provided for outside below G.L. from 20 cm.

20mm.dia. M.S. Bar steps shall be provided and fixed in wall at 30 cm. c/c. for facilitating access into the chamber. First step should be at a depth of 0.5 m from top and last step should be 0.5 m above bottom.

Chamber shall be covered with 150mm.thick. RCC 1:2:4 pre cast or cast in situ slab in four parts with key hole to insert key for operation.

Reinforcement for the cover slab shall be provided considering heavy traffic load. Curing of concrete B.B. Masonry, R.C.C. etc. shall be done using chemical or water for 14 days.

12mm.dia. M.S. Bar handles minimum two nos shall be provided to each piece of slab during the time of casting of slab.

Sides of chamber shall be refilled properly with selected excavated earth. All the above items shall be carried out in workman like manner as per prevalent sound engineering practice and instruction of engineer in charge.

7.0 Steel

Supplying cutting, bending, binding and placing in position steel as per plan and design and as per ISS 2502 incl. Cost of steel and binding wire for reservoirs/ structures only incl. Lift up to 6 meter height or depth below G.L. .for all diameters high yield strength deformed(HYSD) bars/confirming to IS 1786 (latest) CRS Fe-500 grade bars.

1) Mild steel shall be supplied by the contractor at his own cost and shall be as per the I.S. 2502/1963.

2) The Contractor shall cast the materials on site at his own cost. Mild (Deformed) stencil bars should be cleaned should be free from rust. The binding materials shall be provided by the contractor at his cost. The dimension spacing and binding bars will be as per design. The reinforcement shall have to be got approved by the Executive Engineer or his Deputy Engineer.

- 1) Before starting concreting necessary certificates for testing of mild steel shall have to be obtained from the engineer in charge the contractor.
- 2) All main reinforcement shall be necessary be tied to the cross reinforcement to prevent any displacement during laying of concrete.
- 3) The bars shall be out to required sizes and shall be than be cold bent accurately in accordance with the approved design and drawing. Correct to the directed by the engineer in charge. Bending shall be carried out in accordance with procedure specified in I.S 2502/1963 code of practice for binding and fixing.
- 4) The bars shall then be placed in position as shown in the detailed drawing the same shall be tied together with black steel enameled wire 16-S W.G. (I.S 626) or equivalent I.S. gauge.
- 5) The yawing shall be firm with ends of the wire turned in to the main body of concrete. Bars shall be tied at the all inter sections except where the spacing is less than one four (0.08 m) in each direction then alternate inter section shall be tied. All lapped joints shall over lap for a length as out worked by following formulas.

Bars in tension :-

Overlap = bend length.

Bar diameter x Tensile stress in bar

4 x permissible average bend stress.

Minimum over lap = 30 x diameter of bars.

Bars in compression.

Overlap = bend length.

Bar diameter x Compressive stress in bar

5 x permissible average bend stress.

Minimum over lap + 24 x diameter of bar.

All lapped joints shall be staged suitable and shall be got approved from the engineer in charge. All meshed reinforcement shall be of such dimension as will enable the ceases aggregate in the concrete to pass easily through the meanness of reinforcement.

6) The spacing of sher reinforcement been shall be in accordance with the detailed drawing and as per schedule.

7) A hook of the end for bars shall an inner diameter of at least four times the diameter of the bar and length of shall be four times the diameter of the bar. The fixing shall be rigid enough so that the bars raining correctly spaced during the laying ramming, vibrating etc of concrete.

8) The distance from the forms shall be maintain ally precast mortar blocks of approved shape and dimension. The use of pestles., pieces of broken stone or brick wooden blocks etc is not permitted. Mild steel which are in contact with exterior surface concrete shall not be permitted unless they are galvanized.

8) Before concreting any detrimental rust loose scale or dirt on the surface or reinforcement may have occurred during the process of tying and placing may be cleaned by suitable methods.

The contractor shall maintain a hook showing the details of mild steel reinforcement to be placed in concrete and the entire there in shall be got signed by engineer in charge or the departmental representative before laying the contractor. Contractor shall be only

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after the engineer in charge or his authorized agent has checked the reinforcement placed in position and has permitted him to do so. Payment for this item shall be on the basis of complete. weight in tones m. s bars after measuring the length including specified lap length and hooks.

The rate is including of all operations as stated above and the entire work shall be carried out as detailed approved drawings as per the instruction of the engineer in charge.

