

**BIDDING DOCUMENT FOR DISTRIBUTION SYSTEM FOR 24*7 WATER
SUPPLY SCHEME
FOR MOR RAIPUR CITY CENTER AREA**



REQUEST FOR PROPOSAL

For

Work for 24x7 Water Supply System under Smart City Mission in Mor Raipur City Centre Area of Raipur Municipal Corporation including Refurbishment of existing network in ABD and Outer Area including all work of Mechanical, Electrical, SCADA, Household Connections, Consumer Water Meter Fittings work with three months trial run and post completion Management of 24 x 7 Water Supply in Smart City for a period of 5 years including 2 years defect liability period on

DESIGN, BUILD AND OPERATE BASIS

Volume III: Employer's requirement and Technical Specifications

1. TECHNICAL SPECIFICATIONS

1.1 Design Specifications:

Distribution System:

CPHEEO manual recommends considering following peak factors for the city with a population ranges as follows:

For Population less than 50,000	3.0
For a population range of 50,000 to 2,00,000	2.5
For population above 2,00,000	2.0
For small water supply schemes	3.0

Residual Pressure:

As per CPHEEO Manual, distribution system should be designed for the following minimum residual pressures at ferrule points:

Single Story Building: 7 m

Two Story building: 12 m

Three Story building: 17 m

A minimum residual head at ferrule point is considered as 7 m

Network Design:

The design of the transmission system and the distribution system is in the form of an optimal mix of tree network and looping of pipelines will be designed using software by Bentley, namely Water GEMS v8i. For major smart roads, distribution network has to be considered on both sides of road.

Hydraulic Gradient:

Pipes are designed keeping in mind friction loss of less than 4 in 1000.

Minimum Pipe Size:

Minimum diameter of 100 mm to be considered for distribution network. For diameter 200mm & above, parallel pipes are to be considered for house connections.

Hazen William's Coefficient:

As per CPHEEO Manual 1999 (Ref Table 6.1.page 108), a 'C' value of 140 has been recommended for Centrifugally Lined DI pipes. However, for Design Purpose a C-value of 130 has been considered keeping in mind the ageing of the pipe and encrustation inside the pipe line.

1.2 Survey and Preparative Works

1.2.1 Verification of Topographical Survey and Mapping

Contractor is required to verify and study the topographical survey provided by the RSCL in detail and confirm the accuracy of the data in writing to RSCL by conducting confirmatory survey if required and verify completeness of data capturing all the components involved in the project in the specified boundary limit. For any other additional data deemed necessary for the project, contractor should carryout Total Station survey by fixing spot levels and the contours at 0.5 m

interval and other necessary investigations shall be conducted & stored in editable digital format on the GIS base. Contractor will survey all underground utilities located within the Sub Project Area up to 1.5 m depth and mark on GIS based maps. No extra payment shall be entertained for any kind of surveys conducted by the Contractor on behalf of verification and completeness of provided data.

1.2.2 CONSUMER SURVEY

SCOPE OF WORK:

This specification covers the work of carrying out a consumer survey in the Service Area to record all potential and existing consumers. The survey should capture, inter alia, the number of existing and potential domestic, commercial, bulk and industrial consumers. The data to be collected during the survey will be finalized in consultation with RMC.

OBEJECTIVES:-

The objectives of the survey are:

Details of consumption of water by different beneficiaries, i.e. Domestic, Industrial Commercial, non domestic etc.

- Determine the perception of water services received.
- Provide facts for formulation of policy for Water consumption
- Provide information and measures to be taken to improve the efficiency and financial performance of the Water distribution system.
- Evaluate the quality of service when reporting problems or making enquiries.
- Determine the level of awareness of promotional water conservation initiatives.

1.2.3 COMPONENT INCLUDES

Survey of the Utility

- 1 Survey of Consumers in all households in water Distribution area (Residential consumption).
- 2 Survey has to be conducted in all non-domestic consumers like hotels, Lodge, shops (Commercial consumption).
- 3 Survey has to be conducted in all institutions like Schools, hostels, Bus stands, Government offices, hospitals, etc. (Institutional consumption).
- 4 Survey has to be conducted in industrial area. (Industrial consumption)
- 5 Survey has to be conducted at all public stand posts (public stand post consumption)
- 6 No of properties dependent on stand post should be found out Also No. of stand post working / non-working should be noted during surveys.

1.2.4 DATA COLLECTION

Survey form has main five categories as below

1. Identification –

Under this category basic information has to collect his house number, complete address, telephone number, etc.

2. Economic status -

Under this category data has to be collected like name of respondent, sex, education, occupation, family income and size of family etc.

3. Details of House / Building –

Data to capture in this section are type of building, where they live, and construction of building. Also information about number of water closet, number of total taps use in house, uses of water like whether they use water for gardening.

4. Connection Details

In this data collect information of the customer / owner on whose name the connection is Register. Bill connection no. of connection name must be fill accurately.

5. Quantity and use –

Use of water for daily activities in liters from various sources.

6. Health Information:

Information of main diseases occurred in last one year.

1.2.5 TRAINING

Two days training course has to be conducted for surveyor by staff of the company. The aim of the training will be to build their capacities to conduct survey successfully. All surveyors will be given two days training on how to conduct survey, how to interact with respondent, how to facilitate to respondent, how to fill information in the survey form. How to read facial expression of respondent, so that surveyor can get correct information.

1.2.6 METHODOLOGY

Survey has to be conducted house to house

The survey has to simply design to collect information about customer perceptions, their billing habits, their water consumption and usage, their misunderstanding about the water tariff and system, their satisfaction area.

Methodology is an operational framework within which facts are placed so that their meaning may be seen more clearly. The scientific method is further a systematic and organized series of steps that ensures maximum consistency and objectivity in researching a problem.

This survey has to be conducted in which data collectors have to participate as facilitator to the respondents. Data has to be collected by utilizing structured interviews conducted for a total number Household recorded in Municipals Corporation.

A disadvantage of employing interviews to gather data is that the responses given may not be accurate and may not reflect real behavior. Respondents may also provide wrong information and may forget or lack the information required. These disadvantages of the selected data gathering method may well influence the findings of this survey. The surveyor should take care such matters.

The interview schedules questionnaires for the structured interviews have to supply by the Water supply and Sanitation Department. These schedules and survey approach had to be kept consistent for all areas and wards.

Properties shall be taken as per the property register of SMC.

If a single property / Building contains no. of flats, then nomenclature of flat in the building shall be represented as 300/1, 300/2 and so on.

For Chawls and or tenants within a property extra numbers to be considered.

Illegal properties or M.C. water connections shall be identified during consumer survey and shall be shown on G.I.S. Map. By checking day today Register or unregistered consumer & take note in consumer form also.

The contractor has to find out total No. of properties having connection and total no. of properties without connection. Also he has to find out from where the properties without connection gets the water. This should clearly be mentioned in the consumer survey report.

Mode of Measurement and Payment:

Breakup of Payment of rate stipulated in schedule B shall be based on completion of activities at stages below:

1. After completion of consumer survey 50 %
2. After computerization & submission 20 % of computerized data in excel worksheet for checking.
3. After submission of analysis of data and report of computerization data. 10 %
4. After validation approval for the data and report 10 %
5. Submission of G.I.S. layer 10 %

Preparation of GIS Map

Preparation of GIS based consumer mapping, survey & investigation, plotting assets on GIS map by linking with Geospatial data base and hydraulic modeling using suitable software for water supply system.

Survey of Existing water supply System and digitization on GIS Platform

Scope of the Work

This specification covers the survey, investigation, digitization work and also preparation and maintenance of comprehensive data regarding complete water supply system with the help of latest software for optimization of maintenance works and future documentation and digitization of the same on GIS platform.

General

Carry out preliminary activities of surveying all the components of existing water supply system with their details by GPS mapping.

Confirm all ground and underground assets such as pipeline, pumping station, service reservoirs and other important appurtenances by using GPS & pipe locator or GPR technique.

Confirmation of location and other important information of all existing components related to water supply project and correcting same on the base map.

Inserting all the collected information on GIS platform (satellite image & existing Base map will be provided) and preparation of the detailed base map of existing water supply system.

While updating the base map the alignment of existing pipeline (whether left or right side of the road) and interconnections of the existing pipeline network should be corrected according to the road along which the pipelines are laid.

Survey form for surveying existing water supply system should be approved from the authority and below is the list of existing Water Supply System Components to be surveyed as per approved survey form & the collected information to be updated on the base map and GIS platform.

1.3 Preparation of Service Improvement Plan

1.3.1 Hydraulic Modeling requirements

The Contractor shall develop a Hydraulic Network Model (HNM) for water supply system based on DMAs of Operational zones. The data related to water supply infrastructure like Reservoirs, Pumping Stations, rising mains and distribution system, valves and demand allocations shall be obtained through field baseline study and consumer survey captured on the network model.

The hydraulic network modelling by using latest soft-wares shall be carried out by collecting the actual property wise water demand allocated to the nearest junction. Following broad guidelines may be followed during hydraulic modeling:

The junction shall be placed at the branching out/ at the crosses at the valves and where there is a large straight length at every 200 m. The model shall be worked out by considering the domestic demand as 135 lpcd water supply and actual demand for commercial and industrial requirement.

The hydraulic water use pattern for the day spread over 24 hours shall be based on the survey data captured through consumer habits of water use in different hours at present and by following the standard pattern, after continuous water supply is successfully implemented.

The storage reservoir capacities shall be modelled to verify the water level in various hours. It shall neither be empty nor overflow. The incoming flow at constant rate shall be decided accordingly.

The DMAs which are still to develop where the present water requirement is quite less as compared to the design demand, the present scenario with existing water demand shall be run and the incoming flow shall be adjusted accordingly.

The minimum pressure in the distribution network when full demand in the zone cum DMA is developed shall not be less than 7 m of water column at consumer meter point. The excessive pressure in the typical areas shall be managed using the appropriate pressure management techniques at distribution system level and other at the individual connection level.

All new connections shall be considered and captured as additional demand in the model and updated model.

The work also includes the following :

1.3.2 Pressure Zero Tests:-

A Pressure Zero Test (PZT) shall be carried out in accordance with the procedure detailed in this clause in order to prove that the DMA can be isolated fully from the rest of the pressurized distribution system. PZTs shall not be undertaken when the DMA is isolated from the rest of the distribution system, e.g. as part of a water rationing schedule.

In order to undertake the Pressure Zero Tests sufficient pressure logging points shall be installed to verify that the mains pressure has dropped to zero across all parts of the DMA during the test. Suitable locations for pressure monitoring shall also be identified and installed to regularly monitor Average Zonal Pressure (AZP) and Critical Pressure Points (CPP) in each DMA. All AZP and CPP pressure points shall be permanently monitored at the central SCADA server. The PZT procedure shall be as follows:

1. Any sensitive (e.g. hospitals or schools) or large consumers shall be identified and individually informed of the proposed PZT. A general warning shall be given to all other consumers in accordance with the Employer's procedures.

2. Valves isolating the DMA from the rest of the distribution system shall be confirmed operable prior to undertaking the PZT.
3. PZT's are to take place between 1.00am and 5.00am, or during an alternative suitable period when water is available.
4. Deploy pressure loggers on the pressure logging points and set to 5 minute intervals.
5. Shut the supply valve(s) and boundary valves in order to isolate the DMA.
6. The pressure on the loggers, as read on-site, should fall as soon as the supply and boundary valves are closed. If the pressure falls to zero excluding static head, or reduces but will remain steady for more than one hour, this will be accepted as a successful PZT.
7. If a successful PZT is not achieved, check and sound each supply and boundary valve in turn. Passing valves should be fully closed, where possible, and the PZT repeated.
8. If the PZT is not successful, the Contractor shall organize further investigations to find the cause of the failure and then repeat the PZT.
9. On successful completion of the PZT, open the supply valve(s) and confirm that supplies have been restored to their former level within the DMA. Loggers deployed under (4) above shall be left in place for 7 days after the completion of a successful PZT to confirm the impact of the new boundary on local pressures. Customer contact shall be monitored and reviewed over this period also and any necessary action to rectify supply problems shall be taken by the Contractor in consultation with the Engineer-in charge.
10. Ensure all relevant records are completed before leaving site. Paper and electronic copies of the pressure data logging results shall be retained.
11. Prepare the PZT Completion Report in both hard and soft copies and submit to the Engineer.
12. Dial pressure gauges to also be installed during PZT.

All down loading of data form any logging equipment has to be done in the presence of engineer or may on the written permission of engineer. The printout be taken immediately and signed by engineer.

1.3.3 DMA Establishment: -

Following approval of the DMA Design Report by the Engineer-in charge, establishment of the DMA shall commence.

If consumers experience any water supply problems during the creation and proving of a DMA, or when operating DMA valves, the Contractor shall investigate the water supply problem immediately and make any adjustments to DMA design and implementation necessary to resolve it. Similarly, if the DMA boundary is breached, or boundary valves are operated by others, or the water supply regime is changed after DMA formation, the Contractor shall investigate and rectify such breaches. No claims or requests for extension of time will be considered for such investigations, remedial work or consequent delays.

All installation of pipelines, meters and ancillary works shall be carried out in accordance with the relevant clauses of this Specification.

During installation works pipe sections removed shall be bagged, tagged and sent for analysis in order to provide additional data for pipe condition assessment.

DMA boundaries may only be modified, or DMAs combined or sub-divided, with the approval of the Engineer.

With the isolation of DMA's if any area affected for water supply, Contractors shall need to make temporary arrangement of water supply for the affected area. It also includes the new proposal of the pipe line, valves etc. complete to establish the hydraulically discrete areas.

Close liaison with TMC staff is essential when undertaking any operations on live mains. Arrangements for communications shall be agreed and documented prior to any such operations commencing.

1.3.4 Record Plans

The Contractor shall prepare a DMA record plan showing:

- Limit of the DMA
- Names of all roads in which mains are laid
- Diameter and material type for each main
- Locations and sizes of flow meters
- Locations of all valves, with boundary isolating valves, circulating and step-test valves clearly indicated, numbered and marked Clockwise or anti-clockwise closing

- Valve operating schedule for step-testing
- Total number of domestic and non-domestic consumers (all consumers shall be metered) in the DMA and in each step-test area
- Location of any metered consumers that use large quantities of water in relation to the rest of the DMA or use high flow rates at specific times of the day or week
- Location of all public stand posts

The Contractor shall also provide an Operating and Maintenance (O&M) Manual that details a specification and describes operation and maintenance information for all equipment installed under the Contract, together with the procedures for water loss and leakage reduction and control in each DMA. For each DMA there will also be a DMA File recording the historical development of the DMA, its features, results achieved flows and leakage levels, trends, etc. The DMA Files shall be up-dated regularly as work is undertaken in each DMA.

All record plans and the O&M Manual shall be prepared in electronic format using the specified software and copied to CD. Paper copies of the record plans shall be A1 size. Five copies (paper) and two digital on CD Of each DMA shall be issued to the Engineer-in charge.

1.3.5 Deliverables

Deliverables are briefly summarized below:

- Undertake pipeline mapping, location and interconnectivity surveys, and house connection survey
- Development of the Hydraulic Model and Hydraulic Analysis by providing Water Gems /equivalent software of unlimited nodes and pipes.
- Hydraulic analysis shall be done through latest version of Water Gems/equivalent software. The cost of Water Gems /equivalent software need to be considered in the item. No separate payment shall be considered.
- Design DMA (including initial network models) and Establish DMA boundary (install boundary valves / cap mains, and install pressure monitoring points)Formation of District Meter Areas
- Identification of Average Zonal Pressure (AZP) and Critical Pressure Points (CPP) for each of the Pilot zones and providing of data logger on the same & Undertake Pressure Zero Test

- Procurement and installation of bulk / DMA meter on inlet and outlet: volume of production (Distribution input). The cost of bulk / DMA meters, valves, rehabilitation of network will be paid separately as per bill of quantities.
- Procurement of DMA meters, for flow measurement, and consumer meters, valves for assessing consumption need to be done during this phase of the contract. The cost of the same will be paid from price bid.
- Preparation & execution of rehabilitation & Development plan for achievement of the performance targets as set in the contract.
- Record DMA meter readings and all consumer connections, stand post and slum area meters over set period.
- Final out put of DMA establishment is development of initial water balance and initial water loss levels as per formula below.

Water Loss (NRW) is widely reported in percentage terms. However, the water loss for each DMA should be expressed as follows:

$$\text{Initial \% NRW} = X - (A + B + C + D) \times 100 \%, X$$

Where:

X = Water input to the system (DMA) during the period

A = Water billed during the period

B = Water legally supplied but not billed (including slum and stand post consumption) during the period

C = Operational use (scouring, jetting, dust suppression, etc.) during the period

D = Tankers metered and billed/unbilled during the period

Cost under this item includes:-

1. Experts services
2. Design & SIP
3. Survey & investigation
4. Software (ARC GIS Editor, Water GEMS) & hardware's

5. Report generation
6. Water balance
7. Man power , equipment's
8. All item other than bills of quantity
9. Training

Cost under this item excludes:-

Cost to be paid separately under respective bills of quantity.

