

sewers, storm drains or other buried structures. The contractor shall advise the department in advance when charges are to be set off.

After blasting, the contractor shall thoroughly seal the excavated trench/pit, remove all loose and shattered rock or other loose materials and make the excavation safe before proceeding with further work. The contractor shall not be entitled to compensation for removal of loose or shattered rock or other loose materials resulting from the enlargement of the excavation beyond the required limits.

Rock requiring blasting or chistelling shall exclude all rocks such as soft rock, small boulders which can be removed either with pickaxe or crow bars, and shall apply to only rocks which cannot be removed by any of these means. In case of differences in opinion, the decision of the Engineer shall be final and binding on the contractor.

11. CONTRACTOR'S RESPONSIBILITY

The contractor shall be responsible for the adequate pumping, drainage and bailing out water from the excavation. In case of failure to make such provisions or any other provisions which may result in unsuitable sub-grade conditions, the contractor shall replace and repair the sub-grade as directed to the satisfaction of the Engineer, at his own cost and responsibility.

Should the contractor select to use a gravel sub-grade to facilitate flow of water to pumps or other points of disposal, such gravel sub-grade shall not be measured or paid for as extra item.

12. WORKS INCLUDED IN EXCAVATION

The following works as per specifications are also included in excavation and the term 'Excavation' shall construe to mean all such of work. The quoted rates should include the same

1. Provision of side space or additional space in the trench/pit for working and/or accommodating sheathing, shoring, branching, etc.
2. Supply, installation and removal after the work, all sheathing, shoring and bracing required to project the excavation where required or where such work is recommended by the Engineer.
3. Protection of excavations.
4. Providing adequate safety measures.
5. Additional work in connection with overhead wires and poles.
6. Excavation for socket hollows.
7. Change of trench location.
8. Additional work in conducting blasting operations as required, in case the excavation is in rock.
9. Supplying and fixing of sight rails and boning rods in the trench to facilitate measurement of work.

13. DISPOSAL OF SURPLUS EXCAVATED MATERIAL

The excavated material which is in surplus to the requirements after backfilling shall be removed and spread places shown by the Engineer, with all lead and lift from the site of work, for which no extra payment shall be made. No surplus or excess material shall be disposed in



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a stream / channel or in any place where the pre-construction surface shall be disposed neither in a stream / channel nor in any place where the pre-construction surface drainage may have to be provided, without written permission of the Engineer. Carriage for lead beyond 13 KM, will, however, be paid by the employer.

TECHNICAL SPECIFICATION

2.0 CODES AND DESIGN AIDS

All design will be based on BIS or equivalent other international standards and codes (latest revisions), with amendments, if any, as on date. Apart from these codes, specific design guidelines laid in this documents shall be followed.

2.1 General

IS : 875-1987 Code of Practice for Design loads (other than Earthquake) for Building & Structures (Part 1 to 5)

IS : 1983 (Part I) – 2002 - Criteria for Earthquake Resistant Design of Structures

IS : 1983 – 1984 Criteria for Earthquake Resistant Design of Structures

SP : 7 – 1983 National Building Code (NBC) of India

2.2 Concrete Structures

IS : 456 – 2000 Code of practice for plan & Reinforced Concrete

IS : 3370 (Part I & II)–1965 &
IS : 3370 (Part III & IV)–1967 Code of practice for Concrete structures for storage of liquids.

SP : 16 – 1980 Design aids for Reinforced concrete to IS : 456

IS : 2974 – 1992 Code of practice for design and construction of raft foundations (Part III)

IS : 2950 – 1981 Code of practice for general construction of raft foundations

Steel Structures

IS : 800 – 1981 Code of practice for general construction in steel.

2.3 Masonry works

All masonry works shall be as follows :

- 230mm thk Brick Masonry using last class brick work in C.M. 1:6 for CW Pump house & HT Panel room, Rapid Gravity Filter house, Dirty Backwash Recycle Pump house & Chemical house.
- 115mm thk Brick Masonry using 1st class brick work in C.M. 1:6 for Partition Walls & Parapet Walls of pump house & HT Panel room, Dirty Backwash Recycle Pump house & Chemical house.

