



VOLUME - II, PART - 1

SECTION – 2

DETAILED TECHNICAL SPECIFICATION

CIVIL



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**1.0.0 DESCRIPTION OF INVESTIGATIONS AND FACILITIES**

The structures / areas / facilities described under this section are to be included in the contract. The description against each system is indicative only and not exhaustive. Although almost all the systems are covered here but any other system required for successful completion of the project shall form a part of this contract and shall be deemed to be included in the scope of works.

Desalination Plant building shall include Shift In-charge Room, Scada room, Auxiliary room, Technician Room, Chemical Storage Room, Dry Storage cum Spare Room, Laboratory Room, RO Skids and pump Bay with EOT crane facility, Workshop cum Maintenance Area, corridor, Toilet blocks.

Contractor may choose the option either to construct RCC framed with block masonry or PEB with Steel structure considering the completion period of contract.

Dimension of all rooms shall be based on area covered by Mechanical/electrical / I&C equipment's including working space, utility and other facility and reserved space and / or required for future installation of equipment's if any.

1.1.0 GEOTECHNICAL INVESTIGATION**1.Existing Geotechnical Investigation Report**

Successful bidder shall be provided with geotechnical investigation already conducted for Pooling substation 1 and 400 Kv transmission line and RE park which are very near to the proposed project area. Bidder shall be go with pile foundation based on the recommendation of geotechnical investigation Report.

2. Levels

Any other Structures Finished floor level (FFL) shall be minimum 300mm above finished ground level (FGL). For Control building FFL shall be 800mm to 1000mm from Raised FGL. For Tank Foundation FFL shall be 500mm from Raised FGL. Road shall be 200-250mm from FGL. Footpath/walkway shall be 300mm from FGL. These levels are minimum and can be increased.

Where the storm water drain comes in direct contact of the metal paving, 50mm dia hole shall be provided in drain wall just above FGL, in order to drain surface rainwater into storm water drain and avoid flooding of water over metal paving.

3. Finished ground level (FGL):

Entire Desal plant shall be raised 1.0 mt height by filling burrow soil (Murram) to maintain and protect against flood protection.



Existing soil at site will not be allowed and Barrow soil shall be used for raising FGL. Finish floor level FFL of each structure/foundation/Floor shall be higher than respective Raised FGL.

4. Raised FGL protection:

Raised FGL -slope shall be protected against erosion and shall have stone pitching and gabion. Min width of stone pitching shall be 250mm and shall rest on gabion wall/toe wall.

5. Industrial Sign Boards and Safety Signs for plant facilities and at borewell location:

Contractor shall install and fix industrial sign boards and safety signs as per relevant safety regulations. Safety signs and boards shall be in fluorescent Acrylic Night glow stick on the door, framed on walls, and hang on false ceiling with Solid 8 mm GI rod and Clamps.

Contractor shall provide to the owner, detailed specification of sign boards. The sign board shall be made of Aluminium composite sheet backed with 110 Micron and 3 to 5mm thick HDG Steel plate. Letters on the board shall be proper illumination arrangement. All sign boards at open area and on road shall be placed on 400 X 400 mm and 600mm deep RCC foundations. Vertical posts shall be 65NB circular GI pipe, painting with epoxy paint with black and white Strip of 300mm with required Dry film thickness. Post shall be in two pieces. Short arm embedded in concrete pedestals and long arm above the ground shall be connected with short arm by bolt and nut connection.

6. Sign Boards and name plate showing location and area for desalination plant

Contractor shall provide and fix sign boards made out of 2mm Aluminum sheet/4mm ACP (Aluminum composite panel): Pretreated with phosphating process & acid etching; coated with one coat epoxy primer and two coat of best quality epoxy paint; reflectorized with high intensity prismatic grade retro reflective sheeting of type 4 as per ASTM D-4956 and latest M.O.S.T. specification. A warranty of 7 years for the Retro reflective sheeting from the original manufacturer and a certificate copy of 3 years outdoor exposure test report from third-party lab shall be submitted by contractor. Retro-Reflective shall be Class-B type 4 sheeting.

Dimension of all sign boards shall be as per IRC 67:2012 (Indicative 3.6 mt long single and /or double stand post of 110 micron Hot dip galvanized (HDG) iron angle 75X75X6 mm and/or 65NB circular GI pipe as required and frame fabricated from suitable size of GI angle of 35X35X3mm to 50X50X5mm post shall be painted of best quality of epoxy painted with black and white band of 300mm strip. At any point the minimum thickness of HDG shall be 110 micron and no averaging is allowed and the painting thickness shall be decided during detail engineering based on environment condition at site The stand post shall be in two parts and connected with HDG bolts of minimum 8.8 grade. Short arm shall be embedded in concrete. A suitable size of concrete pedestals shall be made available.

**7. Borewells -Raw water source**

Borewells are proposed as a source for the withdrawal of water from Groundwater to satisfy the water demand. Borewell Shall have sheds with steel structure and roof cladding and specifications are attached in the table.

Sl. No.	Item Description	Specification	Remarks
1	General	The shed shall be fabricated and erected using mild steel structural members designed to withstand wind loads as per IS 875 (Part 3):2015 and relevant codes.	All work shall conform to standard engineering practices and site conditions.
2	Material	Grade All structural steel shall conform to IS 2062:2011, Grade E250 (Fe410W) quality.	Material test certificates to be provided.
3	Columns	MS Square Hollow Section (SHS) of min 75×75×4 mm or ISMC 75 Channel section.	Embedded in RCC pedestal with base plate and anchor bolts.
4	Roof Beams & Purlins	MS Angle sections min (ISA 50×50×5 mm) or equivalent C-sections	Spacing and size as per design.
5	Bracings (If any)	MS Flat or Angle diagonal bracing.	To provide lateral stability against wind loads.
6	Roof Sheetting	Pre-coated Galvanized Iron (GI) sheets, 0.5 mm thick, fixed with self-tapping screws and neoprene washers	Roof slope minimum 1:10.
7	Rainwater Disposal	GI gutter and downpipe of minimum 100 mm diameter to drain roof water.	To discharge away from bore well area.
8	Painting System	Surface cleaned and painted with one coat of red oxide zinc chromate primer (IS 2074) and two coats of synthetic enamel paint (IS 2932).	Color as approved by Engineer-in-Charge.
9	Foundation	RCC pedestal of M35 grade concrete, with proper reinforcement and anchor bolts.	Pedestal top 150 mm above FGL to avoid water ingress.
10	Flooring	RC slab followed by min 75 mm thick PCC (1:3:6) over compacted subgrade.	To provide clean and level base all around the bore well.



Sl. No.	Item Description	Specification	Remarks
11	Shed Height	Clear height between 2.4 m and 3.0 m from FGL.	To allow maintenance access for bore well pump and accessories.
12	Access Door	MS framed door or hinged shutter with locking arrangement.	Minimum clear opening 1.0 m × 2.0 m.

The borewell shall be protected by covering with min 2mm PVC coated fence with gate. The borewell is to be constructed with a required diameter of casing pipe based on the water withdrawal and pump size. The Latitude and Longitude provided as per preliminary investigation and the location may shift to suit site condition (with 360° it may vary from 0 to 50m as PV modules are already with tracker) while execution, but the quantity remains to be four (4) Nos of borewells.

Sr. No	Borewell No	As per the Preliminary Investigation	Longitude	Latitude
1	BW-1	L-5	69.60572	24.11856
2	BW-2	L-23	69.60425	24.07616
3	BW-3	L-22	69.58397	24.06809
4	BW-4	L-24	69.61042	24.08966

Contractor shall include in his bid for construction of approach road with subbase, murram, GSB and WMM type connecting from nearest RE park and/or solar project road including construction of Box culvert if any to cross over the storm water drain or any existing facility as well as any modification required in existing facilities. Contractor shall also be responsible to re-instate the existing facilities after executing his tender activities.

7.1 Borewell Methods

The contractor shall choose the borewell method that is appropriate for the site and in accordance with I.S. 2800. The borewell techniques specified under IS 2800 include the following:

- Auger Drilling
- Water Jet Boring
- Calyx Drilling
- Percussion Drilling
- Rotary Drilling
- Down the Hole Hammer (DTH) Drilling

**7.2 Borewell Casing**

A borewell casing is a pipe that is installed into a freshly drilled borewell to maintain its integrity and prevent collapse. Boreholes are constructed by inserting lengths of protective permanent casing. These are lowered or pushed into the hole by the drilling rig to the required depth; the lengths of casing may be joined together by means of screw threads, flange-and-spigot, gluing, riveting, or welding. Casing normally extends up to the surface, with a certain amount (say 0.7 meters) standing above ground level. Lengths of casing may be obtained in plastic (UPVC). The Bore diameter, Casing diameter and casing (UPVC) thickness shall be fixed during detail engineering.

Depth of bore well is 200m or more as per site conditions. However, contractor shall calculate the required diameter of casing pipe & diameter and depth of borewell based on the water withdrawal and pump size.

7.3 Placing Methodology of Casing

The contractor shall prepare and submit a comprehensive methodology for borewell execution, considering the site conditions, for review and approval by GIPCL. Upon obtaining approval, the same shall be submitted to the FI.

1.2.0 LAND DEVELOPMENT FOR DESALINATION PLANT AND BOREWELLS

Land parcel will be provided as it is available, and the contractor is responsible for the readiness of work. The Contractor is responsible for making the site ready and easily approachable by clearing of bushes, felling of trees (if required with appropriate approval from concerned authority), levelling of ground (wherever required) etc. for commencing the project.

1.3.0 FENCING

Fencing shall be provided all around the periphery of the Desalination Plant and movable fencing is provided all around the borewell. Reference drawing for the fence is provided as part of this tender specification.

Plant Fencing shall be 2.2m high from FGL excluding 600mm high Y angle with GI Concentrina wire.

Toe wall is one kind of RCC beam and must be rested of on concrete pile. Bolt grade is 4.6 and it must be Hot dip galvanized.

1.4.0 GATES

There shall be one main gate, 3.0 m high and 6000 mm wide, each with two leaves. For smooth operation of gates, rollers shall be provided which move on rails embedded in RCC Arch beam provided in the road paving.



A minimum of 2 wicket gates (1.2m wide, 3.0 m high) shall be provided to allow entry and exit of pedestrian and cyclists. The gate posts shall be of RCC construction.

The gate frames shall be made of galvanized structural steel tubular / rolled section with plate / mesh for the body.

Gate shall be fabricated out of tubular sections conforming to IS : 1161 and shall be hot dipped galvanized. The outer frame shall be 65 NB (medium) tube and diagonal 50 NB (medium) tube 50 mm sq. welded mesh with 4 mm dia GI wire fabric shall be welded to 25 mm x 6 mm thick GI flat which in turn shall be welded to the outer tubular frame. The gate shall be provided with 20 mm wide x 80 mm dia flat M.S. roller at the bottom. The gate frame shall be fixed to GI tubular post or RCC post.

1.5.0 ROADS

Road network consisting of approach roads from the main RE park road to Desalination plant shall be provided. Approach road shall be provided with RCC Box Culvert to cross RE Park drain. Width of main roads, approach road and all internal road shall be 4.0 m with 1.0 m wide shoulders on both sides. All roads shall be under contractor scope and shall be of RCC Road. A pedestrian walkway of 1.5m wide with light duty paving block shall be connected to PSS-1 southside boundary gate. Wicket gate to have direct access from PSS-1. Adequate turning space for vehicles and Crane shall be provided and turning radius shall be set accordingly. Connecting roads to desalination plant shall be under contractor scope with provision of NB2/NB 3 class Hume pipe underneath for future cable crossing. Road network shall be provided with RCC storm water drain. Storm water drain shall be provided with FRP grating.

Horizontal bores crossing under the roads and other facilities

Major crossing are between TP05 to TP09 those below the 400KV transmission Line. Owners already provided 300mm dia hume pipes for crossing. In case 300mm dia is suitable for passing incoming and distribution line.

Contractor shall carry out all type of crossing with Horizontal drilling. Depth of drilling shall be based on existing facility installed already as well as detail engineering. Type of material whether UPVC, HDPE or RCC shall be fixed during detail engineering and as per project needs. Numbers shall be fixed during detail engineering.

Contractor is requested to carry out as built provision of hume pipes which are already provided below road crossing before detailed engineering. Excavating of driving pit and receiving pit for the required dimensions in all soil strata including shoring and strutting. Thrust arrangements to receive the impacts during pushing operation of encasing pipe. Lowering the following size of



uPVC encasing pipe by using Contractor's crane and machineries and jointing PVC pipes, across the State Highways and driving the horizontal bore by pushing / jacking method (trenchless technology method) using contractor's machineries such as cranes, jacks, jacking materials, generator, welding machineries, compressor, jack hammer and other equipment's etc. without interfering and causing any hindrance to the movement of traffic or any other vehicles, without any disturbances to the railway/road/canal formation etc. including bailing / pumping of water where ever necessary without affecting any installation like water supply pipeline/telephone cable, electric cables etc. passing nearby area and scooping the earth inside the pipes and pit and depositing the surplus earth in a convenient place and levelling the site after completion of entire work as directed by Engineer - in - charge. The work includes the driving pit, thrust bed/wall and receiving pit to the depth of 0 m to 5m including laying of UPVC pipes etc.

Internal roads with Desalination plant:

All facilities are to be accessible and shall be Rigid pavement. Road width and radius as per the requirement of desalination plant operation.

