National Competitive Bidding

Bidding Document for Providing Storm Water Drains Integrated with Waterbodies in Hosur City Municipal Corporation – Package 7

Technical Specification

Volume – 2

TABLE OF CONTENTS

1 GENERAL

1.1 PREAMBLE

The project mainly focuses on the Integrated Storm Water Drainage (ISWD) project, aimed at addressing the long-standing issues of water stagnation and flooding in the area of Hosur City Municipal Corporation. This project aims to provide a climate-resilient stormwater drainage system with all necessary integration of existing water bodies/waterways/major nallah/primary drains, rejuvenation of water bodies, and rainwater harvesting by means of the development of sponge parks and by utilizing the identified vacant lands available in the Hosur City Municipal Corporation.

1.2 SCOPE OF WORK

The detailed scope of work under this tender

1 Natural Nallah / Primary Drains: - 11.16km – Open drains

Improvements to natural nallah with Earthen bund strengthening on both sides for a length of 11.16km with average width of 10m

a. Earthen bund strengthening with natural bed trimming wherever space available and in scattered development areas including desilting, clearing of weeds, MS frame with wire mesh on both sides to avoid dumping of solid waste and connecting the missing links

2 Rejuvenation of Water Bodies: 4 Nos – Krishnarav Eri, Pattalamman Eri, Varatharayan Eri and Kesavakuttai Eri.

- Interlink between major nallah/primary drain and water bodies
- Desilting the water body and removal of weeds to enhance storage capacity
- Stone pitching and turfing works for bund slopes with toe wall (the bottom 1m of the bund alone considered for stone pitching, the area above will be strengthened using green landscape)
- Permeable paver blocks for pathway
- Bund strengthening and bund formation works
- Inlet and outlet weir improvements
- Recharge pit for ground water recharge
- Seating arrangements
- Street lighting
- Shrubs and Saplings plantation in and around waterbodies
- Chain link fencing

All works shall be executed as per the specifications and as per the direction of the Engineer or his authorized representatives. The works shall be executed on item rate basis. The details of works to be carried out in different project components are given in drawings and bill of quantities. Alignment maps indicating the drains with their nomenclature, typical cross section of drains, layout of rejuvenation of water bodies, development of sponge park and OSR sites, etc., are given in the drawing volume for

the guidance of the Contractor. For the execution of works, exact details shall be prepared in terms of construction drawings after taking levels. The drawings given to the contractor are only for general guidance and not to be treated as exhaustive and conclusive. Variations in the drawings shall not be treated as an excuse for not executing any item at the quoted rate and completing the works in the scheduled period.

1.3 WORK PLAN

Contactor shall submit to the employer a realistic work plan including procurement, deployment of men and machinery, commencement and completion of works etc. complete before commencement of work. Each item of work at specific location shall be marked up in the work plan. The work plan shall be exhaustive enough to monitor the activities of the contractor on daily basis. All procurement shall be made and work executed as per the approved work plan so as to complete all components of the work within the agreed time schedule. The Contractor should note that the details given in the tender drawings are to serve as a general guidance only. Some of these details are likely to change at the time of Construction drawings. In case, during actual execution if changes are inevitable in the drawings, the contractor should execute the works as per the revised construction drawings. The Contractors should execute the works at the same quoted rates for various items of works at the time of the construction.

Work plan shall be updated every three months and submitted by the contractor for approval to the Engineer. This updated work plan shall be followed by the contractor for the next three months in construction period.

Contractor shall be expected to have a planning engineer conversant in MS Project Software or Primavera for preparation and up-dation of the work plan. A simple bar chart showing all the items of work shall not be accepted as a work plan.

Works to be carried out during monsoon periods shall be specifically highlighted in the Work Plan.

1.4 METHOD OF WORKING

i) The Contractor should furnish his work programme and construction methodology within 15 days after the Letter of Acceptance and prior to start of construction activities at site.

ii) Before excavation of the trench, the alignment of drain shall be marked by the Contractor at site as per drawings and will be approved by the Engineer.

iii) Construction of drain in design grade is the most important criteria for functioning of any drainage system. For appropriate control of the same, the Contractor shall carry out check level in the following sequence:

iv) On completion of excavation and drain construction (bed and side walls), the Contractor shall take the finished level of the bed and top of side walls.

The Contractor shall submit all the level data to the Engineer for his approval and records before proceeding to the next stage of the work.

v) The trial pits shall be taken by the Contractor, after mutual agreement and approval of the Engineer, along the proposed drain alignment in advance of the excavations for the purpose of satisfying himself as to the location of underground obstructions or conditions.

vi) The Contractor shall proceed with caution, in any excavation and shall use every means to determine the exact location of underground structures, pipelines, conduits etc, prior to excavation in the immediate vicinity thereof. The Contractor shall be solely responsible for the cost of protections or repair or replacement of any structure, pipeline, conduit etc., above or below ground which may be broken or otherwise damaged by his operations.

vii) The lighting, barricading, guarding of the trenches and the provision of watchman shall be done by the Contractor at his cost.

viii) The posts and rails shall in no case be removed until the trench is excavated, the drain is constructed and Engineer gives permission to proceed with the back filing.

ix) The bedding for drain shall be provided as specified in the drawings and as per direction of the Engineer.

x) All the drains are to be constructed perfectly true both in alignment and to gradient specified.

xi) The construction of the works should progress from downstream end (ie. the discharge point) and proceed towards upstream.

xii) The payment schedule shall be as described earlier.

xiii) The reinstatement of road/footpath shall be done as specified and as per the requirements of the local authorities, on completion of all the works.

xiv) The Contractor shall not be paid any additional compensation for excess excavation over what is specified as well as for any remedial measures that are specified.

xv) The excess excavated material shall be carried away from the site of works as specified, failing in view of public safety and traffic convenience, Engineer may carry out the work by any other agency at Contractor’s risk and cost.

xvi) The Contractor shall submit to the Engineer on completion of the work, “As Built” Drawings as specified as here below. These Drawings shall be accurate and correct in all respects and shall be shown to and approved by the Engineer.

xvii) The completion drawings shall be grouped into two categories (i.e.) Plan and L-section.

a) Plan with scale 1:1000 (A1 Size) showing the roads along with other details such as property width, existing sewers and storm water drains, footpaths, location of electrical / telephone poles along with all the dimensions wherever possible shall be prepared. The type of road, footpath details etc, shall be further elaborated in terms of their dimensions and material used. Finally exact alignment of drain and inspection chamber, road side manhole and connection to road side chamber and additional pipe up to property boundary alignment shall be marked on the plan. Nomenclature of network shall be same as given in the network design drawing furnished to the contractor during execution. The connection details at the existing outfall drain shall be shown in plan and section.

b) L-Section: The L-Section should show the drain profile and junction details. The other details such as ground level, drain invert level of incoming and outgoing drain at the junction, drain material, size, slope, inspection chamber type, chainages, inspection chamber no.s, Line no,s, etc. shall be shown in the L-section. The scale for L-section should be chosen such that each A1 Size sheet would show approx. 800 m drain. Also, plan of the drain with roads of concerned length and other important feature should be shown above the L-section profile along with all utility services encountered during execution

xviii) The taking over certificate of the work shall not be issued by the Engineer in the event of the Contractors failures to furnish the aforesaid “As Built” drawings (completion drawing) as mentioned above for the entire works.

1.5 Time of Completion

Time of completion of all the works shall be 24 calendar months (inclusive of monsoon period) from the date of issue of notice to commence. The Contractor has to be aware that on no account the construction period shall be extended; It is essential to plan the works in such a way that the works do not suffer on account of monsoons.

1.6 Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes, to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant Indian Standards and codes in effect shall apply, unless otherwise stated in the Contract. Other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be acceptable subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the Bid Documents.

1.7 Quality Control

For ensuring the requisite quality of construction, the Materials and Works shall be subject to the quality control tests as described in Standard Specifications and Quality Control Manual of PWD Government of Tamil Nadu as applicable and as directed by the Engineer.

The Contractor shall develop a quality control program and provide all necessary materials, apparatus, instruments, equipment, facilities and qualified staff for sampling, testing and quality control of the materials and the works under the Contract.

Without limiting the generality of the foregoing, the Contractor shall either (i) establish a testing laboratory at the site of works which is adequately equipped and staffed to carry out all sampling and testing in accordance with the requirement set out in the General Specifications and/or these Special Specifications and provide all field equipment and apparatus as necessary to conduct all specified in-situ tests and/or any Tests on Completion, or (ii) arrange for routine sampling, testing and reporting, as required, through a certified independent testing laboratory acceptable to the Engineer. The Contractor shall submit for the approval of the Engineer the quality control programme developed by him within the first 15 days of commencement of project and incorporate any modifications suggested by the Engineer within one month of commencement of Contract. If the Engineer does not give comments within 15 days of submission of the QC programme, then the submitted programme shall be deemed to be acceptable to the Engineer.

All costs of such sampling, testing and reporting of test results at specified frequencies will be borne by the Contractor, If the contractor does not provide Testing facilities at site, he shall include sufficient provisions in his tendered rates to allow for independent sampling and laboratory testing under the direction of the Engineer. The Contractor shall furnish certified copies of all test reports to the Engineer within 3 days of completion of the specified tests. The testing frequency for major items of work shall be as provided in the end of this section.

The Contractor shall, within 14 days after the date of the Letter of Acceptance, submit to the Engineer for his consent a detailed description of the arrangements for conducting the quality control program during execution of the Works, including details of his testing laboratory, equipment, staff and general procedures. If following submission, or at any time during the progress of Works, it appears to the Engineer that the Contractor's quality control programme is not adequate to ensure the quality of the Works, the Contractor shall produce a revised program within 10 days after result of written order of the Engineer as desired by the Engineer, which will be adequate to ensure satisfactory quality control.

The testing frequencies set forth are desirable minimum and the Engineer shall have full authority to get the additional tests carried out by the Contractor as frequently as he may deem necessary, to satisfy himself that the Materials and Works comply with the appropriate Specifications.

Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted Engineering practice as per the directions of the Engineer.

1.8 UTILITIES

1.8.1 Protection of Utilities

The contractor has to identify the location of all utilities by opening trial trenches and submit to the Engineer.

The contractor is required to carefully examine the location of the works and their alignments and to make special enquiries and co-ordinate with all departments / authorities / owners concerning all utility lines such as water pipes, sewers, gas pipe, telephone (underground and/or overhead) lines, optic fibre cables, electric and telecommunication cables (underground and/or overhead) lines, any other utility lines irrigation canals, culverts etc; and to determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records/maps. The contractor shall be wholly responsible for the protection and/or relocation and making to sound working conditions of such utilities including removing, keeping under safe custody, replacing or reinstalling in good condition as may be required, and shall not make any claim for extra work or extra time that may be required to protect or facilitate relocating such utilities. Any damage to the utilities shall be restored / repaired at contractor's own cost. Notice of shifting the utility is to be exhibited at the appropriate places, under advance intimation to the owner/ custodian of each utility.

In case the alignment of the drain crosses the high tension, electrical transmission lines belonging to the TNEB/owner or other authorities/ departments/Railways, the contractor shall intimate well in advance and take all precautions necessary to see that the work is carried out with care and safety, without disturbing such transmission lines. The contractor will be responsible to carry out all construction activities in such reaches in consultation with the owners of such facilities. However, satisfactory completion of the entire work will be the responsibility of the contractor. The bidders' quoted rate should be inclusive of all anticipated actual expenses in connection with the handling, reinstalling of temporary shifting of utilities including bringing them to sound working condition without affecting the efficiency & proportional progress of work as per programme, submitted by contractor and approved by the Engineer.

1.8.2 Shifting of Utilities

The contractor shall arrange and be responsible for all shifting of utilities if required and as decided by the Engineer for the execution of work including all liaising work. The cost of shifting shall be paid by the contractor after getting approval by the Employer. The cost of shifting utilities as per actual will be reimbursed to the contractor against paid receipts for the same. Employers' role will be limited to issuing "letter of introduction and/or application". All the shifting works shall be carried out as per the specifications and under the supervision of the concerned Utility Authority. All the temporary shifting shall be arranged by the contractor at no extra cost.

1.9 SAFETY PROVISIONS

The Contractor shall, throughout the execution and completion of the works and the remedying of defects therein, ensure proper safety measures including the following:

1) Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except for such short period work as can be done safely from ladders. When a ladder is used, an extra labourer shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable foot-holds and hand-holds shall be provided on the ladder, which shall be having inclination not steeper than 1 horizontal to 4 verticals.
2) All trenches, 0.60 metres or more in depth shall at all times be supplied with for each 100 metres in length up to the completion of the work. Ladder shall be extended from bottom of trench to at least 1 metre above surface of the ground. Excavated material shall not be placed within 0.60 metres from edge of trench. Cutting shall be done from top to bottom. Under no circumstances, undermining or undercutting shall be done.
3) Before any demolition work is commenced and also during the process of this work, all roads and open areas adjacent to the work site shall either be closed or suitably protected.
4) No electric cable or apparatus that is liable to be a source of danger or a cable or apparatus used by operation, shall remain electrically charged.
5) All practical steps shall be taken to prevent danger to persons employed by the Employer, from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.
6) Workers employed on mixing asphalt materials, cement, lime mortars / concrete shall be provided with protective footwear, hand gloves and protective goggles;
7) Those engaged in welding or handling any materials injurious to eyes shall be provided with protective eye goggles / eye shields.
8) Stone breakers shall be provided with protective goggles and protective clothing shall be seated at sufficiently safe intervals.
9) Whenever men are employed on the work of Lead painting, the following precautions shall be taken;
   - No paint containing lead or lead products shall be used except in the form of paste or ready-made paint;
   - Suitable face masks shall be supplied for use by workers when paint is applied in the form of sprayer or when a surface having lead paint is to be dry rubbed for removal of the paint.
10) The Contractor shall provide to workmen with adequate facilities to enable workers to wash during and on close of day's work.
11) Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following;

- These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good working order and properly maintained.
- Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, free from defects and inspected daily;
- Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 shall be in charge of any hoisting machine including scaffold or of signals operator.
- In case of every hoisting machine and of every chain hook, shackle swivel and pulley block used in hoisting, lowering or as a means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine with a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in the paragraph shall be loaded beyond safe working load except for the purpose of testing.
- As regards Contractor's machines, the Contractor shall notify safe working load of each machine to Engineer or his representative whenever he brings it to site of work and get it verified by him.
- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliance shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce the risk of accident during descent of load to the minimum. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats, working apparel such as gloves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials that are good conductors of electricity.

12) All scaffolds, ladders and other devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work; and provision must be made by the Contractor to issue all those working on the site (including Engineer and Employer and their Staff) protective helmets, reflective jackets and appropriate footwear etc. as required.

13) Arrangement for Traffic during Construction

- Traffic Safety and Control: The Contractor shall at all times maintain the traffic flow along the existing roads, and take all necessary measures for the safety of traffic, pedestrians and workers. The Contractor shall provide, erect, operate and maintain temporary traffic signs, markings,

delineators, lights, barricades, flagmen and traffic control equipment as per the drawings or as otherwise directed by the Engineer. Before commencement of any construction, the Contractor shall prepare and submit the design of the proposed traffic management measures to the Engineer for approval.

- All traffic signs, barricades, and delineators shall be reflective. Regulatory / mandatory, Warning and Informatory traffic signs shall conform to IRC 67-2001 with the sign faces made from retro-reflective sheeting of high intensity grade. Barricades, delineators and any other markers shall be made retro-reflective using either sheeting or plastic corner-cube reflectors.
- At night the *works* shall be marked with flashing lights as per the drawings, or as otherwise directed by the Engineer.

1.9.1 Precautions for Safeguarding the Environment

- **General:** On completion of the works, all areas disturbed by the contractor's construction activities shall be restored to their original condition, or as may be acceptable to the Engineer. The cost of this work shall be deemed to be included in the rates generally.
- **Control of Soil Erosion, Sedimentation and Water Pollution**: The contractor is to ensure that there is good drainage at all construction areas to avoid creation of stagnant water bodies, especially in urban / industrial areas including water in old pipe culverts. All works are to be carried out in such a manner that damage or disruption to the flora and fauna is reduced to minimum wherever possible. Trees or shrubs will be only felled or removed if they impinge directly on the permanent works or necessary temporary works. The monitoring and mitigation measures shall be done as per the direction of the engineer.
    - The contractor shall take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.
    - During continuance of the contract, the contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.
    - Salient features of some of the major laws that are applicable are given below:

a) The Water (Prevention and Control of Pollution) Act, 1974, This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.
b) The Air (Prevention and Control of Pollution) Act, 1981, This provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.
c) The Environment (Protection) Act, 1986, This provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property.

d) The Public Liability Insurance Act, 1991, This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

- **The contractor should strictly follow the Environmental Management Plan provided in Volume 1.**

- The contractor should monitor the impact on environment due to the project as per the following Environmental Monitoring Plan.

S.No	Parameters	No of Locations	Frequency
			Construction Phase
1	Air Quality		
a)	PM10, PM2.5, SO_2, NO_x, CO and NH_3	1	Quarterly (once in 3 months) per year for 2years
2	Nosie Levels		
a)	Day and Night	1	Quarterly (once in 3 months) per year for 2years
3	Water Quality		
a)	Different Physio Chemical and Biological	3 (1 Surface + 1 Ground)	Quarterly (once in 3 months) per year for 2years
4	Soil / Silt quality		
a)	Pb, SAR and Oil & Grease, monitoring silt for presence of toxic metals, etc.,,)	1	Once per year for 2years

1.10 Confined Space Safety Procedure

The contractor shall implement a well-prepared Space Entry Safety Procedure to work in Confined areas / Elevated areas. Such procedures shall incorporate all aspects of staff work activities, internationally adopted best practices, site staff and workmen training, hazard awareness, first aid procedures, particularly applicable to workmen in Elevated / Confined space, provision and use of appropriate safety equipment's, personal hygiene, safety / emergency procedures, method of easy evacuation of workers etc. The Contractor has to develop and implement his own safety procedures. He should also provide necessary insurance to the workers involved in the execution of work.

1.11 Special Traffic Precaution

Attention is specially drawn to the requirements by the traffic police and road authorities and specification regarding traffic control, access and reinstatement of road surface. It is necessary to obtain permission from Police, RTO, Revenue department, PWD etc. prior to taking up any stretch of road for excavation.

It is necessary to carry out the work in such a manner as to cause minimum interference with the public use of roads, footpaths and other thoroughfares, with traffic signals / sign boards, traffic cones, barricading etc. The contractor will provide labour for regulating traffic.

1.12 Mobilization / Demobilisation

General

A. Mobilization shall include the obtaining of all permits; moving onto and off of the site of all personnel and equipment; furnishing and erecting temporary facilities, temporary fence, and other construction facilities, including the dismantling and removal of such facilities; and implementing security requirements; all as required for the proper performance and completion of the work. Mobilization shall include the following principal items:

1. Moving on to the site of all Contractor's equipment required for first month operations.

2. Providing on-site sanitary facilities and potable water facilities.

3. Arranging for and erection of Contractor's work and storage areas.

4. Obtaining all required permits including, but not limited to traffic control, Labour dept of GOTN, safety permits, and all other permits necessary to complete the work.

