Volume-III B

Scope of Work and Technical Specification

For Storm Water Drains & Rain Water Harvesting

1.0 Project Description

1.1 Site Condition

At present, there is 8.5% sewerage system in Raipur City. Remaining area has existing open drain system. The existing open drain systems carry both the sullage and storm water without treatment and disposal. The sewage is either discharged directly into storm water drains along the road networks else to the individual septic tanks. Supernatant from the septic tanks flows into the storm water drains along with the grey wastewater from kitchens and wash basins. The storm drains are carrying the wastewater/sewage to the various water bodies present in Raipur thus polluting them.

The wastewater from septic tanks is discharged in nearby nallahs and to storm water drains of road. In other words, the current treatment system is not adequate to address the environment pollution arising out due to discharge of sewage. It is added here that the wastewater from septic tanks which get discharged either in road side drains or nearby nallahs finally finds its way in lakes and other natural water bodies of the city. This further pollutes the water bodies and create unhealthy situation.

1.2 Necessity of project

Provision of adequate Storm water drainage scheme is a basic necessity, as improper storm water drainage scheme can cause serious problems like water logging and flooding of low lying areas. When a land area is changing from a natural ecosystem to a constructed development, the introduction of rooftops, streets and parking lots significantly alters the hydrology of the system. To avoid these problems, an effective and a well planned drainage system is a primary requirement. The conventional way of collecting and conveying storm water in developing areas consists of catch basins or inlets and drains along with local measures of rainwater harvesting.

1.3 Drainage Master Planning for Project Area

For Catchment Area Analysis, SRTM DEM was used to delineate, and study overall topography of the City. Further, from topographical survey, Triangulated Irregular Network (TIN) surface is generated to to study the existing slopes of the area. This surface is used to generate contours, so as to plan & design drains in such a way that proposed network is aligned to this natural slope and outfall locations are decided.

A tentative planning of sub-catchments & existing outfalls based on topography is shown in Figure-1. Details of areas in sub-catchments & outfalls draining them are given in Table-1.

A tentative Network plan is given in TCE.10596A-CV-3019-SW-30105. Inlet arrangement for Storm Water Drains in smart roads is shown in TCE.10596A-CV-3019-SW-30040.

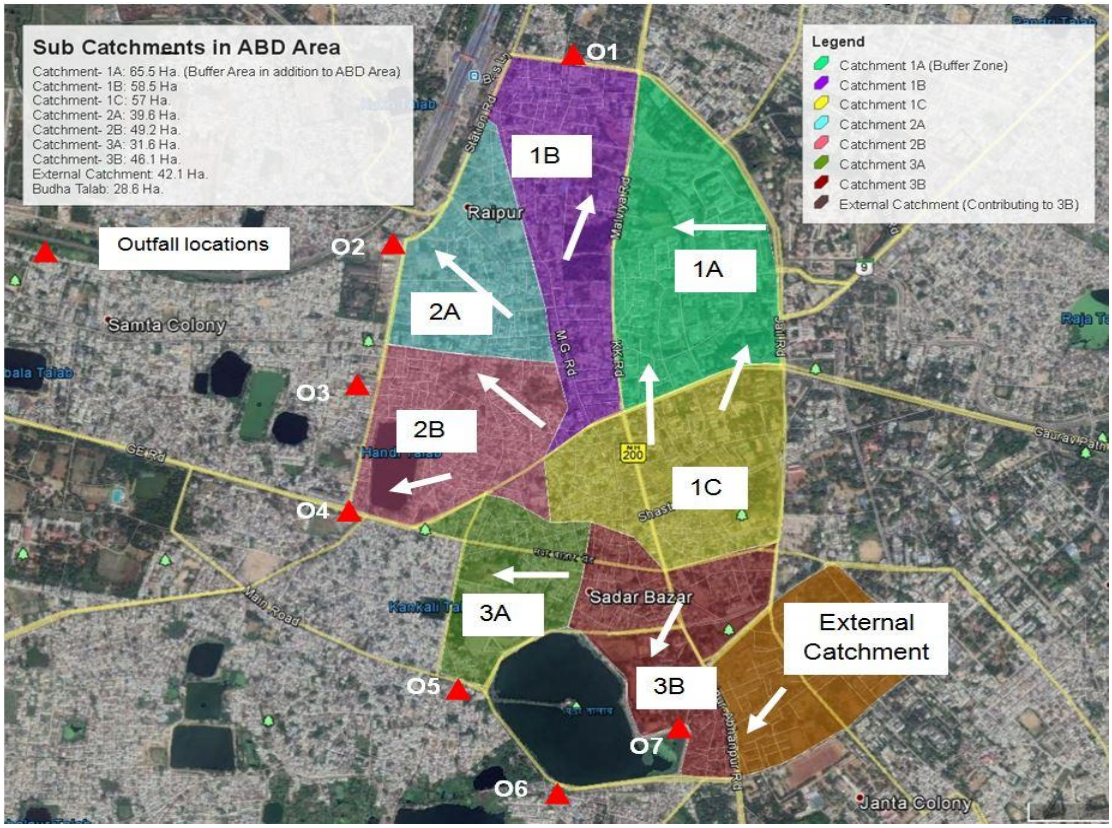


Figure 1 Sub-Catchment in Project Area

Catchment boundaries shown above are tentative and indicative only. Finalization of sub-catchments based on Existing Topography & Drainage system is responsibility of Contractor.