Walkway / footpath

Footpath with concrete or light weight paving blocks shall be provided as per requirements.

Cable Trenches

All underground facilities like cable trenches, drains, etc shall be designed for earth pressure and sub soil water pressure under worst condition. The walls of the cable trenches shall withstand a surcharge of 20 kN / m² in addition to the earth pressure. Walls and base slab of shall be designed as cracked section but limiting the steel stresses as per IS:3370. All water retaining / storage structures shall be designed assuming liquid upto the height of wall irrespective of provision of any overflow arrangement. No pressure relieving devices shall be permitted in underground structures. In Cable trenches the spacing of insert plates for cable tray support angle shall be not more than 1.5 M.

RCC precast cover slabs of cable shall be designed for a live load of 10 kN / sqm. Cable trenches crossing roads shall be designed for Class A loading as per Indian Road Congress – Standard Specification and Code of practice for Road Bridges, IRC-6. Alternatively duct banks (hume pipes) embedded in RCC / PCC may be provided where feasible. Contractor shall make fuji make or equivalent to it for precast cable trench. Cable tray support strip shall be GS and anchored in wall through SS fasteners. Spacing shall be calculated during execution of detail engineering.

Cable trench inside the buildings shall be covered with 6mm thick galvanized chequered plate painted with epoxy and stiffeners along with lifting hooks. Edges of plate shall be grinded off.



The bed of the cable trenches along the length shall be provided with a slope of 1:500 to 1:750 by laying PCC (1:2:4) in second stage to drain out rain / seepage water without compromising the clearance required between the bottom most tray of cable trench and the bed of cable trench.

Suitable expansion joints shall be provided in cable trenches and liquid retaining structures as per IS specification with PVC water stop, bitumen impregnated filler boards, bitumen sealing compound as per specifications or as directed by the Owner. Water proofing cement additive shall be used for the construction of cable trenches to ensure water tightness.

The trench shall be covered with precast R.C.C. cover of suitable thickness and joints shall be pointed with cement mortar 1:3 to prevent entry of rainwater from top. The weight of a single RCC cover shall not be more than 75 kg. Suitable lifting hooks shall be provided for easy handling. Depression at lifting hook portion shall be filled with sand-bitumen to avoid rainwater stagnation. The top of the trenches shall be kept 150 mm above FGL. Suitable lugs of reinforcement steel shall be welded to edge protection angles for ensuring fixity in the concrete. Necessary embedded steel plates shall be provided for supporting the cable trays. Cable trench connection from PSS-1 to Desalination plant via GIPCL site residence shall be provided. RCC Box culvert shall be provided at road crossings of cable trenches.

Interface with existing facilities in RE park and Solar project

Total 4 nos are borewell locations are falling in the project area. The bidder shall be responsible to identify the cable route and water line network. Any crossing to interface of cables and water line (water distribution line and row water line) with Solar project internal and /or external roads (below and/or above ground) is in Bidder's scope.

Contractor shall construct the road (with Murram, GSB and WMM) from/Connecting to the nearest internal SPD road and/or RE park road with provision of RCC Box culvert in case of drain passing through.

1.6.0 DESCRIPTION OF STRUCTURES:

For the list of Structures, General Arrangement drawing (Annexure) shall be referred. This section contains the description of the salient buildings / structures. It is meant to be indicative only and not exhaustive.

1.7.0 DESIGN STANDARDS

All the designs shall be based on the latest Bureau of Indian Standard (BIS) 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 the Engineer. In case of any variation or contradiction between the provisions of the BIS Standards or Codes and the specifications given along with the tender document, the provision given in this Specification shall be followed.

All Reinforced Concrete structural design/details shall conform to the following recently published publications of the Indian Standards Institution:

- | | | |
|--------|-----------------------------|--|
| (i) | I.S. 456 : | Code of Practice for plain and reinforced concrete |
| (ii) | I.S. 875 : | Code of Practice for design loads for buildings and structures
(Part I to V) |
| (iii) | I.S. 3370 : | Code of Practice for concrete structures for the storage of
liquids (Part I to IV) |
| (iv) | I.S. 1893 : | Criteria for earthquake resistant design of structures |
| (v) | I.S. 2911 : | Code of Practice for design and construction of Pile
foundations |
| (vi) | I.S. 2974
(Part 1 to 4): | Code of Practice for design and construction of machine
foundations |
| (vii) | I.S. 4326 : | Code of Practice for Earthquake Resistant Design and
Construction of Buildings |
| (viii) | I.S. 13920 : | Ductile Detailing of Reinforced Concrete Structures subjected
to Seismic forces- Code of Practice |
| (ix) | IRC: 6 : | Standard specification and Code of Practice for road bridges
Loads and Stresses |
| (x) | SP: 16 : | Design Aids for Reinforced Concrete to IS 456 |
| (xi) | SP: 34 : | Handbook on Concrete Reinforcement and Detailing |

All Structural steel design shall conform to the following recently published publications of the Indian Standards Institution:

- | | | |
|-------|------------|---|
| i) | I.S. 800 : | Code of Practice for general construction in steel |
| ii) | I.S. 806 : | Code of Practice for use of steel tubes in general building
construction |
| (iii) | SP: 38 : | Handbook of Typified Design of Structures with Steel Roof
Trusses |

1.8.0 DESIGN LIFE

The design life of all structures and buildings shall be 25 years.

1.9.0 DESIGN LOADINGS

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, and dynamic loads.

1.10.0 CIVIL WORKS FOR SUMP & TANK STRUCTURES:

The civil works for sump structures are reinforced concrete and on-ground tanks (FRP, Metallic etc) -excluding concrete tanks-shall be executed in accordance with the relevant sections specified in the mechanical disciplines.

1.10.1 Below ground sumps

As per the specific requirement of each listed structure mentioned above, material of construction of all the proposed sumps shall be RC Concrete. The RCC sump will be designed as a water retaining structure, further requirement of which is specified in the sections elsewhere, in the specification and will be checked for uplift due to buoyancy during construction and permanent operating condition when the sump is empty. For details including dimensions, depth of storage, free board, low water level, dead storage etc., corresponding general arrangement drawing shall be referred. Material of construction shall be RCC.

Corrosion resistant rung ladders will be provided for access to the sump.

The sump will be coated with 3mm Epoxy Screed for inner surfaces.

1.10.2 Structural Design and Detailing Requirements

1.10.2.1 General

This section covers the minimum requirements for the design and detailing for structures. Other accepted international codes (BS, ACI etc.,) may be used wherever relevant Indian standard codes have not been published.

All Tank structures, foundations, water retaining structures etc. will be designed as per latest relevant IS / IRC codes in general. Construction, in general, will follow provisions of IS: 456 / IS:3370 for liquid storage structures.

All structures will be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads, wind loads, seismic loads, forces developed due to differential settlement, wave forces, current forces and any other loading conditions which can occur during the design life of the facility.

1.11.0 LOAD & LOAD COMBINATIONS

1.11.1 Dead loads

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery. In estimating the loads of process equipment all fixtures and attached piping shall be included, but excluding contents, shall be considered.



Dead loads shall be in general as per I.S. 875 Part (I). However, the following minimum loads shall be considered in design of structures.

The following unit weight of material will be considered for computation of loads. Loads given in IS:875 (part I) will be made use for the material not listed below.

1.11.2 Imposed loads

Imposed loads in different areas will include live loads, minor equipment loads. The loads considered will not be less than that specified in IS:875 (Part II). The loads listed hereunder are the minimum loads for the areas involved. Special use areas will be investigated, and loads revised upward as necessary. Floors and supporting members, which may be subjected to heavy equipment live loads, will be designed based on the weight of equipment or specifically defined live loads, whichever is greater.

However, the following minimum live loads shall be considered in the design of structures:

- | | | | |
|--------|---|---|---|
| (i) | Weight of water | : | 10 kN/m ³ |
| (ii) | Weight of soil (irrespective of strata available at site and type of soil used for filling etc). | : | 20.00 kN/m ³ |
| | However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered | | |
| (iii) | Weight of concrete | : | 24.00 kN/m ³ |
| (iv) | Weight of reinforced concrete | : | 25.00 kN/m ³ |
| (v) | Weight of Brickwork (exclusive of plaster) | : | 20.00 kN/m ² per mm thickness of brickwork |
| (vi) | Weight of Solid Concrete Blockwork (exclusive of plaster) | : | 24.00 kN/m ² per mm thickness of blockwork |
| (vii) | Weight of plaster to masonry surface | : | 18.00 kN/m ² per mm thickness |
| (viii) | Weight of granolithic terrazzo finish or rendering screed, etc. | : | 24.00 kN/m ² per mm thickness |
| (ix) | Weight of MS chequered plates | : | 78.5 kN/m ² per mm thickness |

Live load shall include the superimposed loads due to the use/occupancy of the structure/building not including dead, wind or earthquake load. Live loads shall be in general as per I.S. 875 Part (II).

**1.11.3 Earth pressure loads**

Earth pressure for all underground structures will be calculated using coefficients of earth pressure at rest.

In addition to earth pressure and ground water pressure, etc., a minimum surcharge load of 20kN/ m² will also be considered for the design of all underground structures including channels, sumps, cable and pipe trenches, etc. to take into account the vehicular traffic in the vicinity of the structure.

1.11.4 Wind load and Seismic load

Wind loads shall be as per I.S. 875 Part (III)-Latest Revision and Seismic forces shall be as per I.S. 1893(Part I)-2016.

1.11.5 Vehicular Wheel Load

For any structure or pipeline below the roads, Class A loading of IRC 6 shall be considered.

1.11.6 Other loads

- a) Apart from the specified live loads, any other equipment load or possible overloading during construction / erection / hydro-test of equipment or piping / maintenance shall also be considered in the design
- b) Design of all structures shall also consider any other relevant and consequential load / stress imparted to the structure
- c) All liquid / storage structures shall be designed assuming liquid up to the full height of wall irrespective of provision of any overflow arrangement
- d) Pressure relief valves or similar pressure relieving devices for relieving ground water pressure shall not be made in underground water retaining / storage RCC structures

1.11.7 Load combinations

The individual members of the frame will be designed for the worst combination of forces such as bending moment, axial force, shear force and torsion. Permissible stresses for different load combinations will be taken as per IS:875 (Part-V) and other relevant IS codes. Wind and seismic forces will not be considered to act simultaneously. Load factors will be based on the factors given in the relevant codes of practice – in general all loads which are variable (including earth and ground water pressure) will be treated as live loads for purpose of determining the load factor.

1.11.8 Load combinations for underground structures

Following loading conditions will be considered for the design of sumps, tanks, and other underground structures.



Only liquid pressure from inside and no earth pressure, ground water pressure and surcharge pressure from outside (applicable only to the structures which are liable to be filled with water or any other liquid). Internal liquid pressure shall be computed for the full height of the structure, assuming that overflow provisions may be non-functioning.

Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

Design will also be checked against buoyancy due to ground water during construction and operation stage. Minimum factor of safety as per IS:3370 against buoyancy will be ensured considering empty conditions ignoring superimposed loads. The ground water level will be at FGL for design.

1.12.0 DESIGN METHODOLOGY FOR RCC STRUCTURES

For the following structures additional loading criteria as mentioned below will be considered in addition to the criteria discussed above:

1.12.1 General

All designs of RCC structures will be carried out by limit state method as per IS / IRC unless use of working stress method is specifically mentioned. Design strength of materials and design loads will be calculated using appropriate partial safety factors over characteristic strength and characteristic loads as per IS / IRC.

For reinforcement detailing IS:5525 and SP:34 will be followed.

1.12.2 Foundation and underground structures

The type of foundation system, i.e., isolated, strip, raft or pile to be adopted will be decided based on the structure, loading arrangement, load intensity and soil strata. Design of foundations at various levels will be dependent upon the soil bearing capacity at that level.

Foundation system adopted will ensure that settlement / relative settlement is as per provision of IS:1904 and other Indian Standards. However, the settlement will be restricted to a lower value, if necessary, as per the system requirement.

All foundations will be of RCC construction. All foundations will be designed in accordance with relevant parts of the latest revisions of Indian standards IS: 2974, IS:456 and IS:2911. Raft foundations will be designed as per IS:2950.

Effects of uplift and reduction in bearing capacity due to underground water table will also be considered.

**1.12.3 Liquid retaining structures**

RCC water retaining structure like storage tanks, reservoirs etc., shall be leak proof with tightness class 3 as per Table 4 of IS 3370 and designed in accordance with IS:3370 (Part 1 to IV) by limit state design method, by limiting the crack width to 0.2 mm.

Liquid retaining structures with "severe" exposure as per Table 3 of IS 456 However, the parts of such structures not encountering liquid or vapour may be designed according to IS:456 excepting ribs of beams of suspended floor slabs, roofs and counterforts of walls, which shall be designed as per IS 456.

Water channels, if any, and substructure of pump houses will be designed as per IS: 3370 (Part 1 to IV).

All water retaining / storage structures shall be designed assuming liquid up to the height of wall irrespective of provision of any overflow arrangement. No pressure relieving devices will be permitted in underground structures.

In all liquid retaining structures, PVC water bar will be provided at each construction / expansion joint. The sequence of construction (and backfilling) will also be specified on drawings showing construction / contraction joints.

1.12.4 Increase in stresses

Where stresses due to wind (or seismic) and temperature are combined with those due to other loads, the allowable stresses in concrete and reinforcement steel will be increased by 33.33% in case of working stress design only.