5. Having the Contractor's superintendent at the job site full time.

6. Submitting initial submittals, including those required for the Preconstruction Conference.

7. Completing the Preconstruction Conference.

B. Demobilization shall include moving off the site all equipment and temporary facilities; final cleaning of all work sites and the Contractor's staging area; completion of all punch list items; and submittal of construction record drawings, any required permits signed by the issuing agency, certifications, and operation and maintenance manuals.

1.13 TEMPORARY FACILITIES AND CONTROLS

Summary

A. Section Includes: temporary facilities for the project including sanitary facilities, storage of materials, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, disposal of trash, debris and excavated material, and pest and rodent control.

1.14 CONTRACTOR'S RESPONSIBILITY

A. Comply with applicable requirements as specified in other sections.

1. Maintain and operate temporary facilities and systems to assure continuous service.

2. Modify and extend systems as work progress requires.

3. Completely remove temporary materials and equipment when their use

is no longer required.

4. Restore existing facilities used for temporary services to the specified or to original condition.
5. Maintain water supply.

1.15 TEMPORARY UTILITIES

A. Obtaining Temporary Service:

1. Make arrangements with utility service companies for temporary services as necessary to complete the work.
2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.
3. Be responsible for utility service costs until the Work is substantially complete. Included are fuel, power, light, heat, water, and other utility services necessary for execution, completion, testing, and initial operation of the Work.

B. Water:

1. Provide water required for and in connection with Work to be performed or for other use as required for proper completion of the Work.
2. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel and Engineer or his Representatives.

C. Electricity and Lighting:

1. Provide electric power service as required for the Work. Provide power for operation of the Contractor's equipment, or for any other use by Contractor.

D. Sanitary Facilities:

1. Provide and maintain sanitary facilities for persons on the job site; comply with the regulations of State and local departments of health.
2. Enforce the use of sanitary facilities by construction personnel at the job site. Such facilities shall be enclosed. Pit-type toilets will not be permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause a nuisance or health problem; have sewer and waste hauled off-site and properly disposed in accordance with applicable regulations.
3. Locate toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

1.16 FIELD OFFICE

Maintain a separate field office within the project area

1.17 STORAGE OF MATERIALS

A. Storage of materials not susceptible to weather damage may be on blocks off the ground.

B. Store materials in a neat and orderly manner. Place materials to permit easy access for identification, inspection and inventory.

C. Stockpile materials in a way that provides drainage temporary and existing buildings and facilities.

D. Materials and equipment shall not be stored on private property without receiving written approval from property owner.

1.18 SAFETY REQUIREMENTS

A. Conduct operations in strict accord with applicable GOI and GOTN safety norms and statutes and with good construction practice. The Contractor is fully responsible and obligated to establish and maintain procedures for safety of all work, personnel and equipment involved in the Project.

B. Observance of and compliance with the regulations shall be solely and without qualification the responsibility of the Contractor without reliance or superintendence of or direction by the Engineer or the Engineer's representative. Submit one copy of accident reports to Engineer within 2 days of occurrence.

C. Safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and safety equipment, in the specifications and shown on the Drawings are obligations of the Contractor.

D. Maintain required coordination with the Police and Fire Departments during the entire period covered by the Contract.

1.19 FIRST AID EQUIPMENT

A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.

B. Have at least one person thoroughly trained in first aid procedures present on the site whenever work is in progress.

1.20 FIRE PROTECTION

A. Conform to specified fire protection and prevention requirements established by GOTN or GOTN and as provided in Contractor's Safety Program.

1.21 SECURITY MEASURES

A. Protect all Work materials, equipment, and property from loss, theft, damage, and vandalism. Contractor's duty to protect property includes Employer's property used in connection with the performance of the Contract.

B. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.

1.22 PROTECTION OF PUBLIC UTILITIES

A. Prevent damage to existing public utilities during construction. Give owners of utilities at least 48 hours' notice before commencing work in the area, for locating utilities during construction, and for making adjustments or relocation of utilities when they conflict with the proposed work.

1.23 PROTECTION OF THE WORK AND PROPERTY

A. Preventive Actions:

1. Take precautions, provide programs, and take actions necessary to protect the Work and public and private property from damage.
2. Take action to prevent damage, injury or loss, including, but not be limited to, the following:
    a. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with progress of the Work or the Employer's operations.
    b. Provide suitable storage for materials which are subject to damage by exposure to weather, theft, breakage, or otherwise.
    c. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
    d. Frequently clean up refuse, rubbish, scrap materials, and debris caused by construction operations, keeping the Project site safe and orderly.
    e. Provide safe barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways, and other hazardous areas.
3. Obtain written consent from proper parties before entering or occupying with workers, tools, materials or equipment, privately-owned land.
4. Assume full responsibility for the preservation of public and private property on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of the work by the Contractor, it shall be restored by the Contractor to a condition equal to or better than that existing before the damage was done.

B. Barricades and Warning Signals: Where work is performed on or adjacent to any roadway, right-of-way, or public place, furnish and erect barricades, fences, lights, warning signs, and danger signals; provide watchmen; and take other precautionary measures for the protection of persons or property and protection of the work. Use barricades painted to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade. Erect sufficient barricades to keep vehicles from being driven on or into work under construction. Furnish watchmen in sufficient numbers to protect the work. Maintain barricades, signs, and lights, and provide watchmen until the project is accepted by the Employer.

1.24 PROTECTION OF EXISTING STRUCTURES:

1. Underground Structures:

   a. Underground structures are defined to include, but not be limited to, sewer, water, gas, and other piping, and manholes, chambers, electrical and signal conduits, tunnels, and other existing subsurface installations located within or adjacent to the limits of the Work

   b. Known underground structures, including existing siphons are shown on the Drawings. This information is shown for the assistance of the Contractor in accordance with the best information available, but is not guaranteed to be correct or complete.

   c. Explore ahead of trenching and excavation work and uncover obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption of utility services. Restore to original condition damages to underground structure at no additional cost to the Employer.

   d. Necessary changes in location of the Work may be made by the Engineer to avoid unanticipated underground structures.

   e. If permanent relocation of an underground structure or other subsurface installations is required and not otherwise provided for in the Contract Documents, the Engineer will direct Contractor in writing to perform the Work, which shall be paid for under the provisions for changes in the Contract Price as described.

2. Surface Structures: Surface structures are defined as existing buildings, structures and other constructed installations above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities that are visible above the ground surface.

3. Protection of Underground and Surface Structures:

   a. Support in place and protect from direct or indirect injury underground and surface structures located within or adjacent to the limits of the Work. Install such supports carefully and as required by the party owning or controlling such structure. Before installing structure supports, Contractor shall satisfy the Engineer that the methods and procedures to be used have been approved by the owner of the structure.

   b. Avoid moving or in any way changing the property of public utilities or private service corporations without prior written consent of a responsible official of that

service or public utility. Representatives of these utilities reserve the right to enter within the limits of this project for the purpose of maintaining their properties, or of making such changes or repairs to their property that may be considered necessary by performance of this Contract.

c. Notify the owners and/or operators of utilities and pipelines of the nature of construction operations to be performed and the date or dates on which those operations will be performed. When construction operations are required in the immediate vicinity of existing structures, pipelines, or utilities, give a minimum of 5 working days advance notice. Probe and flag the location of underground utilities prior to commencement of excavation. Keep flags in place until construction operation reaches and uncover the utility.

d. Assume risks attending the presence or proximity of underground and surface structures within or adjacent to the limits to the Work including but not limited to damage and expense for direct or indirect injury caused by his work to any structure. Immediately repair damage caused, to the satisfaction of the owner of the damaged structure.

4. Protection of Installed Products:

a. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.

b. Control traffic to prevent damage to equipment, materials, and surfaces.

c. Provide coverings to protect equipment and materials from damage.

5. Protection of Landscaping

a. The Contractor shall be responsible for the protection of all the trees, shrubs, irrigation systems, fences, and other landscape items adjacent to or within the work area, unless they are directed to do otherwise on the plans.

b. In the event of damage to landscape items, the Contractor shall replace the damaged items to the satisfaction of the engineer and the owner, or pay damages to the concerned as directed by the Employer.

c. When the proposed pipeline is to be within planted or other improved areas in public or private easements, the Contractor shall restore such areas to the original condition after completion of the work. Restoration shall include a

placement of 5 inches of topsoil, resoding, seeding, and replacement of all landscaped items.

d. If the Contractor does not proceed with the restoration after completion of the work or does not complete the restoration in a satisfactory manner, the Employer reserves the right to have the work done and to charge the Contractor for the actual cost of the restoration including all labour, material, and overhead required for restoration.

1.25 ROADS AND PARKING

A. Prevent interference with traffic on existing roads to the maximum extent possible.

B. Designate temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Employer.

C. Minimize use by construction traffic of existing streets and driveways.

D. Do not allow heavy vehicles or construction equipment in existing parking areas.

1.26 ENVIRONMENTAL CONTROLS

A. Provide and maintain methods, equipment, and temporary construction as necessary for controls over environmental conditions at the construction site and adjacent areas.

B. Comply with statutes, regulations, and ordinances which relate to the proposed Work for the prevention of environmental pollution and preservation of natural resources, including but not limited to the Environmental Protection Act of 1986.

C. The City recognizes that the site has considerable natural value and that construction of projects should have minimum impact to the surrounding environment. The Contractor shall adopt construction procedures that do not cause unnecessary excavation and filling of the terrain, indiscriminate destruction of vegetation, air or stream pollution, nor the harassment or destruction of wildlife.

D. Recognize and adhere to the environmental requirements of the Project. Disturbed areas shall be strictly limited to boundaries established by the

Contract Documents. Particularly avoid pollution of "on-site" streams, wells or other water sources.

E. Burning of rubbish, debris or waste materials is not permitted.

1.26.1 Pollution Control

A. Prepare a Spill Response and Prevention Plan, specific to the Contractor's means and methods. Submit prior to mobilization per Section 01300, Contractor Submittals.

B. Provide methods, means, and facilities required to prevent contamination of soil, water or atmosphere by discharge of noxious substances from construction operations.

C. Provide equipment and personnel to perform emergency measures required to contain any spillage, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.

D. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.

E. Prevent toxic concentrations of chemicals.

F. Prevent harmful dispersal of pollutants into the atmosphere.

G. Use equipment during construction that conforms to current State and local laws and regulations.

H. Dispose of all trash and debris in permitted landfills or recycling facilities, as applicable, in accordance with state and local laws and regulations.

1.26.2 Pest and Rodent Control

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.

B. Employ methods and use materials which will not adversely affect conditions at the site or on adjoining properties.

1.26.3 Noise Control

A. Provide vehicles, equipment, and construction activities that minimize noise to the greatest degree practicable. Noise levels shall conform to the latest Pollution control standards.

B. Conduct construction operations during daylight hours except as approved by Engineer.

C. Select construction equipment to operate with minimum noise and vibration.

1.26.4 Dust Control

A. Control objectionable dust caused by operation of vehicles and equipment. Apply water or use other methods, subject to approval of the Engineer, which will control the amount of dust generated.

1.27 CLEARING AND DEMOLITION

1.27.1 Summary

A. The Chapter includes all work necessary to move or remove and legally dispose of all interfering or objectionable material from the project site, including but not necessarily limited to trees, tree branches, tree stumps, brush, shrubs, weeds, debris, roots, rocks, concrete rubble, concrete masonry units, pipe, concrete curbs and gutters, asphalt pavement, concrete structures and concrete slabs, but only as required.

1.27.2 Definitions

A. Clearing: Clearing shall consist of cutting, removing, and disposing of trees, shrubs, brush, limbs, and other vegetative growth. Clearing shall also include the removal and disposal of trash piles, rubbish and fencing, and the preservation of trees, shrubs, and vegetative growth which are not designated for removal.

B. Grubbing: Grubbing is the removal and disposal of wood or root matter below the ground surface remaining after clearing.

C. Stripping: Stripping refers to the removal and disposal of all organic sod, topsoil, grass, and grass roots; all evidence of surface improvements and other objectionable material remaining after clearing and grubbing.

D. Demolition: The removal of existing structures, portions of existing structures, equipment, utilities, concrete curbs, sidewalks, and driveways, pipelines and other appurtenances.

1.27.3 Equipment

A. Equipment shall be suitable for the work to be done and shall be in good operating condition. Equipment operators and workmen are to be skilled in such operations and shall be competently supervised.

1.27.4 Clearing, Grubbing and Stripping

A. Clearing and grubbing shall be in accordance with the provisions of Section 16 of the
Caltrans Standard Specifications.

B. Clear, grub and strip areas to be excavated or surfaced.

1.27.5 Demolition

A. Remove existing structures, portions of existing structures, and equipment called for on the plans and as directed by the Engineer.

B. Contractor shall not demolish existing facilities beyond the limits designated on the drawings unless specifically directed to do so by the Engineer.

1.27.6 Preservation of Property

A. The project area shall be cleared and grubbed only to the extent necessary to accommodate the work in conformance with the notes and details shown on the plans. Trees or growth shall not be trimmed back unnecessarily.

B. Contractor shall take extreme care not to damage shrubs, trees, fences, irrigation systems and other improvements of adjacent property owners.

C. All existing improvements not specifically designated on the plans to be removed or relocated shall remain in their original condition and location undisturbed. However, upon written permission by the Employer, existing improvements may, for the convenience of the Contractor, and at his expense, be removed and temporarily relocated during construction and shall be replaced in their original location in as good or better condition as when the Contractor entered upon the work site.

1.27.7 Demolition of Surface Improvements

A. Where the plans indicate replacement of existing asphaltic pavement, the existing pavement shall be removed and disposed of off-site.

1.27.8 Demolition of Underground Pipe

A. Demolition of underground pipe shall be only as shown on the Drawings or necessary as determined in the field by the Engineer.

1.27.9 Removal of Debris

A. All demolished and cleared material shall become the property of the Contractor and shall be legally disposed of by the Contractor.

B. Removed concrete and asphalt concrete shall be legally disposed of off the right-of-way at a location provided by the Contractor. Demolished concrete shall not be buried in structure backfill areas.

2 DETAILED SPECIFICATTION

2.1 TECHNICAL SPECIFICATION

The technical specification for the items of works covered under the project scope of works are mainly,

- Natural Nallah / Primary Drains: - 11.16km – Open drains and Earthen bund strengthening
- Rejuvenation of Water Bodies: 4 Nos – Krishnarav Eri, Pattalamman Eri, Varatharayan Eri and Kesavakuttai Eri

The detailed work methodology and specification for the above components are described in the following sections.

2.2 DISMANTLING AND DEMOLITION

Dismantling/demolishing of culverts and storm water drains will be required wherever reconstruction is proposed. Dismantled/demolished material may be concrete, dry rubble, random rubble, laterite, brick etc. Serviceable material obtained from dismantling/demolishing shall be stacked separately for reuse. Unserviceable materials obtained from dismantling/demolishing shall be disposed of with all lead and lift or as directed at places pointed out by the Engineer.

2.3 SITE CLEARANCE AND SITE GRADING

All area of the Site marked in the Specification Drawings for clearance or from which material is to be excavated or upon which filling is to be deposited shall be cleared to the extent required by the Engineer of all buildings, walls, gates, fence and other structures and obstructions and of all bushes, hedges, trees, stumps, roots and other vegetation except for trees marked for preservation. Material so cleared shall so far as suitable be preserved and stacked for further use but shall otherwise be disposed of the Site as directed by the Engineer.

2.3.1 Trees

Where directed by the Engineer, trees shall be uprooted or cut down as near to ground level as possible. Branches and foliage shall be removed or disposed of the Site. Useful timber shall remain the property of the HCMC and shall be cut into suitable lengths and transported to a distance not exceeding five kilometres to a location designated by the Engineer where it shall be offloaded and stacked.

2.3.2 Stumps

Stumps and roots whether existing or remaining after tree felling, shall where directed by the Engineer be grubbed out and disposed of the Site. The resulting hole shall be filled with approved material deposited in 225 mm layers and compacted to the same dry density as the adjoining soil.

The contractor shall arrange to make trial pits at appropriate intervals to ascertain the underground services and to fix up Storm Water Drain alignments.

During execution of works if contractor causes damages to the underground services like Water pipe lines, TNEB Cables Telephones cables.

Light Cable, and other OFC cables etc., it should be restored to its original condition by the contractor his own cost. Further if any damage charges, claimed by the service departments, will also be borne by the contractor. HCMC will be liable for such payments.

2.3.3 Excess Excavation to be Made Good

The Contractor shall, if directed, remove from the Site all material resulting from excess excavation and shall make good the same with such kind of fill material or in such class of concrete as may be reasonably required by the Engineer having regard to the circumstances.

2.3.4 Stripping Top Soil

Where ordered by the Engineer, topsoil shall be stripped to such depths and over such areas as he may direct, as a separate operation prior to any further excavation which may be required.

2.3.5 Supporting Excavations

a. The Contractor shall well and effectually support the sides and ends of all excavations to prevent any fall or run from any portion of the ground outside the excavation and to prevent settlement or damage to structures adjacent to the excavation. Any excavation necessary to provide space for such support or other working space shall be carried out. If, for any reason, any portion of the bottoms, sides or ends of any excavations shall give way, the Contractor shall at his own expense take all necessary remedial measures including the excavation and removal of all the ground thereby distributed.
b. Where the Contractor elects and is permitted by the Engineer to perform excavations with sloping faces (other than sloping excavations shown on the Drawings or required as permanent features of the Works) and without shoring, the excavated faces shall be to stable slopes and heights.

2.3.6 Trimming Excavations

a. When excavating to specified or required levels for the foundation of any structure or to specified or required limits for the face of any structure required to abut undisturbed ground, the Contractor shall not excavate the last 12.10 mm until immediately before commencing the constructional work, except where the Engineer shall permit otherwise. Should the Contractor have excavated to within 150 mm above these specified levels or to within 150 mm of these specified limits before he is ready or able to commence the constructional work he shall, where required by the Engineer, excavate further so as to remove not less than 150 mm of material immediately before commencing the constructional work.

b. Before commencement of any constructional work all shattered and loose materials shall be removed from the excavations by hand so as to ensure that the work rests on a solid and perfectly clean foundation or abuts against solid ground.

2.3.7 Site Grading

(i) Site grading shall be carried out as directed by the Engineer. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as specified under (ii) of this Clause unless otherwise indicated below.

(ii) The approved material shall be placed in layers not exceeding 225 mm in depth before compaction and shall be compacted to a dry density not less than 95 percent of the maximum dry density obtained by the test in Part VII of IS 2720.

(iii) To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

(iv) Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well.

(v) The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected materials and make good the slip.

(vi) The fill shall be carried out to such dimensions and levels as directed by the Engineer, after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

(vii) If specifically permitted by Engineer, compaction can be obtained by allowing loaded trucks conveying fill or other material to ply over the fill area. Even if such a method is permitted, it will be for the Contractor to demonstrate that the desired/specified compaction has been obtained. In order that the fill may be reasonably uniform throughout,

the material should be dumped in place in approximately uniform layers. Traffic over the fill shall then be so routed to compact the area uniformly throughout.