Table 1 List of Sub-Catchments in Project area

Catchment Area	Area Name	Outfall Location	Approx. Area (Ha)
1A (ABD Buffer Zone)	Station Road, Moudhpara, RDA Building and Complex, Flows from Catchment 1B & 1C	O_1	65.5
1B	Forest Officers Colony, Police Colony, Pandit Jawaharlal Nehru Memorial Medical College Area, Pramila Gokuldas Daga Girls College Area, Jail Road, Flows from Catchment 1C	O_1	58.5
1C	Krishak Nagar, Gol Bazaar, Nayapara Area, Raipur Municipal Corporation Office Area.	O_1	57
2A	Janta Colony, Ramsagar Para, Bhawani Patna, Some Part Of Jawahar Nagar	O_2	39.6
2B	Jawahar Nagar, Handipara, Mominpara, New Bombay Market Area	O_3	49.2
3A	Sports Complex, Raipur Indoor Stadium, Raipur District Stadium, Kankali Para	O_5	31.6

Catchment Area	Area Name	Outfall Location	Approx. Area (Ha)
3B	Baijnath Para, Sadar Bazaar Area, Police Colony Ward No 16, Budhapara	O_7	46.1
Budha Talab Overflow	Budha Talab, Budha Talab Periphery Roads near Kailash Nagar Chowk	O_6	28.6
External Catchment	Byron Bazaar	O_7	42.1
Total Catchment Area			**418.2**
Non-ABD Catchment (incl. buffer zone)			107.6

2.0 DETAIL SCOPE OF WORK

2.1. A separate survey to be carried out for existing storm water drains capturing drain GL, IL, Profile (L-Section), Culverts (Section Details) chainage-wise from intersection to intersection, in consultation with Engineer-in-charge.

2.2. Study & delineation of catchments in & around project area, and identify any external catchments draining into project area.

2.3. Rainfall Analysis shall be done (minimum 30 years) to derive design rainfall intensity.

2.4. Design and analysis of Storm water drain for project catchment area.

2.5. Contractor shall identify the drainage basins (as given in 2.4) based on actual existing topology of the project area for designing an optimum network & approval for the same shall be taken.

2.6. Criteria for designing of the proposed drainage system should be in accordance with the basic assumptions and design criteria specified in Clause 2.0 Volume III B of the tender document & CPHEEO Manual on Sewerage and Sewage Treatment (2013).

2.7. Proposed design slope should be derived in such a way that the depth of excavation or filling for network should be optimum.

2.8. As much as possible contractor has to reuse the adequate existing sections based on hydraulic condition.

2.9. Contractor should set out a hydraulic modelling network, ensuring no water logging within the project area for approved design criteria.

2.10. Construction of 'RCC Box' Storm Water drains shall be as per the approved design.

2.11. Contractor has to provide necessary provision to connect plot outlets carrying discharge from household with proposed storm water drains.

2.12. Every household along the proposed smart roads shall be provided with two separate connections, one each for i) Plot Storm Runoff & ii) household wastewater.

2.13. Contractor has to provide necessary arrangements for easy maintenance & replacement of house connections.

2.14. Road side Drains shall be covered with precast concrete slab to withstand the vehicular load.

2.15. Primary Drains shall be provided with chain linked fencing to minimise solid waste dumping.

2.16. Suitable arrangement shall be provided for mechanical cleaning & dredging of primary drains.

2.17. All drainage works carried out by the Contractor shall comply with the Specification of CPHEEO Manual, IS 456-2000, IRC-SP 42,50, IS 458, IS 12592, and IS 15916.

2.18. The Contractor shall not implement any proposals to dam up or divert existing watercourses (either temporarily or permanently) without the prior approval of the relevant statutory body by way of approved drawings or written instruction.

2.19. Before commencing construction of any culvert, the Contractor shall set out on site the culvert inlet and outlet positions to the location and levels shown on the drawings.

2.20. Traffic bypass arrangement shall be taken care while constructing the culvert in consultation with respective authorities.

2.21. Design output should be submitted along with supporting design models & calculations in editable format for approval.

2.22. L-section drawings should be submitted for review along with the design calculations.

2.23. Type of RWH Structure suitability has to be investigated and studied based on site condition, space availability, detailed Hydro-Geological investigation, etc.

2.24. The scheme shall have settlement chamber, filter & flush mechanism before the RWH structure to settle / remove / flush any solid debris or material brought by surface runoff.

2.25. Contractor shall take all necessary permissions from concerned departments before starting Hydro-geological investigation.

2.26. Contractor needs to submit proposed RWH scheme drawings and details before execution, along with supporting detailed hydro-geological investigation study report.

3.0 Design Basis

3.1. Basic assumptions and design criteria

3.1.1. General

The design norms should be adopted for preparation of STORM water drain components of Raipur ABD area are in line with CPHEEO Manual (2013), & standard practices. Whenever felt necessary guide lines laid down in other internationally accepted manuals can be followed. The design norms for Storm Water Drainage network are provided in subsequent paragraphs.

3.1.2. Type of System

Three different system configurations for storm and wastewater disposal are generally being followed. These are combined system, separate system and partly combined system. The Storm Water network in the study area is proposed to be designed as a Storm system only as per client's requirement, though there are narrow road network in the entire catchment area which is prohibitive for laying at least two conduits required for a separate system of dry weather flow and other for storm flow.

3.1.3. HYDROLOGIC ANALYSIS

To arrive at storm runoff reaching the drains, following basic parameters are should be worked out,

1. Storm frequency
2. Time of concentration
3. Rainfall intensity

3.1.4. STORM FREQUENCY

As per Manual on Sewerage and Sewage Treatment by CPHEEO and IRC SP: 50-2013 recommendation a return period of once in 2 year for designing the urban drainage system is ideal.