No payment shall be made of extra members or length including in the design and which in the opinion of the engineer in charges are essential for the purpose of the item of work even through provided by the contractor as supports or other reasons and allowed to be embedded in the concrete by the engineer.

The weight of soft iron wire used for tying the bars shall not be taken in to account for payment purpose.

Signature of Contractor

**Executive Engineer
P.H. Works Division
Limbdi**

**Dy. EXECUTIVE ENGINEER
P.H.S.Sub Division
Limbdi**

ITEM WISE DETAILED SPECIFICATIONS

GUJARAT WATER SUPPLY & SEWERAGE BOARD
CIVIL WORKS

Name of Work:- “Demolition of Existing old RCC ESR ,RCC U/G Sump, Pump House, Staff Quarter at Kalyanpar HW, Shiyani HW,Panshina Village, Janshali HW, Kanpara HW, Chokdi HW, Bagodara Store/HW, Limbdi Store Under M&R to S2 S3 RWSS Year-2026-27”

DETAILED TECHNICAL SPECIFICATION:
SCHEDULE – B-1

ITEM WISE SPECIFICATION

ITEM NO.1

Demolition and dismantling of the existing RCC Elevated Storage Reservoir (ESR) , RCC UG Sump,Pump House, Staff Quarter. The scope includes the complete dismantling of the RCC structure, including walls, slabs, beams, columns, and other related components. All serviceable materials such as steel reinforcement bars, C.I. pipes, C.I. specials (tees, bends, sluice valves), G.I. pipe railings, and C.I. manhole frames and covers must be stacked at a location designated by the Engineer-in-charge, at no extra cost for stacking.The contractor is responsible for the removal and disposal of all unserviceable materials, including concrete (C.C.) and brick masonry scraps, with all lead and lift to the designated disposal site as directed. After demolition, the contractor must ensure the site is cleaned, all debris is removed, and the ground is leveled, leaving the site in a clean and safe condition as per the Engineer-in-charge's instructions.The rates for this work shall include the cost of all serviceable materials and scrap value of reusable items. The contractor must comply with all relevant permits, safety measures, and local regulations. The entire work, from demolition to site cleanup, must be completed with due diligence, ensuring no debris is left and the site is left in an acceptable condition, as specified by the Engineer-in-charge.

- The scope includes the complete dismantling of the RCC structure, including walls, slabs, beams, columns, and other related components. All serviceable materials such as steel reinforcement bars, C.I. pipes, C.I. specials (tees, bends, sluice valves), G.I. pipe railings, and C.I. manhole frames and covers must be stacked at a location designated by the Engineer-in-charge, at no extra cost for stacking.
- The contractor is responsible for the removal and disposal of all unserviceable materials, including concrete (C.C.) and brick masonry scraps, with all lead and lift to the designated disposal site as directed. After demolition, the contractor must ensure the site is cleaned, all debris is removed, and the ground is leveled, leaving the site in a clean and safe condition as per the Engineer-in-charge's instructions.
- The rates for this work shall include the cost of all serviceable materials and scrap value of reusable items. The contractor must comply with all relevant permits, safety measures, and local regulations. The entire work, from demolition to site cleanup, must be

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completed with due diligence, ensuring no debris is left and the site is left in an acceptable condition, as specified by the Engineer-in-charge.

1.0 Materials & Tools:

- All necessary tools and equipment such as sledgehammers, chisels, crowbars, pickaxes, pneumatic breakers, electric or hydraulic concrete cutters if required.
- Adequate supply of labour including skilled, unskilled, and supervisory staff.
- Trucks or other transport vehicles for removal and disposal of debris.
- Safety gear including helmets, gloves, goggles, reflective vests, boots, and dust masks for workers.

2.0 Workmanship:

- The RCC structure shall be carefully dismantled in a systematic and controlled manner to avoid collapse or damage to adjoining structures.
- Demolition shall be done from top down in stages, ensuring stability of remaining structure at every stage.
- Removal of reinforcement bars shall be done carefully; rebars shall be separated from concrete rubble.
- Serviceable materials such as steel reinforcement, reusable concrete blocks or precast elements shall be stacked neatly at designated locations as instructed by the Engineer-in-charge.
- Unserviceable debris, rubble, and waste shall be collected and transported to approved disposal sites within all lead and lift, ensuring no spillage on public roads.
- Dust suppression methods such as water spraying shall be adopted during demolition to reduce air pollution.
- Protection of existing services (water lines, electrical conduits, drains) shall be ensured. Any damage caused shall be rectified by the contractor at his own cost.
- No debris shall be dumped in watercourses, drains, or unauthorized locations.