(viii) If so specified, the rock as obtained from the excavation may be used for filling and levelling to indicate grades without further breaking. In such event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level indicated above has been carried out, the void in the rock fill shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 tonne roller. Not less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

2.3.8 Inspection by the Engineer

a. When the specified levels or limits of excavation are reached the Engineer will inspect the ground exposed, and if he considers that any part of the ground is by its nature unsuitable, he may direct the Contractor to excavate further. Such further excavation shall be refilled to the specified levels or limits with concrete, selected excavated material or selected imported material as directed by the Engineer.

b. Should the material forming the bottom of any excavation, while acceptable to the Engineer at the time of his inspection, subsequently become unacceptable to him due to exposure to weather conditions or due to flooding or have puddled, soft or loose during the progress of the works, the Contractor shall remove such damaged, softened or loosened material and excavate further by hand.

2.4 EXCAVATION

2.2.1 General:

Contractor shall be deemed to have visited the site prior to submitting his bid and made all necessary inspection and investigations and to have decided for himself the means of access and working space, the nature of the ground and subsoil, if any, the level of water table, extent of rock demolition, alterations, support of neighboring properties, etc. Soil report is attached for the reference.

2.2.2 Related work:

1) Clearing, grubbing and removing all vegetation from the site.
2) Excavation including getting out, and necessary dressing to make surface ready to receive blinding.
3) Filling and backfilling and compaction of fills.
4) Removal and disposal of surplus material.
5) Stone soling to roads and paving /GSB.
6) Dewatering.

The Contractor shall provide all labour, equipment, materials and any incidentals necessary to complete all aspects of work included in the drawings and specifications.

2.2.3 Applicable Standards:

The following standards shall be followed:

1) IS: 3764-1966 Safety Code for Excavation Work.
2) IS: 1498-1970 Classification and identification of soils for general engineering purposes.
3) British Standard 1377-Methods of test for Soils for Civil Engineering Purposes.
4) British Standard 5930- Code of Practice for Site Investigations.
5) SP27 Handbook of method of measurement of building works.
6) Local Building Regulations and Statutory Regulations.

2.2.4 Definitions

Clear: The removal of trees, shrubs and artificial obstructions including fences, concrete slabs, kerb and channel, remains of old buildings and the like.

Grub: The removal of tree stumps and roots.

Topsoil: Topsoil is all surface soils, which have sufficient humus to support plant growth without resort to artificial fertilization.

Cut: A general term for ‘in place’ material removed by digging from the ground. The term ‘excavation’ or derivatives thereof may be used interchangeably.

Fill: A general term for material spread and compacted over the ground to make up finished levels or levels to sub-grade. The term ‘Embankment’ or derivatives thereof may be used interchangeably.

Sub-Grade: The finished, trimmed and prepared surface of the earth works after completion of all cut and fills operations. The term ‘formation level’ or derivatives thereof may be used interchangeably.

Sub-Base: A selected filling layer spread and compacted over the sub-grade to make up levels to the underside of the base course or floor slab**.**

Base course: A selected filling layer spread and compacted to levels immediately below road wearing course.

Spoil: Excess cut material remaining at the end of filling operations.

Bulk Earthwork: Earthworks to create, by excavation and/or filling and compacting, building platforms, road formations, parking areas, reservoir**s**, embankments, drainage canals or any other formation where the unimpeded use of large earthmoving equipment is possible. This is distinct from backfill of trenches, foundations or other earthworks immediately adjacent to completed or partially completed structures.

2.2.5 Site Preparation:

2.2.5.1 Site Inspection – Preamble

Any Site details or site information included in the contract documents or Drawings are provided for the Contractor's guidance only. The information provided may not be a complete or accurate description of conditions existing below the surface of the ground. The correctness of the information is not guaranteed and the Contractor shall be responsible to make its own interpretation of sub-surface conditions.

The Contractor shall visit the site, examine the boreholes, and decide for himself the nature of the ground and the subsoil to be excavated. No claim for extra payment will be entertained because of any misunderstanding, incorrect information, assumptions, or ignorance of existing conditions.

2.2.5.2 Site Quality Control

The Contractor shall provide in his quality assurance programme information to show that a system will be used to ensure that all works carried out under this section (including any done by Sub-Contractor) will comply with all the requirements of this section.

2.2.5.3 Antiquities

Any ancient carvings, relics, coins or other curiosities discovered during the excavation or other work shall remain the property of the owner and shall be handed over to the owner as required under the General Conditions of Contract.

2.2.5.4 Setting Out and Clearing of the Site - Scope to Include:

The Contractor shall set out the centre line of the building or other involved works after clearing the site and get the same approved from the Project Manager / Professional Team. It shall be the responsibility of the Contractor to install substantial reference marks, benchmarks etc., and maintain them as long as required by the Project Manager / Professional Team. The Contractor shall assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

2.2.5.5 Benchmarks and Setting Out:

The Contractor shall engage a qualified surveyor to establish permanent benchmarks in suitable locations around the site. These benchmarks shall enable the Contractor to set out the location of all buildings, paths, roads, utility lines, storm water drains and all other portions of the Contract work.

If an error in setting out causes some portion of the work to be constructed in the wrong location, or to the wrong dimensions, the Contractor shall make good the incorrect work at his own expense to the satisfaction of the Project Manager / Professional Team. The Contractor shall be liable for any consequential loss experienced by the Client.

2.2.5.6 Excavation Classification:

1) Excavate foundation from existing ground level to the formation levels shown in drawing.
2) Excavation to pit working level.
3) Earthworks outside property line.
4) Excavation, compaction and backfill to plinth and service trenches.
5) Dewatering

2.2.5.7 Related Works

1) Site clearance, layout and preparation
2) Dewatering, shoring and strutting.
3) Cast-in-Situ Concrete

2.2.5.8 Classification of Soil / Rocks:

Ordinary soil

This includes excavation in all types of soil (excluding soft medium rock) including soil containing gravel, murum, loose boulders, viz., ordinary gravely soil, hard gravely soil, wet soil, stiff slushy soil, in under water etc. as per TNDSS detailed specifications

Soft Rock

This shall include soft disintegrated rock, laterite, soft rock or kankar not requiring blasting as per TNDSS detailed specifications

Medium Rock

This shall include all component of as per TNDSS detailed specifications

Hard Rock

This shall include all rock occurring in large continuous masses which cannot be removed except by blasting for loosening it. Harder varieties of rock with or without veins and secondary minerals which, in the opinion of the Engineer require blasting shall be considered as hard rock as per TNDSS detailed specifications

2.2.5.9 Trial pits

Trial pits are to be carried out continuously with special care to ascertain the desilting depth based on the designed Bed level at every 100m and to identify expected utilities under advance intimation to the owner of utilities. Trial pits may be excavated by the Contractor, without being directed to do so, along the lines of the trenches as shown on the drawings in advance of the excavations for the purpose of satisfying himself as to the location of underground obstructions or soil conditions. Nothing extra shall be paid on account of this work. Trial pits shall be excavated by hand. Any damage to the existing utilities shall be repaired at Contractor's own cost. Precautionary measures shall be taken by the Contractor while making trial pits and he shall inform the Engineer before commencing such works.

2.2.5.10 Classification of Soils - Scope to Include:

Excavation in all types of soil comprising any of the following:

1) Vegetable or Organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum.
2) Any mixture of soils in above.
3) Mud concrete below ground level.

4) Generally, any material that yields to the ordinary application of excavation equipment.
5) Stiff heavy clay, hard shale, or compacted moorum requiring close application of excavation equipment.
6) Soft rock
7) Gravel and cobblestone usually rounded, having a maximum dimension in one direction of 300mm.

2.2.5.11 Method of Excavation - Scope to Include:

If the excavation is carried out to a greater depth than specified, extra depth shall be made up by filling with lean concrete in a ratio of 1:4:8 (1 cement: 4 coarse sand: 8 stone graded aggregate of 40 mm size) as directed by the Project Manager / Professional Team. The cost of such extra excavation and of the filling therein as specified shall be borne by the Contractor. No extra claims whatsoever will be entertained in this regard. The bottom of excavation shall be trimmed, leveled, rammed and sides dressed and trimmed in accordance with the drawings/directions of the Project Manager / Professional Team. The Contractor shall ensure that excavation is to be carried out as indicated on the drawings with sufficient working space to permit erection of forms, shoring, inspection of foundations and any other activity likely to be carried out below ground level. All ramps for excavation except one will be cleared before completion (unless specifically noted otherwise) and made good before final completion. No concrete shall be placed in the foundation until the Contractor has achieved the Project Manager / Professional Team's approval that a secure foundation has been prepared.

The Contractor shall ensure proper methods are adopted to control the creation of dust. Method adopted shall be approved by the Project Manager / Professional Team.

2.2.5.12 Excavation and Preparation for Concreting:

Excavation shall include removal of all materials of whatever nature at all depths and whether wet or dry necessary for the construction foundation and substructure (including mass excavation for underground reservoir where applicable) exactly in accordance with lines, levels grades and curves shown in the drawing or as directed by the Project Manager / Professional Team. The bottom of excavation shall be leveled both longitudinally and transversely or sloped as directed by the Project Manager / Professional Team.

Should the Contractor excavate to a greater depth or width than shown on the drawings or as directed by the Project Manager / Professional Team he shall at his own expense fill the extra depth or width in cement concrete in proportion as directed by the Project Manager / Professional Team but in no case with concrete of mix leaner than 1:4:8 cement concrete.

The Contractor shall report to the Project Manager / Professional Team when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the Contractor has obtained Project Manager / Professional Team approval in case, the excavation is done through different strata of soil and if the same is payable as per provision in the Schedule of Quantities the Contractor shall get the dimensions of the strata decided by the Project Manager / Professional Team for payment. If no specific provisions are made in the Schedule of Quantities, it will be presumed that excavation shall be in all types of soil and other material and the Contractor's rate shall cover for the same.

After the excavation is passed by the Project Manager / Professional Team and before laying the concrete, the Contractor shall get the depth and dimensions of excavation and levels (and nature of strata as applicable as per Schedule of Quantities like hard rock, soft rock etc.,) and measurements recorded from the Project Manager / Professional Team. Excavated pit should have adequate clearance from the face of concrete at all faces to have adequate working space.

2.2.5.13 Stacking of Excavated Materials:

All materials excavated will remain the property of the Project Manager / Professional Team and rate for excavation including sorting out of useful materials and stacking them on site as directed but with a safe distance from the edge of excavation to avoid collapse/ shielding of excavated area. Materials suitable and useful for back filling, plinth filling or leveling of the plot or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of men, animals and vehicles or encroach on the area required for constructional purposes.

2.2.5.14 Disposal / Carting of Surplus Earth - Scope to Include:

Top layer of hard soil free from vegetation, spoils, rocks, boulders for a quantity of approximately 15% of the total excavated earth quantity shall be stocked at locations as directed by the Project Manager / Professional Team for re-use up to a distance of 300m from the project site. The remaining excavated earth, except for the hard rock excavated, shall be disposed of including lifting out, transportation to locations approved by local bodies, Government agencies or as directed by the Project Manager / Professional Team, as the case may be.

The Contractor is responsible for finding suitable dumping yard and for the removal of all sub grade obstructions, whether indicated or not, wherever it is likely to interfere with execution and completion of the Project is deemed to be included in its Scope.

All surplus and unusable earth shall be carted out and disposed off outside the Site but at a location approved by local authority and conforming to their specifications.

The Contractor shall quote its rate for disposing off or carting away the item considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed of.

2.5 DEWATERING

Rate for excavation shall include bailing or pumping out which may accumulate in the excavation during the progress of work either from seepage, rain water or any other cause and for diverting surface flow, if any by bunds or other means. Pumping out water shall be done in such approved manner as to preclude the possibility of any damage to the foundation trench, concrete or masonry or any adjacent structure inside or outside the wall frontage. When water is met in foundation trenches or in tank excavation, pumping out water shall be from auxiliary pit of adequate size dug slightly outside the building excavations. The depth of auxiliary pit shall be more than the working foundation trenches / levels. The auxiliary pit shall be refilled with approved excavated materials after the dewatering is over.

The Contractor shall adopt an appropriate method of dewatering work and shall submit its proposal for carrying out the dewatering work for the approval of the Project Manager / Professional Team. The water shall be pumped continuously to keep the water level at a minimum of two 2’ (feet) below the lowest point of excavation level. The operation shall be continued until the entire excavation has been completed so as to ensure the excavation is always dry.

1) Adequate number of pumps shall be deployed to ensure a continuous dewatering process.
2) Power / Fuel required for the operation of pumps etc., shall be provided and paid for by the Contractor.

Softening of the bottom of excavation will not be allowed. If softening occurs due to weather or any other source, the Contractor shall remove the affected area and replace as specified and directed by the Project Manager / Professional Team at no extra cost.

Necessary grading, trenching and temporary sumps shall be made around excavations as required to prevent water runoff into excavation and to ensure proper protection to slopes from erosion.
The excavation shall be kept free from water: -

1) During inspection
2) From start to completion of concreting till they come above existing ground.
3) Till the Project Manager / Professional Team considers that the concrete is sufficiently set.

2.6 SHORING AND BRACING

Pursuant to Clauses of Standard Specifications the Contractor shall supply, fix and maintain necessary sheathing, shoring and bracing etc., in steel or wood, as may be required to support the sides of the excavation, to protect workmen in the trench and to prevent any trench movement which might any way injure or delay the work, change the required width of the trench, make unsafe condition for adjacent pavements, utilities, buildings or other structures above or below ground.

Sheathing, shoring and bracing shall be withdrawn and removed as the backfilling is being done, except when the Engineer may agree that such sheathing, shoring and bracing be left in place, at the Contractor's request. In any case, the Contractor shall cut off any such sheathing at least 60 cm below the surface and shall remove the cut off material from the trench.

All sheathing, shoring and bracing which are left in place under the foregoing provisions shall be removed in a manner so as to not endanger the completed work or other structures, utilities or property, whether public or private. Rate for these items should deemed to be included in the relevant item and shall be executed as per BOQ provisions.

2.7 BACKFILLING

Pursuant to earthwork, erosion control and drainage of Standard Specifications, the Contractor shall use selected surplus soils from excavated materials for backfilling. All fill material shall be subject to Engineer’s approval and shall be conforming to Standard Specifications. The excavated materials suitable for backfilling shall be stored not closer than 60 cm from the edge of the trench and shall not obstruct any public utilities or interfere with travel by local inhabitants or general public. Handling and storage of excavated materials must meet with the regulations of the Local Government Authorities. The detailed specification for backfilling shall be as per Clause 5.15.4 of the general specifications.

Method of Backfilling:

Trenches and excavated pits for structures shall be backfilled to original ground level or to such other levels, as the Engineer may direct. All backfilling shall be carried out in orderly manner expeditiously and consistent with good workmanship. Mechanical vibrators shall be used for compaction of the trenches filled with back fill material wherever required and necessary.

Backfill material put into the trenches/pits for backfilling, shall unless otherwise specified be compacted and built up as to minimize future settlement. For this, care shall be exercised in selecting backfill material free from large hard clay lumps, especially in cramped areas directly adjoining the walls of structures.

Backfilling in the trenches and around structures shall be carried out in horizontal layers of uniform thickness of not more than 150 mm when measured loose. As may be necessary to attain maximum compaction, the backfill material shall be moistened by sprinkling with water. After placing each layer of backfill material, the

layer shall be thoroughly and uniformly compacted by means of mechanical or hand tampers. The compacting equipment and the manner of its use shall be subject to the approval of the Engineer.

Before final acceptance of the work, additional tamped earth shall be added to restore the settled trench surface to the required level of the adjacent earth surface or to the finished earth base.

Pursuant to Clauses of Standard Specifications, if from the excavated soil, enough backfill material is not available, imported, selected and approved backfill material from the borrow pits is required to be placed for backfill, on approval of the Engineer. Pursuant to Clause of Standard Specifications, backfilling of trenches where the excavation is in the rock shall be with the surplus soft soil located within 200m from the site of work. If the soil is to be obtained from borrow pits the availability of earth for this purpose including the lead and lift should be verified by the contractor while quoting the rates and no extra payment will be made on this account.

Disposal of Surplus Excavated Material

The excavated material, which is in surplus to the requirements after backfilling shall be removed/disposed off as directed by the Engineer with all leads and lifts from the site. The landfill site is to be assessed by the Contractor and got approved by the Engineer. No surplus or excess material shall be disposed off in a stream / channel or in any place where the pre-construction surface drainage may have to be provided, without written permission of the Engineer.

Unauthorized excavation

All the unauthorized excavation carried out beyond or below the lines and grades given in the project drawings, together with the removal of such excavated materials, shall be at the Contractor's expense.

Control of Water

While drains and other appurtenances are under construction, the contractor, at his own expense shall keep all excavation free of water. He shall provide all bunds, flumes or other works necessary to keep the excavation entirely clear of water, and shall provide and operate pumps or other suitable equipment of adequate capacity for dewatering the excavated trench / pit. Concrete or masonry shall be done in water free trench/pit and the drain shall be kept dry enough until concrete and masonry are set and are resistant to water damage. The water shall be disposed off in a manner approved by the Engineer.

The Contractor has to take adequate care of construction materials and equipments brought to site by him against rains, floods etc., at his own cost.

All gutters, pipes, drains, conduits, culvert, catch basin, storm water inlets, ditches, creeks and other storm water drainage facilities shall be kept in operation or their

flows be satisfactorily diverted and provided for during construction. The existing drainage facilities that are diverted shall be restored after the work is completed, to the satisfaction of the Engineer. All costs for diverting surface and restoring storm water facilities disturbed or damaged by the construction for keeping the excavation free of water during construction shall be included in the price bid.

2.8 CONCRETING

2.6.1 Related Work

1. Concrete Formwork
2. Concrete Reinforcement
3. Concrete Finishing
4. Sealants

2.6.1.a Applicable Standards:

IS - 299 Specification for Ordinary, rapid hardening and low heat Portland
IS - 455 Cement
IS - 1489 Specification for Portland Blast Furnace Slag Cement
IS - 4031 Specification for Portland Pozzolona Cement
IS - 650 Method of physical tests for Hydraulic Cement
IS - 383 Specification for Standard sand for testing of cement
Specification for Coarse and fine aggregate for use in mass concrete
IS - 515 Specification for natural and manufactured aggregates for use in mass concrete.
IS - 2387 Method of test for aggregates for concrete.
IS - 516 Methods of test for strength of concrete.
IS - 1199 Methods of sampling and analysis of concrete
IS - 3025 Methods of sampling and testing (physical and chemical) for water used in industry.
IS - 2645 Specification for integral cement waterproofing compounds
IS - 1791 Specification for batch type concrete mixers
IS - 2438 Specification for roller pan mixer
IS - 2505 Specification for concrete vibrators, immersion type
IS - 2506 Specification for screed board concrete vibrator
IS - 2514 Specification for concrete vibrating tables
IS - 3344 Specification for pan vibrators
IS - 4656 Specification for form vibrators
IS - 2722 Specification for portable swing weigh batchers for concrete (single & double bucket type)
IS - 456 Code of practice for plain and reinforced concrete
IS - 1343 Code of practice for pre-stressed concrete
IS - 457 Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.