For smart cities, as per international standard, the return period for Storm network shall be 5 years for starting drains, 10 years for secondary drains, 25 years for medium drains and 50 to 100 years for major streams / outfalls to rivers. This will be economical and take care of submergence for short period's equivalent to Tc only.

For this project 5 year return period is considered for design of tertiary drains i.e. road side drain, 10 years for secondary and 25 Years for primary drains.

3.1.5. TIME OF CONCENTRATION

Time of concentration (t_c) is equal to inlet time (t_i) plus the time of flow in the drainage pipe (t_f). The inlet time is dependent on the distance of the farthest point in the drainage basin to the inlet manhole, the shape, characteristics and topography of the basin.

$$t_c = t_i + t_f$$

CRITICAL TIME OF CONCENTRATION

The longest time of concentration among the times for different routes has to be assumed as critical time of concentration of the area drained.

t_c generally varies from 5 to 30 minutes. In highly developed areas, the inlet time may be as low as 3 minutes (as per IRC: SP: 13).

For this project minimum time of concentration should be taken as 7 min for design consideration.

3.1.6. RAINFALL INTENSITY

It has been observed that shorter the duration of critical rainfall, greater would be the expected average intensity during that period. The critical duration of rainfall is the one which produces maximum runoff. This duration is equal to the time of concentration, since shorter period do not allow the whole area to contribute, and longer duration will give smaller average rainfall intensity.

Rainfall intensity calculation should be performed by Contractor using the standard methods. IRC SP 42 & CPHEEEO Manual can be used as a basic guideline for data analysis. Contractor has to purchase the rainfall data for analysis from relevant Govt. organisation.

3.1.7. PERCENTAGE OF IMPERVIOUSNESS OF AREAS

Contractor has to derive the percentage of imperviousness of the project area, depending on the profile of the city.

3.1.8. TYPE OF DRAINS

Size of drain either on both side or one side should in line with the requirement of carriage way and other utilities.

Primary, secondary and Tertiary drains should be identified by Contractor.

3.1.9. MINIMUM AND MAXIMUM VELOCITIES

While deciding the drain sections it is also required to keep in view the velocity in the drain. Drains are designed to achieve a velocity range of 1.2 m/s to 2.5 m/.s at full flow condition, so that every section can achieve the minimum self-cleaning velocity of 0.80 m/sec and a maximum velocity up to 3.0 m/sec as per CPHEEO 2013 Table 3.9(for concrete drains) during the non-monsoon period.

3.1.10. DRAIN SECTION

The Buildings & Settlements in ABD Area being very old, Adopting RCC Channel Drains will reduce the excavation depths. Also the internal roads being RCC Rigid type, the Excavation Width can be reduced.

Primary Drains Will be provided with Cunette at the centre of Channel Bed to Carry Dry-Weather Flow during non-monsoon period.

3.1.11. DRAIN SLOPES

Drain slope should be as per recommendation of CPHEEEO Manual to achieve the minimum cleansing velocity at the time of non-monsoon period.

3.1.12. MINIMUM FREE BOARD

With reference to clause 4.9.3 of IRC -SP 50(b), free board adopted for drain varies from 100 mm to 300 mm based on the bottom width of drain.

Table 1.2: Free Board Criteria for Storm water drainage

Sr. No.	Drain Width (M)	Free Board (M)
1	< 0.3	0.1
2	0.3 to 0.9	0.15
3	0.9 to 1.5	0.3
4	> 1.5	Depends on discharge

Source: IRC: SP-50-2013

3.1.13. DESIGN BASIS

Basic design criteria should be adopted for designing water logged free project area. All other assumptions should be as per CPHEEO Manual.

4.0 EMPLOYER'S REQUIREMENTS

4.1. ITEM NO:-1 EXCAVATION FOR STORM WATER DRAIN INCLUDING ALL SAFETY PROVISIONS OF STACKING EXCAVATED STUFF UPTO A LEAD OF 50 METERS CLEANING THE SITE ETC. COMPLETE FOR LIFTS AND STRATA AS SPECIFIED

4.1.1 SCOPE

This specification covers the general requirements of earthwork in excavation in different materials, site grading, filling in areas as shown in drawing, filling back around foundations and , conveyance and disposal of surplus soils or stacking them properly as shown on the drawings and as directed by the ENGINEER and all operations covered within the intent and purpose of this specification.

4.1.2 APPLICABLE CODES

As per Volume -III

4.1.3 GEOTECHNICAL INVESTIGATION

a) Detailed geotechnical investigation shall be carried out by the Contractor.
b) Based on the plot plan developed, the Contractor shall prepare field and laboratory testing scheme and obtain the approval of Employer prior to commencing the investigation.
c) Following minimum field tests shall be conducted:
    - Permeability tests,
    - Shallow bore hole
d) In rock strata, core recovery and Rock Quality Designation (RQD) shall be noted carefully for each run, immediately after cores are taken out of barrel.
e) During boring, the level at which ground water is struck shall be carefully noted. Ground water samples shall be collected for chemical analysis. Water samples shall be collected before the addition of water or drilling mud to the hole.
f) Following minimum laboratory tests shall be conducted: (Preferably on Undisturbed soil samples and if UDS is not possible, on remoulded soil samples.)
    - Grain size analysis,
    - Hydrometer analysis,
    - Sieve analysis,
    - Specific Gravity,