Bearing capacity of the soil will be increased by 25% under seismic/ wind load condition.

1.12.5 Stability of structures

Design will be checked against buoyancy due to the ground water during construction and maintenance stages for structures like underground storage tanks, pits, trenches etc. Minimum factor of safety of 1.2 against buoyancy will be ensured considering empty condition inside and ignoring the superimposed loading. For purpose of calculating downward load due to any overburden, only the mass located vertically above the projected area of the base slab will be taken into consideration.

All building sub-structures including pump houses will be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases will be taken as mentioned in IS: 456 and other latest relevant IS codes. However, following minimum factor of safety will be followed:



- a) Factor of safety against overturning due to wind, seismic or other lateral load will be 1.5 minimum
- b) Factor of safety against sliding will be 1.5 minimum
- c) Factor of safety against uplift due to hydrostatic forces will be 1.2 and due to any other loads will be 1.5.

Stability of the structure will also be investigated for loading conditions during construction, repair or other temporary measures. Lower factor of safety may be used for such loading conditions as per relevant IS codes. In cases where dead load provides the restoring force, only 0.90 times characteristic dead load will be considered. Imposed loads will not be considered as restoring force.

2.0.0 GENERAL REQUIREMENTS

2.1.0 EXPANSION / CONSTRUCTION JOINTS

Expansion and construction joints shall be provided wherever required.

Two-part poly-sulphide sealant conforming to IS: 12118 shall be used for sealing of joints in contact with water. For other cases, bitumen sealing compound conforming to IS: 1834 can be used. Preformed Duraboard HD 100 or equivalent shall be used as joint filler.

All expansion and construction joints of the water retaining structures and underground structures in RCC shall be made watertight using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops may be used for the base slabs and in other areas where it is required to facilitate concreting.

Leak test of water retaining structure

Contractor shall perform water leak test or Hydro test as per relevant IS code. In case of water leakage found in structures, contractor shall submit the repair methodology and attend leakages with approved material as per International / IS standards.

2.2.0 DRAINAGE

Floor Drainage

All garlands drain and Storm water drain shall be RCC and not Brick masonry. It shall be connected to RE park drain near RE park type 1 road.

Roof Drainage

Roof drainage system shall be provided for quick and efficient draining of rainwater from roof to avoid seepage and damage to roof. The runoff gradient for the roof shall not be less than 1 in 100. Roof drainage system shall consist of roof drain heads, rainwater down comers and fixtures. System shall be designed to handle design for the specific site and shall be in



accordance to stipulations of IS: 1742 and IS: 2527. Roof drains shall conduct water to storm drains around the building.

The rainwater down comer pipes shall be HDPE pipes of minimum 150mm diameter conforming to IS 4984.

2.3.0 WATER PROOFING OF UNDERGROUND STRUCTURES

All underground structures like the tanks shall be designed for inherent leak tightness with plasticizer cum waterproofing cement additives conforming to IS:9103. In addition, limits on permeability as given in IS:2545 will also be met with.

The surfaces in contact with water shall be provided with relevant epoxy coating.

In case the leak-tightness test does not meet the acceptance criteria as per codes, provision shall be made on the inner surface of walls and base slab so that waterproofing grout can be injected to stop leakages.

2.4.0 VALVE CHAMBERS

Valve chambers shall be provided for valves such as Non return valve, Drain valves, Air release valve, Isolation valves, flange valves, gate valves, Sluice valves, scour valves etc, at the places shown in the Drawings. Clear Space all around valves shall be minimum 1.0 m to attend maintenance work.

Base course for foundations for valve chambers shall be in cement concrete (1:3:6) using 40 mm and downsize metal, with hard broken granite, trap, basalt or with any other approved grade as per the specifications. Base course shall be 500 mm thick, laid at a level not less than 1 m below the natural ground level. Inner surface shall be epoxy paint and outer surface direct in contact with soil shall be protected by applying bituminous coat.

Inside building, it shall be covered with chequered plate. But All kind of external valve pits shall be RCC with M-35 grade of concrete with RCC precast covers. Rebar/steel for reinforcement shall be Fe550D TMT-CRS with Approved make.

All kind of chamber/ Valve pits shall be covered with 6mm GI chequered plate as per corrosion C- 5 and shall be easily lifted by 2 persons with lifting hook provision.

Handrail shall be HDG with Painting shall be provided to get down into the valve chambers from door level.

Cement concreting and cement mortar shall be done as per the specifications.



Necessary earth work excavation and back filling etc. Complete as per the requirements shall be done as per the specifications.

All proposed valve chamber will be cast- in- situ with grade of concrete M35. The thickness for the valve chamber is as follows,

Description	Min thickness (mm)
Precast Cover slab	75
side walls and base slab	150

2.5.0 DAMP PROOFING

Damp proof course in a thickness of 50mm and consisting of cement concrete with admixture of approved water proofing compounds shall be provided at plinth level for masonry walls in super structure.

The proportion of cement to aggregates shall be 1:1.5:3 using 6 mm down stone chips with a waterproofing admixture. The percentage of waterproof admixture shall be as per manufacturer's specification but not less than 1% by weight of cement. The brick masonry surface shall be levelled, flushed up and prepared as directed to receive the damp-proof course. In masonry walls of buildings, it shall normally be placed above the external ground level. It shall be laid for the full width of the wall. The top surface shall be kept rough or ribbed for proper adhesion of mortar for brickwork coming over it. All exposed surfaces of the damp proof course shall be finished fair and smooth. It shall be cured for at least seven days. After the surface has partially set cold bitumen paint is applied to surface.

2.6.0 TEMPERATURE LOAD

Suitable expansion joints shall be provided in the longitudinal direction of the structure wherever necessary with provision of twin columns to account for the expansion and contraction due to changes in temperature of materials of the structure.

The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.

Analysis shall be carried out for ambient temperature variation. The temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and



mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand thermal stress due to 50% of the temperature variation.

Co-efficient of thermal expansion for steel shall be taken as per IS: 800. Co-efficient of thermal expansion for concrete shall be taken as per IS: 456.

2.7.0 WIND LOAD

Wind loads on structures shall be calculated as per provisions of IS: 875 (Part 3). The wind shall be assumed to blow in any direction and most unfavorable condition shall be considered.

The various design parameters shall be as per IS: 875 (Part 3).

The wind analysis shall consider the wind direction relative to the structure and both external and internal pressures as applied to the windward and leeward sides of the structure.

2.8.0 SEISMIC LOAD

All structures shall be designed for Seismic loads as per the latest edition of IS: 1893 (Part 1 & 4). Response spectrum method shall be used for the seismic analysis. The structures shall be classified into categories as per Table 6 of IS: 1893 (Part 4)-2015.

The damping factors shall be as per Table 5 of IS: 1893 (Part 4)-2015.

RCC Structures	-	5%
Steel Structures	-	2%

The importance factor for each structure shall be as per Table 3 of IS: 1893 (Part 4)-2015.

Response Reduction factor shall be as per Table 4 of IS: 1893 (Part 4)-2015.

2.9.0 EARTH PRESSURE LOAD

Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable).

2.10.0 LOAD COMBINATIONS

The individual members of the frame shall be designed for worst combination of forces such as bending moment, axial force, shear force and torsion. Different load combinations and permissible stresses for different load combinations shall be taken as per IS: 875 (Part-V) and other relevant IS codes. Wind and seismic forces shall not be considered to act simultaneously.

Wind and Seismic loads acting in the transverse and longitudinal direction shall be considered independently as separate load cases.

**3.0.0 REINFORCED CONCRETE STRUCTURES AND FOUNDATIONS**

All structures, building foundations, water retaining structures, trenches, pits, etc., shall be designed as per IS relevant Codes in general. Construction in general shall follow provisions of IS: 456 and IS: 3370 for normal and water retaining structures respectively.

3.1.0 DESIGN METHODOLOGY**General RC Structures**

All designs of RCC structures shall be carried out by limit state method as per IS: 456 unless use of working stress method is specifically mentioned.

Foundations and Underground Structures

All underground pits, trenches, etc., shall be leak proof RCC structure where specified design depth of ground water table so warrants. Foundations shall be checked for safety against sliding and overturning.

No foundation shall rest on filled up soil. Minimum depth of foundation shall be at least 1.5m below virgin soil. CNS (cohesive non swelling) soil shall be used for foundations on shallow depth.

Pile Foundations

All kind of foundations in Desalination plant shall be rest on pile foundations.

The detailed design, preparation of construction drawings, installation and testing of piles forming foundations to buildings and structures shall conform to the latest IS:2911 – Code of Practice for Design and Construction of Pile Foundations.

The Contractor shall be responsible for all aspects of the pile performance installed including demonstration of the adequacy of his design by testing. During detailed design, the Contractor shall submit the proposed firm to undertake piling work with details of piling system, method of installation, summary of design basis; number, type and size of construction equipments to be engaged for the work including crane, piling equipment, concreting equipment and proposal for installation & testing of trial piles and tests on working piles.

Liquid Retaining Structures

Water retaining structures shall be designed as per provisions of IS 3370 and IS 456.

In case of leakage in the above structures injection grouting method shall be applied to repair the structure according to the requirement of IS: 6494.

Approved water proofing compound shall be used for addition in concrete to all liquid retaining structures.

**3.2.0 STABILITY OF STRUCTURES**

Factor of safety shall be taken as mentioned in IS: 456 and other relevant IS codes. However, following minimum factor of safety shall be followed.

- a. Factor of safety against overturning shall be 1.5 minimum.
- b. Factor of safety against sliding shall be 1.5 minimum.
- c. Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5.

3.3.0 MINIMUM THICKNESS OF STRUCTURAL ELEMENTS

The following minimum thickness shall be followed :

- | | | | |
|----|---|---|------------------------|
| a. | Suspended floor slab / roof slab / walkways / canopy slabs etc. | - | 125 mm |
| b. | Ground floor slab (non — suspended) | - | 150 mm |
| c. | Water Retaining Slab / Walls | - | 200 mm |
| d. | Cable / Pipe Trenches / Underground pit / and base slab | - | 125 mm |
| e. | All footings (including raft foundations) | - | 300 mm |
| f. | Tapered footings | - | 200 mm (Min. at edges) |
| g. | Parapets / Chajjas | - | 125 mm |
| h. | Sunshades | - | 75 mm at edge |
| i. | Precast trench cover slabs / floor slabs/ louvers | - | 75 mm |
| j. | Paving | - | 100 mm |
| k. | Pile cap | - | 500 mm |

From fire resistance point of view minimum thickness of reinforced concrete members shall be as per Fig 1 of IS 456. Minimum fire rating of 2 hours shall be considered where fire hazard is expected.

3.4.0 CONCRETE MIX

Unless otherwise specified Cement used will be PPC or Ordinary Portland Cement (OPC) 53 grade conforming to IS: 12269-1987 mixed with slag cement confirming to IS 455-1989 Ground Granulated Blast Furnace Slag (GGBS) max 60% shall be used for on shore and offshore structures, or portions of structures, exposed to seawater. All structural concrete will be design mixes.

All RCC works shall be design mix as per IS: 456. As chloride is encountered along with sulphates in both sub-soil and ground water, Cement type shall be Portland slag cement Or



Sulphate Resisting Cement for all buried RCC structural members. Based on Corrosion Zone, site environmental exposure conditions grade of concrete shall be adopted as M35. Ready mix concrete shall be used. The proportions for nominal mix of concrete will be as per Table 9 of IS: 456. The concrete grade used for different non-structural applications will be as follows.

M10	: Blinding layer of 75mm thick below foundations, trenches and underground structures.
M20	: Pavement around buildings including plinth protection work, damp proof course below brickwork etc.
M20	: Block area paving, screed concrete, etc.
M 35	: All Buildings superstructure, Non-Liquid Retaining Structures and Base plate encasement, liquid retaining structures with "Very severe" exposure as per Table 3 of IS 456

Minimum cement content, maximum water cement ratio, and minimum grade of concrete will be considered as per IS: 456 for severe exposure condition. Minimum fire rating of 2 hours will be considered where fire hazard is expected, and accordingly minimum cover will be taken as per Table 16A of IS: 456. For structures below ground level which are exposed to sulphate attack, requirement of cement will be as per Table 4 of IS: 456.

The following list of cement brands shall be adopted:

- a) ACC
- b) Ambuja
- c) UltraTech
- d) Sanghi
- e) J K Lakshmi
- f) Siddhi
- g) Hathi
- h) Hi-Bond

3.5.0 REINFORCING STEEL

Reinforcement bars will be as per the following codes: TMT from approved primary manufacturer conforming to IS: 1786 for mechanical properties.

Welded wire fabric : IS:1566

Grade of steel will be FE500D, TMT- CRS is recommended as per site condition (Saline condition)



The Contractor shall adopt the following brands:

1. TATA
2. Jindal
3. SAIL
4. RINL
5. Electrotherm

3.6.0 GROUTING

Non-shrink flowable grout will be used for under pinning work below base plate of columns. Non-shrink cum plasticizer admixture will be added in the grout. For grouting of base of machine foundation high strength ready mixed non-shrink flowable grout will be used. Crushing strength of the grout will generally be one grade higher than the base concrete. Minimum grade of grout will be M40.

Nominal thickness of grouting will be at least 50mm for columns and pedestals of major equipment. For secondary posts, stair and ladder base, etc. grouting will not be less than 25mm thick.