IS - 3370 Code of practice for concrete (Part I to IV) structures for storage of liquids
IS - 3935 Code of practice for composite construction
IS - 3201 Criteria for design and construction of pre-cast concrete trusses.
IS - 2204 Code of practice for construction of reinforced concrete shell roof.
IS - 2210 Criteria for the design of R.C. shell structures and folded plates.
IS - 3558 Code of practice for use of immersion vibrators for consolidating concrete
IS - 3414 Code of practice for design and installation of joints in buildings
IS - 2571 Code of practice for laying in-situ cement concrete flooring
IS -12269 Code of practice for 53 grade cement

2.6.2 Definitions:

a. Water / Cement Ratio:
The ratio by weight of water to cement in a mix expressed as a decimal fraction. Water being that which is free to combine with cement, including free water in aggregate, but excluding that for arriving at the ratio.

b. Hot Weather:
Shade air temperature of 37^{o} C and higher.

2.6.3 Quality Assurance:

1) Supervising staff shall have qualifications and experience specified in the contract.
2) The following tests shall be carried out by the approved agency:

a. Testing preliminary test cubes;
b. Testing work test cubes;
c. Testing in situ concrete at site by hammer test, ultrasonic tests and core tests.

a. Standards:
Comply with the following codes, specifications and standards and as shown on the drawings.

1) IS 456: 2000 - Specifications for plain and reinforced concrete.
2) IS 269:1976 or latest amendment - Specifications for ordinary and low heat Portland cement.

2.6.4 Materials:

2.6.4.1 Quality

All materials used in the works shall be of best quality of their respective kind as specified herein, obtained from suppliers and sources approved by the Structural Engineer and shall comply strictly to tests instructed by the Project Manager / Professional Team, and where tests are not laid out, with the requirements of the latest issue of the relevant Indian Standard.

2.6.4.2 Test Certificate

All manufacturer's test certificates, proof sheets, etc. showing that the materials have been tested in accordance with the requirements of the specification and of the approved Indian Standard(s) are to be supplied free of charge on request to the Project Manager / Professional Team.

2.6.4.3 Cement

Cement shall be of Portland type and shall comply with IS: 269 and IS - 12269. The cement used shall be of approved manufacture and the sources of supply shall not be changed without approval of the Project Manager / Professional Team.

It shall be received in bags of 50 kg each conforming to IS 2580-1982 IS 11652-1986 or IS-11633-1986 or IS-12174-1987. The bags shall be marked with the manufacturer's name or its registered trademark, if any, type of cement and grade legibly and each batch shall be accompanied by a Test Certificate from the factory.

Samples shall be taken immediately on receipt of cement at about one sample per 1000 bags. Tests shall be carried out on fineness, initial and final setting time and compressive strength as per IS: 4031 and result shall be verified by the Project Manager / Professional Team before use in the permanent works. Samples shall be taken immediately on receipt of cement at site. Sampling shall be as per IS 3535.

Stacking and Storage of Cement

Cement shall be stored in such location so as to prevent deterioration due to moisture. A dry and waterproof shed designated, as "cement godown" shall be best suited for this. Bags shall be stacked on rigid waterproof platforms about 15 to 20 cm clear above the floor. Flooring of the shed shall consist of the two layers of dry bricks laid on a well-consolidated earth to avoid contact of cement bags with the floor. It shall also be 35 to 45 cm clear from the surrounding walls. A maximum high stack of Ten (10) bags is permitted. The bags shall be arranged in header and stretcher fashion. Stacks shall be so arranged that the first batches are used first, and so that they permit easy access for inspection and handling.

The size and dimensions of the cement go down shall got to be approved, before its construction, from the Project Manager / Professional Team.

For extra safety during monsoon, or when cement is expected to be stored for an unusually long period, each stack shall be completely enclosed by a waterproofing membrane, such as polyethylene which shall cover the top of the stack. Care shall be taken to see that the stored cement is not damaged at any time during the use.

Storage of the cement at the Site shall be at the Contractor's expense and risk. Any damage occurring to cement due to faulty storage in the cement go down or on account of negligence on its part, shall be the liability of the Contractor.

2.6.4.4 Aggregate

1) To be crushed naturally occurring materials conforming to IS: 383-1970. All physical properties and grading parameters must conform to this code.
2) Aggregate, 95% of which shall be retained on 4.75 mm test sieve.
3) Aggregate shall be from crushed granite, quartzite, trap, and basalt quarries.
4) Free from soft friable thin porous laminated or flaky pieces.
5) Free and clean from dust and foreign matters, namely injurious amounts of disintegrated pieces, alkali, vegetable matters and other deleterious substances.
6) Shall be chemically inert when mixed with cement.
7) The aggregate shall not contain any material that will attack the reinforcement. The maximum quantities of deleterious materials in coarse aggregates shall not exceed the limits laid down as per IS: 2386 (Part I & II)
8) Shall be angular in shape
9) Maximum size of the aggregate shall be 20mm.
10) Shall have a minimum specific gravity of 2.6(Standard Surface Dry basis)
11) When stone aggregate or gravel is brought to the site single sized (un graded), it shall be mixed with single sized aggregates of different sizes in the proportion to be determined by the field tests to obtain graded aggregate or specified nominal size. The Contractor is deemed to have included the cost for above in its Scope.
12) Coarse aggregates shall be measured in stacks and adjustment shall be made by deducting seven and half (7.5) per cent of gross measurements of stacks in respect of aggregate of nominal size 40 mm and above. No deduction from the gross measurements of the stacks is to be made in respect of aggregates of nominal size below 40 mm.

Coarse aggregates brought to site shall be washed clean if required and as directed by the Project Manager / Professional Team.

2.6.4.5 Fine Aggregate

a) Shall be washed dry sand and shall confirm to IS: 383-1970 between Grading Zone I and II for structural concrete.

b) Shall pass through IS sieve 4.75mm test sieve leaving a residue of not more than 5%
c) Shall not contain any traces of silt, and the sand shall be thoroughly washed with water so as to bring the percentage of silt content within the prescribed limit. Nothing extra is payable to Contractor on this account.
d) Fine aggregates shall be so stacked as to prevent dust and foreign matter getting mixed up with it as far as practically possible.
e) Since fine aggregates bulk to a substantial extent when partially wet, measurements shall be taken when the stacks are dry or an appropriate allowance has been made for bulking.

2.6.4.6 Water

1) Water for mixing shall be from potable supply system or from bore well supply.
2) Water for curing shall be from potable supply or from bore well supply.
3) Water shall be tested in accordance with IS: 3025-1986. Maximum permissible limits of deleterious materials in water shall be as given in IS: 456-1978.
4) The pH value of water shall not be less than 6 and more than 9.
5) Water which may erode or discolour concrete or which has got more than 1000 ppm of chloride content shall not be used.
6) The Contractor shall make its own arrangements for storing of water if necessary, in drums, tanks or cisterns to the satisfaction of Project Manager / Professional Team. Care shall be taken to ensure that water is not contaminated in anyway.

2.6.4.7 Expansion and Contraction Joints

1) Joint filler shall be Bitumen impregnated shalitex board 25mm thickness or Supreme board of 25mm thick (CAPCELL HD 100) for expansion joint.
2) Poly sulphide/ polyurethane/ silicon-based joint sealants shall be provided in expansion joint.
3) Sliding type neoprene bearing pad of structural grade for expansion joints.

2.6.4.8 Miscellaneous

Chemical curing compound of approved make to form a membrane or surface which will disintegrate and flake from that surface over a period of days commencing at least 7 days after application.

Vapour barrier and separation layer to underside of concrete slab, as and when necessary, and grade 10 mil (.25 mm) thick polyethylene sheets with laps 100mm on sides and ends.

2.6.5 Proportioning, Batching & Mixing of Concrete

2.6.5.1 Proportioning

a. Aggregate:

The proportions, which shall be decided by conducting preliminary tests, shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weight batchers conforming to I.S. 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the Project Manager / Professional Team that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stockpiles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by Project Manager / Professional Team to ensure maintaining of grading in accordance with the samples used in preliminary mix designs. The material shall be stockpiled well in advance of use.

b. Cement:

The cement shall be considered by weight, for design mix.

c. Water:

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

d. Definition of Water/Cement Ratio

The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.

e. Water/Cement Ratio

The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by the Project Manager / Professional Team. Maximum water-cement ratio shall be restricted to 0.53

f. Proportioning by Water/Cement Ratio

The W/C ratio specified for use by Project Manager / Professional Team shall be maintained. Contractor shall determine the water content of the aggregates as frequently as desired by the Project Manager / Professional Team as the work progresses and as specified in IS 2386 (Part III) and the amount of mixing water added at the mixer shall be adjusted as directed by the Project Manager /

Professional Team so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

2.6.5.2 Batching and mixing of concrete:

The proportions of the materials for the concrete mix as established by the preliminary test for mix design shall be followed for all the concrete in the works and shall not be changed except when specifically permitted by the Project Manager / Professional Team.

If approved by the Project Manager / Professional Team concrete may be produced by volume batching the ingredients except the cement. Fine and coarse aggregate shall be proportioned volumetrically by subsequent conversion of the weights of volumes knowing their bulk densities as stipulated in Para 9.2.2 or I.S. 456-2000. All concrete shall be mixed in mechanically operated batch mixers complying with I.S. 1791 of approved make with suitable provisions of correctly controlling water delivered to the drum. The quality of water actually entering the drum shall be checked with reading of gauge or valve setting before starting the job. The test shall be made while mixer is running. The volume of the mix material shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour for the minimum period of 2 minutes after all the materials and water is in the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The weighing gauge of mix shall be periodically checked or as directed by the Project Manager / Professional Team. The Contractor should carry out rectifications immediately if found necessary.

Mixer and the weight batcher shall be maintained in clean and serviceable condition. The accuracy of the weight batcher shall be periodically checked. Both mixer and the weight batcher shall be set up level on firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately.

Each time the work stops, the mixer shall be cleaned out and on next commencing the mixing, the first batch shall have 10% additional cement to allow for striking in the drum.

2.6.5.3 Batching Aggregate by Volume:

1) Obtain approval before using this method.
2) Batch cement by weight and water by either weight or volume.
3) Measure aggregate in metal container whose depth is not less than their greater width and the size of which is such as to enable the whole to be easily checked.
4) Concrete shall be mixed in concrete mixers until a uniform distribution of the material, and a uniform colour and consistency is obtained.
5) Concrete mixing shall in no case be less than two minutes.
6) Each batch shall be so charged into the mixer that approximately 10% of the water enters the drum before the cement and aggregate. Water shall be added gradually while the drum is in motion, so that all the water is in the drum until the first quarter of the minimum time.
7) The amount of concrete mixed in drum shall not exceed the rated capacity of the mixer and the whole of the material shall be removed before a fresh batch enters the drum.
8) Do not modify the mixed concrete either by addition of water or cement or other means.

2.6.5.4 Cleanliness:

1) Clean mixer and handling plant by washing with clean water at the end of the work and at intervals of 30 minutes during mixing.
2) If old concrete mix remains in the mixer drum, rotate the drum with clean aggregate and water before mixing the cement.

2.6.5.5 Planning of Concrete:

1) Project Manager / Professional Team shall be informed 24 hrs in advance before the pour of each concrete to allow for inspection of reinforcement, sizes and levels of the members to be concreted, concrete cover, cleanliness, filling of gaps and voids and supporting props.
2) Ensure that the spaces to revive concrete are clear free from debris and free from water.
3) Transportation: Use approved methods to identify that the grade of concrete to be placed in proposed location.
4) Use suitable stools, walkways, barrow runs, for traffic over reinforcement or freshly placed concrete.
5) Clean the transportation equipment immediately after use or whenever cement and aggregate is used by using clean water.

Following issues are to be noted while planning of concrete pours:

a) Slabs: to be cast in strips and not in alternate bays.

b) Walls: to be cast in successive pours working away in both directions from the center with no shrinkage gaps except for final closure.

c) Starters: shall be the same as for the main member and shall be vibrated / rammed into place and prepared as for other joints. Starters to be cast for walls monolithically with foundation. In case of columns, they can be cast after concreting of foundation / slab.

2.9 ORDINARY CONCRETE:

1) Ordinary cement concrete where specified shall be used
2) Proportions 1:5:10, 1:3:6, 1:2:4, 1:1.5:3, etc., in the specification refers to the quantity of cement by volume, dry coarse sand by volume, quantity of coarse aggregate by volume.
3) Cement shall be weighed based on 1 cum. of cement weighs 1440 kgs or 1 full bag of cement (50 kg) corresponding to 35 litres. by volume.
4) Correction factors to be applied for bulking of sand when the sand is either wet or moist.
5) Water cement ratio used shall be just sufficient for the workability of concrete.
6) Minimum strength of concrete shall be obtained as below

S No.	Proportion of Concrete	Preliminary Tests	Work Tests
1	1:5:10	75 kg/sq.cm.	50 kg/sq.cm.
2	1:3:6	135 kg/sq.cm.	100 kg/sq.cm.
3	1:2:4	200 kg/sq.cm.	150 kg/sq.cm.
4	1:1.5:3	265 kg/sq.cm.	200 kg/sq.cm.

Compressive strength of concrete shall be obtained by testing 15 cm. cubes at 28 days curing.

1) Testing: 9 cubes shall be taken from any mix, 3 of them to be tested at 7 days, 3 at 14 days, 3 at 28 days.
2) Strength of concrete at 7 days shall be two-thirds of the strength of concrete at 28 days.
3) Strength of concrete at 28 days shall be as mentioned in table above and the criteria for accepting concrete is only the strength of concrete at 28 days.

2.10 REINFORCED CEMENT CONCRETE:

RCC comprises of formwork, reinforcement and concrete. Payment of Reinforced Cement Concrete shall be item wise as specified in the Conditions of Contract. Concrete shall be classified by its compressive strength at the 28^{th} day. The concrete grade shall be as designated in Table 2 of IS: 456-2000.

Drawings and Specifications shall specify various types of concrete aimed to be used in the Project. It shall be the Contractor's responsibility to carry out design mixes and obtain approval of the same from the Developer's Representative well in advance of the actual pouring of concrete at the Site in the permanent works.

The basic aim of mix design shall be to find the most economic proportion of cement, aggregate and water which will give the desired target mean strength of concrete, workability and durability for specified grade of concrete. Also, it is important that the Mix should be easily worked with the help of equipment available at the Site. The operations involved are measurement of materials, their mixing, placing, compacting, finishing required and curing. The design shall be carried out strictly to IS Specifications and IS Codes of Practice, namely IS: 456-2000 and SP: 23-1982.

In order to ensure that not more than the specified proportion of test results are likely to fall below the characteristic strength, the concrete mix has to be designed for higher average compressive strength for a specified grade of concrete is defined a Target Mean Strength.

2.10.1 Design Mix and Trial Mixes:

Design Mix and weigh batching will be done as approved by the Project Manager / Professional Team. The Contractor shall submit to the Project Manager / Professional Team the tentative mix design it proposes to use at the site.

On receipt of the above, the Project Manager / Professional Team may immediately order to carry out work or site test before the final approval. This shall be done with the mixer, weigh batches, etc. and materials actually used in the Project.

This shall give the Contractor additional chance to check for itself actual workability and make sure that the mix proposed by it will be satisfactory with regards to slump, water-cement ratio and workability.

Test cubes shall be of size 150 mm x 150 mm x 150 mm. These are to be legibly marked with location and date of concreting. Where concrete (in works) is to be vibrated or not vibrated, the cubes are to be casted as per IS Standards.

Where the concrete in the works is un-compacted, pour the concrete into the mould in three layers and compact each layer with a 16 mm diameter tamping rod.

Six (6) cubes shall be taken from each of the three batches to test the mix. Cubes shall be cast, stored, cured, transported and tested as per IS:516-1959. The test may be carried out at the Site or at laboratory as approved by the Project Manager / Professional Team.

Trial mix

1) Within 7 days of signing the contract and before commencing work on site, prepare trial mixes for each type of concrete and submit 6 preliminary test cubes from each mix to the testing authority.
2) The testing authority shall test three test cubes at 7 days and three at 28 days for each type of mix where the difference between the higher and the lowest test results from any one trial mix at 7 days exceeds 15% of the average and any cube weaker than the minimum requirement, make a further trial mix, increasing the proportion of cement if necessary to obtain the required strength.

3) If any test results from any one-trial mix fail to exceed the minimum strength at 28 days:

i. Remove from site materials from which the trial mix was prepared.
ii. Provide new materials and prepare and test further trial mixes until specified requirements are achieved.

The Design Mix shall hold good so long as the materials continue to be of the same quality and from the same source. Minor adjustments are to be done daily based on the tests of materials used.

Control concrete shall be proportioned to obtain the required strength by conducting lab tests using the coarse aggregate, sand and cement based on the design mix.

Control concrete shall have suitable workability for proper consolidation.

At places having heavy reinforcement when compacting concrete is a problem, the control concrete shall be designed with special care to the required strength and workability at no extra cost.

Testing facilities to access the moisture content of aggregate at frequent intervals, testing of concrete cubes and testing of aggregate shall be done at the site by establishing testing laboratories.

Concrete shall be weighed batched. The dials of weigh-batching units shall be checked with standard weights periodically.

Under special circumstances the conversion of weights to volumes will be allowed by the Project Manager / Professional Team.

The minimum cement content to be used for the job is as follows:

M 25	350 Kg/cum
M 30	390 Kg/cum

Fly ash Conforming to Grade I of IS3812 may be used as part of replacement of Ordinary Portland cement is ensured. However, the Proportion of fly ash shall not be more than 25% of the total cementitious content in the given design mix

Super plasticizers (Glenium or equivalent) as per the Manufacturer's specification approved by consultants

Note: These are minimum quantity of cement to be used irrespective of the design mix.

Further the Contractor has to provide and maintain all the equipment and stock at the Site throughout to carry out the following tests in a small Site laboratory or get these tests done from approved laboratories without extra cost to the Contract.

1. Grading of aggregate
2. Silt content of sand
3. Moisture content of aggregate
4. Slump test of concrete mix
5. Concrete cube test

The Contractor shall maintain full records for all above tests in a register. The format of the records shall be prepared in consultation with the Project Manager / Professional Team. It shall have full access to the Contractor's site laboratory. The Contractor shall include charges for these in its Scope and no extra whatsoever shall be payable on this account of designing, testing, maintaining laboratory, etc.,

2.10.2 Assumed Standard Deviation:

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table below may be assumed.

Grade of Concrete	Assumed Standard Deviation N/Sq.mm
M 10	2.3
M 15	3.5
M 20	4.6
M 25	5.3
M 30	6
M 35	6.3
M 40	6.6

However, when adequate post records for a similar grade exists and justify to the designer a value of standard deviation different from the shown in table above, it shall be permissible to use that value.

2.10.3 Standard Deviation Based on Test Results:

1) Number of test results - Total number of test results required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.