2.4 MATERIALS

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2.9 Dead load

Dead load shall include the weight of all structural and architectural components and other permanent equipments. Unit weight of various materials shall be in accordance with IS:875 (Part-I)

2.10 Live load/ Imposed loads

Live loads shall be in general as per IS : 875 (Part II) . However the following minimum live load shall be considered.

i)	Process Building (Pump Operating Floor & Filter Gallery)	
	Operating area	: 500 kg/m ²
	Maintenance area	: 500 kg/m ²
ii)	Service Platform	
	Isolated Platform (for valve operation)	: 250 kg/m ²
	Access Way	: 250 kg/m ²
iii)	HT Panel room	
	Panel Floor	: 1000 kg/m ²
iv)	Office Floor on Filter Gallery	: 300 kg/m ²
v)	Staircase	
	All locations	: 300 kg/m ²
vi)	Flat roof of Building (accessible)	: 150 kg/m ²
vii)	Flat roof Building (inaccessible)	: 75 kg/m ²
viii)	Sloped roof Building (inaccessible)	: 75 kg/m ²
ix)	Roof slab of reservoir	: 150 kg/m ²

Reduction in live load shall be as per IS : 875 (Part - 2) and IS: 1893

Monorail load shall be considered under live loads . Impact factors for the design of structure supporting monorail hoist shall be as per IS : 875

2.11 Wind load

Wind load on building/ structures shall be computed as per IS : 875 (Part - 3) . The parameters for calculation of design wind speed as per IS : 875 (Part - 3) are as follows -

Basic wind speed, V _b	:	50 m/sec
Risk Coefficient, k ₁	:	1.0
Terrain, Height, Structure size factor, k ₂	:	To suit the height of the structure for terrain category-3 and class-B or as appropriate.
Topography factor, k ₃	:	1
Design wind Speed, V _z	:	V _b X k ₁ X k ₂ X k ₃
Design wind Pressure, P _z	:	0.6 X V _z ²

Cement

Ordinary Portland Cement – 33 grade IS269 shall be used-

Plain Cement Concrete

The mud ma/ base lean concrete except UGR, sump, pump house & intake structure shall be as follows –

Elements	Thickness (mm)	Grade
Under base slab of Water Retaining Structures & Footing of Non- Water Retaining Structures	75	1:3:6
All Masonry Wall Foundations	150	1:3:6
Damp proof course at plinth level of masonry walls	40	1:2:4

Reinforcement bars

Reinforcement bars shall be of high yield strength (Fe415) bars conforming to IS:1786-1985.

LOADS AND FORCES

General

Buildings and structures shall be designed for the most critical combination of dead loads, superimposed loads, equipment loads, crane loads, wind loads, seismic loads etc.

Design loads and combinations shall comply with the requirements of IS:875 (Part 1 to 4). The following types of loads shall be considered in general for analysis and design of structures and foundations

- Dead Load
- Live Load/ Imposed loads including monorail load
- Wind load
- Seismic load

The external and internal pressure co-efficient shall be as per respective clauses of IS : 875 (Part-3)

Seismic load

Buildings :

Earthquake Load is considered as per IS : 1983 (Part-I) : 2002

- Seismic Zone : (v)
- Damping for Concrete Structure shall be considered as 5%
- Importance Factor : 1
- Response Reduction Factor : 3

Note : 1. In calculating, W_1 , the weight of walls and columns in any storey is assumed to be shared half between the top and bottom supports and all weights are assumed to be lumped at the level roof or any floor/ plinth beam at column beam junctions. The analysis of frame for seismic will be done using STAAD-Pro software and response spectrum method.

2. Calculation of base shear and distribution of seismic force shall be done using STADD-pro.
3. Seismic load may be calculated for maximum dead load & appropriate amount of live load to get worst effect on the structure.

LOAD COMBINATIONS

Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc resulting from the most critical combinations of loads as specified below. Permissible stresses for different load combinations shall be taken as per relevant IS codes. Wind and earthquake forces shall not be considered to act simultaneously.

Load combination for design purposes shall be the one that produces maximum forces and effects from the following combination of loads.

- a) Dead Load + Live Load
- b) Dead Load + Live Load + Wind/ Seismic Load
- c) Dead Load + Wind / Seismic Load

In case of structures bearing monorail loads, live load shall include monorail loads also. Values of partial safety for Limit State Design are considered as per Table 18 of IS : 456-2000

DESIGN CRITERIA – CIVIL & FOUNDATION WORKS

BASIS OF DESIGN

i) Except for liquid retaining structures, Limit state method of design, as per IS: 456-2000, shall be adopted for the design of concrete structures.

ii) Liquid retaining structures shall be designed as per IS : 3370.

b) FINISHED GROUND LEVEL (FGL) AND FINISHED FLOOR LEVEL (FFL)

These levels will be determined during approval of design.

c) SOIL DENSITY

Unit weight of soil considered in design is 1.8 T/m³ (dry).
Submerged unit weight of soil considered is 0.8 T/m³ (sub).

d) DESIGN GROUND WATER TABLE

Design Ground water level is considered with reference to existing ground level as per Report on Soil Investigation work to be done by the Contractor to supplement such information given in this document in Section P(1).

e) BEARING CAPACITY & TYPE OF FOUNDATIONS

Net safe bearing capacity of soil shall be considered as per Report on Soil Investigation report.