3.7.0 MINIMUM COVER TO FOUNDATION BOLTS

Minimum distance from the Centre line of foundation / anchor bolt to edge of pedestal will be the maximum of the following:

- a) Clear distance from the edge of base plate / base frames to the outer edge of the pedestal will be minimum 50mm.
- b) Clear distance from the face of pocket to the outer edge of pedestal will be 75mm.
- c) Clear distance from the edge of sleeve or anchor plate to the edge of pedestal will be 75mm.

3.8.0 MINIMUM COVER TO REINFORCEMENT

The minimum cover to the main reinforcement for all the structures, unless otherwise specified, will be as follows - (higher covers shall be adopted wherever necessary as per relevant codes / best practices):

S. No	Item	Top mm	Bottom mm	Sides mm
1.	Raft foundation /isolated footing/ pile cap	50	75	50
2.	Grade slab	25	25	25
3.	Column	50	--	50



S. No	Item	Top mm	Bottom mm	Sides mm
4.	Beam above EL (±)0.000 m	25	25	25
5.	Slab & Staircase above EL (±)0.000 m	25	25	25
6.	Liquid retaining structures			
	a. Base raft	50	75	50
7.	b. Side walls			
8.	In contact with earth face	50	--	50
9.	In contact with water face	50	--	50
10.	Precast units	15	15	15

3.9.0 FORMWORK REQUIREMENTS

Formwork panels shall be stiff enough to prevent damage to the concrete surface caused by excessive movements of the panel during vibration of the concrete.

Damaged and used formwork shall not be re-used without repairing.

All joints in form work and joints between the form works shall be sufficiently tight to prevent loss of liquid from the concrete through these joints.

The part of the ties shall be capable of being removed, so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement. Holes left after the removal of ties shall be filled with concrete or mortar of approved composition.

Formwork props shall be positioned between permanent supports so that all members are supported not more than 3 meters center in both directions.

The props shall be in the form of space frames, composite or single members with sufficient stiffness or bracing so that props shall neither sway nor buckle under loads which they are designed to carry.

The formwork or the false work shall not be removed from a structural component until CONTRACTOR ensures that the concrete has attained sufficient strength.

The concrete is to be regarded as sufficiently hardened when the component has attained such strength that it can resist all loads acting at the time of removal of the formwork.



Particular care shall be taken with components which have to carry virtually the full design load directly upon removal of the false work (e.g. in the case of roofs, or floor slabs which have to support loading from floors above them which have not yet hardened).

Props shall remain in position for as long a period as possible, particularly for structural components, which are subjected to a major proportion of their design loading as soon as the formwork has been removed.

No superimposed load shall be allowed on any part of the concrete work prior to the removal of the forms and props.

Tolerance for formed and concrete dimensions shall be as per IS:456.

3.10.0 PLACING OF CONCRETE

Before each concreting CONTRACTOR shall give sufficient notice to the Owner as directed such that an inspection shall be made before the concreting.

The concrete shall be mixed in the mixer of adequate capacity having a power elevated loading hopper. The mixer shall be equipped with an automatic water-measuring tank filled with a device for locking the discharge setting. The Mixing shall continue until there is a uniform distribution of the materials and the mass is uniform in color and consistency.

Any concrete surplus to immediate requirements shall be thrown away. In no case circumstances may the surplus be used later.

The volume of mixed materials in each batch shall comply with the mixer manufacturer's written recommendations.

Concrete shall be transported as quickly as possible from the mixer to its final position without segregation or loss of any of the ingredients.

All equipment to be used for transporting material shall be kept clean; all containers used for transporting concrete shall be thoroughly washed out whenever mixing ceases.

Concrete shall be placed continuously up to construction joints while it is still sufficiently plastic for adequate compaction.

At all times when reinforced concrete is being placed a competent steel fitter shall be in continuous attendance. CONTRACTOR shall adjust and correct the position of any reinforcement, which may be displaced.



CONTRACTOR shall keep on site a complete record of the works showing the time and date when concrete is placed in each part of the work.

Concrete shall be thoroughly compacted by suitable mechanical vibrators during placing and shall be carefully worked around all reinforcement and embedded fixtures and in to the side and corners of the formwork.

Whenever, concrete is being vibrated at least one spare vibrator of each type in use shall be available in case of breakdown.

Compaction shall start as soon as there is sufficient concrete within the formwork to immerse the vibrator and vibration shall continue during the placing operation so that at no time shall there be a large volume of uncompacted concrete in the form work.

For top surfaces of slab and other surfaces for which formwork is not provided a smooth finish shall be provided with a wooden float after compaction.

The concrete shall not be placed directly against a vertical form face but shall be placed to flow to this surface during the compaction process. Care shall be taken to avoid the form face being splashed with mortar during the placing operation.

Exposed surfaces, immediately after final set, shall be protected from the sun. All concrete shall be well watered after it has been set and shall be kept continuously damp until thoroughly cured. Provision shall be made for adequate water distribution to all parts of the work so that if required this treatment can be continued sufficiently throughout the whole period of construction. In order to keep the concrete continuously damp, all exposed surface shall be covered with continuously damped gunny bags or shall have water compounded on them, for full period of curing.

On exposed concrete surfaces in high sun temperatures and /or strong drying wind conditions CONTRACTOR shall use curing method, which also shields the concrete, and this shall be placed in position not later than half an hour after final tamping.

4.0.0 EARTHWORK IN EXCAVATION AND BACKFILLING

This section covers the requirement of site clearing, excavation, conveyance, disposal & backfilling in all types of soil for foundations, basements, trenches, drains, culverts including necessary shoring, dewatering, protective fencing etc.

The work to be provided for by the contractor unless otherwise specified shall include furnishing all labour, supervision, services, materials, scaffolds, equipment, tools and plants transportation etc.

**4.1.0 CODES AND STANDARDS**

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

IS:1200	Part 1 - Method of Measurement of building and engineering works - Earth work
IS:1498	Classification and identification of soils for general engineering purposes
IS:2720	Methods of test for soils (Relevant Part)
IS:3764	Excavation works - Code of safety
IS:4081	Safety code for blasting and related drilling operations
IS:9759	Guidelines for dewatering during construction
IS:7293	Safety code for working with construction masonry
SP-27	Handbook of Method of Measurement of Building Works

4.2.0 SETTING OUT

The contractor should submit to the Engineer, detailed drawings of the excavation work to be executed by him showing the dimensions as per drawings and specification adding his proposals of slopes, shoring, approaches, dewatering sumps, beams etc. Upon Engineer's approval the contractor should set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers shall be fixed at intervals prescribed by the Engineer. The contractor should proceed with the work after Engineer's approval. It should be noted that this checking by the Engineer prior to start of the work shall in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels and grades as per drawing; and subsequent corrections, if necessary, should be carried out by the contractor free of cost to the Owner.

In firm soil, the sides of excavation in foundations shall be kept vertical up to a depth of 1.5 m from the bottom and for greater depths the sides shall be widened by forming steps of 300 mm on either sides after every 1.5m from the bottom. Where soil is soft, loose or slushy, the width of steps shall be suitably increased or the side sloped or shored up, as directed by the Engineer. Working space shall be approved by the Engineer.

4.3.0 INITIAL LEVELS

Initial levels either in a definite grid pattern or as directed by the Engineer shall be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-section for volume measurement or for cross-checking the depths obtained from tape measurements.

**4.4.0 CLEARING AND GRUBBING ETC.**

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush etc. and leveled up.

Before earthwork starts, all the spoils and unserviceable materials and rubbish shall be removed from the site to approved disposal areas as specified. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer.

4.5.0 EXCAVATION AND CUTTING

Excavation in all kinds of soil including old (from demolished structures) underground RCC / CC / brick masonry shall be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work shall be carried out in a workman like manner without endangering the safety of nearby structures/ services or works and without causing hindrances to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work shall be checked by the Engineer thoroughly and the balance work shall be carried out carefully to avoid any over-excavation. On completion, the work shall be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips etc. are expected, the Engineer may order to suspend the work at any stage and instruct the contractor to carry out the balance work just before the foundation work of the structure can be started.

Undercutting shall not be permitted; Sides of excavation shall be cut sharp true to line.

When machines are used for excavation, the last 300 mm before reaching the required level shall be excavated manually or by such equipment that the soil at the required final level will be left in its natural condition.

While carrying out excavation for drain work, the sides and bottom shall be cut to the exact shape, slope and gradient as shown on the drawings. The surface shall be properly dressed. Excavated material shall not be placed within 1.5 m from the edge of any excavation or half of trench depth whichever is more.

4.6.0 VARIATION IN EXCAVATION**Bad Soil**

Should the bottom of any excavation at design depth appear to be soft, unsound or unstable, the Contractor shall report the matter to the Engineer and if the Engineer so directs, shall excavate the same to indicated depths. The extra depth shall be filled up with concrete or such other materials as the Engineer shall direct.

**Excavation Too Deep**

If the Contractor excavates to levels deeper than those shown on drawings for any reason other than required, he shall fill it up at his own expense to the proper level with lean concrete 1:4:8. No payment will be made for excavation taken down to depths more than those shown on the drawings or for the filling carried out as directed.

Slips and Falls

Every precaution shall be taken against slips and falls of earth, clay, sand or other materials in the excavations, but in the event of any such occurring, the Contractor shall at his own expense make good the space affected by slips or falls even if the affected area is outside the dimension of the work ordered.

The Engineer will determine in each case whether such affected area is to be filled up in whole or in part with concrete, brickwork or masonry of the quality used in the adjoining work or where only a part is to be so filled, the materials to be used for this remaining part.

If in the opinion of the Engineer there is a possibility of the newly constructed work having been damaged or disturbed by such collapse, the work shall be laid bare at the expense of the Contractor for inspection. Any damage caused shall be made good by the Contractor, at his own expense.

4.7.0 KEEPING WORKS SITE FREE FROM WATER

The Contractor shall provide and operate pumps and all other equipment necessary to drain the sub-soil water, rain water etc. to the nearest drain through properly laid pipes or channels and keep excavation pits, trenches etc. free from water at all times during excavation, backfilling and the continuance of the contract. Adequate care shall be taken to prevent movement of water through freshly laid concrete or masonry work.

Sumps made for dewatering shall be kept clear of the foundation. Method of dewatering shall be approved by the Engineer but in no case the pumping arrangement shall be such that there is any movement of sub-soil or blowing-in due to differential head of water during pumping.

4.8.0 PROTECTION OF WORK

The Contractor shall support and maintain adjoining and abutting property and structures to render work safe to persons and property.

The Contractor shall provide necessary decking, guard, fencing, planking with red flags and red lights at night to maintain safe pedestrian and vehicular traffic near all open excavations.



The contractor shall provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that, there is no hindrance to the movement of men and materials and equipment of other agencies connected with the project.

4.9.0 SHORING AND STRUTTING

Shoring and strutting shall be used as directed when excavation is to be carried out in soft or slushy soil which is likely to collapse during the excavation of the work. The shoring shall be either open or close boarded type depending on the nature of the soil and depth of excavation and the type adopted shall be as directed by the Engineer. While excavating in very unstable ground requiring support throughout the period of excavation, runners shall be used and shall be driven always in advance of the excavation. The size and spacing of different members to be used in shoring shall be as directed by the Engineer, depending on the site conditions. If, however slips do occur, the same shall be removed by him and backfilled later by him at his own expense. The withdrawal of shoring & shoring material shall be done very carefully to prevent the collapse of pit or trench. No claim shall be entertained for any material which cannot be removed and is lost or buried.

4.10.0 DISPOSAL

- a. The excavated soils shall be disposed of as directed by the Engineer-in-charge in any or all the following manners:
 - i) By using it for backfilling straightway.
 - ii) By stacking it temporarily for use in backfilling at a later date during execution.
 - iii) By either spreading, or spreading and compacting at designated disposal areas.
 - iv) By selecting the useful material and stacking it nearly in areas designated by the Engineer for use in backfilling by some other agency.
- b. The surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Engineer. All goods excavated from the pits and all assorted materials of dismantled structures shall be the property of the Owner.

4.11.0 BACKFILLING AND FILLING IN PLINTH

- a. The backfilling material shall consist of materials, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the Engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc. In certain locations, the



Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete.

- b. Filling and compaction in pits and trenches around structures: As soon as the work in foundations has been accepted and measured, the space around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc. and filled with earth in layers not exceeding 250 mm in loose thickness; each layer being watered, rammed and properly compacted to the satisfaction of the Engineer. Earth shall be rammed with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and leveled to proper profile as desired by the Engineer. Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimize the moisture content.

The backfilling shall be carried out at optimum moisture content to achieve 90% of Proctor's Maximum Dry Density.

- c. Plinth Filling: The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slopes intended to be given to the floor.
- d. Filling in trenches for water pipes and drains: Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.
- e. Filling in disposal area: Surplus material from excavation which is not required for backfilling shall be disposed of in designated disposal areas. The spoils shall not be



dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas, rollers shall be employed and compaction done to the satisfaction of the Engineer at the optimum moisture content which shall be checked and controlled by the contractor.

In certain cases, the Engineer may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench.

4.12.0 EARTHWORK IN EXCAVATION AND BACKFILLING

This section covers the requirement of site clearing, excavation, conveyance, disposal & backfilling in all types of soil for foundations, basements, trenches, drains, culverts including necessary shoring, dewatering, protective fencing etc. The work to be provided for by the contractor unless otherwise specified shall include furnishing all labour, supervision, services, materials, scaffolds, equipment, tools and plants transportation etc. Bidder shall download CBuD (call before U DIG Mobile application & mandatory to inform the concerned underground utility owners prior to critical underground infrastructure.