2) Standard deviation to be brought up to date - The calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

2.10.4 Determination of Standard Deviation:

a) Concrete of each grade shall be analysed separately to determine its standard deviation.
b) The standard deviation of concrete to a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample.
c) Estimated standard deviation S=Square root of (sum of squared deviations of the individual strength of n samples divided by n-1) where n = number of sample test results.
d) When significant changes are made in the production of concrete batches (for example changes in the materials used. mix design, equipment of technical control), the standard deviation value shall be separately calculated for such batches of concrete.

2.10.5 Mixing of Concrete:

Weigh Batching shall be followed if mixed at the site for all structural concrete works. The Contractor shall provide Concrete Batch Mixers, Vibrators, Weigh Batchers conforming to relevant IS Specifications and from approved and recognized manufacturers. The capacity and number of mixers and vibrators required at the Site from time to time shall be to the approval of Project Manager / Professional Team. No equipment from the site shall be removed without the prior written approval of the Project Manager / Professional Team. The Contractor shall maintain a platform weighing scale of capacity 300 kg with fraction of 100 gm at the site.

The machine will have to be got calibrated by the Contractor once in every two weeks or after 200 cum of concrete whichever is earlier, and records of these calibrations shall be maintained. The dials of the weigh batchers shall be checked with standard weights periodically.

2.10.6 Consistency:

The concrete which will flow freely into the forms and around the reinforcement without any segregation of coarse aggregates shall be used. The consistency shall depend upon the type of vibrator etc. to be used. The controlling factor for the same is the Slump Test.

When considered necessary by the Project Manager / Professional Team, the workability of the concrete shall be ascertained by Compacting Factor Test and VEE BEE consistometer method as per IS:1199-1959. The computing of values of workability of concrete by above two methods IS: 456-2000 has to be referred to.

2.10.7 Temperature of Concrete:

The placing temperature of concrete shall not be more than 38 degrees Celsius. If it is more, the Project Manager / Professional Team may order addition of ice or chilled water to the concrete. Also, the Contractor shall take following precautions:

1) Mixer and Weigh Batcher shall be painted white color.
2) Aggregate storing bin shall not be exposed to the sun.
3) Water shall be sprinkled on aggregate well before concreting to keep the temperature low.

Similarly, during the cold weather, concreting shall not be done when the temperature falls below 4.5 Degrees Celsius. The concrete placed shall be protected against by suitable covering. The concrete damaged by frost shall be removed and work redone with no extra cost.

2.10.8 Shrinkage Cracks:

Concreting shall be avoided in very warm weather. Under such circumstances, the placed concrete shall be covered with damp Hessian cloth within two hours of placing of concrete.

To achieve good result the concrete shall be immediately covered with a plastic sheet and not allowed to any direct wind contact to eliminate shrinkage cracks.

2.10.9 Workmanship:

All works shall be true to level, plumb and square and all corners and edges in all cases shall be unbroken and neat.

Any work not to the satisfaction of the Project Manager / Professional Team or the Design will be rejected and the same should be rectified or removed and replaced with work of the required standard of workmanship at no extra cost.

2.10.10 Transportation:

Concrete shall be transported with the help of pumps of sufficient capacity to achieve necessary heights wherever required from the mixer to the place of laying as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability. The pumps can be either compressor type or boom type. All the pumping equipments have to be maintained and kept operational by the Contractor.

2.10.11 Placing of Concrete:

Placing of concrete shall be done using pumps only at all levels. The pumps shall be of sufficient capacity to achieve necessary heights wherever required.

The slump of concrete placed with the help of pumps shall not be more than 90mm unless otherwise instructed by the Project Manager / Professional Team. Concreting shall commence only after formwork is approved reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Project Manager / Professional Team.

Formwork should be clean, free from dust, pieces of wood or any other foreign material. It should be treated by form releasing agent prior to the laying of reinforcement and concrete, based on sample approved by the Project Manager / Professional Team prior to start of construction at Site. Concrete shall be as gently deposited as is practically possible, in its final position to avoid rehandling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footings, it may be done with the help of chutes. Concrete from wheelbarrows shall not be dumped away from the face of concrete already been placed. It shall be dumped into the face of concrete already in place. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the Project Manager / Professional Team. No concreting shall be done within half an hour of the closing time of the day, unless permitted by the Project Manager / Professional Team.

For concreting of slabs and beams wooden plant or catwalks of chequerred MS plates or bamboo mats or any other suitable materials supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of final deposition without disturbing the reinforcement in anyway. In no case labour or any other persons are allowed to walk over the reinforcement.

In case of columns and walls, it is desirable to place concrete without any construction joints. The progress of concreting in the vertical direction shall be restricted to one meter per hour.

2.10.12 Compaction of Concrete:

Concrete shall be thoroughly compacted into a dense mass, as depositing shall proceed by means of suitable vibrators. The vibrator shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during whole period occupied by placing of concrete. Care should be taken not to over-vibrate the concrete. While vibrating no holes should be visible in concreting. Compaction should be completed before the initial setting time. Compaction shall be done till air bubbles cease to appear. Concrete already set shall not be disturbed by successive vibration.

Hand tamping shall not be permitted. But only in exceptional cases, depending on the thickness of the members and feasibility of vibrating the same, the Project Manager / Professional Team may permit hand tamping. Hand tamping or compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement embedded fixtures, and into the corners of the form look.

The layers of concrete shall be so placed that the bottom layer does not finally set before the top layers are placed. The vibrators are so applied so that the centre of mass being compacted at the time of placing of concrete.

Vibrator shall be of immersion type with frequency of 100 Hz minimum when operating in concrete, or the exterior with a frequency of 50 Hz minimum.

Care shall be taken to ensure that at no time the vibrators and /or vibration action is used to push the concrete ahead. Vibrators shall be applied systematically to overlap zones of influence.

It shall be ensured that the needle vibrators are not applied directly on the reinforcement on the formwork, which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use the standby petrol, diesel or kerosene vibrator should always be available at the concreting point

2.10.13 Expansion Joint:

As indicated in the drawing, or as directed by the Structural consultants / Project Manager / Professional Team. Sealing the joints shall be done with Polyurethane / Polysulphide sealants as specified by Consultants / Architects.

2.10.14 Curing:

Curing of concrete is most important. There shall be no compromise on this activity as it is for the Contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Project Manager / Professional

Team. As said above after concrete has begun to harden, i.e. about 1 to 2 hours after laying. It shall be protected from quick drying with moist or damp Hessian cloth or any other material approved by the Project Manager / Professional Team. After 24 hours of laying of concrete, the surface shall be cured by flooding with water or covering with moist hessian cloth for period of 7 days to keep it moist. For the next seven days surface shall be kept wet all the time by sprinkling water continuously.

In order to properly monitor the curing activity, the Contractor shall write legibly with paint, the date of casting the concrete of each member of the structure which shall remain clearly visible at least till the completion of curing.

2.10.15 Finishing:

Concrete surface shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted:

1. Roof shall be trowelled even and smooth with a wooden float, before the concrete begins to set.
2. Surface that will receive plaster shall be roughened immediately.
3. Surfaces that will be in contact with masonry shall be roughened immediately
4. Surfaces that will receive floor finishes, tiling, etc. shall be roughened while it is still green.
5. Every care shall be taken not to disturb the freshly laid concrete.
6. For Ramps and Basements concrete shall be broom-finished.

On finishing standards and quality / workmanship, the decision of the Project Manager / Professional Team shall be final and binding on all parties.

2.10.16 Inspection and Corrective Measures:

Immediately on removal of formwork, the RCC surface shall be examined by the Project Manager / Professional Team. Till such time, no remedial measures shall be carried out by the Contractor. All remedial actions including breaking, if any, shall be on the instructions of the Project Manager / Professional Team. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Project Manager / Professional Team in this regard shall be final and binding to all parties.

Sagged, bulged, patched, honeycombed work to an extent detrimental to structural safety or architectural concept shall stand to be rejected and Contractor shall rectify by breaking or redoing, if required, as directed by the Project Manager / Professional Team and all expenses incurred due to this shall be to the Contractor’s account.

a) Surface defects minor in nature may be accepted as a special case by the Project Manager / Professional Team/ whose decision in this matter is final

and binding on the Contractor. Once accepted, the defects shall be rectified as follows and all expenses incurred due to the rectification process, shall be to the Contractor's account.

b) Surface defects which require repair when forms are removed, usually consist of bulges due to the movement of forms, ridges at form joint, honey combed areas, damage, resulting from the stripping of forms and bolt holes, bulges and ridges are removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey combed and other defective areas must be clipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly undercut to provide a key at the edge of the patch.

c) If permitted in writing by the Project Manager / Professional Team shallow patches are first to be treated with a coat of thin grout composed of one part of cement and one part of fine sand added with polymer modified cementitious material as per manufacturer's specification, and then filled with mortar (mixed with non-shrink additives) similar to that used in concrete. The mortar is placed in layers not more than 10 mm thick and each layer is given scratch finish to secure a bond with the succeeding layer. The laid layer is finished to match with the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

d) Or as an alternative to Para (b) above, as directed by the Project Manager / Professional Team the patch-work shall be treated with epoxy based proprietary items like non-shrinking grouts etc. available in the market. In such cases, the methodology as indicated by the manufacturer of the item shall be followed - if permitted in writing by the Project Manager / Professional Team. .

e) Large and deep patches require filling up with concrete held in place with try forms. Such patches are reinforced and carefully drawled to the hardened concrete.

f) Or as an alternative to Para (d) above, epoxy based proprietary items like grouts as directed by the Project Manager / Professional Team shall be used. The methodology as specified by the manufacturers of the proprietary item shall be strictly adhered to.

g) Holes left by bolts are to be filled with non-shrink grouts, as specified and directed by the Project Manager / Professional Team carefully packed in to places in small amounts. The mortar is mixed as dry as possible to allow enough water to go into it, so that it will be tightly compacted when forced into the place.

h) Tiered holes extending right through the concrete may be filled with mortar or non-shrink grout, as the case may be, a pressure gun similar to the gun used for greasing motorcars.

i) Normally, patches appear darker than the surrounding concrete. When uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of while Portland cement to the patching mortar, the actual quantity being determined by trial.

j) The same amount of care shall be taken to avoid the material in the patches as with the whole structure. Curing shall be started immediately after packing is done to prevent early drying. A membrane curing compound is these cases will be most convenient.

2.10.17 Cracks:

Cracks observed shall be examined. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Project Manager / Professional Team and the following procedure shall be followed:

i. Cracks not propagating/developing further and according to the Project Manager / Professional Team not detrimental to the strength of the construction shall be grouted with non-shrinking epoxy-based cement slurry or as directed by the Project Manager / Professional Team.

ii. Cracks developing further and felt detrimental to the strength of construction shall be tested as per the relevant Indian Standards.

iii. Based on results, the Project Manager / Professional Team shall order remedial measures or order the Contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequent works thereto as directed/specified.

iv. Cost of above shall be borne by the Contractor if the failure is on its part unless it is due to a design fault, decided at the discretion of the Project Manager / Professional Team.

2.10.18 Terminology:

Ready Mix concrete - Concrete delivered at site or into the purchaser's vehicle in a plastic condition and requiring no further treatment before being placed in the

position in which it is to set and harden. All provisions for good workmanship, quality control and treatment, as stated in previous clauses shall be applicable.

Agitation - The process of continuing the mixing of concrete at a reduced speed during transportation to prevent segregation.

Agitator - Truck mounted equipment designed to agitate concrete during transportation to the site of delivery.

Truck mixer - A mixer generally mounted on a self-propelled chassis capable of mixing the ingredients of concrete and of agitating the mixed concrete during transportation.

2.10.19 Materials:

Cement - The cement used shall be ordinary Portland cement or low heat Portland cement conforming to IS-269-1976* or Portland slag cement conforming to IS 455-1976+ or Portland-pozzolana cement conforming to IS: 1489-1976+ or rapid hardening Portland cement conforming to IS 8041E-1976 as may be specified by at the time of placing the order. If the type is not specified ordinary Portland cement shall be used.

Fly ash: when Fly ash used for partial replacement of cement, shall conform to the requirements of IS: 3812 (part I)-1966.

Water: Water used for concrete shall conform to the requirement of IS: 456-1964.

Admixtures shall only be used when so agreed to between the purchaser and the manufacturer. The admixtures shall conform to the requirements of IS 456-1964 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS: 3812 (Part II)-1966.

Measurement and Storage of Materials - Measurement and storage of materials shall be done in accordance with the requirements of IS: 456-2000.

2.10.20 Basis of Supply:

The ready mixed concrete shall be manufactured and supplied on the following basis.

a) Specified strength based on 28-day compressive strength of 15-cm cubes tested in accordance with IS: 456-1964.
b) When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the manufacturer.

2.10.21 General Requirement:

In addition to the requirements specified in this standard and subject to such modifications as may be agreed to between the purchaser and the manufacturer at the time of placing order, the ready-mixed concrete shall generally comply with the requirements of IS: 456-2000.

When a truck mixer or agitator is used for mixing a transportation of concrete, no water from the truck-water system or from elsewhere shall be added after the initial introduction of the mixing water for the batch, except when on arrival at the site of the work, the slump of the concrete is less than that specified; such additional water to bring the slump within required limits shall be injected into the mixer under such pressure and direction of floor that the requirements for uniformity specified in Appendix A are met.

Unless otherwise agreed to between the purchaser and the supplier, when a truck mixer of agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within 1.5 hours (when the prevailing atmospheric temperature is above 20°C) and within 2 hours (when the prevailing atmospheric temperature is at or below 20°C) of adding the mixing water to the dry mix of cement and aggregate or of adding the cement to the aggregate, whichever is earlier.

Temperature - The temperature of the concrete at the place and time of delivery shall be not less than 5°C. Unless otherwise required by the purchaser, no concrete shall be delivered, when the site temperature is less than 2.5°C and the thermometer reading is falling.

The temperature of the concrete shall not exceed 5^0C above the prevailing shade temperature, when the shade temperature is over 20^0C. The temperature of concrete mass on delivery shall not exceed 40^0C.

Sampling and testing: Adequate facilities shall be provided by the manufacturer for the purchaser to inspect the materials used, the process of manufacture and the methods of delivery of concrete. He shall also provide adequate facilities for the purchaser to take samples of the materials used.

Unless otherwise agreed to between the purchaser and the supplier, the sampling and testing of concrete shall be done in accordance with relevant requirements of IS: 456-1964, IS: 1199-1959 and IS: 516-1959.

Consistency or workability - The tests for consistency or workability shall be carried out in accordance with requirements of IS: 1199-1959 or by such other method as may be agreed to between the purchaser and the manufacturer.

Strength Test - The compressive strength and flexural strength tests shall be carried our in-accordance with the requirements of IS: 516-1959 and the acceptance criteria for concrete whether supplied on the basis of specified strength or on the basis of mix proportion, shall conform to the requirements of Table 5 and other related requirements of IS: 456-1964.

Cost of Testing - Unless otherwise agreed to between the purchaser and the manufacturer, the cost of the tests carried out in accordance with the requirements of this specification shall be borne as follows:

a) By the manufacturer if the results show that the concrete does not comply with the requirements of this standard.

b) By the purchaser if the results show that the concrete complies with the requirements of this standard.

Manufacturer's Records and Certificates - The manufacturer shall keep batch records of the quantities by mass of all the solid materials, of the total amount of water used in mixing and of the results of all tests. If required by the purchaser, the manufacturer shall furnish certificates, at agreed intervals, giving this information.

The concrete quality shall meet all requirements and Specifications of concrete as stated hereof. Contractor shall be allowed to use own Batching Plant or procure concrete, but Quality Tests will be the responsibility of the Contractor and off-site Batching Plants shall be open for inspection to the Project Manager / Professional Team throughout the Project.

Annexure 1

Coarse Aggregate Grading

IS: 383 Table 2

IS Sieve Sizes	Percentage passing for single size Aggregate						Percentage passing for Graded Aggregate Nominal Size			
	63mm	40mm	20mm	16mm	12.5mm	10mm	40mm	20mm	16mm	12.5mm
80mm	100	-	-	-	-	-	-	-	-	-
63mm	85 to 100	100	-	-	-	-	100	-	-	-
40mm	0 to 30	85 to 100	100	-	-	-	-	-	-	-
20mm	0 to 5	0 to 20	85 to 100	100	-	-	95 to 100	100	-	-
16mm	-	-	-	85 to 100	100	-	30 to 70	95 to 100	100	100
12.5mm	-	-	-	-	85 to 100	100	-	-	90 to 100	-
10mm	0 to 5	0 to 25	0 to 20	0 to 30	0 to 45	85 to 100	-	-	-	100
4.75mm	-	-	0 to 5	0 to 5	0 to 10	0 to 20	10 to 35	25 to 55	30 to 70	40 to 85
2.36mm	-	-	-	-	-	0 to 5	0 to 5	0 to 10	0 to 10	0 to 10

Annexure 2

Grading of Fine Aggregates

IS: 383 Table 4

IS Sieve Designated	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10mm	100	100	100	100
4.75mm	90 to 100	90 to 100	90 to 100	95 to 100
2.36mm	60 to 95	75 to 100	85 to 100	95 to 100
11.18mm	30 to 70	55 to 90	75 to 100	90 to 100
600 microns	15 to 34	35 to 59	60 to 79	80 to 100
300 microns	5 to 20	8 to 30	12 to 40	15 to 50
150 microns	0 to 10	0 to 10	0 to 10	0 to 15

2.11 REINFORCEMENT

2.11.1 Related Works:

1. Concrete Formwork
2. Cast in-situ Concrete

2.11.2 Applicable Standards:

IS - 432	Specification for Mild steel and medium tensile bars and hard drawn steel wire.
IS - 1139	Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.
IS - 1566	Specification for plain hard drawn steel wire fabric for concrete reinforcement
IS - 1785	Specification for plain hard drawn steel wire for pre stressed concrete.
IS - 1786	Specification for cold twisted steel high strength deformed bars for concrete reinforcement.
IS - 2080	Specification for high tensile steel bars used in pre stressed concrete
IS - 2751	Code of practice for welding of mild steel structures are folded plates
IS - 2502	Code of practice for bending and fixing of bars for concrete reinforcement

2.11.3 BIS Certification:

Material received at the Site shall have BIS Certification mark. Such bundle or coil containing the bars shall be suitably marked with BIS Certification mark. Bars shall also be marked to identify categories. This shall be done as per IS: 1387.

In case bars are without BIS Certification mark, the manufacturer shall give a certificate stating the process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the cart to which it applies, corresponding to the number or identification mark to be found on the material.

All reinforcements shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any other foreign deleterious material present on the surface. Cleaning should be done to the satisfaction of the Project Manager / Professional Team.

Each batch of steel brought to the Site shall be tested prior to use. Cost of all tests shall be borne by the Contractor.

Material acceptable as per IS Specifications will be allowed into the Project. All rejected material shall be removed from the Site by the Contractor within 30 days of its rejection. If the same is not done, the Project Manager / Professional Team can get work done by third party at the Contractor's risk and cost and shall impose a penalty of Rs 500 (Rupees Five Hundred only) per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

2.11.4 Storage:

Reinforcement bars received at the Site shall be stored on hard, concreted platform and clear of the ground to a minimum of 200 mm with the use of timber sleepers or any other means. Reinforcements shall be kept covered by tarpaulins or plastic to avoid excessive corrosion or any other contamination. It is advised to follow storage methods as described in IS: 4082.