1. All items executed like house service connection, repairs, rehabilitation of network, pipe laying, valves, meters, water meters etc.

The performance of the contractor will be evaluated based on the successful establishment of the DMA's and will payable in terms of DMA fees. The formula to derive the DMA Fees as per performance is detailed out in Schedule 5 : Contract Payment Terms of the bid document.

Mode of Payment :

The payment shall be made on the approval of SIP by competent authority of RMC / consultant basis.

1.4 DI PIPES

Applicable Codes:

The manufacturing testing, supplying, at work sites of Ductile Iron pipes shall comply with all currently applicable statutes, regulations, standards and codes.

In particular, the following standards, specified herein shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of specifications conflict with the requirements of the codes and standards, this specification shall govern.

- | | |
|-----------|--|
| IS: 8329 | Specification for Centrifugally Cast (spun) Ductile Iron pressure pipes for water, gas and sewage specification. |
| IS: 1387 | General requirements for supply of metallurgical materials. |
| IS: 1500 | Methods for Brinell hardness test for metallic materials. |
| IS: 9523 | Ductile Iron fittings for pressure pipes for water, gas and sewage. |
| IS: 12820 | Dimensional requirements. of rubber gaskets for mechanical Joints and push on joints for use with cast Iron pipes and fittings for carrying water, gas and sewage. |
| ISO: 4179 | Ductile iron pipes for pressure and no pressure-Centrifugal cement mortar lining - General requirements. |

- ISO: 2531 Ductile iron pipes, fitting and accessories for pressure pipe lines.
IS: 12288 Code of practice for use & laying of Ductile iron pipes.

Manufacturing

General

1. The pipes shall be of centrifugally cast (spun) Ductile Iron pipes K-7 class with internal cement mortar lining confirming to IS 8329: 2000. The pipes shall be of push on joint type (Rubber Gasket Joints). The flange connection shall be used only in case of fitting of specials or under special circumstances as directed by Engineer in Charge.
2. The pipes shall be coated with zinc coating and finishing layer shall be of bitumen and have factory provided internal cement mortar lining as per the provisions of IS 8329: 2000 the mortar thickness shall be minimum 5 mm as per Table 15 of the code. The tolerances for pipes and fittings regarding dimensions, mass, ovality and deviations from straight line in case of pipes shall be as per IS 8329/IS 9523.
3. The pipes shall be supplied in standard length of 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety shall also be supplied with a rubber EPDM/ (SBR) gasket. The flanged joints shall confirm to Clause 6.2 of IS: 8329. The pipe supply shall include one rubber gaskets for each flange. Any change in the stipulated lengths will be approved by the Engineer- in -Charge. The gaskets shall conform to IS 5382:1985. The gaskets shall also be supplied by the contractor. They shall preferably be manufactured by the manufacturer of the pipes. In case they are not, it shall be the responsibility of the contractor to have them manufactured from a suitable manufacturer under his own supervision and have it tested at his / sub contractors premises as per the instruction and to the satisfaction of the Engineer- in -Charge. The pipe contractor shall however be responsible for the compatibility and quality of the products. The flanged joints shall conform to Clause 6.2 of IS 8329
4. RSCCL representative shall at all reasonable times have free access to the place where the pipes are manufactured for the purpose of examining and testing the pipes and for witnessing the test and manufacturing.
5. All tests specified either in this specification or in the relevant Indian Standards shall be performed by the supplier/contractor at his own cost and in presence of employer's representative if desired. For this, sufficient notice before testing of the pipes shall be given to employer.
6. If the test is found unsatisfactory, employer may reject any or all pipes of that lot. The decision of RSCCL representative in this matter shall be final and shall be binding to the contractor and not subject to any arbitration or appeal.

Inspection and Testing of pipes during manufacture

Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in IS: 8329 / IS: 9523. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS: 8329. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/IS: 9523.

Brinell Hardness Test

For checking the Brinell hardness, the pipes used for the ring test and tensile test shall comply with the requirements specified in IS: 1500/IS: 8329.

Retests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements, the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

Hydrostatic Test

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in IS: 8329 / IS: 9523 for a period of minimum 15 seconds, during which the pipes shall be struck moderately with a 700 g hammer for confirmation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

The pipes shall be subjected to following tests for acceptance:

Visual and dimensional check as per Clause 13 and 15 of IS 8329

Mechanical Test as per Clause 10 of IS 8329

Hydrostatic Test as per Clause 11 of IS 8329

The test report for the rubber gaskets shall be as per acceptance tests of IS 5832 and will be in accordance to Clause 3.8. The sampling shall be as per the provisions of the IS 8329.

Markings

All pipes will be marked as per Clause 18 of IS 8329 along with the requisite information as provided below:

- Manufacturer name / stamp
- Nominal diameter
- Class reference
- A white ring line showing length of insertion at spigot end
- Employers mark as "RSCL"

Coatings

Pipe shall be supplied internally (cement mortar lining) and externally with Zinc coating along with a finishing layer of bituminous coating as per IS 8329:2000. The materials and finishing shall be as per the relevant specifications.

Joints**General**

Jointing of DI pipes and fittings shall be done as per IS 12288 and manufacturer's recommendations. Rubber sealing rings/gaskets used for jointing shall conform to IS 638, IS 12820 and IS 5382.

Spigot and Socket joints

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS 12820. The gaskets/sealant used for joints shall be suitable for water conveyance. The material of rubber gaskets for use with mechanical joints and push-on-joints shall conform to IS: 5382.

Flanged Joints

These shall be of 10 bar rating and shall comply with dimensions and drilling details as specified in IS 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all

bolts and isolation washers under all bolt heads and nuts. The bolts shall be of mild steel unless otherwise specified. They shall be coated with cal tar epoxy coating after tightening.

Slip on Type Couplings

Slip-on type couplings shall include the following couplings:

- Straight flexible couplings
- Stepped flexible couplings

Slip-on type couplings shall be procured from approved suppliers whose fittings meet the same Specification. The preparation of pipe ends for slip-on type couplings shall be in accordance with the requirements and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

Slip-on type couplings shall be protected if buried with Densomastic and Densotape wrapping or similar approved material applied in accordance with the manufacturer's recommendations. Flexible joints shall be harnessed or tied where shown on the Drawings. Flexible couplings shall be supplied with transit protection.

Lubricant for Pipes and specials

Lubricant for the assembly of Ductile Iron pipes and specials suitable for Tyton push-on rubber ring joints shall conform to IS 9523.

Please add Dimensions and Tolerance on Diameter, Tolerance on Thickness, Tolerance on Length, Permissible Deviation from Straight Line , Tolerance on Mass , Lining Thickness etc.

DI Pipe handling, Laying, jointing, testing and Commissioning

- Laying of DI pipes shall conform to IS: 12288-1987. All pipes, fittings and material shall be tested and approved by the Engineer- in -Charge before being laid. Polyethylene sleeves wound pipes shall be used for water logged areas as directed by the Engineer- in -Charge.
- The transportation and handling of pipes shall be made as per IS 12288-1987.
- Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used. When using crane hooks at sockets and spigot ends; hooks shall be broad and protected by rubber or similar material, in order to avoid damage to pipe ends and lining. Damage to lining must be repaired before pipe laying according to the instructions of the pipe manufacturer. the trench must not be refilled before laying of the pipes.
- All specials like bends, tees etc. and appurtenances like sluice or butterfly valves etc. shall be laid in synchronization with the pipes. No pipe shall be laid in wet trench conditions. On gradients of 1:15 or steeper, precautions should be taken to ensure that the spigot of the pipe laid does not move into or out of the socket of the laid pipe during the jointing operations. The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.
- Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels, maximum velocities, high flood levels, seasonal variation, etc. which affect

the design and laying of pipeline. The assembly of the pipes shall be made as recommended by the pipe manufacturer using suitable tools.

- Where a pipe line crosses State highway, National highway, canals, railways etc., pipe shall be laid after taking approval of the competent authority. All the expenses in this regard shall be taken care by contractor.

Pipe testing and commissioning

- The pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber). Contractor shall test stretches not exceeding 1 km.
- The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. Complete setting of the thrust blocks. Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches. The testing conditions for the pipelines shall be as per the test pressures and condition laid out in IS 8329 for DI pipes.

The testing conditions for the pipelines are summarized as follows:

A test shall not be more than 1000m. initially on straight or curved line.

- All air shall be expelled from the test segment by making air vents at the highest point of test section and or both of testing segment.
- The first part of the testing shall be stabilize the section at a lower pressure of 1-2 kg/sq. cm at the highest point for a duration of at least 4 hours. On satisfactory completion of this joints shall be tested against leakage by increasing the test pressure to 5.50 Kg/Cm² and holding it for 15 minutes.
- If the pressure drop is less than 0.2 kg/sq. cm. over this period, the test shall be deemed satisfactory.
- For the purpose of the test, either power-driven or manual reciprocating pumps shall be used with clean water. The contractor has to arrange water for testing.
- The pressure gauges shall be in good condition and of suitable ranges and least count of at least 0.2 kg/cm².
- The air vent holes shall be properly plugged and sealed with coupling/nut on completion of the test. The suitable water sealing chemical shall be used in case of any leakage.
- At the end of testing section temporary concrete thrust block shall be casted of sufficient size and strength to resist the testing pressure. The cost of such thrust block, jacks, wedge etc are inclusive in the rate.

A pipe segment once tested shall not be used as a support to anchor the end blocks used for testing the next segment.

The length of this period of time depends on many factors such as slight movement of the pipeline under pressure whether air is trapped in the pipeline has concrete lining which absorbs water.

The pipeline is then pressurized up to the full test pressure and the section under test completely closed off. The test should be maintained for a period of not less than 15 minutes to reveal any defects in the pipes, joints or anchorages.

The test pressure should be measured at the lowest point of the section under test or alternatively, an allowance should be made for the static head between the lowest point and the point of measurement, to ensure that the required test pressure is not exceeded at the lowest point.

For the test section required end cap at both the end for testing purpose shall be arranged by the contractor at his own cost. It includes jointing & removing after testing, including all cost of jointing materials & labor etc comp.

If the test is not satisfactory the fault should be found and rectified. Where there is difficulty in locating a fault, the section under test should be sub divided and each part tested separately.

Methods employed for finding leaks include :

- a) Visual inspection of each joint if not covered by the backfill;
- b) Use of a bar probe to detect signs of water in the vicinity of joints, if backfilled;
- c) Aural inspection using a stethoscope or listening stick in contact with the pipeline;
- d) Use of electronic listening device which detects and amplifies the sound or vibration due to escaping of water, actual contact between the probe and the pipe is not essential.
- e) Injection of a dye into the test water particularly suitable in water logged ground.
- f) Introduction of nitrous oxide in solution into the test water and using an infra-red gas concentration indicator to detect the presence of any nitrous oxide that has escaped through the leak.

After all sections have been joined together on completion of section lasting a test on the complete pipe line should be carried out. This test should be carried out at a pressure not less than the maximum sustained operating pressure or the maximum static pressure of the pipeline and during the test, inspection made of all work which has not been subject to section tests.

It is important to ensure that proper arrangement are made for the disposal of water from the pipeline after completion of hydrostatic testing and that all consents which may be required from authorities have been obtained. In some cases, for example, heavily chlorinated water some treatment may be necessary before final disposal.

1.5 DI SPECIALS

Providing & Supplying at store or site of work D.I. Flange, Socket & Spigot specials like bends, tees, reducers, caps etc. as per I.S. 9523 class A, series K-12 with ISI mark suitable for push on joint or mechanical joint.

The rate inclusive of all taxes, loading, unloading, carting, stacking, insurance, inspection charge, octroi, weighing etc. complete with internal cement mortar lining.

The rate shall be per Kilogram basis as per actual weight. The contractor shall produce weight slip for each specials.

D.I. Pipe and specials like Tee, Bend, reducer etc shall be laid in line & level in the trench. If required DI pipe shall be cut using appropriate cutting equipment, after cutting pipe edge shall be grind by grinding machine suitable to tyton joint. Rate is inclusive of cutting, grinding, labor,

power, SBR rubber ring, chain pulley block, rope etc necessary for laying DI specials in line & level.

Codes of practice

IS:8329 Centrifugally cast (spun) Ductile Iron pressure pipe for water, gas and Sewage.

IS:3764 Excavation Work - Code of Safety.

IS:12288 Code of Practice for use and laying of Ductile iron pipes

1.6 SLUICE VALVES.

For Valves of Diameter upto 250mm, DI Resilient Sluice Valves should be used: Features required for Sluice valves suitable to water work application for continuous operation up to 70 degree Celsius are as follows or otherwise the standard BS 5163/EN 1074-1&2 Ductile Iron / Spheroidal Graphite (S.G.) Iron Double flanged resilient seated Sluice Valves Full bore in accordance with BS 5163/EN 1074-1&2 of PN-10 /16 rated, with Body and Bonnet of Ductile Iron confirming to GGG-50/40 or IS 1865 Gr. (SG 500/7 or SG 400/15), Wedge of WRAS or DVGW approved EPDM rubber (approved for drinking water), Integral Wedge nut, Shaft of S.S. AISI 420, O rings of NBR. Body & Bonnet coated with electro statically applied epoxy powder coating to DIN 30677-2 & GSK guidelines or equivalent to GSK Guide line. Blue colour RAL 5005/5017 with a coating thickness of 250 microns both inside & outside. Sluice valve shall be compatible for buried applications without valve chamber. Face-to-face dimensions as per BS 5163/EN558 and Flange drilling as per IS 1538. 100% tight shut-off. Manual operation by Hand wheel at present but it should be upgradable for Motorized operation by Electrical Actuator suitable for SCADA system.

The contractor shall provide C.I. cap as per I.S. and Hand wheel for valve.

a) Testing

All Sluice valves must undergo hydraulic testing to BS 5163/EN 1074-1&2

- Seat test 1.1 x PN rating
- Body test 1.5 x PN rating

b) Materials

Summary of materials used are as follows:

ITEM	COMPONENT	MATERIAL	GRADE	STANDARAD
1	Body, Bonnet	Ductile Iron	500-7 or 400-15	BS EN5163/ IS1865
2	Wedge core	Ductile Iron	500-7 or 400-15	BS EN5163/ IS1865
3	Wedge nut	Brass	CZ 132	BS 2872/4
4	Rubber (vulcanized on wedge)	EPDM	EUW 70	WRA Sor DVGW Approved
5	Stem	Stainless steel	A276-420	EN 10088-1
6	Stem collar	Dezincif. res. Brass	CZ 132	BS 2872/4
7	Bonnet bolts	Stainless steel	A2	ISO 3506

8	Bonnet gasket	EPDM	EUW 70	WRAS or DVGW Approved
9	O-ring	NBR	-	-
10	Dust seal ring	NBR	-	-
11	Hand wheel	Grey cast iron	250	EN 1561
12	Actuator (Rotork/Auma)	Mfg. Std.	-	-

c) Markings and labeling

Valves shall have the following marking in raised letters: -

- a. The nominal size (i.e. DN)
- b. The nominal pressure designation (i.e. PN)
- c. The body material identification (i.e. GGG)
- d. The manufactures name/trademark
- e. Year of manufacturing
- f. Direction of closing markings (i.e. in cast direction arrow)
- g. Traceable serial number for each valve, - either as engraved tag plate or bar code labeling of aluminum or equivalent durable material.

d) Certification

- a. Manufacture or supplier is requested to provide a copy of the certificate and testing report from recognized certification body.
- b. The Manufacture's quality system ISO 9001:2008 certified by authorized body and copy of certification submitted on request.
- c. Manufacture should give minimum 10 Years of Warranty.
- d. The contractor shall also produce third party inspection test certificate of 'TATA', EIL or CEIL & RITES. The third party inspection charge will be borne by the contractor.
- e. The contractor shall provide manufacturer's test certificate fulfilling quality of valves as per relevant Indian standard.

The rate of item covers cost of supply of valves inclusive of all taxes, duties insurance, loading, unloading, carting etc. complete. The rate shall be on number basis.

1.7 BUTTERFLY VALVE

- Butterfly valve shall be as per IS 13095/BS EN 593. Valve shall be suitable for mounting in any position.
- When the valve is fully closed, the seal shall seat firmly so as to prevent leakage.
- All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.
- All valve, spindles and hand wheels shall be positioned to give good access for operational personnel.
- The time from fully open to fully closed position and vice versa shall be limited to about 5 minutes. The valve shall be suitable for controlling flows by throttling.
- Valves shall be provided with enclosed gear arrangement for ease of operation. Hand wheel manual over-ride shall be provided. The operation gear shall be such that they can be opened

and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N (for manual hand wheel operation).

- All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels. Hand wheels shall be provided with an integral locking device to prevent operation by unauthorised persons.