Structures like Clear Water Reservoir with Suction sump, Pump House, HT Panel Room, Rapid Filter House, Flocculation tank, Inclined Plate Settlers & Chemical House are founded on BCIC Pile Foundation.

Lightly loaded Structures like Collection Well, Parshall Flume, Flash Mixer, Clarified Water Channel, Dirty Backwash Water Sump, Sludge Sump & Recycle Pump House & Boundary Wall are founded on Open foundation as per recommendations of above mentioned soil report.

Increase in Net Safe bearing capacity of soil up to 25% is allowable, when the load combination Dead Load + Live Load + Wind/ Seismic Load governs the foundation design. Percentage loss of contact area of footings with the soil for gross pressure is limited to 30%.

f) DEFLECTION

The deflection criteria shall conform to clause 23.2 of IS : 456-2000

g) COVER TO REINFORCEMENT (As per Table-16 of IS : 456-2000)

Clear cover to main reinforcement shall be as follows.

Footings and rafts

Earth Face : 50 mm

Others : 30 mm

Columns/ Pedestals : 40 mm

Beams : 30 mm

Slabs

For moderate exposure : 30 mm

Liquid retaining structures

(a) Face in contact with liquid : 30 mm

(b) Face away from liquid but in contact with earth : 40 mm

(c) Free face : 30 mm



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h) SAFETY FACTORS FOR STABILITY

Stability against Sliding : 1.5
 Stability against Overturning : 2.0

2.15 DESIGN CRITERIA – STRUCTURAL STEEL WORKS

a) GENERAL

Structural steel rolled sections and plates shall conform to specified grade "A" of IS : 2062. All materials shall conform to the specifications as per the list of standards given below –

- IS : 226/ IS : 2062 Hot rolled sections and plates
- IS : 1363 Hex head bolts, screw and nut of production grade C
- IS : 1364 Hex head bolts, screw and nut of production grade A & B
- IS : 1367 Tech Supply conditions of threaded fasteners
- IS : 2016 Specs for plain washers
- IS : 3502 Specs for chequered plates

Bolts, nuts and washers shall conform to the requirement of IS : 800

Slop of roof truss shall be 1V : 3H

Roof covering and side cladding for structural steel shed over flocculation tank and inclined plate settlers shall be provided with translucent sheets.

Handrails – 1000 mm high with 32 NB (M) M.S tubes as top-rail, mid-rail and upright.

Toe Plate (100 mm X 5 mm) shall be provided for all hand railing, except for staircase. Spacing of uprights shall be 1500 mm maximum.

b) Permissible Stresses

Permissible stresses in structural members and bolts shall be as specified in IS : 800. Permissible stresses in welds shall be as per IS : 813

c) Permissible deflections

The permissible vertical deflections for structural members shall be as specified below -

Sl. No.	Description	Allowable deflection
1	Grider/ beam for supporting dynamic equipment/ hoist	L/ 500
2	Grating/ Chequered plates	L/ 200 or 6 mm whichever is less
3	Other structures/ Structural components	As per relevant IS codes

L represents span of member

d) Minimum Thickness

Sl. No.	Description	Minimum Thickness
1	Trusses, purlins, side girts and bracings	6 mm

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Sl. No.	Description	Minimum Thickness
2	Column, Beams	7 mm
3	Gussets	8 mm
4	Stiffeners	8 mm
5	Base Plates	16 mm
6	Chequered plate	6 mm (over plane)
7	Grating	3 mm
8	Structural components (except gratings and chequered plates) which are directly exposed to weather and in – accessible to repainting	8mm

e) **INCREASE IN PERMISSIBLE STRESSES**

Increase in permissible stresses for steel members and connections shall be as per relevant clauses of
IS : 800

3.0 **DESIGN CRITERIA**

3.1 The basic layout of the Intake structure, Raw Water Pump House, Water Treatment Plant, Clear Water Reservoir and Pump House, Booster pumping Stations, hill top reservoirs and service reservoirs shall be as per Tender Drawings. The Elevation of the Pump House building and the Reservoir shall be of suitable Architectural design and Drawings and detailing have to be provided by the tenderers. The Tenderer shall submit with his Tender, the Architectural Elevation of the building and the Reservoir. However, the architectural Elevation may have to be modified at the time of approval by the Chief Engineer, Guwahati Development Department for which no extra charge will be paid.

Design and construction of all R. C. C. Structures, brick masonry walls and Foundation shall conform to the latest edition of the following IS Codes.