Reinforcement steel shall be stored in such a manner as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.

2.11.5 Quality Assurance:

1. Supervisory staff shall have adequate qualification and experience in the above field.
2. Welders qualified and having approved certificates for welding shall be employed.

2.11.6 Handling:

1. Bend test requirements shall conform to the following and shall be based on 1800 bends of full-size bars around pins.

Bar diameter (mm)	**Pin diameter for test bend**
10, 12,16	3.5 x bar dia
20, 22, 25	5.0 x bar dia
28, 30, 32	7.0 x bar dia

2. Spacers shall be of any of the following:
   i. Wire
   ii. Pre cast concrete
   iii. Moulded plastic

3. Spacer material shall be of durable quality and shall not lead to corrosion of reinforcement or spilling of concrete. Precast concrete spacers shall be of the same mix as that of surrounding concrete.

4. Tying wire shall be of 18 G black annealed mild steel wire or other approved type double fold to tie the reinforcements.
5. Cover blocks shall be non-corrosive material such as plastic, but not wooden or broken bricks or stone. Specially made concrete blocks shall be used. Such cover blocks shall be cast from concrete and not from cement mortar; strength of these blocks shall be equal to the concrete in use.
6. Tying wire shall be of 18G black annealed mild steel wire or other approved type double fold to tie the reinforcements. It shall be face from rust, oil, paint, grease, loose mill seales or any other deleterious material undesirable for concrete or reinforcement or which may prevent adhesion of concrete to reinforcement.

2.11.7 Unit Weights:

Unit weights payable per meter shall be as follows:

6 mm ∅	0.22 kg/ rm
8 mm ∅	0.39 kg/ rm
10 mm ∅	0.62 kg/ rm
12 mm ∅	0.89 kg/ rm
16 mm ∅	1.58 kg/ rm
20 mm ∅	2.47 kg/ rm
25 mm ∅	3.85 kg/ rm
28 mm ∅	4.83 kg/ rm
32 mm ∅	6.31 kg/ rm

2.11.8 Execution:

2.11.9 Cutting and Bending:

1. Flame cut and hot bending is absolutely forbidden.
2. Cut and bend reinforcement to approved shop drawings and details shall be used.
3. Bars to be cold-bend, either mechanically or by hand, but to correct radius using proper tools, machine and platform and confirming to IS 2502-1963.
4. Do not rebend without approval. In case of re bending, care shall be taken that the rating of bend is not less than 4 x bar dia at construction joints for plain steel bars and 6 x bar dia for high strength bars.
5. Reinforcement projecting from concrete shall not be bent without approval.
6. Bar bending schedule to be submitted to the Project Manager / Professional Team for approval prior to commencement of any cutting, bending and binding of steel at site.
7. Cracked end of bars shall not be used on this Project.

8. Bars should be inspected for visible defects such as cracks, brittleness, excessive rust, loose mills scale, etc.

2.11.10 Welding:

1. Do not weld reinforcement unless authorized by the Project Manager / Professional Team and recommended by the manufacturers.
2. Site welding shall be done with suitable safeguards and techniques.
3. Welding, if approved, may be used for:
   i. Lapping reinforcement in position
   ii. Fixing reinforcement to other steel members.
4. The length of run deposited in a single pass shall not exceed 5 x bar diameters. If a longer welded length is required divide into sections with the space between runs not less than 5 x bar diameters.
5. Welded joints:
   i. Shall not be made at bends in reinforcement.
   ii. Stagger joints in parallel bars of principal reinforcement unless otherwise approved.
   iii. The distance between staggered joints shall not be less than the end anchorage length joints.

2.11.11 Mechanical Splicing:

a. To comply with ISI 456-2000. ACI 318-1983 and ACI 439-3R-83
b. Use as indicated in structural drawings.
c. Structural Consultants / Project Manager / Professional Team has to approve mechanical splices before use at site.

2.11.12 Inspection:

a. Ensure that the reinforcement placing is checked by Project Manager / Professional Team.
b. Ensure that the Formwork to receive the reinforcement is clean and free from debris.
c. Cracked end of bars to be cut out.

2.11.13 Anchoring:

Anchoring of bars and stirrups shall be provided exactly as detailed in the structural drawings or as directed by Project Manager / Professional Team.

In case of reinforcement steel in tension, deformed bars may be used without end anchorage provided the Construction length requirement is satisfied. Hooks shall

normally be provided for plain bars in tension. Construction length of the bars shall be determined as per relevant clauses of IS: 456 - 2000.

The anchorage length of straight bar in compression shall be equal to the Construction length of the bars in compression as specified in relevant clause of IS: 456 - 2000.

2.11.14 Lapping of Bars:

Laps shall be strictly as per the structural drawing or as directed by the Project Manager / Professional Team. For general guidance the following principles shall be followed as given in IS: 456 - 2000

1. As far as possible bars of the maximum length available shall be used.
2. Laps shown on drawings or otherwise specified by the Structural will be based on the Contractor using bars of maximum length.
3. In case Contractor wishes to use bars of shorter length, laps shall be provided at the Contractor's expense in the manner and the locations approved by the Structural.
4. Splices shall be provided as far as possible away from the sections of maximum stress and be staggered.
5. Not more than half of the bars shall be spliced at a section
6. If more than half of the bars shall be spliced at a section, special care shall be ensured such as increasing length of lap or closer spacing of stirrups around the length of splice.
7. Lap splice shall not be used for bars having diameter larger than 36 mm. For larger diameters bars it may be welded. Lap length including anchorage value of hooks in flexural tension shall be La (as defined in Article 25.2.1 of IS: 456-2000) or 30 times the diameter of the bar whichever is greater and for direct tension 2La or 30 times the diameter of the bar whichever is greater. The straight length of lap shall not be greater than 15D or 20 cm, whereas D is the diameter of the bar.
8. Lap length in compression shall be equal to the Construction length in compression calculated as described in relevant clause of IS: 456-2000 or as specified in the structural drawing but not less than 24 times the diameter of the bar.
9. Overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 1.25 times the maximum size of the coarse aggregate, whichever is greater.
10. When above is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the diameter of such bars with two strands of annealed binding wise of 0.90mm to 1.6mm diameter twisted together tightly.

11. As and when necessary welded laps shall be provided as specified by the Project Manager/ Professional Team.

2.11.15 Securing Reinforcement:

1. Adequately secure with tying wire or approved steel clips.
2. Bend the tying wires well back clear of forms.

2.11.16 Precautionary Measures:

1. Do not insert bars into placed concrete.
2. Do not damage forms and form linings, if any when fixing reinforcement.

2.11.17 Adjustment and Cleaning:

1. Check reinforcement prior to and during placing concrete with particular attention to the top reinforcement in Cantilever sections.
2. Ensure that reinforcement is clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement concrete or the bond between the two.
3. Protect the projecting reinforcement from weather where the rust staining of exposed concrete surfaces may occur.

2.12 FORMWORK

Design, Fabrication, erection and striking of formwork for in - situ concrete

2.12.1 Related Work:

1. Concrete
2. Reinforcement

2.12.2 Applicable Standards:

IS - 303	Specification for Plywood for general purposes
IS - 4990	Specification for plywood for concrete shuttering work
IS - 1629	Rules for grading of cut size of timber
IS - 2750	Specification for steel scaffoldings.
IS - 4014	Code of practice for steel tubular, scaffolding

2.12.3 Quality Assurance:

Design and construction shall be executed and supervised by fully qualified personnel.

In accordance with quality assurance programme, the Contractor shall provide the Project Manager / Professional Team with information demonstrating that a system

will be used to ensure that the work carried out under this section (including that done by sub-Contractors) will comply with the requirements of the specifications.

1. Supervisory staff shall have qualifications and experience in the above field.
2. IS Standards – Note: Latest amendments shall be followed.

2.12.4 Design Criteria:

Formwork system shall be executed and designed by a specialist qualified to the shapes, lines, forms and dimensions shown on drawings. The Contractor shall submit to the Project Manager / Professional Team a method statement backed by design calculations. Required drawings and sketches shall be enclosed along with the statement for the proposed area to be taken up for working at a time. The number of repetitions expected, type of material used, etc shall be detailed therein.

Formwork shall start only after written approval from the Project Manager / Professional Team has been received. Approval of the proposal in submitted form and acceptance of modification does not relieve the Contractor of its obligation to achieve the required line finish within accepted tolerance limits in terms of quality of works completed and safety. Neither will it diminish the Contractor's responsibility for the satisfactory performance of formwork.

Basic points to be understood in designing of formwork are stated below:

a) Erected formwork shall be watertight, shall conform to shape, lines, dimensions, verticality, rigid during placing, vibrating and compacting the concrete

b) Formwork system shall be of steel or timber or 12mm thick water-resistant Ply board, and shall be continuous, straight and without any warping or Aluminum system formwork of approved section. Design of formwork shall take into account:

   i. Height of pour
   ii. Thickness of member
   iii. Rate of pour
   iv. Concrete slump
   v. Texture of finish
   vi. Placing temperature
   vii. Concrete density
   viii. Construction joints
   ix. Wind load
   x. Method of Discharge

d) Form work design shall have
    i. Dimensional tolerance
    ii. De mountable without shock, disturbance or damage to concrete

e) All construction joints in beams and slabs shall be provided as shown in drawings.

f) Ties shall be provided where required

g) Cambers shall be provided where shown.

h) Props / supports of extra ceiling height shall be specially designed.

2.12.5 Form Work Material:

Construction formwork with smooth faced plywood, steel or timber / to produce smooth straight level and sharp profiles shall be used for the works. Panels shall be in largest practicable sizes to reduce the number of joints.

1. Form material shall have strength adequate to withstand pressure of newly placed concrete without excessive and adjustable bow or deflection.
2. Factory fabricated adjustable length removable or snap off metal form ties, designed to prevent form deflection and to prevent spalling of concrete surfaces on removal.
3. Ties shall be such that:
    i. A portion remaining within the concrete shall be at least 38mm from the outer concrete surface.
    ii. That will not leave a hole larger than 25mm dia meter on the concrete surface.
4. Form coating compound that will not bond with, stain, nor adversely affect concrete for required bond or adhesion nor hamper the wetting of surface to be covered with water or curing compound.

All propping and centering shall be of adjustable steel supports (built-up sections of rolled steel) and tubular props to full height without joints, and with sufficient bracing to take into account the construction loads, namely full load of concrete with any live load and impact load likely to occur during concreting.

Steel shuttering used for concreting shall be sufficiently stiffened. The steel shuttering shall also be properly repaired before sue and properly cleaned to avoid stains and defects in concreting.

2.12.6 Workmanship:

Formwork shall be classified based on the ultimate finishes required of the concrete surface as:

i. Textured or decorative finish
ii. Fair-faced finish
iii. Rough finish

The Contractor shall account for all material and labour to achieve the above finishes to the satisfaction of the Project Manager / Professional Team in his quoted price.

2.12.7 Guidelines for Good Workmanship:

Following are a few points as guidelines for good workmanship in formwork and shall be accounted for by the Contractor in its quoted price.

1) Erection of formwork may be from pre-moulded, pre-fabricated, pre-assembled plates or form reasonable enough to transport and erect at site to correct lines and levels as set at site.
2) Supports shall be firm and maintained in position by nails, cross bracing, tie-rods, locking bolts, nuts, etc. It shall be rigid and stiff so as to retain its shape during and after concreting.
3) Joints shall be water-tight and no cement slurry shall be allowed to get through
4) Pre-fabricated or site forms shall be assembled so as to de-shutter without any jerk to the green concrete. For these double wedges shall be used. The wedges shall be nailed. The heads left with, allowing easy removal while de-shuttering.
5) Pre-fabricated or site formwork shall be sufficient thickness with supporting spans in both directions. These shall be standardized in size for easy replacement and universal use at site
6) Props shall be of steel only. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be of proper steel plate or timber plank for equal distribution of load
7) In case of multi-storied buildings, any upper floor shall be suitably supported on at least one floor below the same, or as approved by the Project Manager / Professional Team.
8) Props shall be adequately cross-braced horizontally

9) At the design and erection stage following additional points shall be considered and be incorporated into the setting
10) Opening of cleaning prior to the start of concreting
11) Pouring points shall avoid high drops and provide easy access to vibrating needles
12) Surfaces shall be treated with suitable releasing oil or emulsion prior to the laying of reinforcement. Such releasing oil shall be got approved from the Project Manager / Professional Team.
13) Ensure that forms and adjacent surfaces are thoroughly cleaned to receive concrete and debris.
14) Locate construction joints in a manner so as not to impair strength and appearance of structure.

Following points shall be observed very carefully:

1. Joints of formwork shall be watertight. It is easy to check from the bottom and make sure no light is visible
2. Props shall be on solid base, plumbed, in straight line, braced horizontally and cross
3. Tie-bars, bracing and spacers in beams, walls and columns shall be at correct place/location and fully tight
4. Wedges shall be fully secured and nailed with heads left out for easy removal
5. All saw dust, dirt, shavings and any other unwanted material shall be cleaned and hosed out
6. Provision shall be made for watching formwork while concreting and any other platform needed for movement of workers without any disturbance to the reinforcement
7. Provision is made for traffic on form work: not to bear directly on reinforcing steel.
8. Number of reuses shall be decided by the Project Manager / Professional Team on examining the condition of formwork after each use. If during concreting any weakness develops or formwork shows any distress, the work shall be stopped and remedial action taken.

2.12.8 Finishing Formed Surfaces:

The Contractor shall:

i. Repair and patch defective areas with fins and other projections completely removed or smoothed.

ii. To smooth concrete where fins and other projections have formed moisten concrete surface within a day after forms have been removed and rub with carborundum brick until surface is a uniform colour and texture within the projection limits.
iii. Not apply cement ground other than that produced by the rubbing process.
iv. Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the superintendent.

Surface defects shall include colour and texture irregularities, cracks, spills, air bubbles, honeycombs, rock pockets, fins and other projection on the surface, stain and form tie holes.

The Contractor shall:

i. Undercut voids larger than 25mm diameter and fill with fresh concrete after thoroughly wetting concrete surfaces.
ii. Fill small holes and irregularities using 2:1 (Portland cement to fine sand by volume) grout mixed with approved bonding admixture according to manufacturer's specification.
iii. Blend standard Portland cement with white Portland cement, if necessary, so that final colour of dry grout will match adjacent surfaces.
iv. After applying grout to repair area, wipe with Hessian cloth to match adjacent texture and within the specified surface tolerances.
v. Keep concrete patch damp with fog spray for at least 36 hours.

2.12.9 Removal of Formwork

Formwork shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal.

1. Formwork shall be removed carefully without jarring the concrete and curing of the concrete shall commence immediately. Sudden shocks / vibrations during removal of wedges shall be avoided. Where finished edges have re-entrant angles, remove formwork as early as possible to avoid shrinkage cracks.

2. Concrete surfaces to be exposed shall where required by the Project Manager / Professional Team, be rubbed with carborundum stone to give a smooth and even finish.

3. Where concrete requires plastering or other finish later, the concrete surface shall be hacked as directed.

4. No extra charge will be allowed to the Contractor for such work.

Cleaning and Oiling of Forms:

The contactor shall ensure that the surface of the forms that will touch the concrete shall be free from encrustations of mortar, grout, or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire off-cuts and other foreign material to be removed from the interior of the forms before the concrete is placed. Compressed air shall be used to clean the complete formwork and remove all traces of dust and debris before pouring concrete the temporary holes shall then be closed.

The surface of the forms to be in contact with the concrete shall be coated with a reliable coating that will effectively prevent the adherence of concrete and will not stain the concrete surfaces. After each use, the surfaces of forms which have been in contact with concrete shall be cleaned of mortar and any other material sticking to them, then well wetted and treated with form oil approved by the Project Manager / Professional Team.

The Contractor shall provide commercial form release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces.

Openings / Inserts:

Contractor shall provide all required openings, pockets, inserts as detailed in drawings. The Contractor shall provide required material and labour for fixing and supporting during concreting. In its quoted price, it is imperative to consider that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved, i.e. shall be in correct line and level. After concreting the openings shall be secured against any accident by proper covering and guard rail, warning notice, lighting, etc. for which no extra cost is payable to the Contractor.

2.13 BRICK MASONRY

This work shall consist of construction of structures with bricks jointed together by cement mortar in accordance with the details shown on the Drawings or as approved by the Engineer.

2.13.1 Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to:

IS - 1077 Specifications for common burnt clay building bricks

IS - 1200 Measurements for Building works

IS - 1725 Specifications for solid cement blocks used in general building construction

IS - 1905 Code of practice for structural safety of buildings: Masonry walls.

IS - 2116 Sand for masonry mortars

IS - 2180 Specification for heavy duty burnt clay building bricks

IS - 2185 Specification for concrete masonry units: Hollow and solid concrete blocks

IS - 2212 Code of practice for brick work

IS - 2222 Specification for burnt clay perforated building bricks

IS - 2691 Specification for burnt clay facing bricks

IS - 3115 Specification for lime-based blocks

IS - 3414 Code of practice for design and installation of joints in buildings

IS - 3466 Specification for masonry cement

IS - 3861 Method of measurement of plinth, carpet and rentable areas of buildings.

IS - 3952 Specification for burnt clay hollow blocks for walls and partitions

IS - 4098 Specification for lime-pozzolana mixture

IS - 4139 Specification for sand lime bricks

IS - 4441 Code of practice for use of silicate type chemical resistant mortars.

IS - 4442 Code of practice for use of sulphur type chemical resistant mortars

Other I.S. Codes not specifically mentioned here but pertaining to the use of bricks for structural purposes forms part of these Specifications.

2.13.2 Materials

All materials to be used in the work shall confirm to the requirements.

2.13.3 Personnel

Only trained personnel shall be employed for construction and supervision.

2.13.4 Cement Mortar

Cement and sand shall be mixed in specified proportions given in the Drawings. Cement shall be proportioned by weight, taking the unit weight of cement as 1.44 tonne per cubic metre. Sand shall be proportioned by volume taking into account due allowance for bulking. All mortar shall be mixed with a minimum quantity of water to produce desired workability consistent with maximum density of mortar. The mix shall be clean and free from injurious type of soil/acid/alkali/organic matter or deleterious substances.

The mixing shall preferably be done in a mechanical mixer operated manually or by power. Hand mixing can be resorted to as long as uniform density of the mix and its strength are assured subject to prior approval of the Engineer. Where, permitted, specific permission is to be given by the Engineer. Hand mixing operation shall be carried out on a clean water-tight platform, where cement and sand shall be first mixed dry in the required proportion by being turned over and over, backwards and forwards several times till the mixture is of uniform colour. Thereafter, minimum quantity of water shall be added to bring the mortar to the consistency of a stiff paste. The mortar shall be mixed for at least two minutes after addition of water.