- Materials of Construction:

Body : Cast steel (Conforming to ASTM A216 Gr WCB)

Disc : Cast steel (Conforming to ASTM A216 Gr WCB)

Shaft : Stainless Steel (BS 970 431 S29)

Seat Ring : Stainless Steel : ASTM A 743 CF8

Bearing : Teflon

Size of valves and pressure rating shall be as per Bill of Quantities. Location of valves shall be as per contract drawings.

The contractor shall provide test certificates for materials, strength and leakage shall in accordance with BS EN 593 or relevant international standards.

1.8 Pressure Reducing Valve Set

The pilot controlled Pressure Reducing Valves shall reduce higher upstream pressure to lower, preset, constant downstream pressure regardless of fluctuating demand or varying upstream pressure. The desired downstream pressure shall be easy to set at site, by turning the pilot adjusting screw.

Main Valve

The PRV Main Valve units should conform to the following minimum requirements:

- The main valve shall be diaphragm actuated Straight pattern design.
- The valve shall have an unobstructed flow path, with no stem guides, bearings, or supporting ribs.
- The valve body shall consist of a replaceable, in line & on site raised, stainless steel seat ring.
- The actuator assembly shall be double chambered, center guided by a bearing in the separating partition.
- The diaphragm shall not be used as a sealing surface.
- The replaceable radial seal disk assembly shall include a resilient seal and a V-Port throttling plug.
- The valve shall consist of a visual valve position indicator for observing its seal disk opening level.
- Valve flange shall be with flats for vertical support.

Construction Materials

The main valve construction material shall be:

- Body, cover and separating partition: Ductile Iron
- Seat ring, seal disk (closure), shaft, spring, diaphragm washers: Stainless Steel
- Bearing: Bronze
- Diaphragm: Nylon Fabric reinforced Synthetic Rubber
- Seals: Synthetic Rubber
- Bolts and nuts: Stainless Steel

Coating

Valve body, cover and separating partition shall have a protective fusion bonded epoxy coating. Coating color shall be Blue or any other color as approved by Engineer in charge and its thickness shall be 250-350 μ .

Control System

The valve shall be controlled in a 2-way system without a water bleed to the atmosphere.

- The complete valve shall be capable of accepting a Multi-Setting Pneumatic Controlled (MSPC) unit, without removing the pilot from the valve or changing the tubing.
- The pilot body shall be stainless steel/ Brass, pilot setting range shall be 1.0-18.0 bar.
- The control system shall be equipped with isolating cock valves on upstream, downstream, and control chamber ports, a one-way flow control device and an external "Y" shape filter. Washing the filter shall not require isolating the main valve.
- All tubing and tube fittings shall be Stainless Steel with Compression connection.
- Internal spring of the pilot to be of Either Galvanized steel /stainless steel make that comply with water standards.
- The PRV Springs to be provided with the PRV must be of middle weight strength.

Service

All valve components shall be accessible and serviceable without removing the valve from the pipeline. The entire actuator assembly (seal disk to top cover) shall be removable from the valve as one integral unit.

Hydraulic Test and Calibration

Prior to shipment, the valve shall undergo a complete functional test performed under dynamic conditions.

Approvals and Certifications

- The valve manufacturer quality shall be certified to ISO 9001-2000.
- The main valve shall be certified for use with drinking water by a reputable authority.

1.9 Lowering & Laying of Valves.

Loading at store and unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pulley etc. The chambers for housing the valves shall have

stable and firm foundations. The chamber and top roof cover with removable lid shall be provided so that it shall be possible to remove or replace or recondition the valves seats and to remove the parts without removing the valves from the pipe work. For this, suitable flange adapters may be provided. Butterfly valves shall have high nitrile rubber seats, preferably metal reinforced, unless otherwise specified and shall be installed in the pipe work in such a manner that they can be removed from the line for dismantling and replacement of rubber seats.

Where the valves are required to be operated electrically, actuators shall be sized to guarantee valves closures at maximum possible differential pressure across the valve. Each actuator shall be supplied with installation, instructions and wiring diagrams and sufficient spare parts.

Valves used on pipeline shall be straight, through type, and non chokable. Each valve or its operation equipment shall bear an approved name plate stating its function. All operation spindles, gears and head stocks shall be provided with adequate points for lubrications.

The tightening of nut and bolts shall be done smoothly in such a way that no excessive strain occurs on any one side. The nuts shall be tightened on diametrically opposite site at a time.

1.10 DISMANTLING DEAD PIPE LINE OF G.I./ A.C PIPE INCLUDING COST OF NECESSARY EXCAVATION AND REFILLING OF TRENCHES, BREAKING THE JOINTS, LIFTING THE PIPES AND STACKING TO THE PLACE AS DIRECTED BY ENGINEER-IN-CHARGE WITH ALL LEADS AND LIFTS INCLUDING CLEANING THE SURFACE ETC. COMPLETE.

1.11 DISMANTLING FOLLOWING OLD CAST IRON SOCKET AND SPIGOT PIPE CLASS 'LA', 'A', & 'B' INCLUDING BREAKING LEAD CAULKED JOINTS, MELTING OF LEAD AND MAKING IT IN TO BLOCKS INCLUDING STACKING OF PIPES AT SITE LEAD UP TO 50 METERS

1.12 Dismantling of Old Cast Iron socket and spigot class, including cost of necessary excavation, refilling, lifting the pipes and stacking it to the store or to the place as directed by the Engineer-In-Charge. The Rate shall be Quoted in Rmt.

1.13 PROVIDING AND CONSTRUCTING BRICK MASONRY VALVE CHAMBER ANDFLOW METER CHAMBER WITH 15CM THICK 1:3:6 PROPORTION PCC BEDDING EXCLUDING EXCAVATION, BRICK MASONRY IN C.M. 1:5 PROPORTION 12MM THICK CEMENT PLASTER IN CM 1:4 PROPORTION ON BOTH SIDES WITH PROVIDING AND FIXING C.I. MANHOLE FRAME AND COVER IN RCC 1:2:4 COPING OR RCC 1:2:4 PROPORTION X 15CM THICK SLAB, ETC COMPLETE AS DIRECTED BY ENGINEER-IN-CHARGE. (NOTE :- WALL THICKNESS : 0.23 M FOR DEPTH OF 1.2M AND 0.35 M FOR BALANCE DEPTH EXCEEDING 1.2M).

- Additional excavation required to be done shall be carried out as per instruction of Engineer-in-charge. For foundation chamber, 15 cm thick PCC Grade M-25 shall be provided; 20 cm thick RCC walls of Grade M-25.
- 12 mm thick cement plaster in CM 1:4 shall be provided on inside of walls.
- 20 mm dia. MS bar steps shall be provided and fixed in wall at 30 cm c/c for facilitating access into the chamber. First step should be at a depth of 0.5 m from top and last step should be 0.5 m above bottom.

- Chamber shall be covered with 150 mm thick RCC of Grade M-25 pre-cast or cast-in-situ slab in two parts with keyholes to insert key for operation.
- Reinforcement for the cover slab shall be provided considering heavy traffic load.(70R Loading)
- Curing of concrete, RCC etc. shall be done using chemical or water for 14 days.
- 12 mm dia. MS bar handles, minimum two nos., shall be provided to each piece of slab during the time of casting of slab.
- Sides of chamber shall be refilled properly with selected excavated earth.
- All the above items shall be carried out in manner as per prevailing sound engineering practices and instruction of Engineer-in-charge.
- FRP Covers of capacity 2.5 Tonne with double seal & with a closed bottom High strength plastic alloy socket keyhole lifting arrangement. The closed keyhole does not allow mosquito breeding to happen in the chamber, doesn't allow foreign particles to enter the chamber and eliminates/reduces the foul smell from the chamber. The High strength plastic alloy socket keyhole lifting arrangement protects the FRP surface from damage due to multiple lifting operations over the years.
- If any chamber comes under road carriage way, chamber should be separately designed comprising RCC walls of Grade M-25.

1.14 INTERCONNECTION OF EXISTING PIPE LINE.

The contractor shall bring required tools at site of work for cutting the existing pipeline. The pipe shall be cut as per instructions of the Engineer-In-Charge. The pipe should be cut in such a way that it may not damage the existing pipe and develop extended crack in the pipe. The lining of DI pipe shall not be damaged. The materials, debris and waste obtained shall be deposited in stores of the corporation. For dewatering from excavated pit, the contractor shall provide pumping equipment, machinery, fuel, labor, temporary platform and proper disposal of water to nearby storm water drain or drainage manhole as far as possible as per the instructions and requirement to the satisfaction of engineer-in-charge.

The Contractor will be responsible for all above activities along with providing, supplying, fitting and fixing of specials to the Existing as well as Proposed Pipe Lines that are deemed to be necessary for the successful execution of the above said work.

The Rate shall be as per No. of Joints executed.

1.15 HOUSE SERVICE CONNECTIONS

- Supply, laying, testing and commissioning of PE-AL-PE material Plot connections with all necessary fittings of approved make.
- Connecting the DI pipeline from main road to the individual house service connection using PE-AL-PE material of potable type ensuring continuous water supply and in line with the technical specifications.
- All the removed GI of the existing Service Connections (If any) shall be submitted to the RMC store at no extra cost.
- Polyethylene – Aluminum - Polyethylene (PE-AL-PE) Composite Pressure Pipes conforming to IS – 15450 - 2004 U.V. stabilized with carbon black having thermal stability for hot & cold water supply, capable to withstand temperature up to 80°C

- Necessary restoration works to be carried out after providing connection as per the instruction of Engineer in charge.
- The Plot connection shall be of potable type and shall be amicable to fixing of water meters. After that necessary excavation shall be done on new laid line, a hole of a said dia. shall be made by requisite tools and make thread on it. A ferrule shall be fixed with jute & whitener etc. on the top of pipe and after transfer the connection both the pipe shall be filled with earth in layer of 9 inch, necessary watering and ramming shall be done properly. Refer drawing No. TCE.10596A-CV-6169-WS-30021.

1.16 FERRULE CONNECTION :

GENERAL : The item includes making ferrule connection with existing D.I. water supply line including fittings and fixtures.

MATERIAL : The ferrule shall be of GM or brass Conforming to IS-2692/1984 (Reaffirmed 2005), tested to 21.00 kg/sq.cm. & shall be of diameter as specified in the schedule. It shall be fitted with screwed plug or valve capable of completely shutting off water supply. Coupling shall be casted in one piece with cast iron bell mouth cover.

FIXING : The ferrule shall be fixed to the water supply pipe line of specified diameter without protruding inside including making hole in the water main and covering with cast iron bell mouth cover. The ferrule shall be fitted water tight.

DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till completion of the work.

TESTING : Ferrule shall be tested under the testing clause of pipe line. The testing shall be done along with the testing of pipe line.

THE RATE INCLUDES FOR : 1. Ferrule, coupling and cast iron bell mouth cover. 2. Boring hole in the water main and fixing ferrule. 3. Dewatering the trench or pit till completion of work. 4. All necessary labor, materials use of tools.

1.17 THRUST BLOCK.

Anchorage in the form of a thrust block at each deflection in the horizontal and/or in vertical alignment of the pipeline shall be provided as per the design requirements to resist any unbalanced pressure at the bends. Gravity type thrust blocks shall be provided at horizontal and vertical deflections in the pipeline, which shall be designed according to the test pressure and the soil conditions at the site of the thrust block. Before designing the thrust blocks the Contractor

shall assess the stability of the soil considering erosion due to wind and water. The general guidelines to be followed for providing and designing of thrust blocks shall be as under:

- The thrust blocks may not be required for bend angles up to 5%. However, necessary calculations shall be submitted by the Contractor for approval by Employer to establish that the thrust shall be taken care by pipe itself and that it is safe not to have the thrust block.
- The thrust shall be designed according to the field test pressure of the pipe.
- For above ground pipelines, thrust blocks shall be designed to take 100% thrust.
- For buried pipelines, thrust blocks on continuous pipe line sections shall be designed considering 50% thrust to be taken by block and balance by pipe as per CPHEEO manual.
- For buried pipelines, thrust blocks near valve chambers and/or any other dismantling joints shall be designed to take 100% thrust.
- In rock the passive pressure of rock shall be considered for thrust block design
- The thrust blocks shall be of concrete M25, cast in-situ, with minimum surface reinforcement of 5 kg/m². No formwork is required to be used for construction of thrust blocks in buried conditions, unless desired by the Contractor. The calculations for the dimensioning and the shape of the thrust blocks shall be approved by the Employer.
- Anchor blocks shall also be located wherever there is a transition between above ground and buried pipelines. All such anchor blocks shall have flexible joints at either end to allow for small amounts of settlement to occur.
- The Contractor shall construct the thrust blocks as early in the program of work as is practical, and at least six months prior to installation of the above ground pipeline in order to reduce the risk of settlement imposing additional loads on the pipeline supports. All thrust blocks are to be completed on each section before the sectional hydraulic testing is conducted.
- Where possible, the base of the thrust block shall be cast against solid rock in order to prevent any settlement. Any material overlying the rock shall be excavated and replaced with class M20 mass concrete. In the event of no rock being encountered, the base of the thrust block shall be cast against undisturbed ground. Any ground, which in the Employer opinion is unsuitable, shall be excavated and replaced with class M20 mass concrete.

1.18 Full bore Electromagnetic flow meter (For bulk Application):

- Full bore type Electromagnetic flow meter shall be provided as per approved P&IDs. The flow meter shall consist of flow sensor (i.e. flow tube), flow transmitter/ flow computing unit and remote flow indicator cum integrator. The electromagnetic flow meter shall be manufactured as per BS EN ISO 6817 standard (Measurement of conductive liquid flow in closed conduits, method using electromagnetic flow meters).
- The flow tube flanges and transmitter housing shall be properly earthed.
- Flow tube shall have waterproof construction (IP 68) and shall be suitable for installation on underground pipe lines buried directly in the soil and also suitable for above ground pipelines.

- The transmitter of the flow meter shall be SMART type microprocessor based using digital technology having facilities for configuration of engineering units, flow range and features of memory and self diagnosis. The transmitter shall be mounted separate from the flow tube, connected by a cable. The flow transmitter and flow computation/ evaluation unit shall be mounted in a field mounted metallic field enclosure / cabinet.
- The electromagnetic flow meter shall have bi-directional measurement feature and with accuracy better or equal to + 0.5% of measured value inclusive of linearity, repeatability, pressure effect etc.
- Flow transmitter/ flow computing unit should be microprocessor based having digital display with flow-rate indications and integrated flow values with the configuration facility from the front facia.
- Material of construction of the wetted parts of flow meters shall be suitable for functioning on treated / raw and chlorinated water applications. Flow tube shall be rugged in construction and shall be suitable for continuous operation. Flowmeters shall be suitable for the water turbidity at site during various seasons.
- The flow meter shall be installed in such a way that it always remains filled with water. To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter shall be provided, as required by the flowmeter manufacturer. The flow tube shall be installed at a location free from flow turbulence. In order to achieve the same, the flow tubes shall be installed in the pipe section such that straight lengths of pipe without bends or tee connection shall be minimum 5 diameters on upstream and 3 diameters on downstream side. The Contractor shall finalize the exact location of flow transducers in consultation with Employer.
- The flow meter output signals shall contain the data for flow-rate and integrated flow readings. The output signal of the flowmeter will be connected to panel mounted Flow Indicator
- The meter shall be MID approved and OIML compliant.
- Technical Particulars

a)	General		
i.	Service	:	At the ESR output and at the DMA
ii.	Overall accuracy of measurement loop	:	±0.2 % of measured value
iii.	Quantity	:	As per DMA Requirement
iv.	Internal diameter of pipe	:	As per DMA Requirement

v.	Suitable concrete chamber for enclosing flow meter.	:	As per DMA Requirement
b)	Flow tube		
i.	Type	:	In line full bore electromagnetic
ii.	Size of flow tube	:	Same as pipe size
iii.	Weather Protection Class	:	IP 68
iv.	Range	:	Bidder to state
v.	Surge protection devices (SPD) between flow tube and flow transmitter	:	Required for protection from lightning surges
vi.	Electrode material	:	Hastelloy C /SS
vii.	Flow tube Lining	:	PTFE/HARD RUBBER
c)	Flow Transmitter Unit		
i.	Type	:	Pulse o/p Based with GSM/GPRS Connectivity.
ii.	Type of display	:	8 digit LCD for totalized flow in m3/Hr.
iii.	Input	:	From flow tube
iv.	Output	:	Pulse o/p Based with GSM/GPRS Connectivity.
v.	Power Supply	:	Battery Operated, Battery Life Min 10 Years,
vi.	Zero and Span Adjustment	:	Required
vii.	Weather Protection Class	:	IP 67
viii.	Battery backup for totalised flow	:	Required
ix.	Facility for on line diagnosis	:	Required
d)	Data Logger Unit		
i.	Operation	:	Receive Pulse from EMF & PT and Transfer the same through GSM Network
ii.	Polling Time	:	Every 15 Min from Flow Meter & Pressure Transmitter
iii.	Transmit Time	:	Every 24 Hrs. Once in a form of CSV File
iv.	Display	:	8 Digits LCD Display