- | | |
|------------------------------------|---|
| a) Loading Standards | IS : 875 |
| b) Earthquake Resistant Design | IS : 1893 & IS : 4326 |
| c) Reinforced and Plain Concrete | IS : 456 |
| d) Foundations | IS : 1080, IS : 2950
IS : 2911 & IS : 2974 |
| e) Liquid Retaining Structures | IS : 3370 |
| f) Structural Steel | IS : 800 |
| g) Reinforcement | |
| Mild Steel | IS : 456 & IS : 432 |
| Ribbed Tor Steel | IS : 1786 & IS : 1139 |
| h) Masonry and Brickwork | IS : 1905 & ISS: 2212 |
| i) National Building Code of India | |

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12 The clear water reservoir including inlet control chamber and Overflow Pits, the Pump House Building the Pump Suction Sump and Unloading Bay shall be designed with deep Cast-in-situ RCC bored Pile Direct Mud Circulation Foundation. It is to be noted that no foundation other than Pile Foundation will be accepted.

Such piles shall be bored Cast-in-situ R. C. C. Piles (bidder to design diameter, compression, tension & shear capacities of pile foundation). The design, construction and workmanship for these piles shall fully conform to and satisfy the codal requirements of IS 2911 (Latest Edition). Concrete to be used in Piles shall be of M-20 Grade having a Cement content not less than 400 kg/m³. Reinforcement in piles shall be in conformity with the requirements contained in IS:2911 (Latest Edition). The minimum area of Longitudinal Reinforcements shall be as per Codal requirements and such requirements shall be provided for the full length of piles. For piles subject to Upward Tension, reinforcement shall be provided throughout the full length and such reinforcement shall be designed on the basis of upward load they are supposed to carry.

The safe working loads of the R. C. C. Cast-in-situ bored piles should be that as computed as per IS:2911 on the basis of Sub-soil Parameters of the Site with a minimum Factor of Safety 2.5 (Compression) and 3.00 (Up lift) applied there on or that indicated in the following table, whichever is less.

Chart showing pile capacities :

- Av. Ground Level (more or less)
- Cut off level
- Termination depth
- Length of pile
- Pile diameter (mm)
- Cut off Level R. L.
- Safe Working Load (Tonns) under Compression
- Safe Working Load (Tonns) under Up lift
- Pile Termination depth below Cut off level (m)
- * F.S. stands for Factor of Safety

SUCCESSFUL BIDDERS SHALL HAVE TO SPECIFY LEVEL, SIZES AND HIGHTS

3.3 In case of any change in Cut off levels, necessary adjustment in the safe working load will be made. Pile Termination levels shall be chosen carefully. The safe working load of the piles shall be substantiated by Routine Load Test. Sub-soil investigation after award of contract by the Tenderer shall be witnessed by the Engineer-in-Charge or his authorized Representative. The Pile Termination Level shall be fixed by the successful bidders.

These Piles shall be designed for Seismic Condition also. The important factor for Seismic Analysis of Structure shall be 1.50. The Tenderer shall include in his Lump Sum price the cost for Load Test of at least working pile (Routine Test) per 100 piles or part thereof. The testing

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should be as per codal Stipulations. The Tenderer shall also included in his price the cost of installation of one R. C. C. cast-in-Situ, Bored Non working pile having same Structural Details as of Working Pile and Pull out Test of the same as per Codal Stipulations.

3.4 If during initial pile load testing at site, the safe load bearing capacity is found to be more than what has been tabulated in the table under "chart showing pile capacities", the safe load as furnished by the department in the table shall be followed for which no extra claim will be entertained. In case, the safe load bearing capacity during load testing of piles of site is found to be less than what has been provided in the table furnished by the department, the lesser value shall be followed, in this case also, no extra claim be entertained.

3.5 While design the Foundation of different structures, the Tenderer may use the Soil Investigation results provided in the Tender.

The successful Tenderer shall have to undertake fresh investigation of soil at 3 (three) locations at each site of construction as approved by the Department at his own cost for design of the Foundation properly and for detailing the piles in conformity with the Soil Test Report. In no case, extra claim over the Quoted price as accepted by the Department, will be entertained.

In the event of variation in soil Data between NIT Bore Hole Logs and those obtained by the Contractor during execution, the more Conservative Values obtained from the two sets of Reports shall be adopted for design prorata additional claim over the Quoted Price shall be considered in case the SE is convinced and allows additional or increased dia of piles in the event of soil being found unfavourable to what had been in the NIT Bore Hole Log.