3.0 Contractor's Responsibility:

- Providing all necessary safety arrangements including fencing or barricading the demolition area to prevent unauthorized entry.
- Erecting safety signage and ensuring site illumination if working at night.
- Ensuring all workers use personal protective equipment (PPE).
- Complying with all relevant safety codes and local regulations governing demolition work.
- Arranging transportation, loading, unloading, and lawful disposal of waste materials at designated sites.
- Maintaining a clean site by daily removal of demolished materials and debris.
- Conducting demolition operations so as to avoid nuisance from dust, noise, or vibration to surrounding areas and structures.
- Coordination with Engineer-in-charge for sequence of demolition, safety plan approval, and designated stacking/disposal areas.
- Providing adequate dust suppression measures such as wetting surfaces before breaking and during loading/unloading of debris.
- Submitting disposal records or receipts if directed by the Engineer-in-charge to verify legal and proper disposal.

Mode of Payment

- Payment shall be made as per Schedule B.

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- The rate includes all labour, equipment, tools, safety arrangements, stacking of serviceable materials, transportation, and disposal with all leads and lifts, complete in all respects as directed by Engineer-in-charge.

ITEM NO.2

Salvageable value of reinforcement steel retrieved from RCC OHT structure, (ie) Column, Beams, Slab, Vertical wall etc, taken away the materials etc. complete. reinforcement (Scrap Material). Taking Density as 7850 kg/m³

1.0 Scope of Work:

- The item covers the salvage and removal of embedded reinforcement steel from dismantled RCC structural elements such as columns, beams, slabs, walls, braces, domes, or pedestals of an Overhead Tank (OHT).
- Includes cutting, cleaning, lifting, collecting, measuring, and carrying away the retrieved reinforcement as scrap material.

2.0 Materials to be Retrieved:

- Mild steel (MS) or high-yield strength deformed (HYSD) bars used in the RCC construction, of various diameters.
- Bent, rusted, or partially corroded reinforcement bars are also included, as typically encountered in dismantled concrete.

3.0 Workmanship:

- Reinforcement bars shall be carefully extracted after or during dismantling of RCC elements, using chisels, mechanical breakers, gas cutters, or other suitable methods.
- Any attached concrete shall be manually removed from the bars to the extent practical, ensuring steel can be weighed or measured.
- The scrap shall be segregated and collected in designated areas for measurement and verification.
- All handling and removal shall be carried out in a manner that ensures site safety and avoids damage to salvageable materials.
- No reuse of retrieved steel shall be permitted on the site unless specifically approved by the Engineer-in-charge.
- Retrieved steel shall be treated as contractor's property, once accepted and accounted for in the salvage deduction.

4.0 Contractor's Responsibility:

- Arrange all labour, tools, cutting equipment, transportation, and manpower required for salvage and carting away.
- Ensure that proper weighing/scaling or visual estimation is done in presence of departmental representatives.
- Maintain site cleanliness and remove all salvage material from site promptly to avoid congestion or obstruction.
- Provide safety gear to workers and implement all safety protocols during dismantling and cutting activities.
- Prevent damage to any adjoining structure or component not designated for dismantling.
- The contractor shall transport the scrap material away from the site at his own cost as per approved disposal norms.

5.0 Measurement and Recovery:

- Weight of retrieved reinforcement shall be estimated visually or weighed, depending on instructions of Engineer-in-charge.
- Salvage value shall be deducted from contractor's bill as per rate fixed in Schedule B for scrap steel.

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- No separate payment will be made for salvage, dismantling effort, or transportation — it is considered included in the deduction rate.

6.0 Mode of Payment / Deduction:

- Payment shall be made as per Schedule B.
- Payment shall be made as per actual measured Quantity of steel at site.
- Deduction shall be made based on the net weight (kg/MT) of reinforcement steel retrieved and taken away by the contractor.
- Rate of deduction shall be as specified in Schedule B, treating it as scrap material recovered from the site.
- The rate shall be deemed to include cutting, collection, cleaning, stacking, loading, transportation, and all incidental charges.