		:	
v.	Power Supply	:	Battery Operated
vi.	Battery Backup	:	10 Years
vii.	Application Software	:	Suitable for Displaying water consumption detail
		:	
viii.	- Provision for Meter non functionality and tampering notification	:	To be provided
		:	

1.19 Technical specification for Transmitter- Pressure:

- Pressure measuring system shall consist of a pressure sensor/transducer/ transmitter and panel mounted digital pressure indicator and any other items required for completing the measuring system. Where the transmitter is subject to pressure pulsations and/or vibration, it shall be provided with snubber.
 - The pressure transmitters shall be designed for operation over 130 % of full range.
- Technical Particulars

i.	Service	:	At the DMA and at the outlet of ESR
ii.	Accuracy of measuring loop	:	± 0.2% of reading or better
iii.	Type	:	Capacitive/piezoelectric / Silicon resonance
iv.	Material of sensor and other wetted parts	:	SS 316
v.	Transmitter type	:	SMART type, 2-wire indicating type with LCD display for pressure MWC or kg/cm ²
vi.	Range	:	Range to be finalised during detailed engineering without any cost implication
vii.	Zero and span adjustment	:	Required
viii.	Output signal	:	4-20mA DC isolated with HART protocol (version 6 or above) proportional to pressure-2nos.

ix.	Enclosure material	:	Die cast aluminium / non-corrosive
x.	Enclosure protection class	:	IP 65
xi.	Ports for in situ calibration	:	Required
xii.	Over range protection	:	130 % of full range
xiii.	Process connection	:	As per process requirement
xiv.	Accessories	:	• Diaphragm seal assembly with SS 316 diaphragm(as applicable)
			• 3 way isolation valve
			• Impulse tubing, fittings
			• Snubber
			• All other installation hardware

1.20 Technical Specification-MultiJet type Domestic GSM/ GPRS Water Meter

Technical Specification:

- All meters to be offered under the terms of the Tender and Specification must be of a MultiJet/ Volumetric type and must be fitted with liquid filled sealed counters to ensure readability.
- The Meter will be as per Latest Version of IS-779:1994 with its latest version & ISO 4064:1993 with its latest version
- The meters will be Dry dial type, inferential type, horizontal, magnetically coupled.
- Class-B type meters to be supplied.
- Meters which have external calibrating devices are not acceptable.
- Meter should have IP-68 protection class copper can register with 5 mm tempered mineral glass cover.
- Meters to be installed at horizontal, vertical or inclined planes.
- The meters will be fitted with an internal return flow restrictor.
- Successful life cycle test certificate from FCRI is to be provided.
- The meter to be supplied with brass nuts and nipples with complete accessories.

Specification of GSM/GPRS Unit

Power supply	
Power supply	Inbuilt battery
Battery Life	5 years*
Power consumption	

Standby mode Communication	Less than 18uA 550mA
Battery Management	Built-in 1. Battery Voltage Monitoring 2. Battery usage monitoring
Signal Inputs	
Signal Inputs	Serial Interface
Baud Rate	Configurable
Parameters	
Flow Units	Total Flow: m ³
Real Time Clock	Built-in
Memory	
Memory	2K bytes
Parameters Stored	1. Date/Time 2. Total Flow 3. System Flags 4. System Leak Records 5. Tamper Records 6. Dry events
Memory Type	Non-Volatile memory
Memory Retention	100 years
Environmental	
Max. Operating Temperature:	70 °C
Storage Temperature	0 – 80 °C
Humidity	0 – 80 non condensing
Housing:	ABS plastic
Communication Options:	
GSM Modem	
Operating Voltage	3.8V DC
Maximum Current Consumption	2A peak
Frequency bands	Dual Band
Transmit power	Class 4 (2W) at GSM 850 and E-GSM Class 1 (1W) at DCS and PCS
GPRS	GPRS multislot class 10 Multislot class 2 support PBCCH Support

	Coding schemes CS1 to CS4
Voice Features	Not used
SMS	SMS, MT, MO and SMS CB
Data / Fax	Not used
SIM Interface	1.8V / 2.9V interface
Communication protocol	Proprietary protocol over TCPIP, FTP over GPRS

1.21 Ultrasonic Type Flow Meter for House Service Connection:

Sl. No.	Parameter	Specification
1	Media	Clear Water
2	Type	Full Bore Type
3	Line Size Dia (mm)	15, 25
4	Communication to Media	RF Based
5	Display	LCD Display, 8 Digit for Flow rate & Totalized Flow
6	Calibration Range	Throughout the measurement Range
7	Accuracy	+/- 1% of Measured Value
8	Linearity	+/- 0.5% of Measured Value
9	Repeatability	+/- 0.5% of Measured Value
10	Temp. Coefficient	+/- 0.5% per Deg C
11	Process Temp.	Ambient
12	Process Pressure	Ambient
13	Operating Condition	Ambient
14	Max Test Pressure	16 Bar or More
15	Max Head Loss	As per ISO 4064
16	MOC	Flow Tube- SS 304
		Electronics -ABS Plastic/ Die Cast Aluminium
17	Power Supply	Battery Powered (Inbuilt/ External Li-Ion Battery)
18	Minimum Indications to be provided in Meter Display	Battery Low
		Meter Tamper

Sl. No.	Parameter	Specification
		Meter Open
		Empty Pipe
		Leaked Flow
		Reverse Flow
		Burst Indication
19	Battery Life	Min. 10 Years
20	Response Time	Less than 10 Sec or better
21	Ingress Protection	IP 66 or better
22	Process Connection	Threaded/Flanged
23	Data Logging	Normally per day 2 Data Analysis Time (As many as required))

1.22 Electromagnetic Smart AMR Water Meters

Providing, Installing and Giving satisfactory field testing of domestic Battery operated, MID approved with minimum Dynamic ratio (Q3/Q1) of 500:1, AMR Electromagnetic Water Meters from 15 mm to 40 mm having no moving part in contact with water, with fully body made up of composite material, confirming to ISO 4064 along with manufacturing test certificate and Guarantee certificate with Battery life of min. 10 years with GSM / GPRS/ RF Technology for communication.

ITEM	SPECIFICATIONS
a) Measuring Principle	A battery operated inline non- Intrusive Electromagnetic water meter with no moving parts.
b) Power Supply	Power-Supply-Battery operation for complete meter including AMR with battery life of minimum 10 years to ensure recording at all times
c) Meter Lifetime	Minimum 10 years
d) Protection Class	Must comply to IP68 Standard for indoor and outdoor operation, including fully submerged installations
e) Approvals and certifications	The meter should be type approved and verified according to international water meter Standard OIML R 49 and or ISO 4064. The meter type approval from MID is also accepted.

f) Accuracy	+/-2% or better over typical operating range and temperatures. The Electromagnetic water meter should maintain its accuracy over its lifetime. Accuracy class 2 standards of OIMLR49.
g) Calibration	3-Point calibration with calibration certificate available for each unit.
h) Dynamic Ratio (Q3/Q1)	Minimum of 500:1. Measuring range shall be as per ISO 4064/OIMR R 49.
i) Material	The water meter body shall be made of Composite material or Engineering plastic.
j) Pressure Rating	Pressure rating shall be = PN16
k) Environmental Temperature	0 degree C to 50 degree C
l) Data Protection and tamper proof	The meter should be tamper proof with suitable data protection of calibration and revenue parameters
m) Self-diagnostics for error detection.	The smart meter should have advanced diagnostics with active alarm(s) indicated on display
n) Access to information	Display with =8 digits for main information. Index, menu and status symbols for dedicated information
o) Measuring Units	The measuring units should be m ³ for volume and m ³ /h or l/h for flow rate.
p) Facility for Remote Communication interface	The Electromagnetic water meter should be configured with battery operated remote reading capability using point-to-point RF.
q) Indicators / Alarms	Tampering, Reverse Flow, Leakage etc.

Scheme for Bulk Flowmeter, Pressure Transmitter Data Reading

From Bulk Electromagnetic Flow Meter and Pressure Transmitter the Flow & Pressure Data will be fed to Central SCADA system. The Data from that Datalogger unit to SCADA will be transmitted through SMS (CSV Format) through GSM/GPRS Connectivity (1 SMS per Day) Water consumption detail to be calculated from Bulk EMF cumulative for each DMA area.

Warranty

All the supplied smart water meters, their peripherals and equipment, etc., must have a written warranty from the manufacturer covering not less than 10 years from the date of commissioning.

Maintenance liability

All the installed smart water meters, their peripherals and equipment etc. will be subject to a defect liability period of 2 year beginning from the successful commissioning date. This means that if there is a malfunction or breakdown within the period the supplier will be responsible for making good the same by repair/ replacement at his cost.

When there is a malfunction the bidder, It is expected that the problem will be resolved within 48 hours of the supplier receiving the information. In case a spare part has to be imported then the repair should similarly take not more than 21 days.

The supplier should do a classification of what malfunction/breakdown to be given 48 hours or 21 days. This should be in his tender. The list must be exhaustive and include all elements and how they can be detected.

Spare parts

The supplier must show prove that spares for all the supplied/installed items are available and that they will continue to be produced for the next 10 years at the least. It will be preferable for the spares to be within the country, and full explanation given of their availability.

In case the spares are overseas, full contacts, i.e. email, website, postal address and office telephone must be given and tested for workability. The language of communication must be ENGLISH.

Weatherproof

The equipment to be supplied will be installed and used in unfavourable weather conditions, such as in water, very humid, exposed to any external conditions etc. it is therefore required to supply equipment with all units of build standard to IP 68.

1.23 Specifications of Programmable Logic Controller(PLC):

DESIGN AND CONSTRUCTION REQUIREMENTS

PLC H/W & S/W shall be from the same family and should be sourced from approved Vendors only. Programmable logic controller (PLC) shall be microprocessor based with 32 bit or other suitable processor and be fully programmable and capable of performing control relay logic, including timing, counting, sequencing, and interlocking to provide the required functionality. The PLC shall be high performance processors suitable for real time process application. High inherent reliability, self checking, error-recovery and trouble-shooting features shall be some of the features of PLC.

The PLC shall have a modular / modular chassis design which allows for ease of future expansion. The processor module shall be easily removed from the I/O chassis for service or repair. The I/O chassis shall have slots for installing I/O cards, communications, or other special function modules. All I/O cards and modules shall be capable of being installed in any open slot in the chassis or shall be DIN rail mounted. Module and channel level diagnostics should be standard feature.

The PLC shall have a suitable power supply and can be easily serviced or replaceable. The system shall be capable of being powered on 120VAC / 230VAC / 24V DC as per mfr. Std..

The PLC shall be rated to operate from 0 to 60 Degrees C, with a humidity rating of 5 to 95% (non-condensing). All module circuit boards shall be encased and protected such that, when properly installed, they are not exposed to accidental contact by personnel or other objects.

The PLC shall be of high quality and reliability with replacement processors, power supplies, chassis, I/O and specialty modules that are readily available on an urgent or emergency basis. All PLC products shall be fully supported and spares shall be available for purchase for up to ten (10) years from the date of the original system purchase.

User memory	8 MB
I/O memory	0.98 MB
Optional nonvolatile memory	1 GB
Digital I/O, max	128,000
Analog I/O, max	4000
Total I/O, max	128,000
Power dissipation	2.5 W
Thermal dissipation	8.5 BTU/hr
Isolation voltage	30V (continuous), basic insulation type, USB port to backplane Type tested at 500V AC for 60S
USB port(1)	USB 2.0, full speed (12 Mbps)
Module location	Chassis-based, any slot
Wire category(2)	3 - on USB ports
North American	T4A
IECEx temperature	T4
ATEX temperature	T4
Enclosure type	None (open-style)

Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25 °C < Ta < +70 °C (-13 °F < Ta < +158 °F) surrounding air temperature range is -25 °C < Ta < +60 °C (-13 °F < Ta < +140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40...+85 °C (-40...+185 °F)
Temperature, surrounding air, max	70 °C (158 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing

Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10...500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g (45 g with SD card installed)
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80...2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz

Standards: c-UL-us ,CE, RCM, EX, KC, ECA , IECEx

1.24 Technical specifications for receiving indicators mounted at ICP/LCP:

All indicators/controllers shall be electronic (microprocessor based) type programmable indicator and shall be mounted on the control panel located in the control room.

Multiplying factors, shall be specified on manufacturer's nameplate, if applicable.

Specifications, as applicable are as follows:

Process Indicator:

Type : Microprocessor based, programmable

Input : 4-20 mA

Display : 4 ½ Digit, 7 Segment LED display

Display Units : % or Engg. Units, user programmable at site

Alarm Setpoint : Two nos., pot. free relay contact rated at 5A

@230V AC resistive load, adj. over entire range

Transmitter Supply : Required, 24V DC @30mA

Retransmission Output: Required, 4-20 mA in 600 ohm load

Accuracy : + 0.25% of FSD

Terminals : suitable for up to 2.5 sq.mm. wires

Mounting : panel flush mounting

Power : 230 V AC, 50 Hz

Comm. Port : RS-485 Serial Port (Modbus)

Flow Indicator cum totalizer shall also have following in addition to above:

Totalizing Counts/Hr : User Programmable at site

Totalizer Display : 8 Digit Digital Display with Battery Backup to retain totalized data in the event of power failure for a minimum period of 24 hours.

1.25 Technical specification of panel:

General

Control panels shall be prefabricated type. Control Panel shall be CNC machine prefabricated out of CRCA sheet steel of thickness not less than 2 mm, modular in construction, properly reinforced, powder coated and having rigid frame structure. Internal mounting plate including the gland plate shall be 3 mm thick. The control panel shall have dimensions as per system requirement. However, the control panel height shall not exceed 2200 mm.

The exterior corners and edges shall be rounded to give a smooth overall appearance with projections kept to a minimum.

Lifting lugs shall be provided for installation purposes and shall be replaced with corrosion resistant bolts after installation.

a) Control Panel shall be completely metal enclosed and shall be dust, moisture and vermin proof. Panel enclosures shall provide a degree of protection not less than IP 54 in accordance with IS: 13947Part-I.

Control Panel shall be freestanding type. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.

Metal sills in the form of metal channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting the control panels.

Cable entries to the panels shall be from the bottom Control panels shall be provided with louvers along with washable micron filters AIRIN – AIROUT fans will be provided.

All equipment on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.

Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

(c) Earthing for Instruments:

The panel shall be equipped with an earth bus securely fixed along the inside base of panel. All metallic cases of instruments and other panel mounted equipment shall be connected to the instrument earth bus.

Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to create alternative paths to earth bus shall be provided.

A separate instrument earth bus will be created which will be floating and all the cable shields will be terminated onto this bus. This bus will be connected to an electronic earth pit.

(d) Frame Earthing

All metal parts other than those forming part of an electrical circuit shall be connected to a copper earth bar run along the inside bottom of the panel. The minimum section of the earth bar shall be

25 mm x 3 mm. A 15 mm diameter hole is to be provided at each end of the bar. Connection of the earth bar to the station earth shall be carried out by Contractor.

(e) Space Heater

Strip type space heaters of adequate capacity shall be provided inside control panels to prevent moisture condensation on the wiring and panel mounted equipment when the panel is not in operation. The heaters shall operate on 230 V AC. Heaters inside the panels shall not be mounted close to the wiring or any panel mounted equipment. The operation of heaters shall be controlled by thermostats.

(f) Interior Lighting and Receptacle

Each panel shall be provided with either a CFL lighting fixture rated for 11 watt, 230V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance. The illumination lamp shall be operated by door switch or manual switch. Each panel section shall be provided with separate lighting.

Each panel shall be provided with 230V, 1 phase, 50 Hz, combined 5 amps and 15 amps, 3 pin receptacle with a switch and neon. The receptacle with switch shall be mounted inside the panel at a convenient location. If the panel has front and rear doors then maintenance socket shall be provided at both locations.

(g) Voltage Level and Power Supply Units

Generally, voltage levels for control schemes and power supply for instruments in the panels, shall be limited to 24 V DC. In case the instruments require power supply other than 24 V DC, Contractor shall provide necessary transformers, converters, inverters and other associated hardware required to generate the requisite power supply. The power supply distribution board for panel mounted and field mounted instruments shall be provided. Power supply to all the instruments mounted outside the control panel shall be provided from the power supply units in the control panel.

The power supply to all the instruments shall be without interruption and shall be continued even in case of failure of 230 V A.C. power supply. UPS sizing should take this into consideration.

(h) Labels

All the equipment mounted on the front facia of control panel as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. Also the panel shall be provided at the top with a label engraved with panel designation.