4. DESIGN PARAMETERS

4.1 Loadings

A) Clear Water Reservoirs

A park is proposed to be constructed on the roof of the Reservoir at main reservoir of WTP and reservoir at BPS-II and II. The roof is to be designed for a live load of 500 kg/M² and the superimposed Load of saturated earth of 450 mm. depth No. relief shall be allowed due to this Superimposed Load of saturated earth while computing the Uplift on the reservoir.

B) i) Live Load on Roof	150 Kg./Sq.m.
ii) Live load on pump house Floor	500 Kg./Sq.m.
iii) Live load on Control Room Floor	300 Kg/Sq.m.
Weight of each Empty Pump (approx.)	2000 Kg.
Weight of each Motor (approx.)	2000 Kg.
Weight of 400 mm dia Sluice Valve (approx.)	900 Kg.
Weight of 300 mm diameter Sluice Valve (approx.)	500 Kg.
Weight of 300 mm diameter P. D. V. (approx.)	300 Kg.
Load due to Electric Panel (approx.)	1200 Kg. / Sq.m.
Weight of 400 mm dia pipe (approx.)	300 Kg./m

N.B. Loading details given herein above are tentative and subject to verification during final execution. No extra cost will be paid to the Contractor on account of variation within +- 30 % limit.

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Vertical load data for pumps and motors are inclusive of impart factor subject to confirmation of the Pump Manufacturer during final design. The cost in this regard shall be included in the lump sum offer by the Tenderer and no additional claim will be entertained in future due to variation in load data, if any.

The floor slab is to be designed for the worst loading conditions that the floor will be subjected due to the equipment to be housed and may be put anywhere on this floor. The floor slab should be so designed as to withstand such loads.

The floor supporting M. S. suspenders / Cable trays are to be designed for a concentrated static load of 200 Kg. at any point. The Cable Trenches wherever provided shall be absolutely free from any obstruction so as to allow the Cables to be lowered in the trenches from top only during laying. The space inside any beam and column.

Live load in Battery Room operator's Room and Store	500 Kg./Sq.m.
Load of M. S. Chequered Plates	500 Kg./Sq.m.
For trench covers over opening in Floor	500 Kg./Sq.m.
Loading from 5.00 M. T. Hand Operated (H.O.T.) Overhead Crane	As per Crane Manufacturer's Specifications

The Unloading Bay is to be designed for 18 M. T. full truck load.

While designing the side walls of the Clear Water Reservoir and pump house a surcharge of 500 Kg./Sq.m. is to be taken into consideration.

The tenderer has to design in such a way that the permissible limit of vibrations of Rotodynamic Equipments shall be within the limit as specified in IS:11724-1985.

The R. P.M. of pump Motor set may be 750 R. P.M. Sync, subject to confirmation award of equipment contract.

N. B. For calculating earth pressure on the walls of Reservoir / Pump house, the worth value among co-efficient of active earth pressure (Ka) and that of Earth pressure at rest (Ko) is to be considered. Standard backfill materials with conservative soil data are to be considered. No extra claims are to be entertained in this regard.

4.2

Level and Other Salient Information (Successful bidders to specify)

- A. Levels in Meters
- B. Difference in Height / Clearance
- C. Minimum Length, Slopes etc.

Out of the above list, the figures marked with "Astericks" are mandatory requirements whereas the others are suggestive only.

A. Levels in Meters (to be fixed by successful bidders)

Sl No.	Description	Meters
1. *	Finished ground level	
2.	Clear Water Reservoir Floor Level	

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3. * Clear Water Slump Level (Flat Portion)
4. * Minimum Water Level in Sump
5. Maximum Top Water Level in Clear Water Reservoir
6. Motor Floor Level
7. Catwalk / Inspection Gallery Level
8. Top of Concrete level for Clear Water Reservoir
9. Bottom of H. T. O. Crane Hook
10. Top of Crane Rail over Crane Girder
11. Unloading Platform Level

B. Difference in Height, SWD and Head Room in Building and Structure (Successful bidder to specify)

1. Side Water Depth (SWD) in clear Water Reservoir
2. Free Board in Clear Water Reservoir / Clear Water Sump soffit of Slab / Beam

C. Minimum Length, Slope, Clearance etc.

1. Minimum Length along direction of Flow near pump sump (slope portion)
2. Maximum slope from clear water Reservoir to Sump
3. Minimum length of the flat Sump Along the direction of flow

4.3 Special Notes on Horizontal Centrifugal in Horizontal Execution Pump Foundation Design

4.3.1 Foundation system for support of Rotary machines such as Horizontal Pumps shall strictly comply with the requirements of Code IS:2974 (Part-IV)-1979. The Rotary Machine support system require careful study of the foundation system with due consideration of vibration characteristics. For satisfactory design and construction, the following precautions need be taken with careful dynamic analysis of machine foundation and its supporting structures:

- i. The natural frequency of the Foundation System shall be analyzed and the mass of the Foundation System shall be considerably larger than the mass of the whole machine.
- ii. Dynamic Analysis due to insufficient clearance between impeller and causing of Pumps should be checked and frequency out of this type of vibration need to be made as per relevant IS Code.