- Chemical Analysis of soil and ground water including Sulphates, Chlorides, pH value, etc.
- Chemical Analysis of 2:1, Water: Soil extract of the samples giving SO3 content,
- Consistency Index: Liquid Limit, Plastic Limit, Plasticity Index, Shrinkage Limit and Shrinkage ratio,
- Consolidation test giving all relevant parameters,
- Swelling pressure and free swell index for expansive soils,
- Unconfined Compressive Strength on soil samples,
- Direct Shear Test
- Tri axial Compressive Strength Tests,
- Unconsolidated Undrained Test,
- Consolidated Undrained Test,
- Consolidated Drained Test,
- Moisture-density relations for Standard Proctor and Modified Proctor tests,
- The Geotechnical investigation report shall necessarily include, but not be limited to the following information.
- Recommended types of foundation,
- Allowable safe bearing capacities and settlement values in different strata for shallow foundations indicating relevant design criteria adopted, method of analysis adopted etc.,
- Type of cement to be used for concrete substructures and in stone / brick masonry foundations with reference to the chemical nature of sub-soil and ground water,
- Recommendations regarding excavations (shallow & deep), embankment, safe side slopes for excavation and embankment, dewatering, site drainage, etc.,
- Recommended soil properties such as density, specific gravity, cohesion, angle of internal friction etc. for design,
- Precautions to be taken for design of lightly loaded structures when expansive soil is encountered with respect to swelling pressure and free swell index values obtained.
- CBR values for design of pavements.

4.2. REINFORCEMENT FABRICATION AND PLACEMENT

Reinforcing bars supplied in the form of bent coils shall be straightened cold without damage at no extra cost. Bars supplied in bent coils shall be straightened only by machine.

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by ENGINEER. Bar bending machines shall be used to achieve desired accuracy.

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

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

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

Substitution of reinforcement, laps/splices not shown on drawing shall be proposed by CONTRACTOR and approved by ENGINEER.

If permitted by ENGINEER, welding of reinforcement shall be done in accordance with IS: 2751, IS: 9417 and SP: 34 as applicable.

Tolerance on placement of reinforcement shall be as per Cl. 12.3 of IS: 456.

4.3. PREPARATION PRIOR TO CONCRETE PLACEMENT

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

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

4.4. CURING

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

(a) Premature drying out, particularly by solar radiation and wind;

(b) leaching out by rain and flowing water;

(c) rapid cooling during the first few days after placing;

(d) high internal thermal gradients;

(e) low temperature or frost;

(f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

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

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

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

Extra precautions shall be exercised in curing concrete during cold and hot weather as per Clause no. 8.3 of IS: 7861 (Part II) and Clause no. 8.2 of IS: 7861 (Part I) respectively.

Curing arrangement shall be subjected to ENGINEER's approval.

4.5. FORM WORK FOR CONSTRUCTION OF R.C.C STORM WATER DRAIN

4.5.1 SCOPE

This specification covers the general requirements for formwork as well as mode of measurement and payment for completed works.

This specification shall be read in conjunction with Specification Reinforced concrete and allied works. It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. however, all works shall have to be carried out in

accordance with the relevant standards and codes of practices or in their absence in accordance with the best accepted current engineering practices or as directed by Engineer from time to time. The decision of engineer as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on contractor and no claim whatsoever will be entertained on this account.

4.5.2 APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes, including all official amendments/ revisions and other specifications and codes referred to therein, should be considered a part of this specification. In all cases the latest issue/ edition/ revision shall apply. In case of discrepancy between this specification and those referred to herein below or other specifications forming a part of this bid document, this specification shall govern.

4.5.3 Codes of Practice

a)	IS: 303	Specification for plywood for general purpose.
b)	IS: 456	Code of practice for plain and reinforced concrete.
c)	IS:1200 (Part 1 to 12)	Method of measurement of building and engineering works (Parts 2 and 5).
d)	IS: 2750	Specifications for steel scaffoldings.
e)	IS:3370	Code of practice for concrete structures for storage of liquids (Parts 1 to 4).
f)	IS: 3696	Safety code for scaffolds and ladders (Parts 1 & 2).
g)	IS: 4014	Code of practice for steel tubular scaffolding. (Parts 1 & 2).
h)	IS: 4082	Recommendations on stacking and storing of construction materials at site.
i)	IS: 4900	Specification for plywood for concrete shuttering work.
j)	IS: 7969	Safety code for handling and storage of building materials.
k)	IS: 8989	Safety code for erection of concrete framed structures.

4.5.4 GENERAL

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

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

4.6. MATERIALS

4.6.1 STORING OF MATERIALS

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

Contractor will have to make his own arrangements for the storage of adequate quantity of formwork/ shuttering material

4.6.2 FORMWORK

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

The design and engineering of the formwork as well as its construction shall be the responsibility of contractor. However, if so directed by engineer, the drawings and calculations for the design of the formwork shall be submitted to engineer for approval.

Formwork shall be designed to fulfil the following requirements:

a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.

b) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.

c) Capable of withstanding without deflection the worst combination of self weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.

d) Capable of easily striking without shock, disturbance or damage to the concrete.

e) Soffit forms capable of imparting a camber, if required.

f) Soffit forms and supports capable of being left in position, if required.

g) Capable of being cleaned and/ or coated, if necessary, immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of lined timber, waterproof/ plastic coated plywood, steel, plastic depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of ENGINEER. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structure shall be sufficiently tight to prevent loss of slurry from concrete using foam and rubber seals.