ITEM NO.3

Demolition and dismantling of the existing Pump House, Staff Quarter Brick work and stone masonry including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift. (ii) In Cement Mortar. The contractor is responsible for the removal and disposal of all unserviceable materials, including brick masonry scraps, with all lead and lift to the designated disposal site as directed. After demolition, the contractor must ensure the site is cleaned, all debris is removed, and the ground is leveled, leaving the site in a clean and safe condition as per the Engineer-in-charge's instructions. The rates for this work shall include the cost of all serviceable materials and scrap value of reusable items. The contractor must comply with all relevant permits, safety measures, and local regulations. The entire work, from demolition to site cleanup, must be completed with due diligence, ensuring no debris is left and the site is left in an acceptable condition, as specified by the Engineer-in-charge.

- The scope includes the complete dismantling of the Brick structure, including walls and other related components. All serviceable materials must be stacked at a location designated by the Engineer-in-charge, at no extra cost for stacking.
- The contractor is responsible for the removal and disposal of all unserviceable materials, including concrete (C.C.) and brick masonry scraps, with all lead and lift to the designated disposal site as directed. After demolition, the contractor must ensure the site is cleaned, all debris is removed, and the ground is leveled, leaving the site in a clean and safe condition as per the Engineer-in-charge's instructions.
- The rates for this work shall include the cost of all serviceable materials and scrap value of reusable items. The contractor must comply with all relevant permits, safety measures, and local regulations. The entire work, from demolition to site cleanup, must be completed with due diligence, ensuring no debris is left and the site is left in an acceptable condition, as specified by the Engineer-in-charge.

1.0 Materials & Tools:

- All necessary tools and equipment such as sledgehammers, chisels, crowbars, pickaxes, pneumatic breakers, electric or hydraulic concrete cutters if required.
- Adequate supply of labour including skilled, unskilled, and supervisory staff.
- Trucks or other transport vehicles for removal and disposal of debris.
- Safety gear including helmets, gloves, goggles, reflective vests, boots, and dust masks for workers.

2.0 Workmanship:

- The RCC/Brick structure shall be carefully dismantled in a systematic and controlled manner to avoid collapse or damage to adjoining structures.

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- Demolition shall be done from top down in stages, ensuring stability of remaining structure at every stage.
- Removal of reinforcement bars shall be done carefully; rebars shall be separated from concrete rubble.
- Serviceable materials such as steel reinforcement, reusable concrete blocks or precast elements shall be stacked neatly at designated locations as instructed by the Engineer-in-charge.
- Unserviceable debris, rubble, and waste shall be collected and transported to approved disposal sites within all lead and lift, ensuring no spillage on public roads.
- Dust suppression methods such as water spraying shall be adopted during demolition to reduce air pollution.
- Protection of existing services (water lines, electrical conduits, drains) shall be ensured. Any damage caused shall be rectified by the contractor at his own cost.
- No debris shall be dumped in watercourses, drains, or unauthorized locations.

3.0 Contractor's Responsibility:

- Providing all necessary safety arrangements including fencing or barricading the demolition area to prevent unauthorized entry.
- Erecting safety signage and ensuring site illumination if working at night.
- Ensuring all workers use personal protective equipment (PPE).
- Complying with all relevant safety codes and local regulations governing demolition work.
- Arranging transportation, loading, unloading, and lawful disposal of waste materials at designated sites.
- Maintaining a clean site by daily removal of demolished materials and debris.
- Conducting demolition operations so as to avoid nuisance from dust, noise, or vibration to surrounding areas and structures.
- Coordination with Engineer-in-charge for sequence of demolition, safety plan approval, and designated stacking/disposal areas.
- Providing adequate dust suppression measures such as wetting surfaces before breaking and during loading/unloading of debris.
- Submitting disposal records or receipts if directed by the Engineer-in-charge to verify legal and proper disposal.

Mode of Payment

- Payment shall be made as per Schedule B.
- The rate includes all labour, equipment, tools, safety arrangements, stacking of serviceable materials, transportation, and disposal with all leads and lifts, complete in all respects as directed by Engineer-in-charge.

Signature of Contractor

**Executive Engineer
P.H. Works Division
Limbdi**

**Dy. EXECUTIVE ENGINEER
P.H.S.Sub Division
Limbdi**