Mortar shall be mixed only in such quantity as required for immediate use. The mix which has developed initial set shall not be used. Initial set of mortar with ordinary Portland Cement shall normally be considered to have taken place in 30 minutes after mixing. In case the mortar has stiffened during initial setting time because of evaporation of water, the same can be re-tempered by adding water as frequently as needed to restore the requisite consistency, but his re-tampering shall not be permitted after 30 minutes. Mortar unused for more than 30 minutes shall be rejected and removed from site of work.

2.13.5 Soaking of Bricks

All bricks shall be thoroughly soaked in a tank filled with water for a minimum period of one hour prior to being laid. Soaked bricks shall be removed from the tank sufficiently in advance so that they are skin dry at the time of actual laying. Such

soaked bricks shall be stacked on a clean place where they are not contaminated with dirt, earth, etc.

2.13.6 Joints

The thickness of joints shall not exceed 10 mm. All joints on exposed faces shall be tooled to give concave finish.

2.13.7 Laying

All brickwork shall be laid in an English bond, even and true to line, in accordance with the Drawing or as directed by the Engineer, plumb and level and all joints accurately kept. Half or cut bricks, shall not be used, except when necessary to complete the bond. Closer in such cases shall be cut to the required size and used near the ends of the walls. The bricks used at the face and also at the angles forming the junction of any two walls shall be selected whole bricks of uniform size, with true and rectangular faces.

All bricks shall be laid with frogs up on a full bed of mortar except in the case of tile bricks. Each brick shall be properly bedded as set in position by slightly pressing while laying, so that the mortar gets into all their surface pores to ensure proper adhesion. All head and side joints shall be completely filled by applying sufficient mortar to brick already placed and on brick to be placed. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left. No bats or cut bricks shall be used except to obtain dimensions of the different courses for specified bonds or wherever a desired shape so requires.

The brick work shall be built in uniform layers, and for this purpose wooden straight edge with graduations indicating thickness of each course including joint shall be used. Corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. During construction, no part of work shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing. Where this is not possible in the opinion of the Engineer, the works shall be raked back according to the bond (and not toothed) at an angle not steeper than 45 degrees with prior approval of the Engineer. Toothing shall be permitted where future extension is contemplated.

Before laying bricks in foundation, the foundation slab shall be thoroughly hacked, swept clean and wetted. A layer of mortar not less than 12 mm thick shall be spread on the surface of the foundation slab and the first course of bricks shall be laid.

2.13.8 Jointing Old and New Work

Where fresh masonry is to join the masonry that is partially/entirely set, the exposed jointing surface of the set masonry shall be cleaned, roughened and wetted, so as to effect the best possible bond with the new work. All loose bricks and mortar or other material shall be removed.

In the case of vertical or inclined joints, it shall be further ensured that proper bond between the old and new masonry is obtained by interlocking the bricks. Any portion of the brickwork that has been completed shall remain undisturbed until thoroughly set.

In case of sharp corners especially in skew bridges, a flat cutback of 100 mm shall be provided so as to have proper and bonded laying of bricks.

2.13.9 Curing

Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of seven days. Brick work carried out during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period. Top of the masonry work shall be left flooded with water at the close of the day. Watering may be done carefully so as not to disturb or wash out the green mortar.

During hot weather, all finished or partly completed work shall be covered or wetted in such a manner as will prevent rapid drying of the brickwork.

During the period of curing of brick work, it will be suitably protected from all damages. At the close of the day s work or for other period of cessation, watering and curing shall have to be maintained. Should the mortar perish i.e., become dry, white or powdery, through neglect of curing, work shall be pulled down and rebuilt as directed by the Engineer. It any stains appear during watering, the same shall be removed from the face.

2.13.10 Scaffolding

The Scaffolding shall be sound, strong and safe to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left

in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good. Scaffolding shall be got approved by the Engineer. However, the Contractor shall be responsible for its safety.

2.13.11 Weep Holes

Weep holes shall conform to Clause 2706 of MORTH Specifications for Road and Bridge Works (III Revision).

2.13.12 Equipment

All tools and equipment used for mixing, transporting and laying of mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.

2.13.13 Finishing of Surfaces

All brickwork shall be finished in a workmanlike manner with the thickness of joints, manner of striking or tooling as described in these above Specifications. The surfaces can be finished by joining or pointing or by plastering as given in the Drawings. For a surface which is to be subsequently plastered or pointed, the joints shall be squarely raked out to a depth of 15 mm, while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

2.13.14 Jointing

In jointing, the face of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work. The faces of brick work shall be cleaned to remove any splashes of mortar during the course of raising the brick work.

2.13.15 Pointing

Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the Drawing. The mortar shall be filled and pressed into the raked joints before giving the required finish. The pointing shall be ruled type for which it shall, while still green, be ruled along the centre with half round tools of such width as may be specified by the Engineer. The super flush mortar shall then be taken off from the edges of the lines and the surface of the masonry shall be cleaned of all mortar. The work shall conform to IS: 2212.

2.13.16 Plastering

Plastering shall be done where shown on the Drawing. Superficial plastering may be done, if necessary, only in structures situated in fast flowing rivers or in severely aggressive environment.

Plastering shall be started from top and worked down. All putlog holes shall be properly filled in advance of the plastering while the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed vertically 2.5 to 4 meters apart, to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plaster s float and pressing the mortar so that the raked joints are properly filled. The plaster shall be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideways motion 50 mm to 75 mm at a time. Finally, the surface shall be finished off with a plasterer s wooden float. Metal floats shall not be used.

When recommencing the plastering beyond the work suspended earlier, the edges of the old plaster shall be scrapped, cleaned and wetted before plaster is applied to the adjacent areas.No portion of the surface shall be left unfinished for patching up at a later period.

The plaster shall be finished true to plumb surface and to the proper degree of smoothness as directed by the Engineer. The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified by more than 3 mm. Any cracks which appear in the surface and all portions which should hollow when tapped, or are found to be soft or otherwise defective, shall be cut in rectangular shape and re-done as directed by the Engineer.

2.13.17 Curing of Finishes

Curing shall be commenced as soon as the mortar used for finishing has hardened sufficiently not to be damaged during curing. It shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages.

2.13.18 Scaffolding for Finishes

Stage scaffolding shall be provided for the work. This shall be independent of the structure.

2.13.19 Architectural Coping for Wing / Return / Parapet Wall

This work shall consist of providing an Architectural coping for wing/return/parapet walls.
The material used shall be cement mortar 1:3.

The cement mortar shall be laid evenly to an average thickness of 15 mm to the full width of the top of the wall and in continuation a band of 15 mm thickness and 150 mm depth shall be made out of the mortar along the top outer face of the walls.

2.13.20 Acceptance of Work

All work shall be true to the lines and levels as indicated on the Drawing or as directed by the Engineer, subject to tolerances as indicated in these Specifications.

Mortar cubes shall be tested in accordance with IS: 2250 for compressive strength, consistency of mortar and its water retentivity. The frequency of testing shall be one sample for every 2 cubic meters of mortar, subject to a minimum 3 samples for a day work.

In case of plaster finish, the minimum surface thickness shall not be less than the specified thickness by more than 3 mm.

2.13.21 Measurements For Payment

All brick work shall be measured in cubic meters. Any extra work done by the Contract over the specified dimensions shall be ignored.

In arches, the length of arch shall be measured as the mean length between the extrados and intrados.

The work of plastering and pointing shall be measured in square meters of the surface treated. Architectural coping shall be measured in linear meters.

2.13.22 Rate

The contract unit rate for brick work shall include the cost of all labour, materials, tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work, sampling, testing and supervision as described in these Specifications and as shown on the Drawings.

The contract unit rate for plastering shall include the cost of all labour, materials, tools and plant, scaffolding and all incidental expenses, sampling and testing and supervision as described in these Specifications. The contract unit rate for pointing shall include erecting and removal of scaffolding, all labour, materials, and equipment incidental to complete the pointing, raking out joints, cleaning, wetting, filling with mortar, toweling, pointing and watering, sampling and testing and supervision as described in these Specifications. The contract unit rate for architectural coping shall include cost of all labour, materials, tools and plant, sampling and testing and supervision as described in these Specifications.

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2.14 STONE MASONRY

This work shall consist of the construction of structures with stones jointed together by cement mortar in accordance with the details shown on the Drawings and these Specifications or as approved by the Engineer.

2.14.1 Type of Masonry

The type of masonry used for structures shall be random masonry (coursed or un coursed) or coursed rubble masonry (First sort.). However, for bridge work generally, course rubble stone masonry shall be used. The actual type of masonry used for different parts of structures shall be specified on the Drawings.

For facing work, ashlar masonry shall be used where indicated on the Drawings.

2.14.2 Construction Operations

The dressing of stone shall be as specified for individual type masonry work and it shall also conform to the general requirements of IS: 1957 and requirement for dressing of stone covered in IS:1129. Other specific requirements are covered separately with respect to particular types of rubble stone work.

2.14.3 Laying

The masonry work shall be laid to lines, levels, curves and shapes as shown in the plan. The height in each course shall be kept same and every stone shall be fine tooled on all bed’s joints and face full and true. The exposed faces shall be gauged out,

grooved, regulated and sunk or plain molded as the case may be. The faces of each stone between the drafts be left rough as the stone comes from quarry except where sacrificial layer is to be provided or plastering is resorted to due to aggressive environment.

Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar.

Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them. Stones in the hearting shall be laid on their broadest face that gives a better opportunity to fill the spaces between stones. The courses of the masonry shall ordinarily be pre-determined. They shall generally be of the same height. When there is to be variation in the height of courses, the larger courses are to be placed at lower levels, heights of courses decreasing gradually towards the top of the wall. The practice of placing loose mortar on the course and pouring water on it to fill the gaps in stones is not acceptable. Mortar may be fluid mixed thoroughly and then poured in the joints. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar.

In tapered walls, the beds of the stones and the planes of course should be at right angles to the batter. In case of bridge piers with batter on both sides, the course shall be horizontal.

The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet immediately on placement and solidly embedded in mortar before it has set. Clean chips and spalls shall be wedged into the mortar joints and bed wherever necessary to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. For masonry works over rock, a leveling course of 100 mm thickness and in concrete M 15 shall be laid over rock and then stone masonry work shall be laid without foundation concrete block.

Face works and hearting shall be brought up evenly but the top of each course shall not be leveled up by the use of flat chips. For sharp corners especially in skew bridges, through stones shall be used in order to avoid spalling of corners. In case any stone already set in mortar is disturbed or the joints broken, it shall be taken out without disturbing the adjoining stones and joints. Dry mortar and stones thoroughly cleaned

from the joints and stones and the stones reset in fresh mortar. Attempt must never be made to slide one stone on top of another, freshly laid.

Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering, which will loosen the masonry, will be allowed after it is once placed. all necessary chases for joggles, dowels and clamps should be formed beforehand.

Sufficient transverse bonds shall be provided by the use of bond stone extending from the front to the back of the wall and in case of thick wall from outside to the interior and vice versa. In the latter case, bond stones shall overlap each other in their arrangement.

In case headers are not available, precast headers of M 15 concrete shall be used. Cast-in-situ headers are not permitted. Stones shall break joint on the face for at least half the height of the course and the bond shall be carefully maintained throughout. In band work at all angle junctions of walls the stones at each alternate course shall be carried into each of the respective walls so as to unite the work thoroughly.

The practice of building up thin faces tied with occasional through stones and filling up the middle with small stuff or even dry packing is not acceptable. All quoins and angles of the opening shall be made from selected stones, carefully squared and bedded and arranged to bond alternately long and short in both directions.

All vertical joints shall be truly vertical. Vertical joints shall be staggered as far as possible. Distance between the nearer vertical joints of upper layer and lower shall not be less than half the height of the course. Only rectangular shaped bond stones or headers shall be used. Bond stones shall overlap each other by 150 mm or more.

All connected masonry in a structure shall be carried up nearly at one uniform level throughout but when breaks are unavoidable the masonry shall be raked in sufficiently long steps to facilitate jointing of old and new work. The stepping of raking shall not be more than 45 degrees with the horizontal.

2.14.4 Rubble Masonry (Un-coursed and Coursed)

Dressing Stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighboring stone. The bushing on the exposed face shall not be more than 40 mm.

Insertion of chips and spalls of stone may be used wherever necessary to avoid thick mortar beds or joints and it shall be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stones to bring these up to the level of face stones. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

Hearting stones: the hearting or interior filling of the wall face shall consist of rubble stones not less than 150 mm in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing.

Bond stones: Through bond stones shall be provided in masonry upto 600 mm thickness and in case of masonry above 600 mm thickness, a set of two or more bond stones overlapping each other at least by 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.,) the bond stone shall extend only about two-third into the wall, as through stones in such cases may give rise to penetration of dampness and therefore, for all thicknesses of such masonry, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. One bond stone or a set of bond stones shall be provided for every 0.50 sq. m. of the masonry surface.

Quoin stone: Quoin stone i.e., stone specially selected and nearly dressed for forming an external angle in masonry work, shall not be less than 0.03 cubic metre in volume.

Plum stone: The plum stones are selected long stones embedded vertically in the interior of the masonry to form a bond between successive courses and shall be provided at about 900 mm intervals.

Laying the masonry shall be laid with or without courses as specified. The quoin shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as much as possible, and to avoid long vertical lines of joints.

Joints: The face joints shall not be more than 20 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

2.14.5 Square Rubble - Coursed Rubble (First Sort)

Dressing: Face stones shall be hammer dressed on all beds and joints so as to give them rectangular shape. These shall be square on all joints and beds. The bed joints

shall be chisel drafted for at least 80 mm back from the face and for at least 40 mm for the side joints. No portion of dressed surface shall show a depth of gap more than 6 mm from the straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints. The requirements regarding bushing shall be the same as for random rubble masonry.

Hearting stones: The hearting or interior filling of the wall face shall consist of flat bedded stone carefully laid, on prepared beds in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of masonry. While using chips, it shall be ensured that no hollow spaces are left anywhere in the masonry.

Bond stones: The requirements regarding through or bond stone shall be the same as for random ruble masonry, but these, shall be provided at 1.5 meter to 1.8 meter apart clear in every course.

Quoin stone: The quoins shall be of the same height of the course in which these occur and shall be formed of header stones not less than 450 mm in length. They shall be laid lengthwise alternately along each face, square in their beds which shall be fairly dressed to a depth of at least 100 mm.

Face stone: Face stones shall tail into the work for not less than their heights and at least one-third of the stones shall tail into the work for a length not less than twice their height. These shall be laid as headers and stretchers alternately. Laying The stones shall be laid on horizontal courses and all vertical joints should be truly vertical. The quoin stones should be laid header and stretcher alternately and shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm. Joints The face joints shall not be more than 10 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

2.14.6 Ashlars Masonry (Plain Ashlars)

Dressing Every stone shall be cut to the required size and shape, chisel dressed on all beds and joints so as to be free from all bushing. Dressed surface shall not show a depth of gap of more than 3 mm from straight edge placed on it. The exposed faces and joints, 6 mm from the face shall be fine tooled so that a straight edge can be laid along the face of the stone in contact with every point. All visible angles and edges shall be true and square and free from chipping. The corner stones (quoins) shall be dressed square and corner shall be straight and vertical.

Bond Stones: Through bond stones shall be provided in masonry up to 600 mm thickness and in case of masonry above 600 mm thickness, a set of two or more bond

stones overlapping each other at least by 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.,) the bond stone shall extend only about two-third into the wall, as through stones in such cases may give rise to penetration of dampness and, therefore, for all thickness of such masonry a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. One bond stone or a set of bonds tones shall be 1.5 meters to 1.8 meters apart clear in every course.

Laying The face stone shall be laid header and stretcher alternately, the header being arranged to come as nearly as possible in the middle of stretchers above and below. Stones shall be laid in regular courses not less than 300 mm in height and all courses of the same height unless otherwise specified. No stone shall be less in width than its height or less in length than twice its height, unless otherwise specified.

Joints All joints shall be full of mortar. These shall not be less than 3 mm thick. Face joints shall be uniform throughout, and a uniform recess of 20 mm depth from face shall be left with the help of a stone plate during the progress of work.

Pointing: Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the Drawing. The mortar shall be filled and pressed into the raked-out joints before giving the required finish. The pointing shall conform to the Specification. The work shall conform to IS: 2212. The thickness of joints shall not be less than 3 mm for Ashlar masonry. However, the maximum thickness of joints in different works shall be as follows:

Random Rubble	20 mm
Coursed Rubble	15 mm
Ashlars Masonry	5 mm

2.14.7 Weep Holes

Weep holes shall conform to Clause 2706 of MORTH Specifications for Road and Bridge Works (III Revision).

Tests and standard of acceptance

All work shall be done to the lines and levels as indicated on he Drawing or as directed by the Engineer subject to tolerances as specified in these Specifications. Mortar cubes shall be taken in accordance with IS: 2250 for compressive strength, consistency of mortar and its water retentivity. The frequency of testing shall be one sample for every two cubic meters of mortar subject to a minimum 3 samples for a day’s work.

Measurement For Payment

Stone masonry shall be measured in cubic meters. In arches, the length of arch shall be measured as the mean length between the extrados and intrados. The work of pointing shall be measured in square meters. Architectural coping shall be measured in linear meters.

2.15 Finishing

2.15.1 Scope:

These Specifications cover the general requirements of different kinds of finishes.