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

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

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

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

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

Where specified or shown on drawings all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

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

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

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.5 m or as directed by Engineer. Contractor shall temporarily and securely fix items to be cast (embedment/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

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

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

(a) Development of adequate concrete strength,

(b) Permissible deflection at time of striking form work,

(c) Curing procedure employed - its efficiency and effectiveness,

(d) Subsequent surface treatment to be done,

(e) Prevention of thermal cracking at re-entrant angles,

(f) Ambient temperatures; and Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Before removing formwork of soffit of slabs/ beams compressive strength at 7/ 14/ 21 days shall be checked.

Under normal circumstances (generally where temperatures are above 20 deg c) forms may be struck after expiry of the period given in is: 456 unless directed otherwise by engineer. For portland pozzolana / slag cement the stripping time shall be suitably modified as directed by the engineer. It is the contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resists surface damage and any stresses arising during the construction period.

4.6.3 FINISHES

4.6.3.1 GENERAL

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

4.6.4 RE-USE OF FORMS, ETC.

Forms required to be used more than once shall be maintained in serviceable condition and shall be thoroughly cleaned and repaired before reuse.

Where metal sheets are used for lining forms the sheets shall be placed and maintained in the forms with minimum amount of wrinkles, lumps or other imperfections. All forms shall be checked for shape and strength before reuse. Steel forms shall be cleaned by buffing before reuse.

4.6.5 EXECUTION AND REMOVAL OF FORMS

Before placing concrete the surface of all forms shall be coated with suitable non-staining form releasing agents such as raw linseed oil so as to prevent adhesion of concrete and to facilitate removal of forms.

The form releasing agent shall cover the forms fully and evenly without excess over drip. Care shall be taken to prevent form releasing agents from getting on the surface of the construction joints and on reinforcement bars. Special care shall be taken to thoroughly cover form strips for narrow grooves, so as to prevent swelling of the forms and the consequent damage to concrete prior to or during removal of forms.

Immediately before concrete is placed care shall be taken to see that all forms are in proper alignment and the supports and fixtures are properly secured and tightened.

Where forms for continuous surfaces are placed in successive units, the forms shall lap and fit tightly over the completed surface so as to prevent leakage of cement slurry from the fresh concrete and to maintain accurate alignment of the surface.

Forms shall be left in place until their removal is authorised and shall then be removed with care so as to avoid injury to concrete.

Removal of forms shall never be started until the concrete is thoroughly set and adequately hardened such that it can carry its own weight, besides the live load which is likely to come on the work during construction. The length of time for which the forms shall remain in place shall be decided by the Engineer, with reference to weather conditions, shape and position of the structure or structural member and nature and amount of dead and live loads.

In normal circumstances and where ordinary Portland cement is used, forms can be allowed to be struck as under:

1.	Beam sides, walls, unloaded columns	-	after 24 hours
2.	Slabs and arches (props left under)	-	after 4 days
3.	Props to slabs and arches	-	after 10 days
4.	Beam soffit (props left under)	-	after 8 days
5.	Props to beams	-	after 21 days
6.	Lean concrete (sides)	-	after 2 days

Note: Time shall be measured from last batch concreted in respect to the structural member under consideration.

In no case shall forms be removed until there is an assurance that removal can be accomplished without damaging the concrete surface. Heavy loads shall not be permitted until after the concrete has reached its design strength. The forms shall be removed with great caution and without causing any jerks to the structure.

Re-propping shall be done to the below floor to carry the construction load transferred through props/equipments etc. during construction of upper floor and props left under till the period of removal of props supported to or any other load due to construction load on the upper floor. Re-propping shall be part of shuttering/formwork for concrete without any claim for extra cost.

4.6.6 SETTLEMENT OF FORMWORK

Due to various reasons such as closure of form joints, shrinkage of timber, dead load deflections, elastic shortening of form members or formwork, deflections, settlement may occur. The Contractor shall take precautions, including using adequately rigid formwork, in order to prevent excessive settlement/ deflection; the usual acceptable limit being 1/500 of the spans of the formwork.

4.7. BRICKWORK

4.7.1 MATERIALS

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

The nominal size of the modular brick shall be 200mm x 100mm x 100mm with the permissible tolerances over the actual size of 190mm x 90mm x 90mm as per IS 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230mm x ll5mm x 75mm with tolerance upto +3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

Bricks shall be sound, hard, and homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 5N/sq.mm unless otherwise specified in the item.

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

Sample bricks shall be submitted to the ENGINEER for approval and bricks supplied shall conform to approved samples. If demanded by ENGINEER, brick samples shall be got

tested as per IS 3495 by CONTRACTOR at no extra cost to OWNER. Bricks rejected by ENGINEER shall be removed from the site of works within 24 hours.

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work. Sand for masonry mortar shall conform to IS 2116. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by ENGINEER. If so directed by the ENGINEER, sand shall be screened and washed till it satisfies the limits of deleterious materials.

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

The CONTRACTOR shall arrange for test on mortar samples if so directed by the ENGINEER.

4.7.2 WORKMANSHIP

Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 200mm/230mm thick and shall be laid in English Bond unless otherwise specified. 100mm/115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised

only to make up required wall length or for bonding. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 450. But in no case the level difference between adjoining walls shall exceed one metre. Brick-work shall not be raised more than one metre per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10 mm/15 mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/pointing respectively to be done later. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

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

Brickwork shall be kept constantly moist on all the faces for at least seven days. The arrangement for curing shall be got approved from the ENGINEER.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part 1). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on

important works and will be permitted only in certain cases as decided by the ENGINEER. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/painting.

In the event of usage of traditional bricks of size 230 mmxll5mmx75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor or slabs and at the top of the parapet shall be laid with bricks on edge.