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- iii. Dynamic Response check of the block foundation may be carried out as per relevant IS Code.
- iv. Permissible amplitude of Vibration of displacement as per IS Code 2974 (Part-IV), Clause 5.4 Page No. is to be calculated and the design will be checked accordingly.
- v. Permissible stresses in Soil / Concrete be suitably as per IS Code.
- vi. Natural frequency of Foundation System shall be such as will avoid resonance with the Operating Speed of the Machine. The natural frequency of the foundation system should not be within +20% of the operating of the machine.
- vii. The foundation system shall be so dimensioned that the resultant force due to mass of the machine and mass of the Foundation passes through the Centre of gravity of the base area of the Foundation.

3.2 The Tenderer is requirement to submit a "Technical Write-up" with relevant details of Foundation System along with the Part-I of this Tender. This would help the Department to fix up the accepted Parametric Norms of the foundation System that would finally be adopted in the design and construction of the Building and Structures after award of the contract.

5 ARRANGEMENT OF ROOF TREATMENT: EARTH FILL VENTILATING SYSTEM

It is proposed that the Clear Water Reservoirs top at the pumping stations shall have minimum 450 mm thick compacted earth fill as shown in the Tender Scheme Drawing.

5.2 The provision for saturated earth load on the roof slab shall be considered in the design of roof slab of the Clear Water reservoir by the Tenderer. The actual earth fill work is also included in the Scope of this Tender.

5.3 The R. C. C. Roof Slab of the Clear Water Reservoir shall be protected with water proofing treatment as per direction of the Engineer.

6 DESIGN DRAWING AND OTHER INFORMATION TO BE SUBMITTED BY THE CONTRACTOR (SUCCESSFUL TENDERER)

On the award of the Contract, Contractor shall submit to the Engineer, Guwahati Metropolitan Development Authority detailed design and drawings of different structures phase wise keeping pace with the work programme.

If called upon, the Contractor shall also submit relevant books and other references which have been referred to or used in the design. Such books and other references will be returned to the Contractor when done with. Secrecy in regard to details of design of structures, materials and equipments etc. shall not be considered by the Contractor in the name of "Trade Secret" for not furnishing the requirement details asked for by the Engineer. The design and drawings shall be subject to modifications at no extra cost, if found necessary and such modifications shall not vitiate the contract. Similarly, any additional new drawings as found necessary shall be submitted by the Contractor and the drawings shall form part of the Contract Drawings.

Notwithstanding what has been stated above the Contractor shall be responsible for the correctness and soundness of the design and if any provisions are found inadequate or faulty necessary modification will have to be carried out at any stage upto the expiry of the guarantee period.

The Contractor will not be permitted to commence the Actual Work at site unless detailed design and working drawings are approved by the Engineer. Four copies of the approved design and six copies of the approved drawings are to be furnished by the Contractor free of cost for use by the Employer during execution of the work. Any additional copies of same drawings, if required, should also be submitted by the Contractor free of cost at the request of the Employer.



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A tentative work programme in Network Diagram using CPM technique is required to be submitted by the successful tenderer within a fortnight from the date of issue of workorder. The drawings from foundation onward will have to be submitted by the successful tenderer successively as per the work programme to be approved by the Engineer. Adequate resources are to be mobilized during execution of the work, for which no extra payment shall be made.

6.2 Completion of Drawings and Other Documents to be submitted by the Contractor

The Contractor shall submit within one month after the completion of all construction works the followings drawings and documents free of cost.

- a) Six copies of all approved completion drawings. These drawings shall be on black and white prints of thick paper. These drawings are to be submitted in a presentable form as directed by the Engineer. In addition to this, CD/DVD's with folders of these drawings drawn in Auto CAD are to be submitted as soft copies.
- b) Four copies of final designs in properly bound form as directed by the Engineer.
- c) Four copies of detailed specification and schedules of the completed works of all machines, equipments and accessories as per inventory shall be submitted.

6.3 Release of Security Deposit (Retention Money)

The Security Deposit (Retention Money) shall not be released until all the above mentioned Completion Drawings and Documents are submitted by the Contractor and after the fulfillment of the criteria mentioned in Detailed Notice Inviting Tender.