(i) Switches and Miniature Circuit Breakers (MCBs)

Each control panel shall be provided with necessary arrangement for receiving, distributing, isolating and protecting of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with Miniature Circuit Breakers (MCBs). Potential circuits for relaying and metering also shall be protected by MCBs. All Important MCBs will be provided with an auxiliary contact to be used for providing MCB tripped alarm.

(j) Intra-panel (i.e. Panel Internal) Wiring

Connections within a panel, between panel mounted devices and terminal blocks or between two panels mounted devices will be made by 660 volt grade, stranded copper conductor insulated with PVC and designed for a minimum conductor temperature of 90 degrees centigrade. The wires shall be shielded, where necessary. Panels shall be supplied completely wired internally, with a colour coding scheme decided mutually

between the Purchaser and the Contractor, to equipment and terminal blocks and ready for external cable connections at the terminal blocks.

Wires within the panel shall be continuous i.e. without splicing and shall comprise stranded copper conductors. Internal wiring or wiring between the two assemblies shall be commensurate with mechanical safety.

Wire termination shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules, marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire disconnected from terminal blocks. The ferrule system shall adopt single tube printed arrangement so that all the characters remain on one line always & hence easily readable

(k) Terminal Blocks

Terminal blocks for power connection shall be 660V grade, 10 amps rated, one-piece moulded, complete with stud type terminals, washers, nuts and lock nuts and identification markings. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams. All control output terminals will be fused type and all other input signal terminals will be clip on shrouded type. Spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks as required.

There shall be a clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be 250 mm.

Panel internal wiring shall not be looped directly from instrument to instrument. The same shall be looped through the panel terminal block only.

If accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

(l) Cable Supports

All external cables shall present a neat appearance and shall be suitably braced, placed in troughing clipped or laced to prevent effects of vibration.

(m) Terminal/ Identification

Every terminal and test plug shall be uniquely identified within the terminal cabinet by means of a terminal number. Appropriate labels shall be used to permit quick and unambiguous identification of each terminal and test plug.

(n) Painting of System Cabinet/ Control Desk

All sheet steelwork shall be phosphate in accordance with the following procedure:
 The pre treatment shall be hot process with running water for rinsing
 Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
 Rust and scale shall be removed by trickling with clean water followed by final rinsing with dilute dichromate solution.

The control panel shall be powder coated. Thickness of coating of minimum 60 microns. QA test certificate shall be furnished for thickness, adhesion and hardening of powder coating.

1.26 Technical specification for DATA A CQ UISITION SYSTEM AND COMMAND CENTER:

General Activities

Within the framework of the Contractor's responsibilities given in this document, the Contractor shall carry out the following activities. However, these shall not limit the requirement for other activities which otherwise are required as per term and conditions of Contract or to fulfil the Contractor's responsibilities or are essential as per good industrial practices. The Contractor shall be responsible for, but not limited to, the following:

- a) Providing the Centralized monitoring system & SCADA for RMC.
- b) Providing the required staff, but not less than the minimum as specified in this document
- c) Providing all required consumables and spare parts/ instruments required for functioning of plant and equipment.
- d) Maintenance of instrumentation (all field instruments) & control system, software's, PCs, control room, radio telemetry system, UPS, A.C. etc. and all other works constructed in this Contract.
- e) Periodic calibration check of all supplied instrumentation and controls from reputed agencies and submitting the same document to RMC engineers during the period of operation and maintenance.
- f) Reporting;
 - Repair history of all mechanical, electrical and instrumentation control equipment in and pure water pumping stations, water transmission mains;
 - Daily log of operations of all the important instrumentation & equipment
 - Daily start–stop operation of pumps with every hour readings for operating voltage, amperage and power factor;
 - Hourly readings of pressure, flow rate and integrated quantity of water;
 - Hourly levels of sumps;
 - Daily list of alarms with time tag;
 - Logbook format and the data to be included in the logbook shall be decided during commissioning in consultation with RMC;
 - Last periodic maintenance done for all equipment/buildings of the system;
- g) Providing required instrument spares and maintaining adequate inventory of required accessories or equipment itself for repair of system so that the all instrumentation and control equipment, software and communication system can work efficiently for the proper functioning of Central Monitoring System as per the guarantees given or minimum required efficiencies asked under this Contract, without any additional costs to department.

- h) Prior approval to the changes required to be carried out during O&M shall be obtained by the contractor from the RMC engineer. The required changes shall be reported to RMC well in time necessary drawing and literature for any changes shall be submitted to the employer's representative.
- i) The Contractor shall be solely responsible for the safety and security of the goods in the store and will be responsible for any loss or damages in stores for any reason. He may opt for insurance cover against the value of the goods to be stored without any additional costs on the Department.
- j) Daily patrolling of each location, to identify and report the damages / defects if any.
- k) Periodic routine maintenance of structures/control room / chambers of each location of and others built in the Contract. Such maintenance must ensure adequate cleanliness, ventilation, illumination and structural safety. In addition to this, the general hygienic standards must be maintained and adequate plantation, horticultural activities must be taken up to maintain the total environment of the campus / building / room pleasant.
- l) Providing adequate manpower for monitoring / watch and ward of each location of, pumping stations, OHT's etc.
- m) Providing four wheeler vehicle as specified & as approved by engineer-in-charge for transportation facilities between various locations.
- n) Updating and periodic submissions of the operation and maintenance manual as defined in specifications for O&M works. The Contractor shall take up all periodic maintenance works provided in the approved O&M manual.
- o) Submission of Daily report (Water audit / Energy Audit / Water Balance).
- p) Insurance: The Contractor shall, without limiting his or the Employer's obligations and responsibilities, insure;
- The work together with material and plant for incorporation therein, to the full replacement cost (term "cost" in this context shall include profit).
 - The Contractor's equipment and other things brought onto site by the Contractor, for a sum sufficient to provide for their replacement at the site.
 - The insurance shall be in the joint names of the Contractor and the Employer at the Contractor's cost and shall cover the Employer and the Contractor against all losses or damages from whatsoever cause arising from the start of the O&M until the date of completion of O&M in respect of the facility or any section or part thereof as the case may be.
 - Any amount not insured or not recovered from the insurer shall be borne by the Contractor

1.27 Emergency Action Plan

The Contractor shall provide Emergency Plan of Action, as per the following:

(i) The RMC may, at its election, intercede and take, or direct the Contractor to take, any and all actions reasonably necessary to respond to an Emergency.

(ii) The Contractor shall, upon learning of an Emergency or the probable occurrence of an Emergency, (1) immediately provide oral notice to the RMC or its Authorized Representative of the same and (2) as soon as possible, but no later than twelve (12) hours, provide Notice to the RMC or its Authorized Representative of such event or probable event; provided however, if Applicable Law shall provide for a more expeditious oral or written notice of any Emergency to the RMC, the Contractor shall so comply by providing such notice to the RMC or its Authorized Representative.

(iii) The RMC and Contractor or their Authorized Representatives shall coordinate with each another prior to, during and after the occurrence of an Emergency including 1) the planning and implementation of actions designed to prevent or mitigate damage to the System and the environment and (2) the attendance of all meetings related to such planning and implementation.

(iv) The Contractor shall **interact / liaison** and cooperate with appropriate departments of the public entities comprising the RMC and other jurisdictions.

(v) The Contractor shall supply standby employees from normal system staff ready to address an Emergency in an expeditious manner.

(vi) Response Times and Emergencies:-

The Contractor commits itself to a high standard of effective response. To indicate commitment, the Contractor shall establish 'Standards of Service' which shall define the Contractor's response to any emergency with the intention of minimizing the possible impact of an emergency or failure on the output of the Facilities. These standards shall be agreed with the SMC and would typically include:

Situation	Response	Target Time
To any alarm or non-conformity during normal work time, or when the Facilities are being manned.	Any threat to public or personal health.	Immediate
	To attend to and assess the required action and the resources needed to effect remedial action. Effect first call repairs where possible	Immediate
	If the problem requires further resources, to have remedial work on site rectifying the problem	2 Hours

To any alarm Or non-conformity occurring outside normal Operating hours or when Facilities are unmanned	Any threat to public or personal health.	Immediate
	To attend to and assess the required action and the resources needed to effect remedial action.	1 Hours
	Effect first call repairs where possible If the problem requires further resources, to have remedial work on site rectifying the problem	2 Hours

A dedicated problem solving team shall be appointed by the Contractor and this team shall have the responsibility of tracking problems through to a satisfactory outcome. Major events that threaten public, employee or process safety or security shall be managed directly by an Contractor’s Representative, who shall have full authority to utilise whatever resources he considers fit to rectify any emergency situations. In performing these duties, this manager shall have full responsibility for ensuring proper and adequate communications with the RMC and other relevant bodies.

FUNCTIONAL REQUIREMENTS:

The system is provided with Supervisory Control and Data Acquisition (**SCADA**) with Graphical Users Interface (**GUI**) based Man-Machine Interface capable of acquisition of operational and monitoring data from the field station s, validate and consolidate the same, present the same in graphical form, extract trending information, analyze data in real time and apply analytic tools to recommend logical decision for implementation.

The SCADA shall be capable of displaying following information dynamically.

1. Overall view of the water distribution network with dynamic mimic display of status of measured values of the individual Data on daily and monthly basis and event logging.
2. Generate Control Command Signal based on sequential and discrete control operation. Sequence of control operation is on the basis of select acknowledge and execution logic.
3. Man-Machine Interface shall be provided to generate clear graphical representation of the whole of the pipe line water transmission system, alarm management system, storage of data base for trending, daily / monthly / yearly reporting etc.
4. Software program shall be such that any person without any prior knowledge of software shall be capable to operate the system. Program shall be window based menu driven for ease of operation. The user interface shall be through GUI.
5. Printers loggers shall be provided for periodical print out of the parameters alarms events etc. Also to provide print out of data of thirty (30) minutes pre & post occurrence of events.
6. The SCADA shall be provided with an adequate storage system for data. The data and all operational parameters shall make available online at least one (1) month data, which can be recalled and processed on demand. Provision shall be made to download the data on appropriate storage devices for permanent storage for archiving.
7. Computer based SCADA is aimed at achieving efficiency, equitable distribution and uninterrupted water supply management. Automation will also lead to manpower utilization, saving of power, timely service offered to consumers.
8. Operator Console at Central Monitoring Station:

This shall be server class computer of latest specifications available in the market at the time of execution. Vendor shall submit the indicative specification with the bid for approval.

The SCADA system shall be of open architecture type and it should not be monopolized. GSM/GPRS connectivity to be provided at SCADA system for connection with ICC.

Specification Web Server:

Make: DELL / HP / IBM / Any Approved Make

Quantity: As Per Requirement

Type: Workstation type

Processor: Dual / Quad core Intel Xeon 64-bit Processor with min 2 GHZ or higher

Memory: At least 4 GB DDR2 or higher expandable up-to 32 GB. (Memory may be more based on systems architecture and requirement) or higher

Form factor: Tower I/O Interfaces: PS/2 or USB Mouse port, minimum 1 serial and 1parallel port., USB port

Mouse: Scroll Mouse with Pad (External mouse)

Key Board: Standard keyboard for Workstation

HDD: 2 TB SATA or higher

Optical Drives: DVD + /- RW

PCI slots: Minimum 3 (Supplier shall ensure that sufficient PCI slots shall be available for mounting PLC to PC communication cards and LAN Ethernet card.

Monitor: 20" TFT flat panel square colored monitor. The make of monitor shall be same as that of PC.

Graphics Card: 128 MB(Min.) Dual DVI or Dual VGA

OS: Latest Microsoft OS with original Microsoft CD media compatible with PLC & HMI software

Data Storage: One additional external hard-disk of 1 TB capacity to be supplied with each work station.

Specification of Engineering/Operator Work Station:

Make: DELL / HP / Any Approved

Quantity: As per Requirement.

Type: Work Station.

Processor: Intel Core I5 Processor with min 2.5 GHZ, 1066 FSB (minimum) or higher

Memory: At least 4 GB expandable up-to 8 GB or higher

Memory Slot: Minimum 2

Screen: Minimum 52" diagonal LCD / TFT Display

Graphics Card: 512 MB or higher

Mouse: Scroll Mouse with Pad (External mouse)

Key Board: Standard Full keyboard

HDD: Minimum 500 GB

Optical Drives: 8x DVD + /- RW

Network: Intel Gigabyte Network Connection (10 / 100 / 1000)

OS: Microsoft Windows - XP / Latest with original Microsoft CD media.

Communication: Integrated Gigabit LAN Ethernet.

Accessories: Audio Stereo Speaker, Audio Jack, Internal Bluetooth card, Audio jacks, RJ-45, RJ-11 ports, Webcam.

USB Port: Minimum two USB ports for external connection.

Other Software: MS – Office latest student version and Antivirus.

1.28 Laying Of Cables

A distance of minimum 300mm shall be maintained between the cables carrying low voltage AC and DC signals and a distance of minimum 600mm shall be maintained between cables carrying HT and LT signals. In outdoor areas, the cables shall be directly buried. Each instrumentation and power supply cable shall be terminated to individual panel/ terminal box. Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by Contractor.

Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for Employer's Representatives approval.

All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end. Various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. A loop of 1 meter shall be left near each field instrument before terminating the cable.

Cables shall be complete uncut lengths from one termination to the other.

All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedules. Identification tags shall be securely fastened to the cables at both the ends.

Cable shall be rigidly supported on structural steel and masonry, using individually cast or malleable iron galvanized clips, multiple cable supports or cable trays.

Cables And Cable Carrier System

LV(Low voltage) CABLES :

LV Power Cables shall be 1100V grade, single/multi core, stranded aluminum conductor, XLPE insulated with PVC inner sheath, armored and outer sheath made of FRLS PVC compound, generally conforming to IS 1554 Part-I (for PVC) and IS 7098(for XLPE). Copper cables shall be used for all cables sizes up to and including 6 sq mm.

CONTROL CABLES :

Control cables shall be 1100V grade, multi core, minimum 1.5sq.mm cross section, stranded copper conductor, PVC insulated, PVC inner sheathed/galvanized steel wire armored, overall FRLS PVC outer sheathed generally conforming to IS 1150 Part-I.

INSTRUMENTATION CABLES:

The instrumentation cables shall be Annealed, tinned stranded copper conductor, 0.5 sq mm, twisted into pairs, overall screened for digital signals, individual and overall screened for low level analog signals, individual triplet and overall screened, PVC insulated, inner PVC sheathed, GS wire armored and overall sheathed with FRLS PVC.

LT Cables Standards

Standard Description

IS 7098 XLPE insulated electric Cables.

IS 8130 Conductors for insulated electric cables.

IS 5831 PVC insulation and sheath of electric cables.

IS 3975 Mild steel wires, strips and tapes for armoring of cables.

IS 1753 ALLUMINIUM conductors for insulated cables.

GENERAL SPECIFICATIONS OF MATERIALS

M-1 WATER

- 1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in I.S. 456-2000.
- 1.2 If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 269 –1976. Any indication of unsoundness, change in time of setting by 30 minutes or more or decrease of more than 10 percent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.
- 1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.
- 1.4 Hard and bitter water shall not be used for curing.
- 1.5 Potable water shall generally be found suitable for curing mortar or concrete.

M-2 LIME:

- 2.1 Lime shall be hydraulic lime as per I.S. 712-1973. Necessary tests shall be carried out as per I.S. 6932 (Parts I to X) 1973.
- 2.2 The following field tests for limes are to be carried out –
 - a) A very rough idea can be formed about the type of lime by its visual examination. I.e. fat lime bears pure white color. Lime in form of porous lumps of dirty white color, indicates quick lime, and solid lumps indicate the unburnt lime stone.
 - b) Acid tests for determining the carbonate content in lime. Excessive amount of impurities and rough determination of class of lime.
- 2.3 Storage shall comply with I.S. 712-1973. The slaked lime, if stored, shall be kept in a weather proof and damp proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any way shall be rejected and all rejected materials shall be removed from site of work.
- 2.4 Field testing shall be done according to I.S. 162-1974 to show the acceptability of materials.

M-3 CEMENT

3.1 Cement shall be ordinary Portland cement **as per latest amendment of I.S. 12269 of 53/43 grade** or Portland slag cement as per I.S. 455 –1989.

M-4 WHITE CEMENT:

4.1 The white cement shall conform to I.S. 8042-1978.

M-5 SAND:

5.1 Sand shall be natural sand, clean, well graded, strong, durable and gritty particles free from injurious amounts of dust, clay, kankar nodules, soft or flaky particles, shale, alkali, salts, organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8% of silt as determined by field tests. If necessary the sand shall be washed to make it clean.

5.2 Coarse Sand : The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse shall be as under:

I.S. Sieve Designation	% by weight passing sieve	I.S. Sieve Designation	% by weight passing sieve
4.75 mm	100	600 Micron	30 – 100
2.36 mm	90 – 100	300 Micron	5 – 70
1.18 mm	70 – 100	150 Micron	0 – 50

5.3 Fine Sand : The finess modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under –

I.S. Sieve Designation	% by weight passing thru	I.S. Sieve Designation	% by weight passing thru.
-			
4.75 mm	100	600 Micron	40 – 85
2.36 mm	100	300 Micron	5 – 50
1.18 mm	75-100	150 Micron	0 - 10

M-6 STONE GRIT:

6.1 Grit shall consist of crushed or broken stone and be hard, strong, dense, durable, clean, of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar. Grit shall generally be cubical in shape and as far as possible flaky elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383-1970.