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

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

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

RCC/steel beams resting on masonry wall shall be provided with plain or reinforced concrete bed blocks of dimensions as indicated in the drawings duly finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

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

The above items shall be measured and paid for separately under the respective items of work.

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

Reinforced cement concrete transoms and mullions of dimensions as indicated in the construction drawings are generally required to be provided in half brick partition walls. Reinforced concrete for transoms and mullions shall be measured and paid for separately under the respective items of work.

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

Contractor shall note that the unit rates quoted for the masonry work shall be deemed to include for the installation of miscellaneous inserts such as pipe sleeves, bolts, steel sections with anchors etc. and providing pockets, leaving openings, cutting chases etc. in accordance with the construction drawings. Miscellaneous inserts shall he either supplied free by the owner or to be furnished by the Contractor. Any of the miscellaneous inserts which are required to be fabricated and supplied by the contractor and cement concrete to be provided in the pockets for the hold fasts of door/window frames etc. shall however, be measured and paid separately under the respective items of work. .

Facing bricks of the type specified conforming to IS 2691 shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.

Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of painting to be carried out shall be as specified in the item of work. The pattern of laying the bricks shall be as specifically indicated in the drawings.

For facing brickwork, double scaffolding shall be used.

Faced works shall be kept clean and free from damage, discoloration etc., at all times.

4.8. Precast Concrete

4.8.1 Precast concrete shall comply with IS:456 and with the following requirements:

4.8.1.1 All precast units shall be cast on a suitable bed or platform with firm foundation and free from wind.

4.8.1.2 The Contractor shall be responsible for accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.

4.8.2 Striking Forms

Side shutters shall not be struck in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.

4.8.3 Precast Units

The lifting and removal of precast units shall be undertaken without causing shock, vibration or undue bending. The Contractor shall satisfy the Engineer or his representative that the methods proposed to be adopted for these operations will not over-stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

4.8.4 Curing

All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits. Otherwise curing practice as given in Clause 9.10 shall be followed.

4.9. UNPLASTICIZED PVC (UPVC) PIPES

4.9.1 Scope

4.9.1.1 This specification covers the requirements for manufacturing, stacking, supplying, laying, jointing and testing of uPVC pipes used for sewerage and drainage.

4.9.2 Applicable Codes

4.9.1.1 Laying of uPVC pipes and fittings/ specials shall comply with all currently applicable statutes regulations, standard and codes. In particular, the following standards, unless otherwise specified herein shall be referred. In all cases, the latest revision of the standards/ codes shall be referred to. If requirements of this specification conflicts with the requirements of the standards/ codes, this specification shall govern.

IS:4985	Unplasticized PVC pipes for potable water supplies – Specification
IS:7834	Specifications for injection moulded PVC fittings with solvent cement joints for water supplies
IS:10124	Specification for fabricated PVC fittings for potable water supplies
IS:12235	Thermoplastics pipes and fittings – Methods of test
IS:13592	Specification for uPVC pipes for soil and waste discharge systems inside buildings including ventilation and rainwater system

4.9.1.2 Other IS codes not specifically mentioned here but pertaining to the use of uPVC pipes form part of these specifications.

4.9.3 Manufacture

4.9.1.1 The uPVC pipes and fittings shall be in accordance with CG SOR, conforming to IS: 4985, IS:7834 and IS:10124 shall be free from defects (as specified in BOQ). The pipes used for sewers shall be Class 3 (Pressure rating 4 kg/cm^2).

4.9.1.2 Pipes have one end socketed and the other end plain, which fits snugly without the use of couplers and joined by solvent cement.

4.9.4 Typical uPVC Pipe Properties

4.9.1.1 Content of calcium carbonate (treated) shall be between 8-10% by weight. Specific gravity shall be between 1.40 - 1.46.

4.9.1.2 uPVC pipes used for the sewerage system shall have the following wall thicknesses:

- 160 mm dia : 5.4 to 6.2 mm (min. & max. thickness)

4.9.1.3 Pipes purchased from Indian approved manufactures shall have ISI mark. If pipes are purchased from countries other than India it shall have the appropriate certification confirming the above specifications.

4.9.5 Stacking

4.9.1.1 The uPVC pipes must be stacked in a neat manner so that there is no sagging owing to defective stacking. The bottommost layer of pipe must be placed on a horizontal surface over buffer blocks closely placed to prevent any sagging of the pipe. The subsequent layer of pipes shall be placed at right angles to the bottom layer. These pipes may be stacked in tiers upto maximum of 10 tiers. Storing shall be such as to prevent direct exposure to sunlight.

4.9.6 Inspection of Pipes

4.9.1.1 The pipes and fittings shall be inspected before laying for defects, cracks etc. and any pipe or fitting found unsuitable shall be rejected.

4.9.7 Laying and Jointing of uPVC Pipes and Fittings

4.9.1.1 uPVC pipes shall be laid true to line and level in properly excavated trenches with the help of sight rails and boning rods. Checking of all levels shall be with calibrated modern levelling equipment.

4.9.1.2 uPVC pipes shall be laid in excavated trenches over a bed of compacted silver sand cushion and compacted silver sand surround as indicated in drawing and BOQ.

4.9.1.3 The jointing shall be done with elastomeric rubber ring gaskets or using solvent cement. The elastomeric rubber ring gasket must be Manufacturer's supply. In case of jointing with solvent cement, Manufacturer's recommendation must be followed. Jointing shall be done as per the requirement and as per the relevant BIS Codes.

4.9.8 Testing

4.9.1.1 Mechanical tests during the manufacture of pipes and the hydrostatic tests at works shall be carried out under the conditions and pressures specified in the relevant Indian Standards.