7. SPECIFICATION OF FULL BORE ELECTROMAGNETIC FLOWMETER

- 7.1 Full bore electromagnetic flow meters should be designed, manufactured and calibrated according to internationally accepted ISO standards having bi-directional flow measurement and totalisation facility and total measuring accuracy should be $\pm 0.5\%$ of measured value. The manufacturer should have a ISO 9001 certification.
- 7.2 The change in the water demand will result in variation of line pressure. The full bore magnetic flow meters should perform within the required accuracy limit of $\pm 0.5\%$ of measured value without being affected by variation in the line pressure.
- 7.3 The flow sensor lengths should be strictly according to ISO lengths. This is a standardization according to ISO norms which helps the customer to have one to one replacement of flow meter of any manufacturer.
- 7.4 Direct volume comparison calibration method should be used to calibrate these meters. The overall accuracy of the calibration rig should be at least five times better than the accuracy of the full bore electromagnetic flow meter. This is in accordance with ISO norms. The calibration rig should have accreditation by an independent agency with traceability to national and international standards. VENDOR should have this kind of facility in India or they have to show the three point Wet calibration at their principal's works in any country or any other flow calibration rig accredited by National & International standard free of cost. Third party inspection is also applicable for the calibration works.
- 7.5 The flow transmitter cum converter should be wall mounted type with 2 line back-fit LCD display for indication of actual flow rate, forward & reverse flow direction, sum total flow indication and status indications. The transmitter housing should be Die-Cast Aluminum with glass window.

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- 7.6 The protection category for the sensor should be IP68 & the protection category for the transmitter should be IP 65.
- 7.7 Grounding Rings are to be provided on both sides and grounding electrode will not be acceptable
- 7.8 The converter cum transmitter should be fully programmable from the front facia. The programming should be user friendly, self prompting menu driven. The programming should be possible through state of the art 3 key keypad.
- 7.9 The flow sensors will be mounted in the field and will be subjected to all environmental conditions. At some locations flow sensors will be installed in underground chambers. There is a possibility of the flow sensors being submerged in the water. Thus to avoid ingress of water in the sensor housing, sensor has to be of fully welded construction.
- 7.10 At times the submersion of sensor causes corrosion/erosion of the sensor housing and ingress of water in the flow sensor. Therefore the sensor housing and the connection / junction box should be of SS 304. The protection category for the sensor is IP 68.
- 7.11 The transmitter will have one scalable pulse outputs, one current output, one status output.
- 7.12 The transmitter has adjustable field frequency, up to 25 Hz to ensure maximum accuracy and high speed response for pulsating flows.
- 7.13 It should be possible to have a separation between the flow sensor and the signal converter / transmitter upto a max. of 200mtrs. without the need for any signal boosters.

8.0 GENERAL SPECIFICATION OF FULL BORE ELECTROMAGNETIC FLOWMETER OF FORBES MARSHALL/ENDRESS HAUSER

OPERATING CONDITIONS	
SERVICE	RAW WATER
OPERATING TEMPERATURE	Ambient
OPERATING PRESSURE	0 - 10 kg/cm ² (g)
PRODUCT CONFIGURATION	FLOW HEAD AND TRANSMITTER
SENSOR (FLOWHEAD)	
MAKE	REPUTED MAKE
TYPE	PULSE DC EXCITATION
SYSTEM	SEPARATE WITH CABLE OUTPUT
POWER SUPPLY	240V AC, 50 Hz
LINER MATERIAL	HARD RUBBER
TUBE	SS 304
COIL HOUSING	SS 304 WITH FULLY WELDED CONSTRUCTION
ELECTRODE MATERIAL (WETTED PART)	SS 316
END CONNECTION MATERIAL (NON WETTED PARTS)	CS
END CONNECTION TYPE/RATING	FLANGED TO PN 10
CONNECTION / JUNCTION BOX	SS 304
EARTHING	GROUNDING RING (GROUNDING ELECTRODE NOT ACCEPTABLE)