Unless a special stone of a particularly quarry is mentioned, grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-charge. The grit shall have not deleterious reaction with cement.

6.2 The grit shall conform to the following gradation as per sieve analysis:

I.S. Sieve Designation	% passing thru' sieve	I.S. Sieve Designation	% passing thru' sieve
12.50 mm	100%	4.75 mm	0-20%
10.00 mm	85-100%	2.36 mm	0-25%

6.3 The crushing strength of grit will be such as to allow the concrete in which it is used to built-up the specified strength of concrete.

6.4 The necessary tests for grid shall be carried out as per the requirements of I.S. 2386 (Parts I to VIII) 1963, as per instruction of the Engineer-in-charge. The necessity of test will be decided by the Engineering-in-charge.

M-7 LIME MORTAR:

7.1 LIME: Shall conform to specification M-2. WATER: water shall conform to specification M-1. SAND: Sand shall conform to specification M-5.

7.2 PROPORTION OF MIX: Mortar shall consist of such proportions of slaked lime and sand as may be specified in the item. The slaked lime and sand shall be measured by volume.

7.3 PREPARATION OF MORTAR : Lime mortar shall be prepared by wet process as per I.S. 1625-1971. Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in an even layer and ground for 180 revolutions with sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

7.4 STORAGE: Mortar shall always be kept damp, protected from sun and rain till used up, covering it by tarpaulin or open sheds.

7.5 USE: All mortar shall be used as soon as possible after grinding. It should be used on the day on which it is prepared. But in no case mortar made earlier than 36 hours shall be permitted for use.

M-8 CEMENT MORTAR:

8.1 Water shall conform to specification M-1. Cement shall conform to specification M-3. Sand shall conform to M-5.

8.2 PROPORTION OF MIX: Cement and sand shall be mixed to specified proportions, sand being measured by measuring boxes. The proportion of cement shall be by volume on the basis of 50 Kg./bag of cement being equal to 0.0342 cu.m. The mortar may be hand mixed or machine mixed as directed.

8.3 PREPARATION OF MORTAR: In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing

platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform color so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.

8.4 The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

M-9 STONE COARSE AGGREGATE FOR NOMINAL MIX:

9.1 Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

9.2 The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6 mm. less than the cover whichever is smaller.

TABLE

I.S. Sieve Designation	Percentage passing for single sized aggregates of Nominal size			I.S. Sieve Designation	Percentage passing for single sized aggregates of Normal size		
	40 mm	20 mm	16 mm		40 mm	20 mm	16 mm
80 mm	-	-	-	12.5 mm	-	-	-
63 mm	100	-	-	10.00 mm	0-5	0-20	0-30
40 mm	85-100	100	-	4.75 mm	-	0-50	0-50
20 mm	0-20	85-100	100	2.36 mm	-	-	-
16 mm	-	-	85-100				

NOTE: This percentage may be varied somewhat by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

9.3 The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests indicated in I.S. 383-1970 and I.S. 456-2000 shall have to be carried out to ensure the acceptability. The arrangement shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If the aggregates are covered with dust, they shall be washed with water to make, them clean.

M-10 BLACK TRAP OR EQUIVALENT HARD STONE COARSE:

- 10.1 Aggregate for Design Mix concrete : Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.
- 10.2 The aggregates shall generally be cubical in shape, unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, black trap or equivalent hard stones as approved. Aggregate shall have no deleterious reaction with cement.
- 10.3 The necessary tests indicated in I.S. 383-1970 and I.S. 456-2000 shall have to be carried out to ensure the acceptability of the material.
- 10.4 If aggregate is covered with dust it shall be washed with water to make it clean.

M-11 BRICK BATS AGGREGATE:

- 11.1 Brick bat aggregates shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt of any other foreign material. The brickbats shall be of 40 mm to 50 mm size unless otherwise specified in the item. The under burnt or over burnt brick shall not be allowed.
- 11.2 The brick bats shall be measured by volume by suitable boxes as directed.

M-12 BRICKS:

- 12.1 The bricks shall be hand or machine molded and made from suitable soils and kiln burnt. They shall be free from cracks and flaws not nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform color. The bricks shall be molded with a frog of 100 mm x 40 mm and 10 mm to 20 mm deep on one of its flat sides. The bricks shall not break when dropped on the ground from a height of 600 mm.
- 12.2 The size of modular bricks shall be 190 mm x 90 mm x 90 mm.
- 12.3 The size of conventional bricks shall be as under:
225 x 110 x 75 mm .
- 12.4 Only bricks of one standard size shall be used on one work. The following ipsneces shall be permitted in the conventional size adopted in a particular work.
- | | | |
|--------|---|---------|
| Length | : | 3.00 mm |
| Width | : | 1.50 mm |
| Height | : | 1.50 mm |
- 12.5 The crushing strength of the bricks shall not be less than 35 kg./Sq.cm. The average water absorption shall not be more than 20% by weight. Necessary tests for crushing strength and water absorption etc. shall be carried out as per I.S. 3495 (Part I to IV) –1976.

M-12A FLYASH BUILDING BRICKS

The flyash building bricks shall confirm to IS-13757, IS-5454, IS-12894, IS-3495, IS-3812.
The frog of 80 to 100 mm X 40 mm X 10 to 20 mm size
The size of modular bricks shall be 190 mm X 90 mm X 90 mm.

The size of conventional brick shall be 230 mm X 110 mm X 70 mm.

Only bricks of one standards size shall used on one work. The following tolerances shall permitted in the conventional size adopted in a particular work:

Length	:	±3 mm
Width	:	±2 mm
Height	:	±2 mm

The physical characteristic of bricks shall be as follows –

The minimum compressive strength of Burnt Clay Flyash building bricks shall not be less than 70 kg/sq. cm. And the test shall be conform to IS-3495 (Part-I)

The average water absorption shall not be more than 20 percentage by weight and the test shall confirm to IS-3495 (Part – 3). Sampling of flyash building bricks and criteria for conformity shall be as per IS:5454

M-13 STONE:

- 13.1 The stone shall be of the specified variety such as Granite / Trap stone/Quarzite or any other type of good hard stones. The stones shall be obtained only from the approved quarry and shall be hard, sound, durable and free from defects like cavities, cracks, sand holes, flaws, injurious veins, patches of loose or soft materials etc. and weathered portions and other structural defects and strength. The stone with round surface shall not be more than 5% of dry weight. When tested in accordance with I.S. 1134 – 1974. The minimum crushing of the strength of the stone shall be 200 Kg./Sq.cm. unless otherwise specified.
- 13.2 The samples of the stone to be used shall be got approved before the work is started.
- 13.3 The Khanki facing stone shall be dressed by chisel as specified in the item for khanki facing in required shape and size. The face of the stone shall be so dressed that the bushing on the exposed face shall not project by more than 40mm. from the general wall surface and on face to be plastered it shall not project by more than 19 mm nor shall it have depressions more than 10 mm from the average wall surface.

M-14 MILD STEEL BARS:

- 14.1 Mild steel bars reinforcement for R.C.C. work shall conform to I.S. 432 (Part-I) – 1982 and shall be of tested quality. It shall also comply with the relevant part of I.S. 456-2000.
- 14.2 All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust at the time of placing.
- 14.3 For the purpose of payment, the bar shall be measured correct upto 10 mm length and weight payable worked out as per the rate specified below:

i)6 mm	0.22 Kg/Rmt.	viii) 20 mm	2.47 Kg/Rmt.
ii)8 mm	0.39 Kg/Rmt	ix) 22mm	2.98 Kg/Rmt.
iii)10mm	0.62 Kg/Rmt.	x) 25 mm	3.85 Kg/Rmt.
iv)12 mm	0.89 Kg/Rmt.	xi) 28 mm	4.83 Kg/Rmt.
v)14 mm	1.21 Kg/Rmt.	xii) 32 mm	6.31 Kg/Rmt.
vi)16 mm	1.58 Kg/Rmt.	xiii) 36 mm	7.31 Kg/Rmt
vii)18 mm	2.00 Kg/Rmt.	xiv) 40 mm	9.86 Kg/Rmt

M-15 HIGH YIELD STRENGTH STEEL DEFORMED BARS (CRS – Corrosion Resistant Steel and TMT):

- 15.1 High yield strength steel deformed bars shall be either cold twisted or hot rolled and shall conform to I.S. 1786-1985.
- 15.2 Other provision and requirements shall conform to specification No. M-14 for Mild Steel bars.

M-16 HIGH TENSILE STEEL WIRES:

- 16.1 The high tensile wires for use in pre-stressed concrete shall conform to I.S. 2090-1962.
- 16.2 The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength, minimum strength shall be taken as per para. 6-1 or the I.S. 1785-1962. Testing shall be done as per I.S. requirements.
- 16.3 The high tensile steel shall be free from loose mill scale, rust, oil, grease or any other harmful matter. Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing or passing through a pressure box containing carborundum.
- 16.4 The high tensile wire shall be obtained from manufacturers in coils having diameter not less than 350 times the diameter of wire itself so that wire springs back straight on being uncoiled.

M-17 MILD STEEL BINDING WIRE:

- 17.1 The mild steel wire shall be of 1.63 mm or 1.22 mm (16 or 18 gauge) diameter and shall conform to I.S. 280 –1972).
- 17.2 The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust, oil, paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

M-18 STRUCTURAL STEEL:

- 18.1 All structural steel shall conform to I.S. 226 – 1965. The steel shall be free from the defects mentioned in I.S. 226 –1975 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. Rivet bars shall conform to I.S. 1148-1973.
- 18.2 When the steel is supplied by the Contractor. Test certificates of the manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

M-19 SHUTTERING:

- 1.1 The shuttering shall be either of wooden planking of 30 mm minimum thickness with or without steel lining or of steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical bellies properly cross braced together so as to make the centering rigid. In places of Ballie props, bricks pillar of adequate section built in mud mortar may be used.
- 1.2 The form work shall be sufficiently strong and shall have camber, so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration of concrete, live load of men, working with it and other incidental loads associated

- with it. The shuttering shall have smooth and even surface and its joints shall not permit leakages of cement grout.
- 1.3 If at any stage of work during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete form work shall be got inspected by and approved from Engineer-in-charge, before the reinforcement bars are placed in position.
 - 1.4 The props shall consists of bullies having 100 mm minimum diameter measured at mid length and 80 mm at the end and shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm. thick and minimum bearing area of 0-10 sq.m. laid on sufficiently hard base.
 - 1.5 Double wedges shall further be provided between the sole plate and wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.
 - 1.6 The timber used in shuttering shall not be so dry so as to absorb water from concrete and swell or bulge nor so green or wet so as to shrink after erection. The timber shall be properly swan and planed on the sides and the surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted.
 - 1.7 As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.
 - 1.8 The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.
 - 1.9 The shuttering for beams and slabs shall have camber of 4 mm per meter (1 in 250) or as directed by the Engineer-in-charge so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-charge.

M-20 TEAK WOOD:

- 20.1 The teak wood shall be of good quality as required for the item to be executed. When the kind of wood is not specifically mentioned, good Indian teak wood as approved shall be used.
- 20.2 Teak wood shall generally be free from large, loose, dead or cluster knots, flaws, warps, twists, shakes, bends or any other defects. It shall generally be uniform in substance and of straight fibers as far as possible. It shall be free from rot, decay, harmful fungi and other defects of harmful nature, which will affect the strength, durability or its usefulness for the purpose for which it is required. The color shall be uniform as far as possible. Any effort like painting, using any adhesive or resinous materials made to hide the defects shall render the pieces liable to rejection by the Engineer-in-charge.
- 20.3 All scantlings, planks etc. shall be sawn in straight lines and planes in the direction of grains and of uniform thickness.

20.4 The tolerances in the dimensions shall be allowed at the rate of 1.5 mm per face to be planed.

20.5 First Class Teak Wood:

First class teak wood shall have no individual hard and sound knots, more than 6 sq.cm. in size and the aggregate area of such knots shall not be more than 1% of area of piece. The timber shall be closed grained.

20.6 Second Class Teak Wood:

No individual hard and sound knots shall be more than 15 sq.cm. in size and aggregate area of such knots shall not exceed 2% of the area of piece.

M-21 NON-TEAK WOOD:

The non teak wood shall be chemically treated, seasoned as per I.S. Specifications and of good quality. The type of wood shall be got approved before collecting the same on site. Fabrication of wooden members shall be started only after approval. For this purpose wood of Bio, Kalai, Sires, Saded, Behda, Jamun, Sisoo will be used for door frames whereas only Kalai, Siras, Halda, Kalam etc. will be permitted for shutters after proper seasoning and chemical treatment.

The non teak wood shall be free from large, loose dead or cluster knots, flaws, shakes, warps, bends, or any other defect. It shall be uniform in substance and of straight fibres as far as possible. It shall be free from rots, decay, harmful fungi and other defects of similar nature which will affect the strength, durability or its usefulness for the purpose for which it is required. The colour of the wood shall be uniform as far as possible. The scantlings, planks etc. shall be sawn in straight lines and planes in the direction of grain and of uniform thickness.

The department will use the Agency to produce a certificate from the Forest Department in the event of a dispute and the decision of the Department shall be final and binding to the Contractor.

M-22 WOODN FLUSH DOOR SHUTTERS (SOLID CORE):

22.1 The solid core type flush door shutters shall be of decorative or non –decorative type as specified in the drawing. The size and thickness of the shutter shall be as specified in drawings or as directed. The timber species for core shall be used as per I.S. 2202- (Part-I) – 1980. The timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross-section of the members, pitch streaks and harmless pin holes shall be permissible except in the exposed edges of the core members. The commercial plywood, cross bands shall conform to I.S. 303-1275.

22.2 The face panel of the shutters shall be formed by gluing by the hot press process on both faces of the core with either plywood or coarse bands, and face veneers. The lipping, rebating, opening of glazing, venation etc. shall be provided if specified in the drawing.

22.3 All edges of the door shutters shall be square. The shutters shall be free from twist or warp in its plane. Both faces of the shutters shall be sand papered to smooth even texture.

22.4 The shutters shall be tested for ----

- i) End Immersion Test : The test shall be carried out as per I.S. 2202 (Part-I) 1980. There shall be no delamination at the end of the test.
- ii) Knife Test : The face panel when tested in accordance with I.S. 1659 – 1979 shall pass the test.
- iii) Glue Adhesion Test : The flush door shall be tested for glue adhesive test in accordance with I.S. 2202 (Part-I) – 1980. The shutters all be considered to have passed the test if no delamination occurs in the glue lines in the plywood and if no single delamination more than 80 mm. in length and more than 3 mm. in depth has occurred in the assembly glue lines between the plywood face and the style and rail. Delamination at the corner shall be measured continuously around the corner.

Delamination at the knots knot, hole and other permissible wood defects shall not be considered in assessing the sample.

22.5 The tolerance in size of solid core type flush door as under –

In nominal thickness # 1.2 mm. In nominal height # 3 mm. The thickness of the shutters shall be uniform throughout with a permissible variation of not more than 0.8 mm. when measured at any two points.

M-23 ROLLING SHUTTERS:

- 23.1 The rolling shutters shall conform to I.S. 6248-1979. Rolling shutters shall be supplied of specified type with accessories. The size of the rolling shutters shall be specified in the drawings. The shutters shall be constructed with interlocking lath sections formed from cold rolled steel strips not less than 0.9 mm. thick and 80 mm. wide for shutters up to 3.5 m. width not less than 1.25 mm. thick and 80 mm. wide for shutters 3.5 m. in width and above unless otherwise specified.
- 23.2 Guide channels shall be of mild steel deep channel section and of rolled pressed or built up (fabricated) joint less construction. The thickness of sheet used shall not be less than 3.15 mm.
- 23.3 Hood covers shall be made of M.S. sheets not less than 0.92 mm. thick. For shutters having width 3.5 mts. and above, the thickness of M.S. sheet for the hood covers shall be not less than 1.25 mm.
- 23.4 The spring shall be of best quality and shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in position. The spring pipe shaft etc. shall be supported on strong M.S. or malleable C.I. brackets. The brackets shall be fixed on the or under the lintel as specified with rawl plugs and screws bolts etc.
- 23.5 The rolling shutters shall be of self rolling type upto 8 sq.m. clear area without ball bearing and upto 12 sq.m. clear area with ball bearing. If the rolling shutters are of larger then gear operated type shutters shall be used.

- 23.6 The locking arrangement shall be provided at the bottom of shutter at both ends. The shutters shall be opened from outside.
- 23.7 The shutters shall be completed within door suspension, shafts, locking arrangements, pulling hooks, handles and other accessories.