4.9.1.2 On completion, all pipes are to be flushed with clean water. The 'as laid' uPVC pipes are not required to be hydraulically tested with water or otherwise. However the Contractor must ensure good engineering practice while laying and jointing the pipes.

4.9.9 Damage to Pipe Lines

4.9.1.1 If any damage is caused to the pipeline during execution of work or while cleaning the pipeline as specified, the Contractor shall be held responsible for the same and shall replace the damaged pipeline at his own cost to the full satisfaction of the Engineer.

4.9.10 Measurement

4.9.1.1 Measurement for 'as laid' pipes shall be taken as shown in standard drawing. Payment for pipe laying shall be made as per the relevant BOQ item only after satisfaction by the Engineer.

4.10. RAIN WATER HARVESTING METHOD- DEEP RECHARGE

4.10.1 The rainwater harvesting is carried by deep water recharge units comprising mainly the boreholes, screening and casing pipes and the filter media.

4.10.2 **BORE-HOLE:** Bored / Drilled wells are constructed using a rotary bucket auger or drill depending upon the depth. They are usually completed by perforating the casing or using a sand screen with continuous slot openings.

4.10.3 During the test hole drilling, a litho-logic or formation log shall be prepared. Soil and rock samples are taken at various depths and the type of geologic material is recorded. This help in identifying the zones with the best potential recharge depth. This allows more of the rainwater to be recharged to the deeper aquifer. The depth shall be as specified by the Engineer-in-charge.

4.10.4 **Verticality of Wells:** Wells must be perfectly vertical; a simple method is to use plumb disk. Two disks made out of 3mm thick steel plate are connected together by a rod of 25mm diameter and 3 m long tightened with the help of nuts at the ends. Some holes are punched in plates to facilitate immersion in water.

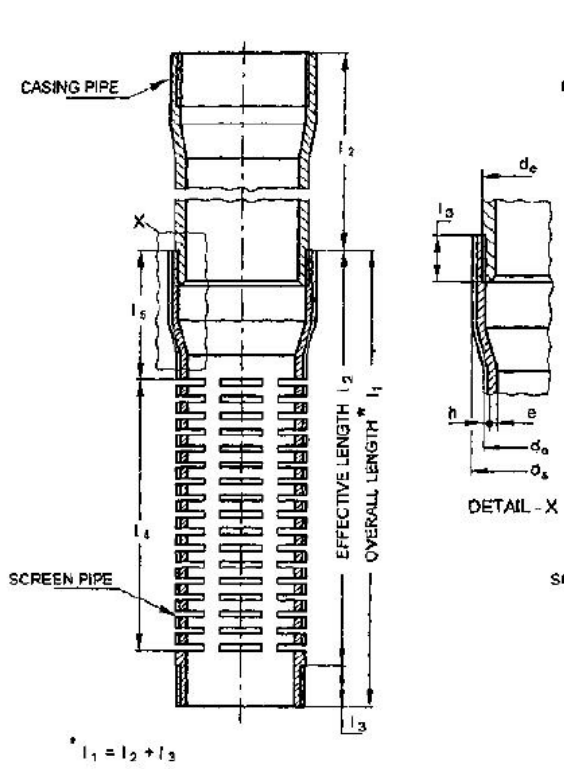
4.10.5 A knob is fixed on the top nut to which a thin steel wire is attached. The disk is suspended into the tube by the wire passing over a pulley on a tripod. When the disk is lowered into the pipe, the wire is exactly in the centre of pipe. When the disks are further lowered down and if the well pipe is not truly vertical, the wire will deviate from the centre and that shall be indicated at the top of pipe. Absolute verticality is ideal but a deviation of 100mm per 30 metres of boring is generally acceptable where submersible pumps are not to be installed.

4.10.6 **SCREENING AND CASING PIPES:** The above pipes shall conform to the standards as specified in IS: 12818:2010 Un-plasticized polyvinyl chloride (PVC-U) Screen and casing pipes for Bore/tube-wells – specifications.

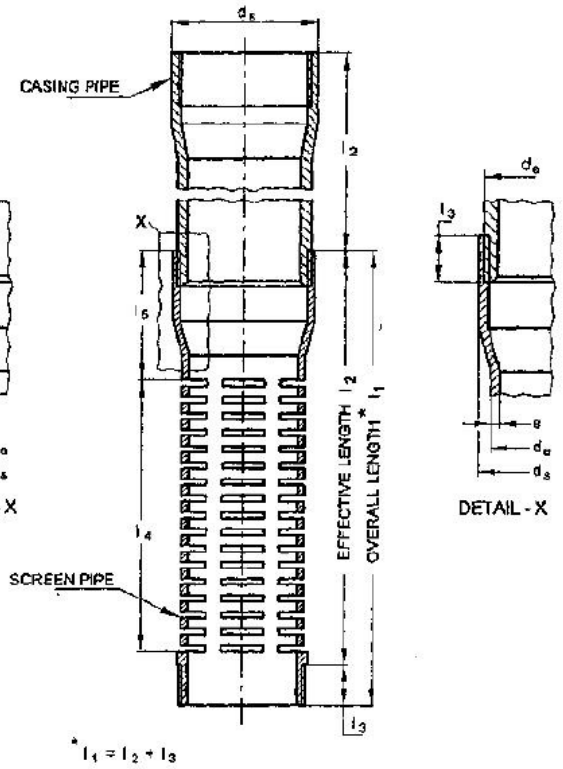
4.10.7 The material from which the pipe is produced shall consist substantially of un-plasticized polyvinyl chloride to which may be added only those additives that are needed to facilitate production of sound and durable pipe of good surface finish and mechanical strength under conditions of use and as directed by Engineer-in-charge.