The works to be provided by the Contractor in respect of excavation in all types of soils including shoring, dewatering, filling around foundations; and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations.

Quality Control: The Contractor shall establish and maintain quality control for the various aspects of the work, method, material and equipment used. The quality control operation shall include but not be limited to the following items of work:

- | | | |
|----|-------------------------------------|--|
| a. | Lines, Levels and Grades:
Grades | i. Periodic surveys
ii. Establishment of markers, boards etc |
| b. | Back-filling | i. Checking the quality of fill material
ii. Checking moisture content of the backfill
iii. Checking the degree of compaction. |

Approaches and Fencing: The contractor should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing shall be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.



Lighting: Full-scale area lighting should be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the filling.

4.13.0 ANTI-TERMITE TREATMENT

Anti-treatment shall be provided injecting chemical emulsion for pre-construction and creating a chemical barrier (through agency approved by Owner) complying to IS 6313. Using Chlorpyriphos Emulsifiable 1.0 % concentration by weight under and all-around foundation pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall and floor, along the external perimeter of building, expansion joints, surrounding of pipes, water conduits or at places suggested by Engineer etc. complete (Plinth Area at ground floor only shall be measured).

5.0.0 MASONRY AND ALLIED WORKS

This section covers the requirements in respect of materials, workmanship and quality for brickwork and plastering.

All masonry works shall be designed in accordance with IS: 1905, IS: 2212, IS: 4326, IS: 2185 and other relevant IS codes as applicable. Structural design of load bearing and non-load bearing walls constructed with bricks or concrete blocks shall be in accordance with criteria specified by National Building Code of India and codal provisions. Fly ash bricks may also be used.

All Masonry walls for buildings shall be raised on plinth beams.

All walls shall be non-load bearing walls. All external and internal walls shall be of at least one brick (230mm) and walls shall be provided with RCC bands (transoms and mullions) wherever necessary to curtail the unsupported length / width / height of the wall.

Salient points to be considered for masonry work:

- a) Compressive strength of brick for all external walls shall be at least 75 kg/sq.cm and for all internal walls shall be at least 35 kg/sq.cm, for non-load bearing brick work.
- b) Cement sand mortar 1:6 for one brick thick wall and 1:4 for half brick thick wall shall be used. For half brick walls, RCC transoms and mullions shall be provided.
- c) Damp proof course shall be provided at plinth level before starting masonry work.
- d) Transoms shall be provided at lintel / door height. The spacing of mullions shall not exceed 2000 mm center to center.

Cut lintels shall be avoided.

All upstands and parapet walls on roof shall be of RCC / brick masonry. Minimum height of parapet walls shall be 750 mm and thickness 230 mm for brick work and 125 mm for RCC.



The Contractor shall lay bricks in full mortar beds with shoved joints. The joints are not to exceed 10 mm in thickness and are to be full of mortar, close, well finished and neatly struck. The vertical joints in any course shall not be nearer than quarter of a brick length from those in the course below. All joints shall be of same width except for small variations to maintain bond. The brickwork shall be laid plumb and trim to line and level. No portion of brickwork shall be raised more than 1 meter above another at one time. If the mortar in any course has begun to set, the joints shall be raked out before another course is laid. The top course of brickwork in reinforced concrete framed structure shall be wedged against reinforced concrete surface and joint well filled with mortar. The Contractor shall flush up thoroughly with mortar all joints as the work proceeds. Where brickwork is to receive plaster, the joints shall be raked to a depth of 10 mm to provide a proper bond.

The brickwork as it progresses shall be thoroughly watered on its faces and top. New work shall be properly bonded with the old work. The surface of unfinished work shall be cleaned and thoroughly wetted before joining new work to it. Any work in which the mortar perishes shall be dismantled and rebuilt by the Contractor.

The Contractor shall carry out work in as clean a manner as possible and shall remove excess material and mortar droppings daily. Where brick walls are to receive plaster, excess materials and mortar droppings shall be removed and the surface shall be brushed clean. During cleaning operations, adjacent work shall be protected. Any damage resulting from improper protection shall be made good by the Contractor at his own cost.

5.1.0 CODES AND STANDARDS

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Indian Standards Institution and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

Brick work

IS:1077	Common burnt clay building bricks
IS:13757	Burnt Clay Fly Ash Building Bricks
IS:1542	Sand for plaster
IS:1597	Code of practice for construction of stone masonry
IS:1661	Code of practice for application of cement and cement-lime plaster finishes
IS:1905	Code of practice for structural use of un-reinforced masonry.
IS:2116	Sand for masonry mortars



IS:2185	Specification for Hollow Cement Concrete Blocks
IS:2212	Code of practice for brickwork
IS:2250	Code of practice for preparation and use of masonry mortars
IS:2572	Code of practice for construction of hollow concrete block masonry
IS:2691	Burnt clay facing bricks
IS:3414	Design and installation of joints in buildings
IS:3495	Methods of tests of burnt clay building bricks
IS:3696	Safety code for scaffolds and ladders
IS:5134	Bitumen impregnated paper
IS:5454	Methods of sampling of clay building bricks
SP:20	Explanatory handbook on masonry works

5.2.0 MATERIALS

Cement

Cement used shall be same as specified for RCC works

Sand

The sand shall be approved river or pit sand and it shall conform to IS:2116 for masonry mortar and to IS:1542 for plaster mortar.

Bricks

Fly ash bricks shall be of uniform strength and size. The bricks shall have smooth surfaces with corners straight; they shall not be twisted or chipped; when broken they shall reveal a fine, uniform, non-vitreous grain; they shall emit ringing sound when tapped with a hammer; they shall absorb water on immersion (not more than one-sixth of its original weight after soaking for 15 minutes) and dry sufficiently quickly. The bricks shall not show any sign of efflorescence after soaking and drying in shade. If the bricks show any sort of efflorescence, the Contractor shall do the necessary treatment at his own cost to the satisfaction of the Engineer in Charge.

All bricks shall be subjected to inspection and approval and representative samples shall be submitted before ordering out. The bricks supplied shall conform to approved samples and may be subjected to tests as required by the Engineer.

Mortar

Mortar shall conform to IS:2250. The type of mortar to be used shall be as mentioned on drawings.

Brick masonry

- i) All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.



- ii) Mortar: Mix for mortar shall be as specified. Cement sand mortar cement and sand in 1:5 proportions shall be mixed dry in a mechanical mixer; and then water added and mixed further to achieve working consistency. Surplus mortar droppings from masonry, if received on surface free from dirt shall be mixed with fresh mortar with additional cement. No mortar which has stood for more than half an hour shall be used.
- iii) Brick Masonry: Fly ash Bricks shall be soaked by submergence in clean water for at least 2 hours in approved vats before use. Bricks shall be laid in English bond. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks are placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar. Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool with green mortar to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. 2 brick thick or more brickwork shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.
- iv) Exposed Brickwork: Almost all the brickwork shall be plastered with cement mortar. Brickwork in superstructures uncovered by plaster shall be executed by skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons should check workmanship frequently with plumb, spirit level, rule and string. All brick work shall be cleaned at the end of day's work. In case of face bricks involvement the brickwork shall be in composite shape with face bricks on the exposed face and balance in routine bricks, maintaining the bond fully; using carborandum stone for rubbing down. Where face bricks are not needed, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified.

Bricks shall not be dumped at site. These shall be stacked in regular tiers on firm ground, even as these are unloaded, to minimize breakage and defacement of bricks. Bricks selected from different situation of use in the work shall be stacked separately.

5.3.0 BRICK WORK

IS : 2212 shall be followed as general guidance for construction of brick work masonry.

The whole of the brickwork shall be carried out by the Contractor in a uniform manner.



All the bricks shall be kept under water till they are completely soaked and used on the works on their becoming skin dry.

The Contractor shall set out and build all brickwork to the dimension, thickness and heights shown on the drawings. The Contractor shall build all brickwork in English bond and half brick walls and casing to pipe, chases etc. in stretcher bond. Brickbats shall not be used except where required for bond.

The Contractor shall lay bricks in full mortar beds with shoved joints. The joints are not to exceed 10 mm in thickness and are to be full of mortar, close, well finished and neatly struck. The vertical joints in any course shall not be nearer than quarter of a brick length from those in the course below. All joints shall be of same width except for small variations to maintain bond. The brickwork shall be laid plumb and trim to line and level. No portion of brickwork shall be raised more than 1 metre above another at one time. If the mortar in any course has begun to set, the joints shall be raked out before another course is laid. The top course of brickwork in reinforced concrete framed structure shall be wedged against reinforced concrete surface and joint well filled with mortar.

The Contractor shall flush up thoroughly with mortar all joints as the work proceeds. Where brickwork is to receive plaster, the joints shall be raked to a depth of 12 mm to provide proper bond.

The brickwork as it progresses shall be thoroughly watered on its faces and top. New work shall be properly bonded with the old work. The surface of unfinished work shall be cleaned and thoroughly wetted before joining new work to it.

Any work in which the mortar perishes shall be dismantled and rebuilt by the Contractor at his own expense.

The Contractor shall carry out work in as clean a manner as possible and shall remove excess material and mortar droppings daily.

Where brick walls, are to receive plaster, excess materials and mortar droppings shall be removed and the surface shall be brushed clean.

During cleaning operations, adjacent work shall be protected and any damage resulting from improper protection shall be made good by the Contractor at his own cost.

Curing

As per standard best practices and Indian Standard (IS) provisions for cement plaster, a mandatory curing period of 7 days is required for the plaster to achieve its specified strength and durability. Contractor has to proceed with the essential quality control step to ensure the



long-term integrity of the surfaces and the project timeline accordingly to reflect the crucial phase.

Concrete shall be protected from loss of moisture for not less than 7 days after the concrete is placed. Trowelled surfaces, except those that receive a separate finish or coating, shall be cured with a membrane curing compound. Float finished surfaces, except those that receive a separate finish, may be cured with either a membrane curing compound or with water. Only water curing shall be used if the surface receives a separate finish.

Water curing:

Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete. Water curing shall begin within 12 hours in dry weather and within 24 hours in damp weather. The rate of water application shall be regulated to provide complete surface coverage with a minimum of runoff. The application of water may be interrupted for surface rubbing. The concrete surface shall not be permitted to dry. After the rubbing has been completed, rubbed surfaces shall be covered with burlap and kept saturated for the remainder of the curing period.

Membrane curing:

Membrane curing compound shall be applied within 30 minutes after final finishing of the surface or as soon as possible after finishing without causing damage to the surface. Membrane curing compound shall be spray applied at a coverage of not more than 7.4 square meters per litre. Membrane curing shall not be used on surfaces that shall be covered at a later date with mortar, concrete, damp—proofing, tile, or any coating. Membrane curing shall not be used on cast-in-place concrete bases for field erected tanks.

Expansion & Separation Joints

Location and details of expansion joints shall be strictly as shown in the drawings and specified in schedule of items. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall be approved by the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of taps shall be to the satisfaction of the Engineer.

5.4.0 PLASTERING

The plastering work including the application of cement punning (Neru) or plaster plaster-of-paris treatment on brick or concrete faces with architectural features shall be executed as per in accordance with the following latest IS codes: POP shall be used only on inside surfaces of ceiling and walls for aesthetic and architectural requirement.

IS:1542 : Sand for plastering

IS:1661 : Code of practice for application of cement and cement lime plaster finishes.



IS:2333 : Plaster of paris

IS:2402 : Code of practice for external rendered finishes

IS:2394 : Code of practice for application of lime plaster finishes.

Mortar for plastering shall be mixed in the proportion in a dry state and then wetted and mixed thoroughly to obtain the required consistency. The mortar shall be mixed in an approved manner including machine mixing in batches for its consumption within half an hour of mixing. Any mortar for partially set plaster shall be rejected and removed from site. The mix for plastering shall be as follows:

Brick wall:

- i) Outside plaster (or Sand faced) : 18 mm thick in 2 coats
1st coat of 12 mm thick in C:M 1:5
2nd coat of 6 mm thick in C:M 1:3 sand faced.
Owner approved Water proofing compound shall be mixed in outer plaster.
- ii) Inside plaster (or plain face) : 12 mm thick (1 cement : 5 sand)
- iii) Concrete ceiling Plaster : 6 mm thick (1 cement : 3 sand)

Before application of plaster, the surface shall be prepared as per IS:1661. In all plaster work, mortar shall be applied in an uniform layer slightly more than the required thickness and well pressed into the joint and in the surface and rubbed & leveled with a flat wooden rule to give required thickness.

Plaster, when more than 15 mm thick, shall be applied in two coats, base coat followed by the finishing coat. Thickness of base coat shall be just sufficient to fillup all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The under-coat shall be thicker than the upper coat. The overall thickness of the plaster shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster.

The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'. The finished surface shall be true to line & plumb; and the contractor shall make up any irregularity in the masonry/concrete work with plaster. The mortar shall adhere to the surface intimately when set; and there should be no hollow sound when struck.

All vertical edges of pillars, door jambs etc. shall be chamfered or rounded off. All corners must be finished to their true angles or rounded. Any plastering damaged shall be repaired and left in good condition at the completion of the job.