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PROTECTION CLASS	IP 68
CABLE GLAND	½" NPT DOUBLE COMPRESSION Ni PLATED BRASS
ACCURACY	±0.5% OF MV INCLUSIVE OF LINEARITY, REPEATABILITY, PRESSURE EFFECTS AND HYSTERSIS
MARKING	FLOW DIRECTION WITH ARROW, SIZE, SERIAL NO. & MAKE
TRANSMITTER (CONVERTOR)	
MODEL	VENDOR SPECIFY
TYPE	MICROPROCESSOR BASED & MODULAR
MOUNTING	SEPARATED
DISPLAY LANGUAGE	ENGLISH
DISPLAY	TWO LINE BACK LIT LCD FOR INDICATION OF ACTUAL FLOWRATE, FORWARD, REVERSE AND SUM TOTALISER
COMMUNICATION	PC INTERFACE
RELAYS	INBUILT - 2 RELAYS
COIL DRIVE CURRENT & FREQUENCY	±125 mA PULSED DC WITH SELECTABLE EXCITATION FREQUENCY UPTO 25 HZ, TO IMPROVE SIGNAL - TO - NOISE RATIO AND HIGH SPEED RESPONSE / SIGNAL CONVERSION TO OVERCOME NOISES
CURRENT OUTPUT	ONE CURRENT OUTPUT 4 - 20mA
PROTECTION CATEGORY	IP-65
ENCLOSURE	DIE CAST ALUMINIUM WITH POLYURETHANE FINISH WITH GLASS WINDOW
PROGRAMMING	FROM FRONT FACIA THROUGH KEYPAD / OPTICAL PIN PROGRAMMING. PROGRAMMING SHOULD BE DONE WITHOUT OPENING OF DISPLAY COVER.
POWER SUPPLY	230 V AC, 50 HZ
MOUNTING	WALL MOUNTED
POWER FAILURE MODE	PROVISION OF RAM / PROM TO STORE PARAMETER ENTERED AND MEASURED FLOW DATA DURING POWER FAILURE
CABLE LENGTH	UPTO 200 METERS.
TERMINAL	SHOCK - HAZARD - PROTECTED PUSH LOCK TERMINAL
ERROR IDENTIFICATION	0/3.6/22 mA
INTERCHANGEABILITY	FULLY INTERCHANGEABLE WITH ALL THE FLOW SENSORS



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9.0 TECHNICAL SPECIFICATION OF LABORATORY EQUIPMENTS

9.1 pH Meter – Table Model (ACM – 340912-R/ Equipments :

Technical Specifications :		
pH/mV	:	
Range	:	0 to 14 pH o to +/- 1999mV
Accuracy	:	+/- 0.05 pH +/- 1 digit
Resolution	:	0.01 pH 1mV
Temp. Compensation	:	Automatic
Input Impedance	:	> 10 12 ohms
Probe	:	Combination pH electrode
Display	:	LED Seven Segment
Input	:	BNC
Temperature		
Range	:	0 to 100 0 C
Accuracy	:	+/- 1.0 0 C
Resolution	:	0.1 0 C
Input	:	Sterio socket
Probe	:	RTD sensor
Environmental Operating Conditions		
a) Operation	:	Indoor
b) Temperature	:	Ambient to 45°C
c) Relative Humidity	:	5 to 90% non-condensing
Power Requirement	:	230 Vac ± 10%, 50Hz

9.2 Weiber Digital Turbidity Meter (Acm-34096-R) :

Display : 3 1/2 Digit LED

Range 0 to 200, 0 to 1000 NTU

Sample System : 30mm Glass Tube

Light Source : 6v, 1 Amp Tungston Lamp

Detector : Photocell/ Photodiode

Power : 230 ± 10% d0 Hz



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9.3 Conductivity Meter Table Model (Acm-340913-R) :

Technical Specifications :		
Conductivity Measuring range	:	0.01mS/cm to 199.9mS/cm. (Depending on the cell used 0.1/1.0/10.0)
Resolution	:	- 0.01 (displayed)
Accuracy	:	- 0.5%
Temperature range	:	0 to 99.90 C
Resolution	:	0.1°C
Relative accuracy	:	+/- 0.2°C
Sensor	:	RTD PT 100
Temp. compensation	:	Automatic
Display	:	20 X 2 line backlighted LCD display
Keyboard	:	Alphanumeric splash waterproof polyester soft keys
Report format	:	(a) Report of selected conductivity readings (b) Calibration report (c) Data table and Graphs (optional)
Input	:	2 - Banana socket for conductivity electrode, 1-ATC-PT100
Output	:	Printer (Parallel) Autostand (optional)
Environmental Operating Conditions	:	(a) Operation : Indoor (b) Temperature : Ambient to 45°C (c) Relative humidity : 5 to 90% non-condensing
Power requirement	:	230 Vac \pm 10%, 50Hz

9.4 Double Walled Water Bath (Acm-54001-Q) :

Temperature Control		
Temperature Sensitivity	\pm °C	0.5 or better
Spatial Deviation in Temperature	\pm °C	0.5 or better
Readability	°C	0.1
Temperature Range	°C	5 °C above ambient to 90 °C (Standard)
Temperature Sensor		PT-100
Temperature Controller		Solid state digital controller/PID optional
Display		LED/LCD
Adjustable alarm limits		Optional with PID controller only
Safety Thermostats		
Temperature variation adjustments		3 (with PID Controller only)
Temperature Sensors		PT-100