M-24 COLLAPSIBLE STEEL GATE:

- 24.1 The collapsible steel gate shall be in one or two leaves and size as per approved drawings or as specified. The gate shall be fabricated from best quality mild steel channels, plates etc. Either steel pulleys or ball bearings shall be provided in every double channel. Unless otherwise specified the particulars of collapsible gate shall be as under..
- i) Pickets : These shall be of 20 mm. M.S. channels of heavy sections unless otherwise shown on drawings. The distance center to center of pickets shall be 12 cms. with an opening of 10 cms.
 - ii) Pivoted M.S. flats shall be 20 mm. x 6 mm.
 - iii) Top and bottom guides shall be from tee or flat iron of approved size.
 - iv) The fittings like stoppers, fixing hold fasts, locking cleats, brass handles and cast iron rollers shall be of approved design and size.

M-25 GLASS :

- 25.1 All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes blisters and other defects. The kind of glass to be used shall be as mentioned in the item or specification or in the special provisions or as shown in detailed drawings. Thickness of glass panes shall be uniform. The specifications for different kinds of glass shall be as under-

Sheet Glass:

In the absence of any specified thickness or weight in the item or detailed specifications of the item of work, sheet glass shall be weighing 7.5 Kg./Sq.m. for panes upto 600 mm x 600 mm.

For panes larger than 600 mm. x 600 mm. and upto 800 mm. x 800 mm. glass weighing not less than 8.75 Kg. / Sq.m. shall be used. For bigger panes upto 900 mm. x 900 mm. glass weighing not less than 11.25 Kg./Sq.m. shall be used.

Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to I.S. 761-1960. Sheet glass of the specified colors shall be used, if so shown on detailed drawings or so specified. For important buildings and for panes with any dimensions over 900 mm. plate glass of specified thickness shall be used.

Plate Glass:

When plate glass is specified it shall be "Polished Patent Plate Glass" of best quality. It shall have both the surface ground flat and parallel and polished to obtain clear undisturbed vision and reflection. The plate glass shall be of the thickness mentioned in the item or as shown in the detailed drawing or as specified. In the absence of any specified thickness, the thickness of plate glass to be supplied shall be 6 mm. and a tolerance of 0.20 mm. shall be admissible.

Obscured Glass:

This type of glass transmits light so that vision is partially or almost completely obscured. Glass shall be plain rolled, figured, ribbed or fluted, or frosted glass as may be specified as required. The thickness and type of glass shall be as per details on drawings or as specified or as directed.

Wired Glass :

Glass shall be with wire netting embedded in a sheet of plane glass. Electrically welded 13 mm. Geogain square mesh shall be used. Thickness of glass shall not be less than 6 mm. wired glass shall be of type and thickness as specified.

M-26 FIXTURES & FASTENINGS:**General**

- i) The fixtures and fastenings, that is, butt, hinges, tee and strap hinges, sliding door bolts, tower bolts, door latch, bath room latch, handles, door stoppers, casement window fasteners, casement stays and ventilator catch shall be made of the metal as specified in the item or its specifications.
- ii) They shall be of iron, brass, aluminum, chromium plated iron, chromium plated brass, copper oxidized iron, copper oxidized brass or anodized aluminum as specified.
- iii) The fixtures shall be heavy, medium or light type. The fixtures and fastenings shall be smooth finished and shall be such as will ensure ease of operation.
- iv) The samples of fixtures and fastenings shall be got approved as regards quality and shape before providing them in position.
- v) Brass and anodized aluminum fixtures and fastenings shall be bright finished.

Holdfasts:

- i) Holdfasts shall be made from mild steel flat 30 cm. Length and one of the holdfasts shall be bent at right angle and two nos. of 6 mm. dia. holes shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite directions.

Butt Hinges:

- i) Railway standard heavy type butt hinges shall be used when so specified.
- ii) Tee and strap hinges shall be manufactured from M.S. sheet.

Sliding Door Bolts (Aldrops) :

- i) The aldrops as specified in the item shall be used and shall be got approved.

Tower Bolts (Barrel Type):

- i) Tower bolts as specified in the item shall be used and shall be got approved.

Door Latch

- i) The size of door latch shall be taken as the length of latch.

Bathroom Latch:

- i) Bathroom latch shall be similar to tower bolt.

Handle:

- i) The size of the handles shall be determined by the inside grip length of the handles. Handles shall have a base plate of length 50 mm. More than the size of the handle.

Door Stoppers:

- i) Door stoppers shall be either floor door stopper type or door catch type. Floor stopper shall be of overall size as specified and shall have a runner cushion.

Door Catch :

- i) Door catch shall be fixed at a height of about 900 mm. from the floor level such that one part of the catch is fitted on the inside of the shutter and other part is fixed in the wall with necessary wooden plug arrangements for appropriate fixity. The catch shall be fixed 20 mm. inside the face of the door for easy operation of catch.

Wooden Door Stop with Hinges:

- i) Wooden door stop of size 100 mm. x 60 mm x 40 mm shall be fixed on the door frame with a hinge of 75 mm. size and at a height of 900 mm. from the floor level. The wooden door stop shall be provided with 3 coats of approved oil paint.

Casement window Fastener:

Casement window fastener for single lead window shutter shall be left or right handed as directed.

Casement Stays (Straight Peg. Stay):

- i) The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully or partially as directed.

Size of the stay shall be 250 mm to 300 mm. as directed.

Ventilation Catch:

- i) The pattern and shape of the catch shall be as approved.

Pivot:

- i) The base and socket plate shall be made from minimum 3 mm. thick plate, and projected pivot shall not be less than 12 mm. dia. and 12 mm. length and shall be firmly riveted to the base plate case of iron pivot and in single piece base in the case of brass pivot.

M – 27 PAINTS:**27.1 Oil Paints:**

Oil paints shall be of the specified color and shade, and as approved. The ready mixed paints shall only be used.

However, if ready mixed paint of specified shade or tint is not available white ready mixed paint with approved strainer will be allowed. In such a case, the Contractor shall ensure that the shade of the paint so allowed shall be uniform.

All the paints shall need with the following general requirements –

- i) Paint shall not show excessive setting in a freshly opened full can and shall easily be re-dispersed with paddle to a smooth homogeneous state. The paint shall show no curling, levering, caking or color separation and shall be free from lumps and skins.
- ii) The paint as received shall brush easily, possess good leveling properties and show no running or sagging tendencies.
- iii) The paint shall not skin within 48 hours in a three quarters filled closed container.

- iv) The paint shall dry to a smooth uniform finish free from roughness, grit unevenness and other imperfections.

Ready mixed paint shall be used exactly as received from the manufacturers and according to their instructions and without any admixtures whatsoever.

27.2 Enamel Paints

The enamel paint shall satisfy in general requirements as mentioned in specification of oil paints. Enamel paints shall conform to I.S. 2933-1975.

M-28 FRENCH POLISH:

The French polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials.

- i) Denatured spirit of approved quality.
- ii) Shellac
- iii) Chandras
- iv) Pigment

M-29 MARBLE CHIPS FOR MARBLE MOSAIC TERRAZZO:

- 29.1 The marble chips shall be of approved quality and shade. It shall be hard, sound, dense and homogeneous in texture with crystalline and coarse grains. It shall be uniform in color and free from stains, cracks, decay and weathering.
- 29.2 The size of various colors of marble chips ranging from the smallest up to 20 mm. Shall be used where the thickness of top wearing layers is 6 mm. in size. The marble chips of approved quality and colors only as per grading as decided by the quality and colors as decided by the Engineer-in-charge shall be used for marble mosaic tiles or works.
- 29.3 The marble chips shall be machine crushed. They shall be free from foreign matter, dust etc. Except as above the chips shall conform to I.S. 2114-1962.

M-30 FLOORING TILES:

A Plain Cement tiles:

- 30.1.1 The plain cement tiles shall be of general purpose type. These are the tiles in the manufacture of which no pigments are used. Cement used in the manufacture of tiles shall be as per Indian Standards.
- 30.1.2 The tiles shall be manufactured from a mixture of cement and natural aggregates by pressure process. During manufacture, the tiles shall be subjected to a pressure of not less than 140 kg/sq.cm. The proportion of cement to aggregate in the backing of the tiles shall be not leaner than 1:3 by weight. The wearing face, though the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm in size. The proportion of cement to the marble chips aggregate in the wearing layer of the tiles shall be three parts of cement to one part of chips by weight. The minimum thickness of wearing layer shall be 3 mm. The color and texture of wearing layer shall be uniform throughout in face and thickness. On removal from mould, the tiles shall be kept in moist condition continuously

atleast for seven days and subsequently, for such long period as would ensure their conformity to requirements of I.S. 1237-1980 requiring resistance to wear and water absorption.

- 30.1.3 The wearing face of the tiles shall be plain, free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tile. All angles shall be right angle and all edges shall be sharp and true.
- 30.1.4 The tile sizes shall generally be square shape 24.85 cm. X 24.85 cm. or 25 cm x 25 cm. The thickness of the tiles shall be 20 mm.
- 30.1.5 The tolerance for length and breadth shall be plus or minus 1 mm. the tolerance on thickness shall be plus 5 mm.
- 30.1.6 The tiles shall satisfy the tests as regards transverse strength, resistance to wear and water absorption as per I.S. 1237 – 1980.

B Plain Colored Tiles:

- 30.2.1 These tiles shall have the same specifications as for plain cement tiles as per (A) above except that they shall have a plain wearing surface wherein pigments are used. They shall conform to I.S. 1237-1980.
- 30.2.2 The pigment used for coloring cement shall not exceed 10% by weight of cement used in the mix. The pigments, synthetic or otherwise, used for flouing tiles shall have permanent color and shall not contain materials detrimental to concrete.
- 30.2.3 The color of the tiles shall be specified in the item or as directed.

C Marble Mosaic Tiles:

- 30.2.4 These tiles have the same specifications as per plain cement tiles except the requirements as stated below-
- 30.2.5 The marble mosaic tiles shall conform to I.S. 1237 – 1980. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free of projections, depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.
- 30.2.6 The tiles shall be prepared from cement conforming to Indian Standards or colored Portland cement generally depending upon the color of tiles to be used or as directed.

D Chequered Tiles

- 30.4.1 Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per (A) above and the latter as per marble mosaic tiles as per (C) except as mentioned below.
- 30.4.2 The tiles shall be of nominal size of 250 mm. x 250 mm. or as specified. The center to center distance of the chequer shall not be less than 25 mm. and not more than 50 mm. The overall thickness of the tile shall be 22 mm.
- 30.4.3 The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain, colored or mosaic as specified.

The thickness of the upper layer measured from the top of the chequers shall not be less than 6 mm. The tiles shall be given the first grinding with machine before delivery to site.

30.4.4 Tiles shall conform to relevant I.S. 1237-1980.

E Chequered Tiles for Staircases:

30.5.1 The requirements of these tiles shall be the same as chequered tiles as per (D) above except in following respects:

- i) the length of a tile including nose shall be 330 mm.
- ii) The minimum thickness shall be 28 mm.
- iii) The nosing shall have the same wearing layer at the top.
- iv) The nosing edge shall be rounded.
- v) The front portion of the tile for a minimum length of 75 mm. from and including the nosing shall have grooves running parallel to nosing and at centers not exceeding 25 mm. Beyond that the tiles shall have normal chequered pattern.

M31 ROUGH KOTAH STONE:

31.1 The kotah stones shall be hard, even, sound and regular in shape and generally uniform in color. The color of the stone shall generally be green. Brown colored stones shall not be allowed for use. They shall be without any soft veins, cracks or flaws.

31.2 The size of the stones to be used for flooring shall be of size 600 mm. x 600 mm. and / or size 600 mm. x 450 mm as directed. However, smaller sizes will be allowed to be used to the extent of maintaining the required pattern. Thickness shall be as specified.

31.3 Tolerance of minus 30 mm. on account of chisel dressing of edges shall be permitted for length as well as breadth. Tolerance in thickness shall be plus 3 mm.

31.4 The edges of stones shall be truly chiseled and table rubbed with coarse sand before paving. All angles and edges of the stone shall be true, square and free from chipping and the surface shall be true and plain.

31.5 When machine cut edges are specified, the exposed edges and the edges at joints shall be machine cut. The thickness of the exposed machine cut edges shall be uniform.

M-32 POLISHED KOTAH STONES:

32.1 Polish kotah stone shall have the same specifications as per rough kotah stone except as mentioned below:

The stone shall have machine polished smooth surface. When brought on site, the stones shall be single polished or double polished depending upon its use. The stones for paving shall generally be single polished, the stones to be used for dado, skirting, platforms sink, veneering, sills, steps etc. where machine polishing after the stones are fixed in situ is not possible shall be double polished.

M-33 WHITE GLAZED TILES:

33.1 The tiles shall be of best quality as approved by the Engineering-in-charge. They shall be flat and true to shape. They shall be free from cracks, crazing, spots, chipped edges and corners. The glazing shall be of uniform shade.

33.2 The tiles shall be of nominal size of 150 mm. x 150 mm. unless otherwise specified. The maximum variation from the stated sizes, other than the thickness of tile, shall be plus or minus 1.5 mm. The thickness of the tile shall be 6 mm. except as above the tiles shall conform to I.S. 777-1970.

M-34 GALVANISED IRON PIPES AND FITTINGS:

Galvanized iron pipe shall be of the medium type and of required diameter and shall comply with I.S. 1239-1979. The specified diameter of the pipes shall refer to the inside diameter of the bore. Clamps, screw and all galvanized iron fittings shall be of the standard "R" or equivalent make.

M-35 BIB COCK AND STOP COCK:

35.1 A bib cock is a draw off tap with a horizontal inlet and a free outlet. A stop cock is a valve with a suitable means of connection for insertion in a pipe line for controlling or stopping the flow.

35.2 They shall be of screw down type and or brass chromium plated and of diameter as specified in the description of the item. They shall conform to I.S. 781 – 1977 and they shall be of best Indian make. They shall be polished bright.

35.3 The minimum finished weight of bib cock and stop cock shall be as given below –

Dia.	Bib cock	Stop cock	Dia.	Bib cock	Stop cock
8mm	0.25 kg.	0.25 kg.	15mm	0.40 kg	0.40 kg
10mm	0.30 kg.	0.35 kg.	20mm	0.75 kg.	0.75 kg.

M-36 GUN METAL WHEEL VALVE:

36.1 The gun metal wheel valve shall be of approved quality. These shall be of gun metal fitted with wheel and shall be of gate valve opening full way and of the size as specified. These shall conform to I.S. 778-1971.

M-37 WHITE GLAZED PORCELAIN WASH BASIN:

- 37.1 Wash basin shall be of white porcelain first quality best Indian make and it shall conform to I.S. 2556 (Part – IV) 1972 and I.S. 771-1979. The size of the wash basin shall be as specified in the item. The wash basin shall be of one piece construction with continued over-flow arrangements. All internal angles shall be designed so as to facilitate cleaning. Wash basin shall have single tap hole or two holes as specified. Each basin shall have a circular waste hole which is either rebated or beveled internally with 65 mm. dia. to top and 10 mm. depth to suit the waste fitting. The necessary stud slot to receive the bracket on the under side of the basin shall be provided. Basin shall have an internal soap holder recess which shall fully drain into the bowl.
- 37.2 White glazed pedestal of the quality and color as that of the basin shall be provided where specified in the item. It shall be completely recessed at the back for reception of supply and water pipe. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 750 mm. to 800 mm. as directed.

M-38 CAST IRON PIPES AND FITTINGS:

- 38.1 All soil, waste, vent and antisiphonage pipes and fittings shall conform to I.S. 1729-1964. the pipes shall have spigot and socket ends with head on spigot end. The pipes and fittings shall be true to shape, smooth, cylindrical their inner and outer surfaces being as nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks, laps, pin holes or other imperfections and shall be neatly dressed and carefully fettled.
- 38.2 The end of pipes and fittings shall be reasonably square to their axis.
- 38.3 The sand cast iron pipes shall be of the diameter as specified in the description and shall be in length of 1.5 M., 1.8 M. & 2.0 M. including socket ends of the pipe unless shorter length are either specified or required at junction etc. The pipes and fittings shall be supplied without ears unless specified or directed otherwise.
- 38.4 Tolerances : The standard weights and thickness of pipes shall be as shown in the table below. A tolerance upto minus 10% may however be allowed against these standard weight.

Sr. No	Nominal Dia	Overall Thickness	Weight of Pipe Excluding Ears		
			1.5M.long	1.8M long	2M. long 1
1.	75 mm.	5.0 mm.	12.83 Kg.	16.52 kg.	18.37 kg.
2.	100 mm.	5.0 mm.	18.14 kg.	21.67 kg.	24.15 kg.
3.	150 mm				
4.	250 mm				

A tolerance upto minus 15% in thickness and 20 mm. in length will be allowed. For fittings tolerance in lengths shall be plus 25 mm. and minus 10 mm.