All plastered surfaces after laying and sufficiently hardened shall be cured for a minimum period of seven days and shall be protected from excessive heat and sunlight by suitable approved means.

Plaster-of-paris Finish: The plaster-of-paris shall be calcium sulphate hemi-hydrate variety. Its initial setting shall be less than 13 minutes. The material shall be mixed with water to workable consistency. Plaster-of-paris shall be applied to the surface in the uniform layer slightly more than 2 mm thick and shall be finished to an even and smooth surface with a steel trowel. Thickness of finish shall not be less than 2 mm. All corners, arises, angle and junctions shall be carefully and neatly finished.

Finish

Sand faced plaster

The plaster shall be applied in two coats. The first coat or the scratch coat should be approximately 12 mm and shall be continuously carried out without breaks to the full length of wall or naturing breaking points such as doors, windows etc. The scratch coat shall be dashed on the prepared to true and even surface and then lightly roughened by cross scratch lines to provide bond for finish coat. The scratch coat shall be cured for atleast 7 days and then allowed to dry.

The second coat shall be 6 mm thick and it shall not be applied until atleast 3 days have elapsed after the application at first coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation and without joints, finish shall be straight, true and even. Only approved river sand shall be used for the second coat and for finishing work. Sand for finish shall be of even coarse size and shall be dashed on the surface and sponged.

Plaster-of-Paris Punning

Plastered surfaces, where specified, shall be finished with plaster-of-paris punning. The material shall be approved by the Engineer-in-charge. The thickness of punning shall be 2 mm and shall be applied by skilled workman. The finish shall be smooth, even and free from undulation.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 1 sq.m area and approval of the Engineer-in-charge taken. The work shall be taken then in hand as per approved sample.

6.0.0 PAINTING, COLOUR WASHING ETC.

This section covers the requirements in respect of materials, workmanship and quality for finishing works to masonry, concrete and steel such as white washing, colour washing,



distempering and painting. Painting shall be done considering high saline C5 (Durability-Very High) zone as per ISO 12944.

6.1.0 CODES AND STANDARDS

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Indian Standards Institution and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder: White washing, colour washing and distempering

- IS:427 Distemper, dry colour as required
- IS:428 Distemper, oil emulsion, colour as required
- IS:6278 Code of practice for white washing and colour washing Painting
- IS:5 Colours for ready mixed paints and enamels
- IS:102 Ready mixed paint, brushing, red lead, non-setting, priming
- IS:123 Ready mixed paint, brushing, finishing, semigloss, for general purposes
- IS:1477 Code of practice for painting of ferrous metals in buildings
- IS:2074 Ready mixed paint, air drying, red oxide-zinc chrome, priming
- IS:2338 Code of practice for finishing of wood and wood based materials.
- IS:2395 Code of practice for painting concrete, masonry and plaster surface
- IS:2932 Enamel, synthetic, exterior, a. undercoating b. finishing
- IS:2933 Enamel, exterior, a. under coating b. finishing
- IS:5410 Specification for cement paint, colour as required

6.2.0 Finishes

The finishes for the buildings be as follows.

Description	floor	Wall	Ceiling
Scada Room	Vitrified tiles	Acrylic emulsion paint with putty and primer	False ceiling. RCC ceiling shall be applied with white wash.
Plant In charge room	Vitrified tiles	Acrylic emulsion paint with putty and primer	False ceiling. RCC ceiling shall be applied with white wash.
Auxiliary room and UPS/server room	Vitrified tiles	Acrylic emulsion paint with putty and primer	False ceiling. RCC ceiling shall be applied with white



Description	floor	Wall	Ceiling
			wash.
O & M room/technician room	Vitrified tiles	Acrylic emulsion paint with putty and primer	False ceiling. RCC ceiling shall be applied with white wash
Store room	IPS flooring with hardener flowing with floor epoxy paint.	Acrylic emulsion paint with putty and primer	Acrylic emulsion paint with putty and primer
Chemical Storage room	Floor Hardener with Epoxy paint with Anti slip grain	Acid resistant tiles upto ceiling	Acid resistance paint
Laboaratory	Acid resistance tiles	Acid resistant tiles upto ceiling	False ceiling with acid resistance paint false ceiling panels.
Workshop/maintenance bay	IPS flooring with hardener following with floor epoxy paint and Anti Slip grain	Acrylic emulsion paint with putty and primer	Acrylic emulsion paint with putty and primer
RO Skid and pump area	IPS flooring with hardener following with floor epoxy paint and Anti Slip grain	Acrylic emulsion paint with putty and primer	Acrylic emulsion paint with putty and primer
Toilet/Bathroom area	Vitrified tiles	Vitrified tiles up to false ceiling	False ceiling. RCC ceiling shall be applied with white wash.
Corridor	Vitrified tiles	Acrylic emulsion paint with putty and primer	False ceiling. RCC ceiling shall be applied with white wash.

In case Bidder choose to go with PEB option then all rooms shall be covered with False ceiling except RO skid and pump room.

A standard color scheme for the different buildings/structures shall be prepared by the Bidder and the approval of the Owner shall be obtained, before commencement of work.



6.3.0 WINDOWS, DOORS, VENTILATORS AND ROLLING SHUTTERS

Doors and windows on external walls of the buildings shall be provided with RCC sunshade over the openings with 300 mm projection on both sides of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings except for main entrance door to the control room where the projection shall be 1500mm.

Aluminium framed doors, Windows and ventilators shall conform to IS: 1081 with necessary glass panels including of all fixtures and painting etc. complete on the external faces. All internal doors and windows shall be made of heavy duty aluminium sections. All sections shall be 20 microns anodized. Sections of doorframe and window frame shall be adopted as per industrial standards and approved by OWNER / ENGINEER. Door shutters shall be made of aluminium sections and combination of compact sheet and clear float/ wired glass as per the requirement of OWNER. Fire doors shall be provided wherever necessary as per the statutory requirements.

All doors of toilet areas shall be PVC doors. Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However, for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20 m.

All accessible ventilators and windows buildings shall be provided with min. 5mm thick float glass, tinted for preventing solar radiations, unless otherwise specified. For single glazed aluminum partitions and doors, toughened float glass of 10 mm thickness shall be used.

All glazing work shall conform to IS: 1083 and IS: 3548. The glass to be used shall be from approved brand / manufacturer and as approved by OWNER. The glass should be free from distortion and thermal stress.

All doors/windows/ventilators openings shall be framed with granite.

Windows shall have rolled and /or vetical blind curtains.

Entrance of Main Building shall have granite steps with SS304 Grade Handrail.

Suitable RCC make Ramp and RCC make loading/unloading platform shall be constructed with HDG handrail provision.

Rolling shutter (Hand operated as well mechanical operated) shall be fabricated from 18 gauge (1.214mm) steel and machine rolled with 75 mm rolling centres with effective bridge depth of 12 mm lath sections, interlocked with each other and ends locked with malleable cast iron clips to IS:2108 and shall be designed to withstand a wind load without excessive deflection. Metal rolling shutters and rolling grills as IS: 6248

**6.4.0 MATERIALS**

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible & paint or one shade is obtained the same manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials to the Engineer's approval.

Distemper

Dry Distemper shall be made from suitable pigments, extenders lime proof tinters, water soluble binders confirming to IS:427. Oil bound washable distemper shall be of oil emulsion type containing suitable preservatives confirming to IS:428.

Gum and blue pigment

Gum and blue pigment for whitewash shall be of best quality and of approved make.

Waterproof Cement Paint

Waterproof cement paint shall be made from best quality white cement and lime resistant colours with accelerators, water proofing agents and fungicides. The paint shall confirm to IS:5410.

Whitewashing

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the Engineer; and shall conform to IS:712 latest edition. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank of water for two days and then



stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of whitewash water and a little quantity.

Acrylic Emulsion paint

Shall be water based acrylic copolymer emulsion with retile titanium dioxide and other selected pigments and fungicide. It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild and water without any deterioration in colour, or without showing flaking, blistering or peeling.

Varnish

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

Primer coat

Unless otherwise specified, the primer coat for concrete, steel and iron work shall be as specified by the manufacturer.

6.5.0 WHITE WASHING, COLOUR WASHING AND DISTEMPERING**Mixing**

The slaked lime shall be screened to pass through a sieve of 49 meshes per sq.cm. and dissolved in a tub with sufficient quantity of water and shall be well mixed to give a thin creamy consistency. It shall then be strained through a clean coarse cloth and clean gum dissolved in hot water added to it at the rate of 2 kg for each cubic meter of lime and ultramarine blue added to the mixture in small proportion just sufficient to give a very light bluish tint.

Colour wash shall be prepared in the same way as for white washing except that necessary amount of colouring matter shall be added to lime wash to obtain the colour specified. No blue shall be added in this case. The entire quantity shall be mixed strictly in accordance with the manufacturer's instructions unless these are varied by the Engineer.

Distemper shall not be mixed in a larger quantity than is actually required for a day's work and hot water shall be used in preparing the mixture.

Preparation of Surface

Before white wash is laid on new wall, the surface of wall shall be well cleaned and brushed and all patching must be scraped properly. After cleaning the surface, all holes, cracks and patches shall be made good with approved materials.



Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and finished with cement wash. For all internal painting the surface shall be made smooth by application of approved paste fillers before applying primer.

The distemper shall not be applied on damp walls and shall be applied in dry weather. The surface to be distempered shall be thoroughly cleaned of dust, dirt, grease, oil marks, cement marks, loose scales etc. and rubbed with sand paper to give a uniform smooth surface.

Workmanship

White wash shall be applied with brush, each coat consisting of vertical stroke from top downwards followed by opposite stroke upwards over the first stroke and horizontal stroke from left to right followed by stroke right to left. Each coat must be allowed to dry before the next coat is applied. On completion, the surface when it becomes dry, shall present a uniform white appearance. When dry, no coat of whitewash shall show any patches, haircracks or streaks nor shall it come off when rubbed with hands. Whitewashing shall be done in 3 coats unless otherwise specified. Doors, PUMP s, floors etc. must be protected from whitewash splashes. Any splashes and droppings shall be removed and cleaned.

Colour wash shall be applied in the same manner as specified for whitewash. During application, the solution shall be stirred continuously, and wash shall be applied with care to avoid any cut shade or brush marks on the walls when the work is complete. For all new work, the surface to be colour washed shall first be treated with a priming coat of lime wash. Unless otherwise specified, two coats of whitewash shall first be applied before colour wash is applied. The colour wash, whether applied inside or outside of a building shall be of uniform tint and shade.

The workmanship for distempering shall conform to IS:427 and IS:428 unless specified otherwise. Distempering shall be done with proper distemper brushes of approved quality. The finished surface shall be of absolutely uniform shade throughout and free from brush marks. On drying, the distemper shall not come off on touch and shall not crack. Distemper shall be applied in two coats over one coat of priming. The priming coat shall be as specified and the primer shall be in accordance with the recommendation of the manufacturer. Before applying the primer, the plastered surface shall be washed with a solution of 100 gm of zinc sulphate to one C of water and then allowed to dry. Succeeding coats shall not be applied until the previous coat has been approved by the Engineer. The first coat shall always be of a lighter tint and shall be applied with care. In case the finish is not upto the standards, the entire surface shall be sand-papared and a fresh coat or coats of distemper shall be supplied without any extra cost.

All decorative mouldings, cornices, bands etc. shall be finished according to detailed drawings. All splashes of distemper shall be removed by the Contractor at his own cost.



The surface to be coated with waterproof cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After four to six hours, water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours), the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

6.6.0 STORAGE

The contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement & stains, Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire. Before starting the work, the contractor shall obtain the Engineer's approval regarding the soundness & readiness of the surface to be painted on.

The Clear Synthetic Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted. For the finishing coats of varnish, the surfaces shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surfaces as well as from the neighborhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on while the next section is being laid on; and excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has began to set, shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh. The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

French Polish : All unevenness of the surfaces shall be rubbed down to smoothness with sand paper and the surfaces shall well dusted. The pores in the wood shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt sienna or umber.



After application of the filler paste, the French polish shall be applied with a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil shall be used on the pad for case of application. The surfaces shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

Chemical Resistant Paint : For chemical resistant paints, epoxy, chlorinated rubber or vinyl butyl paint system shall be used manufacturer's recommendation regarding the paint system exposed to moderately severe corrosive condition and subject to acid/ alkali spillage and fumes, shall be followed.

- a) **Protection :** Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.
- b) In addition to provisions in general conditions, the contractor shall, upon completion of painting etc, remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.
- c) All painted surfaces shall be uniform and pleasing in appearance. All varnished surfaces shall be of uniform texture and high glossy finish. The colour, texture etc. shall match exactly with those of approved samples. All stains, splashes and splatters of paints and varnishes shall be removed from surrounding surfaces.

Handrails

Handrail Shall be HDG and shall have paint as per approved paint scheme. It shall be fixed and removal as per site requirement. Handrails shall be provided at appropriate places to ensure safety e.g. around all floors / roof openings, projections / balconies, walkways, platforms, steel stairs etc. All walkways, stairs, and platforms shall be provided with handrails, supports, bracing as well as kick-plates of minimum thickness of 8 mm & projecting 100 mm above the platform surface. Weather friendly painting is recommended to apply on handrails.



All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per IS: 1161 and shall be galvanized. Handrail shall be a three-rail system with elevations of each rail from floor level shall be as listed below.