4.10.8 Pipe shall be designated by its type, whether ribbed medium well screen (RMS), ribbed deep well screen (RDS), plain medium well screen (PDS) or casing (CS or CM or CD) followed by its nominal diameter DN, slot width and length of the pipe.

4.10.9 The diameters and wall thickness shall be conforming to IS: 12818



1A Ribbed Screen Pipe with Casing Pipe



1B Plain Screen Pipe with Casing Pipe

4.10.10 The screening and casing pipes shall have male threads at spigot end and female threads at the socket end. The threads shall be in accordance with IS 554 and IS 12818.

4.10.11 The Tests shall be in accordance with IS 12818 for its Visual Appearance, Internal Diameter, Density, and Resistance to external blows, Tensile strength and other tests as indicated by Engineer-in-charge.

4.10.12 The scale of sampling and criteria for conformity of a lot for acceptance tests shall be as per test specified in Cl.10 of IS: 12818. All pipes in a single consignment of the same type (screen or casing), same size and manufactured under essentially similar conditions, shall constitute a lot.

4.10.13 FILTER LAYERS: The trench of as specified in the drawing shall be excavated and the back filling with boulders (5-20cm), gravel (5-10mm) and course sand of (1.5-2mm) in graded from boulders at bottom, gravels in between and course sand at the top so that the silt content that will come with runoff will be deposited on the top of coarse sand layer. Sand used shall be dry and free from all deleterious materials and shall conform to IS: 383:2007. Including of providing encapsulated PVC perforated pipes as approved by the engineer in charge.

4.10.14 Wall of the well shall be structurally designed as per site condition

4.10.15 The SS net or Geo fabric filter with 1.5mm openings equivalent for Filtration shall be as per manufacturer's specifications obtained from known and registered Contractors or as directed by Engineer-in-charge.

4.10.16 MEASUREMENT AND PAYMENT FOR MAJOR ITEMS OF WORK: Payment for the rain water harvesting shall be on unit basis complete as per the drawings, specifications and directions of the Engineer in charge.

4.11. MEASUREMENT

Measurement shall be in cum correct to two places of decimal for brickwork of thickness one brick i.e. 200mm/230mm and above. Measurement shall be in sqm correct to two places decimal for facing brickwork and brickwork of thickness half brick i.e. l00mm/115mm and below. Measurement shall be for the quantities as actually executed duly deducting for openings, lintels, transoms/mullions etc. All concrete works shall he measured and paid for separately under the respective items of work.

4.12. HEALTH, SAFETY AND REGULATORY REQUIREMENTS

4.12.1 The work covered in this specification, shall comply with all relevant government and local laws, regulations and standards. For subjects not covered by regulations, codes, standards or specifications, the materials and construction shall be based on good engineering practice, subject to approval by Owner.

4.12.2 All necessary precautions shall be taken to ensure the safety of personal and property. Extreme caution shall be used when working with oil or oil-based paints, cleaning fluids etc., especially in close proximity to oxygen piping or oxygen equipment. Heavy concentrations of volatile or toxic fumes must be avoided and in confined areas, blowers or exhaust fans shall be used.

5.0 Technical Specifications

5.1 Storm Water Drainage

5.1.1 Storm water drains adjacent to the proposed roads (under this Contract) shall be sized based on Rainfall Analysis for the area as per best engineering practice, allowing for 100% runoff from Roads & other paved areas.

5.1.2 Storm Water Drains shall be designed according to CPHEEO Manual on Sewerage and Sewage Treatment (2013) & design assumptions attached.

5.1.3 Drains adjacent to roads shall be in RCC and shall be structurally designed for vehicular loading; the minimum size of drain shall be 300mm x 300mm.

5.1.4 The Grade of Concrete used for Construction of Drains shall be as per Civil Specifications or as instructed by Engineer-in-charge.

5.1.5 The drains shall be designed structurally for IRC Class-A Vehicle Loading.

5.1.6 The Drains shall be covered with precast concrete covers designed for Class-A Vehicle Loading.

5.1.7 For easy drainage of surface runoff, FRP Perforated Water Gully Covers with Frame for 20 Tonnes Load capacities and shall confirm to IS 1726 (or BS EN-124), having a minimum clear opening of 35% to allow smooth flow of water, shall be placed at a distance of 10m c/c.

5.1.8 The top of precast concrete covers & FRP Water Gully Covers with Frame shall be flushed with finished Road Levels in such a way that minimum cross-slope is maintained for quick drainage of water from roads and adjacent paved areas.

5.1.9 The disposal of the storm water from project area is to be done at least 0.5m above the inverts of existing outfall drains.

5.2 Rooftop Rain Water Harvesting Scheme

5.2.1 The water from roads & building roofs shall be conveyed suitably towards Rain Water Harvesting structure.

5.2.2 Suitable First Flush arrangement has to be provided for flushing out the first rains runoff of the season.

5.2.3 The surface runoff before entering the RWH structure shall be free from silt and other impurities. Suitable de-silting chamber / filters shall be provided with suitable mesh size.

5.2.4 An overflow arrangement shall also be provided in RWH structure to dispose off excess runoff to road-side drains.

5.2.5 RWH structure shall be covered with Precast/Cast-in-situ RCC Slabs and can be suitably finished for improving visual aesthetics.

5.2.6 RWH structures shall have a freeboard of at least 0.3m.