The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerance in weights and thickness shall be the same as for straight pipes.

M-39 ASBESTOS CEMENT PIPE (A.C. PIPE):

- 39.1 The asbestos cement pipe of diameter as specified in the description of the item shall conform to I.S. 1926-1980. Special like bends, shoes cowls, etc. shall conform to relevant Indian Standards. The interior of pipe shall have a smooth finish, regular, surface and regular internal diameter. The tolerance in all dimensions shall be as per I.S. 1926- Part-I-1980.

M-40 BITUMEN FELT FOR WATER PROOFING AND DAMP PROOFING:

- 40.1 Bitumen felt shall be on the Hessian bases and shall be of type 3, self finished felt grader and shall conform to I.S. 1322-1970.

M-41 SELECTED EARTH:

- 41.1 The selected earth shall be that obtained from excavated material or shall have to be brought from outside as indicated in the item. If item does not indicate anything, the selected earth shall have to be brought from outside.
- 41.2 The selected earth shall be good yellow soil and shall be got approved from the Engineer-in-charge. In no case black cotton soil or similar expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones or brick bats. The clods shall be broken to a size of 50 mm. or less. Contractor shall make his own arrangements at his own costs for land for borrowing selected earth. The stacking of materials shall be done as directed by the Engineer-in-charge in such a way as not to interfere with any constructional activities and in proper stacks.
- 41.3 When excavated material is to be used, only selected, stuff got approved from the Engineer-in-charge shall be used. It shall be stacked separately and shall comply with all the requirements of selected earth mentioned above.

M-42 MARBLE SLAB:

Marble slabs shall be white or of other colour and of best quality as approved by the Engineer-in-charge. Slab shall be bard, close, uniform and in texture. They shall also be free of defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and the edges machine cut true and square. The rear face shall be rough enough to provide key for the mortar.

Marble slabs with natural veins, if selected shall have to be laid as per the pattern given by the Engineer-in-charge. Size of the slabs shall be minimum 450 mm x 450 mm. and preferably 600 mm x 600 mm. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern.

The slab shall not be thinner than the specified thickness at its thinnest part. A few specimen of finished to be used shall be deposited by the Contractor in the office for reference.

Except as above, the marble slabs shall conform to I.S. 1130 –1969 or as revised from time to time.

M-43 INDIAN TYPE WATER CLOSET:

The Indian type white glazed water closet of first class quality, size as specified in the item and conforming to I.S. 771-1979 and I.S. 2556- (Part-II) – 1981. Each pan shall have integral flushing ring of suitable type with adequate number of holes all around as directed to have satisfactory flushing. It shall also have an inlet at back of front for connecting flush pipe as directed. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth. Pan shall be provide with 100 mm. diameter “p” or “S” trap with approximately 50 mm. water seal and 50 mm. diameter vent horn.

FOOT RESTS:

A pair of white glazed earthen ware rectangular foot rests of minimum size 250 mm x 130 mm. shall be provided with the water closet.

M-44 GLAZED EARTHEN WARE SINK:

The glazed earthenware sink shall be of specified size, colour and quality. The sink shall conform to I.S. 771- Part-II-1979. The brackets for sinks shall conform to I.S. 775-1970. The pipes shall conform to I.S. 1239- Part-I-1973 and I.S. 404-1962 for steel and lead pipes respectively. 32 mm brass waste coupling of standard pattern with brass chain and rubber plug shall be provided with sink.

M-45 GLAZED EARTHEN WARE LIPPED TYPE FLAT BACK URINAL / CORNER TYPE URINAL.

The lipped type urinal shall be flat back or corner type as specified in the item and shall conform to I.S. 771-1979.

It shall be of best Indian make and size as specified and approved by the Engineer-in-charge. The flat back or corner type urinal must be of first class quality, free from any defects, cracks etc.

M-46 FLUSH COCK:

Half turn flush cock (heavy weight) shall be of gun metal chromium plated of diameter as specified in the description of the item. The flush cock shall conform to relevant Indian Standards.

M-47 NAHNI TRAP:

Nahni trap shall be of cast iron and shall be sound and free from porosity or other defects which affect serviceability. The thickness of the base metal shall not be less than 6.5 mm. The surface shall be smooth and free from crack, chips and other flaws or any other kind of defects which affect serviceability. The size of nahni trap shall be as specified and shall be of self cleansing design.

The nahni trap shall be of quality approved by the Engineer-in=charge and shall generally conform to the relevant Indian Standards.

The nahni trap provided shall be with deep seal, minimum 50 mm. except at places where trap with deep seal can not be accommodated. The cover shall be cast iron, Perforated cover shall be provided on the trap of appropriate size.

M-48 GULLY TRAP:

Gully trap shall conform to I.S. 651-1960. It shall be sound, free from defects such as fire cracks or hair cracks. The glaze of the traps shall be free from crazing.

They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters.

The size of the gully trap shall be as specified in the item.

Each gully trap shall have one C.I. grating of square size corresponding to the dimensions, of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 mm x 300 mm. The cover weighing not less than 4.53 Kg. and the frame not less than 2.72 Kg. The grating cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

M-49 GLAZED STONE WARE PIPE AND FITTINGS:

The pipes and fittings shall be of best quality as approved by the Engineer-in-charge. The pipe shall be of best quality manufactured from stone-ware of fire clay, salt glazed thoroughly burnt throughout the whole thickness, of a close even texture, free from air blows, fire blisters, cracks and other imperfections, which affect the serviceability. The inner and outer surfaces shall be smooth and perfectly glazed. The pipe shall be capable to withstand pressure of 1.5 m. head without showing signs of leakage. The thickness of the wall shall not be less than $1/12^{\text{th}}$ of the internal dia. The depth of socket shall not be less than 38 mm. The socket shall be sufficiently large to allow a joint of 6 mm. around the pipe. The pipes shall generally conform to relevant I.S. 651-1980.

M-50 CRYDON BALL VALVE:

Ball valve of screwed type including polythene float and necessary lever etc. shall be of the size as mentioned in the description of item and shall conform to I.S. 1703-1977.

M-51 CRACKSEAL:

Crackseal manufactured by Chemistic / Chemisol Indian Ltd., is an acrylic base ready application compound.

M-52 COLORED CEMENT

52.1 Colored cement shall be with white or gray Portland cement as specified in the item of the work.

52.2 The pigments used for colored cement shall be of approved quality and shall not exceed 10% of cement used in the mix. The mixture of pigments and cement has such properties as to provide for durability under exposure to sunlight and weather.

M-53 STONE DUST:

53.1 This shall be obtained from crushing hard black tray or equivalent, it shall not contain more than 8% of silt as determined by field test with measuring cylinder. The method of determining silt contents by field test is given as under:

53.2.1 A sample of stone dust to be tested shall be placed without drying in 200 mm measuring cylinder. The quantity of the sample shall be such that it fills the cylinder upto 100-mm mark. Clean water shall be added upto 150 mm mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

53.3 The height of silt visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below. The stone dust containing more than 8% silt shall be washed so as to bring the silt content within the allowable limit.

53.4 The fineness modulus of stone dust shall not be less than 1.80.

M-54 CINDER:

54.1 Cinder is well burnt furnace residue which has been fused or sintered into lumps of varying sizes.

54.2 Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only. It shall be sound clean and free clay, dirt, ash or other deleterious matter.

54.3 The average grading for cinder aggregates shall be as mentioned below.

20 mm	100
10 mm	86
5.75 mm	70
2.36mm	52

M-55 GALVANIZED IRON SHEETS:

55.1 The galvanized iron sheets shall be plain or corrugated sheets of gauge as specified in item. The G.I. sheets shall conform to IS: 277-1977. The sheets shall be undamaged in carriage and handling either by rubbing off of zinc coating or otherwise. They shall have clean and bright surface and shall be free from dents, bends, holes, rust or white powdery deposit.

55.2 The length and width of G.I. sheets shall be as directed as per site condition.

M55-A G.I. VALLEYS GUTTER, RIDGES:

55-A.1 The G.I. ridges and hips shall be of plain galvanized sheet class-3 of the thickness as specified in item. These shall be 600-mm width and properly bent up to shape without damage to the sheets in process of bending.

55-A.2 Valley gutters and flashing shall be also of galvanized sheet of thickness as specified in item. Valleys shall be 900 mm wide over all and flashing shall be 380 mm, wide over all. They shall be bent to the required shape without damage to the sheet in the process of bending.

M-56 ALUMINIUM DOORS, WINDOWS, VENTILATORS:

56.1 Aluminum alloy used in the manufacture of extruded window sections shall conform to IS designation HEA-WP of IS:733-1975 and also to IS: Designation WVG-WP OF IS: 1285-1975. The sections shall be as specified in the drawing and design. The fabrication shall be done as directed.

56.2 The hinges shall be cast or excluded aluminum hinges of same type as in window but of large size.

56.3 The hinges shall normally be of 50 mm projecting types non-projecting type of hinges may also be used if directed. The handles of door shall be of specified design. A suitable lock for the door operable either from outside shall be provided. In double shutter door, the first closing shall have a concealed aluminum alloy bolt at top and bottom.

M-57 PLYWOOD

57.1 The plywood for general purpose shall conform to IS:303-1975. Plywood is made by cementing together thin boards or sheets of wood into panels. There are always an odd number of layers 3,5,7,9 ply etc. The piles are placed so that the grain of each layer is at right angles to the grain in the adjacent layers.

57.2 The chief advantage of plywood over a single board of the same thickness is the more uniform strength of the plywood along the length and width of the plywood and greater resistance to cracking and slitting with change in moisture content.

57.3 Usually synthetic resins are used for gluing. Phenolic resins are usually cured in a hot press which compresses and simultaneously heats the piles between hot plates which maintain a temperature of 90 – degree C. to 140 degree C. and a pressure of 11 to 14 kg./sq.cm. on the wood. The time of heating may be any thing from 2 to 60 minutes depending upon thickness.

57.4 When water glue are used the wood absorbs so much water that the finished plywood must be dried carefully. When synthetic resins are used as adhesive, the finished plywood must be exposed to atmosphere of controlled humidity until the proper amount of moisture has been absorbed.

57.5 According to IS:303-1975 the plywood for general purpose shall be of three grades namely BWR, WWR and CWR depending upon the adhesives used for bonding the veneers and it will be further classified into six types namely AA, AB, AC, BB, BC and CC based on the quality of the two faces, each being of three kinds namely A, B and C. After pressing, the finished plywood should be reconditioned to a moisture content not less than 8 percent and not more than 16 percent.

57.6 THICKNESS OF PLYWOOD BOARDS

Board

Thickness

3 ply	3mm
	4mm
	5mm
	6mm
5 ply	5mm
	6mm
	8mm
	9mm
7 ply	9mm
	13mm
	16mm
9 ply	13mm
	16mm
	19mm
11 ply	19mm
	22mm
	25mm

M-58 FLUSH COCK:

Half turn flush cock (heavy weight) shall be of gun metal chromium plated of diameter as specified in the description of the item. The flush cock shall conform to relevant Indian Standards.

EXECUTIVE ENGINEER
RAIPUR SMART CITY LIMITED.

SIGNATURE AND SEAL OF THE CONTRACTOR:

NAME AND ADDRESS:

DATE:

INDICATIVE VENDOR LIST

S.No.	Item/equipment	List of Makes of various equipment
1	Sluice Valve / Reflux Valve/	Fouress/ IVC/ Kirloskar/ IVI/Calsens/ LP Valves or equivalent as per tender technical specification.
2	Butterfly valve	
3	Air valve	
4	DI pipes	Jindal, TATA Metallic, Electrosteel.
5	Reinforcement Steel	SAIL, VIZAG STEEL, TATA TISCO.
6	Cement	ACC, Ambuja, Lafarge, Ultratech.
7	Pressure Gauge	AN Instruments, Altop Industries limited, Mazgaon Instrument, Precision industries (MASS, Ashcroft, Heise), Gauges Bourdon (India) Ltd., WIKA Instruments India Pvt. Ltd., Goa Instruments Industries Pvt. Ltd., M Guru Controls Pvt. Ltd., Pyro Electric Instruments Pvt. Ltd., Walchandnagar Industries Ltd., Baumer Technologies India Pvt. Ltd.
8	Pressure Switch	Baumer Technologies India Pvt. Ltd., Chemtrols, Dag Process Instruments, Gauges Bourdon (India) Ltd., Indfos Industries Ltd., Orion Instruments, Precision industries (MASS, Ashcroft, Heise), Switzer Instrument Ltd., Sherman International Pvt. Ltd., Varma Trafag Ind. Pvt. Ltd., WIKA Instruments India Pvt. Ltd.
9	Differential Pressure Gauge	Gauges Bourdon (India) Ltd., AN Instruments, Baumer Technologies India Pvt. Ltd.,
10	Differential Pressure Switch	Indfos Industries Ltd. Switzer Instrument Ltd., Varma Trafag Ind. Pvt. Ltd., Baumer Technologies India Pvt. Ltd., Gauges Bourdon (India) Ltd.,
11	Pressure Transmitter	Foxboro (Schneider electric), Nivo Controls Pvt. Ltd., Honeywell
12	Differential Pressure Transmitter	Baumer Technologies India Pvt. Ltd., Honeywell

13	Electromagnetic Flowmeter (Bulk & Domestic)	Instrumentation Engineers Limited, Foxboro (Schneider electric), Honeywell Automation India Ltd., Manas Microsystems Pvt. Ltd., Nivo Controls Pvt. Ltd., Siemens Ltd., Toshbro Controls Pvt. Ltd. (Nivo controls), Yokogawa India Ltd., ABB Instrumentation Limited, Endress+Hauser (India) Pvt Ltd, Krohne Marshall, Mikamachi or equivalent as per tender technical specification.
14	Pressure Reducing Valve	Bermad, Fouress, IVC, IVI or equivalent as per tender technical specification.
15	Programmable Logic Controller	Siemens Ltd., Schneider Electric India Pvt. Ltd., Yokogawa India Ltd., ABB Instrumentation Limited, GE Fanuc Systems Pvt. Ltd. [GE Intelligent Platforms], Honeywell Automation India Ltd., Mitsubishi electric India Pvt. Ltd., Rockwell Automation India Pvt Ltd,
16	Domestic water meter	Itron, Zenner, ARAD, Belan, Honeywell, Dasmesh, Xylem (Census), Kamstrup, loTA, Electronet, RLT, Adept, Venus
17	PE-AL-PE Pipe	Jindal, KiTEC.
18	Instrumentation Cable	Associated Cables Pvt. Ltd., Associated Flexibles & Wires Pvt. Ltd., Chandresh cables Limited (Avocab), Belden, Cords India Ltd., Delton Cables, Finolex cables Limited, GEMSCAB, Helukable India Pvt. Ltd., Kerpen cables, LAPP India Pvt. Ltd., Nicco Corporation Limited, POLYCAB WIRES PVT. LTD., RPG Cables (a division of KEC International Limited), TCL Cables Ltd., TC Communications Pvt, LTD., Thermo Cables Ltd., Udey Pyrocables Pvt. Ltd., Universal Cables
19	Control Cable	Associated Cables Pvt. Ltd., Associated Flexibles & Wires Pvt. Ltd., Chandresh cables Limited (Avocab), Belden, Cords India Ltd., Delton Cables, Finolex cables Limited, GEMSCAB, Helukable India Pvt. Ltd., Kerpen cables, LAPP India Pvt. Ltd., Nicco Corporation Limited, POLYCAB WIRES PVT. LTD., RPG Cables (a division of KEC International Limited), TCL Cables Ltd., TC Communications Pvt, LTD., Thermo Cables Ltd., Udey Pyrocables Pvt. Ltd., Universal Cables

20	Control Panel	Rittal, Eldon CS enclosures Pvt. Ltd., Enclotek Ready Panels Ltd, Kaysons Techno Equipments Pvt. Ltd, Manshu Comtel Pvt Ltd, Positronics Pvt. Ltd., Pyrotech Controls (I) Pvt. Ltd.
21	Ethernet switches	Allied Telesis, AGC Networks Limited, Harting India Pvt. Ltd. Phoenix Contacts (India) Pvt. Ltd., Siemens Ltd., Schneider Electric India Pvt. Ltd.

Notes:

The following guidelines are to be noted with regard to use of materials in the work:

- a) The contractor shall produce samples of the materials for approval of the Engineer-In-Charge (EIC). The materials of the makes, out of the above as approved by the EIC shall be used on the work.
- b) In respect of materials for which approved makes are not specified above, the make/brand will be decided by the EIC.
- c) Before bulk purchase of quantities of materials, it is the responsibility of the Contractor to get the samples of materials approved from consultant and EIC.
- d) All cost towards the testing shall be borne by the contractor.
- e) For all the material of approved brands necessary testing as per IS standards shall be done by the agency and no extra payment shall be paid for that.