- the top rail at 1250 mm
- the intermediate rail shall be at 850 mm
- the bottom rail shall be at 450 mm

Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the protected horizontal opening and shall not exceed 1850 mm in such a case.

6.7.0 WATER SUPPLY

Suitable arrangement of water shall be ensured to cater the day-to-day requirement of drinking water during entire O&M period.

For operation people, potable water storage tank (six layer) either Sintex or equivalent conforming to IS: 12701 shall be provided over the roof of the control room. The capacity of the tank shall be at 45 liters per day per person with minimum two days storage capacity, complete with all fittings including float valve, stop cock etc. The capacity of the tank shall not be less than 2000 liters.

6.8.0 PLUMBING AND SANITATION

UPVC pipes of Grade I PVC 1120 conforming to ASTM D-1785 and fittings conforming to ASTM D-2466/2467, of approved make and brand shall be used for water supply. PVC pipes (Minimum Pressure 6 kg/cm²) conforming to IS 13592 and fittings conforming to IS 14735, of approved make and brand shall be used for sanitation. The make and brand shall be approved by OWNER / ENGINEER.

Toilet shall be designed as per number of occupancies as directed by OWNER for minimum persons or as directed by OWNER / ENGINEER; and constructed with following finish

- a) Door: PVC Door
- b) Ventilators: Mechanical exhaust facility
- c) Plumbing fixtures: Approved make
- d) Sanitary ware: Approved make
- e) EWC: 390 mm high with health facet, toilet paper roll holder and all fittings
- f) Urinal (430 x 260 x 350 mm size) with all fittings.
- g) Wash basin (550 x 400 mm) with all fittings.
- h) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing
- i) CP brass towel rail (600 x 20 mm) with C.P. brass brackets
- j) Soap holder and liquid soap dispenser.
- k) GI pipes (B class) or UPVC of approved makes
- l) Overhead water tank equivalent of 1,000 litre capacity with required pumping facility



Gully trap, inspection chambers, septic tank and soak pit shall be provided for designed occupancy.

QUALITY CONTROL

Contractor shall establish fully equipped quality control laboratory at site to conduct all acceptance test on all construction materials, concrete cube test, compaction of soil testing. This shall be housed with covered buildings. All testing equipment like Owen, Electric operated cube testing equipment, sieves for grading of sand and aggregates, flakiness and elongation index testing sieve, density of aggregates, abrasion testing equipment, impact testing equipment, bitumen testing equipment like thermometer, Marshall test apparatus.

Other apparatus like cube moulds, sump cones. Vicat apparatus, moisture meter, dry film thickness gauge meter.

Contractor shall arrange for design mix of concrete for each grade of concrete from GIPCL approved laboratory or NABL (National accreditation board for testing and calibration laboratories).

Contractor shall arrange for gradation mix for road works-Murram, granular subbase, Wet mix macadam, Water Bound macadam, dense bitumen macadam, bituminous coarse etc.

All testing equipment's shall be periodically calibrated to the satisfaction of owner and as per manufacturer manual and instruction.

INSPECTION AND TESTING

The Owner shall have free access at all times to those parts of the manufacturer's works which are concerned with fabrication of the steel work and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification.

Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch Tolerance for fabricated structures shall be as per IS:7215.

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, it shall be liable to rejection. No structure or part of the structure once rejected shall be resubmitted for test, except in cases where the Owner considers the defect as rectifiable.

Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the Owner.



All gauges and templates necessary to satisfy the Owner shall be supplied by the manufacturer. The Owner may, at his discretion, check the test results obtained at the manufacturer's works by independent tests at the Government Test House or elsewhere, the costs of such tests shall be borne by the Contractor.

Before dispatch from fabrication shop, prototype of each structure shall be shop assembled and checked for fabrication tolerance. Also if ordered, by the Owner, the same shall be presented for inspection.

DRAWINGS & DOCUMENTS

The Contractor shall submit his detailed schedule for submission of all information, documentation, calculations, drawings, schedules etc within such periods or dates, which are required to guarantee a smooth handling of the project without delays.

After award of contract, the Contractor shall submit the designs, layout and construction drawings and detailed working drawings including fabrication drawings and bar bending schedule for all structures and items covered under the scope of this contract. The quality of the submitted documents must be in accordance with acceptable national practice and allow a speedy checking procedure.

The design drawings shall consist of general arrangement drawings showing location of tower and various equipment foundation along with cable trenches and all other related items / services required for the project. Subsequently detailed drawings along with design calculation shall be submitted by the Contractor for approval. Subsequent to approval of GA drawings, fabrication drawings for steel structures and Bar Bending Schedule for RCC structures shall be submitted before commencement of construction.

Detailed dimension drawings and design calculation for all civil and structural works shall be submitted to the Owner for scrutiny and approval. No construction shall commence prior to obtaining of written approval from the Owner. Any approval given by the Owner to the designs & drawings shall not relieve the Contractor of his responsibilities for the correctness of the same and for execution of the work in accordance with the terms of the specifications. Detailed drawings approved by the Owner shall supersede the general drawings when they differ from them.

The drawings bearing the Owner's approval or drawings corrected in accordance with the comments of the Owner shall be deemed to be contract drawings and no variation there from shall be taken without the Owners written consent.

**7.0.0 PEB SPECIFICATIONS**

The specification covers the general requirements and the specific technical requirements for the Pre-Engineered Building works (PEB), which are not covered by any of the other technical specifications but are required to be carried out for the satisfactory completion of the work. It shall be noted that all Codes of Practice and Standards shall be those of latest issue.

The Bidder shall design the building as per latest version of IS: 800 and the technical requirements furnished by OWNER / ENGINEER. Fabrication & erection shall start only after getting approval on design & drawings from the OWNER / ENGINEER.

The Bidder shall be fully responsible for the complete structural design, fabrication, transportation to site and safe erection of the building at site, within the agreed time frame and Structural Stability Certificate for the structure for intended life period. Any approval from ENGINEER or OWNER shall not relieve the Bidder from the responsibilities for correctness of his designs and drawings.

Some of the major and mandatory requirements are as indicated below:

- a) The layout shall be designed for a life of 25 years as per requirement of Equipment and as per clearances required. The Bidder shall have to get the structural design done as per the prevailing Indian standard codes and International Standard. The structural design of shed shall be submitted to OWNER for approval before actual start of the work.
- b) The general arrangement and architectural drawing of insulated roofing & cladding system for providing general idea about work to be performed under the scope of the contract shall be submitted to OWNER as bid submission.
- c) The PEB shall have robust water tightness at all joints and connections. The building shall have high-class durability and performance during the adverse weather conditions.
- d) PEB shall be complete with painting, metal facia, metal gutter, rainwater down comers, sun-shades, openings, etc., along with associated structural steel, cladding and roofing work insulation, Trims & Flashings. Each item of PEB like panels, masonry, plastering, flooring, foundation, fittings etc. shall be suitable for complete life of plant.
- e) The design basis and construction methodology for PEB shall also be submitted to OWNER for approval before start of works.



- f) Generally straight/ uniform / tapered solid web Steel portal frame shall be provided, as per OWNER's requirements.
- g) Roof of buildings shall be suitably sloped to affect proper drainage. The entire roof with gutter shall be tested against water leaking prior to placing of equipment.
- h) Nylon safety net shall be provided below roof sheeting as a safety measure during the roof sheeting erection.
- i) A suitable arrangement of rainwater down takes shall be provided to collect the rainwater discharge from the roof to the ground level. The PEB CONTRACTOR shall design rainwater gutter size. The downspout shall be provided at appropriate locations.
- j) Rainwater down take pipes shall be provided up to ground level and up to nearest storm water chamber. All the necessary fittings, bends, elbows, etc. shall be provided by the PEB CONTRACTOR. The connection of rainwater down takes to the PVC pipe provided in the nearest inspection chamber below ground shall be provided by the Bidder.
- k) The cage ladders shall be provided wherever required as per the OWNER's requirement. The colour of the cage ladder and staircase structure shall match the sheeting colour and patterns.
- l) The supporting arrangement for all rolling shutters shall be provided by the PEB Bidder. For fixing the rolling shutters, the Jamb headers shall be clamped to plinth beams below using mechanical fasteners. Thickness of supporting members of jamb headers shall not be less than 6mm.
- m) The Pre-Engineered Building (PEB) shall have brick masonry side walls and roofing of structural steel with insulated sandwich (PUF) panels. Roofing panels shall have an outer steel sheet of 0.8 mm and inner sheet of 0.6 mm, with a minimum yield strength of 550 MPa and AZ-150 GSM coating in accordance with AS 1397 or equivalent international standards. Roof shall be solid steel web portal frame with Poly Urethane Foam (PUF) panel, seating above the purlin members. The sheeting shall be fixed to purlin with "Standing Seam" system. The roof shall be totally non-pierced type. The material of PEB shall be compatible as per C5 (Durability – Very High) corrosion category.
- n) PUF must be made of continuous method PU foam and must be CFC free, self-extinguishing, fire retardant type with density 40 +/-2 kg/m³ and thermal conductivity



0.019-2.2 W/ (m.K) at 10°C. The PUF panels shall be a factory-made item ready for installation at site.

- o) The PEB Panel shall be made of Sandwich insulated panels 80 mm or higher thickness with Poly Urethane Foam (PUF) as filler material between polyester pre-coated cold rolled steel. PUF insulated panels Metal Sheet for Roofing cladding consist of external sheet as troughed permanently colour coated sheet & internal sheet as plain permanently colour coated sheet.
- p) The type and locations of inner vertical bracing will be decided during detail engineering. Bracing system shall be provided for the columns in the entire building, wherever required as per design. The access as demarcated in the general arrangement drawings shall be free of bracing. On grids having rolling shutters, portal bracings up to rolling shutter level shall be provided and above cross angle bracings may be provided.
- q) PEB Bidder shall plan the bracing bays and shall take approval from OWNER/ENGINEER on patterns and location before going for detailed engineering.
- r) Rod / Angle / pipe / tube bracing shall be provided for the roof, wherever required as per design. The vertical bracings shall be of angle / channel / pipe / tube members only.

Primary members fabricated from plates shall conform to IS: 2062 min Grade E250 Quality BR/ ASTM A572-12 Grade 50 with minimum yield strength of 345 MPa. Steel shall be semi-killed/killed. Minimum thickness of steel plates shall be 6 mm. Hot rolled primary structural members and Rod /Angle bracing shall conform to IS: 2062 Grade E250 Quality A

A secondary member for Purlins and Girts shall conform to the specification of IS: 811 or ASTM: A1003-12 made from steel sheets conforming to ASTM: A1011- 12b Grade 50 having minimum yield strength of 345 MPa. The minimum thickness of secondary members shall be 3 mm.

Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind columns, beams, truss member, base plate.

Secondary structural framing shall include the purlins, girts, eave struts, bracing, flange bracing, base angles, clips, flashings and other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.

Sealant used for cladding shall be butyl based two parts poly sulphide or equivalent approved, non-staining material and be flexible enough not to interface with fit of the sheets.



Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations.

Flashing and / or trim shall be furnished at the rake, corners, eaves, and framed openings and wherever necessary to provide weather tightness and finished appearance. Colour shall be matching with the colour of wall. Material shall be 26 gauge (0.455mm) thick conforming to the physical specifications of sheeting.

Gutters and down-comers shall be fabricated out of same material as that of sheeting. It shall be brought down to the ground level for smooth discharge of water.

All bolts and nuts shall be galvanized of mild steel and shall conform to IS: 6639. Unless shown or specified all bolts and nuts shall be hexagonal. All nuts shall fit tight. Steel bolts, nuts and washers complying with relevant IS codes. High Strength Bolts for Primary Connections IS: 1367 (Part III) Gr. 8.8 . Bolts for Secondary Connection are: 1367 (Part III) Gr. 4.6 . Anchor/foundation Bolts shall conform to IS: 5624 and relevant IS code.

Door frames shall be of T-iron frame of mild steel Tee-sections. All doors shall be provided necessary fittings like hinges, handles, mortise locks, tower bolts, stopper, hydraulic door closer, etc. of CP brass complete.

Internal doors shall be anodized aluminium provided with extruded built up standard tubular sections, appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, including necessary filling up of gaps at junctions with required PVC/neoprene felt etc. including hinges / pivots and double action hydraulic floor spring of approved brand and manufacture IS: 6315 marked, lock, handle and all necessary fittings as per the details submitted by Bidder in shop drawing and approved by OWNER / ENGINEER.

The door entrance shall include pressed steel single leaf door. The structural steel shall conform to IS: 7452 and IS: 2062. The holdfasts shall be made from steel flats (50 mm and 5 mm thick). The fixtures, fastenings and door latch are to be made with same materials.

Window frame shall be anodised aluminium section frame of size 92x31 mm, minimum 16 gauge (1.519mm) thick as per approved design. Toughen glass with minimum thickness of 8mm and aluminum grill shall be provided.

Ventilators shall have anodized aluminium frame of minimum size 62x25 mm and 16 gauge thick as per approved design. Ventilators/duct shall be provided with bird guard. Size of opening at wall for ducts shall be min 18-gauge (1.214mm) GI sheet ducts shall be supported with suitable means, as approved during detail engineering. All accessible ventilators and



windows of all buildings shall be provided with min. 5mm thick float glass, tinted for preventing solar radiations. Suitable sunshades made out of approved colour sheet will be provided to all external windows and doors. The minimum projection for the sunshades will be 600 mm and 300mm wider than the width of the opening.

Rolling shutter Both Hand operated and mechanically operated shall be fabricated from 18 gauge (1.214mm) steel and machine rolled with 75 mm rolling centres with effective bridge depth of 12 mm lath sections, interlocked with each other and ends locked with malleable cast iron clips to IS:2108 and shall be designed to withstand a wind load without excessive deflection. Metal rolling shutters and rolling grills as IS: 6248.

The structural steel shall be hot-dipped galvanized, conform to IS: 4759 or relevant Indian standard. The min. thickness of galvanizing shall be 126 microns at any point of the galvanized structure. Galvanization shall be measured with elcometer or the material can be sent for testing to laboratory as and when required. No averaging is allowed for measuring the thickness of galvanization. All side shall be galvanization with same specification and shall be maintained for any hollow components of structures.

Self-Weight of Structure including Purlins, Sheeting, Girts, Bracings, lighting fixture, fire sprinkler pipes, fire header pipe, and turbo ventilators to be considered as Dead load etc. Live loads shall be as per IS: 875.

Point load of 0.15 kN shall be considered at centre span of each purlin. Miscellaneous collateral load of 0.5 kN/m² on projected plan area of the building shall be considered for design of Portal beams and columns.

The basic wind speed of the site and values of K1, K2, K3 and K4 and other pressure coefficients shall be as per IS: 875-(Part 3) latest version. It shall be as per Pd defined in specification.

The wind shall be assumed to blow in any direction and most unfavorable condition shall be considered.

Basic Wind Speed = 55 m / s

K1 factor = 1.08

K2 factor = Corresponding to Terrain Category 2

The external / internal pressure coefficients shall be as per respective clauses of IS : 875.

The Seismic forces shall be considered as per IS: 1893 (latest version).

The limiting permissible vertical and horizontal deflection for structural steel members shall be as per IS 800 code (latest version) where 'h' is height of building at eaves from FGL.



1. Dimension of all rooms shall be based on area covered by electrical / I&C equipment's including working space, utility and other facility and reserved space and / or required for future installation of equipment's if any.
2. The structure shall consist of RCC elevated platform as per approved GA and PEB shall be placed over elevated platform to accommodate O&M requirement and equipment layout requirement. This shall be further reviewed during detail engineering.
3. The FFL of building shall be minimum 500mm above the raised FGL. Equipment rooms shall be sized and designed as per the OEM recommendations to ensure desired life of equipment. The static live load on floor shall be higher of 1000 kg/m² or actual equipment load.
4. Bidder shall furnish the architectural and construction drawings of the proposed building to the OWNER / ENGINEER for approval, prior to construction. The layout, design, and drawings for all RCC structure, etc. and foundation system shall be approved from OWNER/ENGINEER before start of works. The buildings and allied works shall be designed to meet national building code (latest edition) requirements.
5. All Rooms shall be equipped with Air-conditioner, Exhaust fans, power sockets, power supply as per O&M requirement. Numbers of above each shall be finalized during detail engineering. Storerooms shall have Minimum carpet area of 30 sq.m. It shall have 4 nos. of cupboard with lock and key arrangement have heavy duty slotted angle racks (minimum 4 Nos.) with minimum thickness of 10 gauge and approved make by OWNER. It shall have sufficient power socket of 16 A and 6 A as required.
6. Laboratory rooms shall have sandwich platform with Cabinets (Modular style), approved make of Sink, Water supply, Drainage Plumbing, Power sockets, have Heavy duty Acid Resistance floor tiles and Wall tiles up to 2100mm from FFL. Rest height of wall shall be apply with Acid Resistance paint. Laboratory room shall be equipped with required O & M tools and Apparatus and other related laboratory Infrastructures.
7. RO Skid and Pump house shall have sufficient vertical clearance to ceiling/roof to have hassle free arrangement to bring or replace tools with Forklift, Hydra, crane and shall be finalized during detail engineering. RCC ramp shall be made for easy movement of vehicle/equipment with galvalium Rolling Shutter. Rolling Shutter shall have both provisions of mechanical (Motorized) and manually.
8. Plinth protection 1000 mm wide and 100 mm thick shall be provided around the buildings in PCC M15 grade of concrete.
9. RCC Garland drain shall be made around the Control building.

**False Ceiling**

The SCADA, Shift Incharge, Technician Room, laboratory, Toilet shall be provide with false ceiling of 15 mm thick mineral fibre board, in tile form of size 600mm x 600mm, along with galvanised light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and colour, to give grid of maximum size of 1200x600 mm as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts(if required), return air grills (if required), light fixtures, etc., all complete. The SCADA cabin shall be fitted with split type air conditioning units. However, OWNER / ENGINEER's approval shall be obtained.

Flooring

1. Pump House, Workshop, maintenance bay and Storerooms shall have Granolithic flooring with non-metallic floor hardener and shall be painted with PU epoxy floor paint with Ant Slip grains.
2. RO Skid and battery room shall have floor with 12mm thick acid/alkali Resistance tiles and wall tiles up to 2100 mm with compatible cement mortar. Lobby shall have Heavy duty vitrified ceramic tiles and skirting of 150 mm matching with floor tiles.
3. All other rooms including toilet block shall be provided with vitrified ceramic tiles of size 600X 600 mm of min 8-10mm mm thickness, laid with 3 mm ground joints as per approved pattern.
4. The floor finish for toilet shall be vitrified ceramic anti-skid tiles and Dado glaze ceramic tiles up to 2.1m shall be used. The normal size of Ceramic tiles shall be 300 mm X 300 mm X 9 mm and shall comply IS: 15622.
5. Bidder shall furnish the architectural and construction drawings of the proposed building to the OWNER / ENGINEER for approval, prior to construction. The layout, design, and drawings for all RCC structure, etc. and foundation system shall be approved from OWNER/ENGINEER before start of works. The buildings and allied works shall be designed to meet national building code (latest edition) requirements.
6. The minimum detailed specifications of buildings shall be as described below.
 - (a) Plinth protection 1000 mm wide and 100 mm thick shall be provided around the buildings in PCC M15 grade of concrete. Garland drain shall be provided all round building. Building peripheral drains shall be stone/brick masonry/concrete works. These side drains shall be connected to nearest drain network.
 - (b) 20 mm thick Kota stone/Granite shall be provided for steps. Storeroom shall have 50 mm thick cement concrete flooring with non-metallic floor hardener.



WINDOWS, DOORS, VENTILATORS AND ROLLING SHUTTERS

1. Doors and windows on external walls of the buildings shall be provided with RCC sunshade over the openings with 300 mm projection on both sides of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings except for main entrance door to the control room where the projection shall be 1500mm.
2. Aluminum framed doors, Windows and ventilators shall conform to IS: 1081 with necessary glass panels including of all fixtures and painting etc. complete on the external faces. All internal doors and windows shall be made of heavy-duty aluminum sections. All sections shall be 20 microns anodized and 2.0mm thick. Sections of doorframe and window frame shall be adopted as per industrial standards and approved by OWNER / ENGINEER. Door shutters shall be made of aluminum sections and combination of compact sheet and clear float/ wired glass as per the requirement of OWNER. Fire doors shall be provided wherever necessary as per the statutory requirements with minimum 2 hours fire rating.
3. All doors of toilet areas shall be PVC doors. Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However, for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20 m.
4. All accessible ventilators and windows buildings shall be provided with min. 5 mm thick Float glass, tinted for preventing solar radiations, unless otherwise specified. For single glazed aluminum partitions and doors, toughened float glass of 10 mm thickness shall be used. All glazing work shall conform to IS: 1083 and IS: 3548. The glass to be used shall be from approved brand / manufacturer and as approved by OWNER. The glass should be free from distortion and thermal stress. Approved material of High-Quality Vertical Blinds of nylon Slat Shades Window Curtains including Aluminum handrail, Chain control shall be provided.
5. Industrial rolling shutter (Galvalium) shall be provided as per requirement. Dimension of rolling shutter and RCC made ramp with proper gradient shall be such a way to accommodate, entry, exit and hauling of truck / forklift with carrying maximum size of loaded equipment.

Roof Water proofing

1. Roof of the Building shall consist of Cast-in-situ RCC slab with an approved water proofing system suitable for local climatic conditions with 10 years of leak-proof



guarantee. The roof of the building shall be waterproofed with approved Polymeric membrane type waterproofing and laid as per manufacturer's recommendation. The roof shall be designed for minimum superimposed load to 150 kg/m².

2. For efficient disposal of rainwater, the runoff gradient for the roof shall not be less than 1:100 and the roof shall be provided with projection of minimum 600mm all-round. This gradient can be provided either in structure or subsequently by water-proof screed concrete of grade M20 (using 10 mm down-graded coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. The roof of building shall project out by at least 750 mm all around the building from its external walls with and parapet wall above the roof beam. Height of parapet wall shall be minimum 600 mm above top of roof level.
3. Stair shall be provided to access the roof of the building.

8.0.0 MISCELLANEOUS ITEM

1. Watchman cabin:

The Prefabricated/RCC building of size 3 m x 3 m at the main entrance gate shall be designed and constructed by the Contractor keeping in view the safety and security of the desalination plant. It shall be equipped with 2 no. wooden table with drawers, 2 no of chairs and wall mounted locker & key box. Security cabin shall have proper ventilation, ceiling fan and proper light with additional power sockets. Material spec, drawing and design shall be provided for approval.

2. Key sets and master key:

All rooms and gate shall have 3 sets of keys with key tags with proper key identification mark and master key.

3. Roof:

Roof of the Building shall consist of Cast-in-situ RCC slab with an approved water proofing system suitable for local climatic conditions with 10 years of leak-proof guarantee. The roof of the building shall be waterproofed with approved Polymeric membrane type waterproofing and laid as per manufacturer's recommendation. The roof shall be designed for minimum superimposed load to 150 kg/m². Also, Chajja, canopy shall have water proofing as explained above.

For efficient disposal of rainwater, the runoff gradient for the roof shall not be less than 1:100 and the roof shall be provided with projection of minimum 600mm all-round. This gradient can be provided either in structure or subsequently by water-proof screed concrete of grade M20



(using 10 mm down-graded coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. The roof of building shall project out by at least 750 mm all around the building from its external walls with and parapet wall above the roof beam. Height of parapet wall shall be minimum 600 mm above top of roof level. Stair shall be provided to access the roof of the building.

4. False ceiling in case of RCC building:

All rooms shall be provided with false ceiling of 15 mm thick mineral fibre board, in tile form of size 600mm x 600mm, along with galvanised light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and colour, to give grid of maximum size of 1200x600 mm as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts(if required), return air grills (if required), light fixtures, etc., all complete. The SCADA cabin shall be fitted with split type air conditioning units. However, OWNER / ENGINEER's approval shall be obtained.

5. Preferred vendors for materials of Constructions.

Material / Item	Manufacturer
Cement (SRC/PSC)	ACC, Ultratech, Ambuja, JK laxmi, Sanghi Cement, HI-Bond, Hathi
Reinforcement steel HYSD / TMT-CRS steels bars with Grade Fe500D	SAIL, Tata Tiscon, Jindal Steel,JSW, RINL
Admixtures / water proofing compounds / Hardener	Dr. Fixit, Sika, BASF, Fosroc
Structural steel	Jindal, Tata Steel, SAIL, RNIL, Essar, JSW
Steel - Hot Rolled section (Angle / Channel / Beam / Round bar)	Jindal, Tata Steel, SAIL, RNIL, Essar
Steel coil for purlins, girts and cold frame member	JSW, Essar, Tata Blue scope
Bricks / light weight block	Approved make by owner
Rolling Shutter	Approved make by owner
Aluminum Sheet	Hindalco, Jindal,Tata blue scope
Metal cladding puff panel / sandwich panel	King span Jindal, Sintex, ThyssenKrupp Steel, Tata Blue scope
Welding Electrodes	ISI marked



Industrial Rolling Shutter	Approved make by owner
Aluminum Section for Door / Window / Partition	Hindalco, Balco, Jindal
Steel doors	Approved make by owner
Door closer	Godrej, Dorver, Yale
Door / window fixates like lock, handle	Godrej, Dorma, Kich
Panic Bar / Push bar with safety sign display sticker	Dorma
Vitrified tiles/ Ceramic tiles-premium class	Nitco, Kajaria, Asian , RAK, Somany Johnson
Fireproof Sealant	Sika, Fosroc, Hilti
Acid resistant tiles	Johnson, Kajaria, Somany
Stainless steel	Tata Steel, Jindal, SAIL
Acid / epoxy resistant paint	Asian, Burger
Acid resistant Brick	Sika, Fosroc, Hilti
Glass	Saint-Gibain , Modi Glass
Raised floor	Approved make by owner
Acrylic and emulsion paint, weather proofing paint	Fosroc, Sika, Hilti, BASF make
Water stopper / water bar	Approved make by owner
CI / FRP / RCC Manhole cover	Approved make by owner
Plumbing pipes (PVC/CPVC)	Finolex, Supereme
Putty	Birla, Asian , Berger, Nerolac, Fosroc
Elevated water tank of 6 layer	Sintex, supereme, plasto
sanitary hardware	
sanitary hardware	Hindware, Kohler, Jequar ,Cera
Light duty and Heavy duty paver block	Approved make by owner
Hume pipe	Approved make by owner
Structural bolt	Approved make by owner
sump pump	Approved make by owner