2.15.1 Applicable Codes

IS:16-1991 (Part: I)	Shellac:Part:I-Hand Made Shellac (3rd Revision).
IS:16-1991 (Part: II)	Shellac:Part: II-Machine Made Shellac (3rd Revision)
IS:75-1973	Linseed Oil, Raw and Refined (Reaffirmed 1990) (2nd Revision)
IS:77-1976	Ready Mixed Paint, Brushing, Red Lead, Non setting, Priming (Reaffirmed 1991) (Revised)
IS:102-1962	Specification For Ready Mixed Paint, Brushing, Zinc Chrome, Priming (Reaffirmed 1993) (2nd Revision)
IS:104-1979	Ready Mixed Paint, brushing, priming Plaster to Indian Standard Colour No. 361, 631 White and off White (Reaffirmed 1993) (1st Revision)
IS:109-1968	Ready Mixed Paint, Brushing, priming Plaster to Indian Standard Colour No. 361, 631 White and off White (Reaffirmed 1993) (1st Revision)
IS:117-1964	Ready Mixed Paint, Brushing, Finishing Exterior, Semigloss for General Purposes to Indian Standards Colours (Reaffirmed 1988) (Revised)
IS:133-1993	Enamel, Interior (a) Under Coating (b) Finishing (3rd Revision)
IS:137-1965	Ready Mixed Paint, Brushing, Matt or Egg Shell Flat, Finishing Interior to Indian Standard Colour as required (Revised 1993)

IS:158-1981	Ready Mixed Paint, Brushing, Bituminous Black, Lead Free, Acid, Alkali and Heat Resisting (Reaffirmed 1988) (3rd Revision)
IS:217-1988	Specification For Cut Back Bitumen (2nd Revision)
IS:218-1983	Specification For Creosote and Anthracene Oil for Use as Wood Preservatives (Reaffirmed 1990) (2nd Revision)
IS:290-1961	Coal Tar Black Paint (Reaffirmed 1991) (1st Revision)
IS:337-1975	Varnish, Finishing Interior (Reaffirmed 1991) (1st Revision)
IS:341-1973	Black Japan, Types ‘A’, ‘B’ & ‘C’ (Reaffirmed 1991) (1st Revision)
IS:345-1952	Wood Filter, Transparent - Liquid (withdrawn)
IS:347-1975	Varnish, Shellac for General Purposes (Reaffirmed 1991) (1st Revision)
IS:348-1968	French Polish (Reaffirmed 1991) (1st Revision)
IS:419-1967	Putty For Use on Window Frames (Reaffirmed 1992) (1st Revision)
IS:427-1965	Distemper, Dry Colour as Required (Reaffirmed 1993) (Revised)
IS:428-1969	Distemper, Oil Emulsion, Colour as Required (Reaffirmed 1993) (1st Revision)
IS:524-1983	Varnish, Finishing, Exterior, Synthetic Air Drying (Reaffirmed 1990) (2nd Edition)
IS:533-1973	Gum Spirit of Turpentine (Oil of Turpentine) (Reaffirmed 1990) (1st Revision)
IS:712-1984	Specification For Building Limes (Reaffirmed 1991) (3rd Revision)
IS:1200-1976 (Part: XII)	Method of Measurements of Building and Civil Engineering Works: Part: XII-Plastering and Pointing (Reaffirmed 1992) (3rd Revision)
IS:1200-1987	Method of Measurements of Building and Civil Engineering

	Works:
IS:1200-1994 (Part: XIII)	Method of Measurements of Building and Civil Engineering Works: Part 13 White Washing, Colour Washing Distempering and Painting of Building surfaces. (5th Revision)
IS:1200-1987 (Part: XV)	Method of Measurements of Building and Civil Engineering Works: Part: XV-Painting Polishing, Varnishing etc. (Reaffirmed 1992) (4th Revision)
IS:2339-1963	Aluminium Paint for General Purposes, In Dual Container (Reaffirmed 1993)
IS:2932-1994	Enamel, Synthetic, Exterior (a) Undercoating, (b) Finishing (2nd Revision)
IS:2933-1975	Enamel, Exterior (a) Undercoating (b) Finishing (Reaffirmed 1991) (1st Revision)
IS:5410-1992	Cement Paint (1st Revision)
IS:5411-1974 (Part: I)	Plastic Emulsion: Paint Part I For Interior Use (Reaffirmed 1991) (1st Revision)
IS:6278-1971	Code of Practice for White Washing and Colour Washing (Reaffirmed 1991).

2.15.2 Cement Plastering

The cement plaster shall be 12, 15 or 20 mm thick, finished with a floating coat of neat cement, as described in the item. When the plaster has been brought to a true surface with the wooden straight edge it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

2.15.3 Mortar

The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified in Chapter 7. For external work and under coat work, the

fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

2.15.4 Thickness

Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

2.15.5 Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the Contractor's expense by such means as the Engineer may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

2.15.6 Cement Plaster on Cement Concrete and reinforced Cement Concrete work

Scaffolding

Stage scaffolding shall be provided for the work. This shall be independent of the walls.

Preparation of Surface

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushed. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacing of not more than 5 cm. Centers, the pock being made not less then 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned of all oil, grease etc. and well wetted before the plaster is applied.

Mortars

Mortars of the specified mix using the types of sand described in the item shall be used.

Application

To ensure even thickness and a true surface, gauges of plaster 15 X 15 cm. shall be first applied at not more than 1.5 m intervals in both directions to serve as guides for

the plastering. Surface of these gauged areas shall be truly in the plane of the finished plaster surface. The plaster shall be then applied in a uniform surface to a thickness slightly more than the specified thickness and shall then be brought to true and even surface by working a wooden straight edge reaching across the gauges. Finally, the surface shall be finished true with a trowel or with wooden float to give a smooth or sandy granular texture as required. Excess troweling or over working of the floats shall be avoided. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Plastering of ceiling shall not be commenced until the slab above has been finished and centering has been removed. In the case of ceiling of roof slabs, plaster shall not be commenced until terrace work has been completed. These precautions are necessary in order that the ceiling plaster is not disturbed by the vibrations set up in the above operations.

Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

Thickness

The average thickness of plaster shall not be less than 6 mm. The minimum thickness over any portion of the surface shall not be less than 5 mm.

Measurements

Length and breadth shall be measured correct to a cm. and its area shall be calculated in sqm. correct to two places of decimal. Dimensions before plastering shall be taken. Thickness of plaster shall be exclusive of the thickness of the key i.e., depth or rock marks and hacking. Plastering on ceiling at height greater than 5 m above the corresponding floor level shall be so described and shall be measured separately stating the height in stages of 1 m or part thereof.

Plastering on the sides and soffits of the projected beams of ceiling at a height greater than 5 m above the corresponding floor level shall be measured and added to the quantity measured. Plastering on spherical and groined ceiling and circular work not exceeding 6 m in radius, shall be measured and paid for separately.

Flowing soffits (viz., portion under spiral stair case etc.,) shall be measured and paid for separately, ribs and mouldings on ceiling shall be measured as for cornices, deductions being made from the plastering on ceiling in case the width of the moulding exceed 15 cm.

The mode of measurement of exterior plaster and patch plastering (in repairs) shall be the same. Deduction shall not be made for openings or for ends of columns, or columns caps of 0.5 sqm each in area and under. No additions will be made either for the plastering of the sides of such openings. For openings etc. of areas exceeding 0.5 sqm deduction will be made for the full opening but the sides of such opening shall be measured for payment.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

2.15.7 Cement Plaster for Slab Bearing

Cement plaster shall be 6 mm thick finished with a floating coat of neat cement and thick coat of lime wash on top of walls for bearing of slabs.

Application

The plaster shall be applied over the cleaned and wetted surface of the wall. When the plaster has been brought to a true surface with the wooden straight edge it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

Lime wash

This shall be applied in a thick coat after curing the plaster for three days.

Measurements

Length and breadth shall be measured correct to a cm and area worked out in sqm correct to two places of decimal.

Rate

The rate shall include the cost of all labor and materials involved in all the operations described above.

2.15.8 Rough Cast Plaster

Rough cast finish comprises of a mixture of sand and gravel in specified proportions dashed over a freshly plastered surface.

Preparation of Surface

The joints shall be raked out, dust and loose mortar, shall be brushed out. The surface shall be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

Mortar

Mortar of specified mix using the type of sand described in the item shall be used, where coarse sand is to be used, the fineness modulus of the sand shall not be less than 2.5 mm.

Application

The plaster base over which rough cast finish is to be applied shall consist of two coats, under layer 12 mm thick and top layer 10 mm.

12 mm under layer

This shall be applied in the same manner as for under 18 mm plaster.

Top layer

The top layer shall be applied a day or two after the under layer has taken initial set. The latter shall not be allowed to dry out, before the top layer is laid on. The mortar used for applying top layer shall be sufficiently plastic and of rich mix 1:3 (1 cement, 3 fine sand) or as otherwise specified so that the mix of sand and gravel gets well pitched with the plaster surface. In order to make the base plastic, about 10 % of finely grinded hydrated lime by volume of cement, shall be added when preparing mortar for the top layer.

Finish

It shall be ensured that the base surface which is to receive cast mixture is in plastic state. The rough cast mixture shall consist of sand or gravel or crushed stone of uniform color from 2.36 mm to 12.5 mm or as specified and in the proportions as specified accurately to the effect required. The mixture shall be wetted and shall be dashed on the plaster base in plastic state by hand scoop so that the mix gets well pitched into the plaster base. The mix shall again be dashed over the vacant spaces if any so that the surface represents a homogeneous surfaces of sand mixed with gravel. A sample of rough cast plaster shall be got approved by the Engineer. Specification for other details like precautions, measurement and rate shall be as described under Laying.

2.15.9 Cement Water Proofing Compound

It shall be used for cement mortar for plastering or concrete work.

Water Proofing Compound

Integral cement water proofing compound conforming to IS: 2645 and of approved brand and manufacture, enlisted by the Engineer from time to time shall be used.

The Contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added. It shall be measured by weight.

The rate shall include the cost of all labor and materials involved in all the operations described above.

2.15.10 White Washing with Lime

Preparation of Surface

Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings and foreign matter.

Preparation of lime wash

The lime wash shall be prepared from fresh stone white lime. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth, 40 gm of gum dissolved in hot water, shall be added to each 10 cubic decimeters of the cream. The approximate quantity of water to be added in making the cream will be 5 liters of water to one kg of lime.

Indigo (Neel) up to 3 gm per kg of lime dissolved in water, shall then be added and stirred well. Water shall then be added at the rate of about 5 liters per kg. of lime to produce a milky solution.

Application

The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat

shall be inspected and approved by the Engineer before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the Contractor at his own cost and the surfaces cleaned. Damages, if any to furniture or fittings and fixtures shall be recoverable from the Contractor.

Measurements

Length and breadth shall be measured correct to one cm. and area shall be calculated in sqm correct to two places of decimals.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area.

i. Corrugated asbestos cement sheet – 20%
ii. Semi corrugated asbestos cement sheet – 10%

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 50 sq.cm each with material similar in composition to the surface to be prepared.

Work on old treated surfaces shall be measured separately and so described.

Rate

The rate shall include all material and labour involved in all the operations described above.

2.15.11 Colour Washing

The mineral colours, not affected by lime, shall be added to white wash. Indigo (Neel)

shall however, not be added. No colour wash shall be done until a sample of the colour wash of the required tint or shade has been got approved from the Engineer. The colour shall be of even tint or shade over the whole surface. If it is blotchy or otherwise badly applied, it shall be redone by the Contractor.

For new work, the priming coat shall be of white wash with lime or with whiting as specified in the description of the item. Two or more coats, shall then be applied on the entire surface till it represents a smooth and uniform finish.

The finished dry surface shall not be powdery and shall not readily come off on the hand when rubbed.

2.15.12 Dry Distempering

Material

Dry distemper of required colour (IS:427) and of approved brand and manufacture from the Engineer before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water using 6 decilitres (0.6 litre) of water per kg of distemper or as specified by the makers. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable overnight) before use. The mixture shall be well stirred before and during use to maintain an even consistency.

Distemper shall not be mixed in large quantity than is actually required for one day's work.

Preparation of Surface

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth.

New plastered surfaces shall be allowed to dry for at least two months, before applying, distemper.

Pitting in plaster shall be made good with Plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

Priming Coat

A priming coat of whitening shall be applied over the prepared surface in case of new work, if so, stipulated in the description of the item. No white washing coat shall be used as a priming coat for distemper.

The treated surface is allowed to dry before distemper coat is given.

Application

In the case of new work, the treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows as even colour.

For application of each coat the entire surface shall be coated with mixture uniformly, with proper distemper brushes (ordinary white wash brushed shall not be allowed) in horizontal strokes followed immediately by vertical ones which together shall constitute one coat.

The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform and shall show not brush marks. Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

After each day's work, the brushes shall be washed in hot water and hung down to dry. Old brushes which are dirty or caked with distemper shall not be used.

2.15.13 Oil Emulsion (Oil Bound) Washable Distempering:

Materials

Oil emulsion (Oil Bound) washable distemper (IS: 428) of approved brand and manufacture shall be used. The primer were used as on new work, shall be cement primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's works shall be prepared.

The distemper and primer shall be brought by the Contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the Contractor and the Engineering. The empty tins shall not be

removed from the site of work, till this item of work has been completed and passed by the Engineer.

Preparation of the Surface

For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of pairs mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patches surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

Application

The priming coat shall be with distemper primer or cement primer, as required in the description of the item.

Note: If the wall surface plaster has not dried completely, cement primer shall be applied before distempering the walls, but if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied, within six months of the completion of wall plaster. However, newly plastered surfaces if required to be distempered before a period of six months shall be given a coat of alkali resistant priming paint conforming to IS: 109 and allowed to dry for at least 48 hours before distempering is commenced.

2.15.14 Distemper Coat

1. For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat.
2. The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain as an even shade.

3. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat.
4. 15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

Rate

The rate shall include the cost of all labour and materials involved in all the above operations (including priming coat) described above.

2.15.15 Cement Primer Coat

Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on asbestos cement surfaces before oil emulsion distemper paints are applied on them. The cement primer is composed of a medium and pigments which are resistant to the alkalis present in the cement lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper paints.

Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion paints etc.

Preparation of the Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filing up the undulations and then sand papering the same after it is dry.

Application

The cement primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least

48 hours, before oil emulsion paint is applied.

2.15.16 Cement Paint

Materials

The cement paint shall be (conforming to IS:5410) of approved brand and manufacture. The cement paint shall be brought to the site of work by the Contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work.

Preparation of mix

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

In case of cement paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

Application

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement paint shall be as per manufacturer's Specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three or more coats

of water proof cement paint as found necessary to get uniform shade.

Precaution

Water proof cement paint shall not be applied on surface already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

2.15.17 Painting

Materials

Paints, oils varnishes etc. of approved brand and manufacture shall be used. Only ready mixed paint (exterior grade) as received from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer shall be used.

Approved paints, oil or varnishes shall be brought to the site of work by the Contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least of fortnight's work. The empties shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer.

Commencing Work

Painting shall not be started until the Engineer has inspected the items of work to be painted satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm.

Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work. The room should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the paint work being started.

Preparation of Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer after

inspection, before painting is commenced.

Application

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers, when applying also, the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly kin a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation. Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and dust cleaned off before the next coat is laid.

No left-over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work. In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need not be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.

On painting steel work, special care shall be taken while painting over bolts, nuts, rivets overlap etc.

The additional Specifications for primer and other costs of paints shall be as according to the detailed Specifications under the respective headings.

Brushes and Containers

After work, the brushes shall be completely cleaned of paint and linseed oil by rinsing with turpentine. A brush in which paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that paint does not thicken and also shall be kept safe from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

Measurements

The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm (correct to two places of decimal), except otherwise stated.

Small articles not exceeding 0.1 sqm of painted surfaces where not in conjunction with similar painted work shall be not enumerated.

Painting up to 10 cm in width or in girth and not in conjunction with similar painted work shall be given in running metres and shall include cutting to line where so required.

Components of trusses, compound girders, stanchions, lattices and similar work shall, however, be given in sqm. irrespective of the size or girth of members. Priming coat of painting shall be included in the work of fabrication.

In measuring painting, varnishing, oiling etc. of joinery and steel work etc. the coefficients as indicated in following tables shall be used to obtain the area payable. The coefficients shall be applied to the areas measured flat and not girthed.

Equivalent Plain Areas of Uneven Surface

Sl No.	Description of work	How measured	Multiplying coefficients
I.	Wood work doors, windows etc.		
1.	Panelled or framed and braced doors, windows etc.	Measured flat (not girthed including)	1.30 (for each side)

Sl No.	Description of work	How measured	Multiplying coefficients
2.	Ledged and battened or ledged, battened and braced doors, windows etc.	Frame, edges, chocks, cleats, etc. shall be deemed to be included in the item.	
3.	Flush doors etc.	-do-	1.20 (for each side)
4.	Part panelled and part glazed or gauzed doors, window etc. (excluding painting of wire gauze portion)	-do-	1.00 (for each side)
5.	Fully glazed or gauzed doors, windows etc. (Excluding painting of wire gauze portion)	-do-	0.80 (for each side)
6.	Fully venetioned or louvered doors, windows etc.	-do-	1.80 (for each side)
7.	Trellis (or Jaffri) work one way or two ways.	Measured flat overall, no deduction shall be made for open spaces, supporting members shall not be measured separately	2 (for painting all over)
8.	Carved or enriched work	Measured flat	2 (for each side)
9.	Weather boarding	Measured flat (not girthed) supporting frame work shall not be measured separately	1.20 (for each side)
10.	Wood shingle roofing	Measured flat (not girthed)	1.10 (for each side)
11.	Boarding with cover fillets and match boarding	Measured flat (not girthed)	1.05 (for each side)
12.	Tile and slate battening	Measured flat overall, no deductions shall be made for open	0.80 (for painting all over)

Sl No.	Description of work	How measured	Multiplying coefficients
		spaces	
II.	Steel Work Doors, Windows etc.,		
13.	Plain sheeted steel doors or windows	Measured flat (not girthed) including frame edges etc.	1.10 (for each side)
14.	Fully glazed or gauzed steel doors and windows (excluding painting of wire gauze portion)	-do-	0.50 (for each side)
15.	Partly panelled and partly glazed or gauzed doors and windows (excluding painting of wire gauze portion)	-do-	0.80 (for each side)
16.	Corrugated sheeted steel doors or windows	-do-	1.25 (for each side)
17.	Collapsible gates	Measured flat	1.50 (for painting all over)
18.	Rolling shutters of interlocked laths	Measured flat (size of opening) all over jamb guides, bottom rails and locking arrangement etc. Shall be included in the item (top cover shall be measured separately)	1.10 (for each side)
III.	GENERAL		
19.	Expanded metal, hard drawn steel wire fabric of approved quality, grill works and gratings in guard Bars, balustrades railing partitions and MS Bars in windows frames	Measured flat overall: no deduction shall be made for open spaces: supporting members shall not be measured separately	1 (for paint all over)
20.	Open palisade fencing and	-do-	1(for paint all

Sl No.	Description of work	How measured	Multiplying coefficients
	gates including standards, braces, rails stay etc. in timber or steel	(see note No.12)	over)
21.	Corrugated iron sheeting in roofs, side cladding etc.	-do-Measured flat (not girthed)	1.14 (for each side)
22.	AC corrugated iron sheeting in roofs, side cladding etc.	-do-	1.20 (for each side)
23.	AC semi corrugated sheeting in roofs, side cladding etc. or Nainital pattern using plain sheets	-do-	1.10 (for each side)
24.	Wire gauze shutters including painting of wire gauze	-do-	1.00 (for each side)

Explanatory notes for Table 12-1

1. *Measurements for doors windows etc., shall be taken flat (and not girthed) overall including frames, where provided. Where frames are not provided, the shutter measurements shall be taken.*
2. *Where doors, windows etc., are of composite types other than those included in the above Table 12-1, the different portion shall be measured separately with their appropriate coefficients, the centre line of the common rail being taken as the dividing line between the two portions.*
3. *The coefficients for door and windows shall apply irrespective of the size of frames and shutter members.*
4. *In case steel frames are used, the area of doors, windows shutters shall be measured flat excluding frames.*
5. *When the two faces of door, window etc., are to be treated with different specified finishes, measurable under separate items, the edges of frames and shutters shall be treated with one of other type of finish as ordered by the Engineer and measurement of this will be deemed to be included in the measurement of the face treated with that finish.*
6. *In the case where shutters are fixed on both faces of the frames, the measurement for the door frame and shutter on one face shall be taken in the manner already described, while the additional shutter on the other side face will be measured for the shutter only excluding the frame.*
7. *Where shutters are provided with clearance at top or / and bottom each exceeding 15 cm height, such openings shall be deducted from the overall*

measurements and relevant coefficient shall be applied to obtain the area payable.

8. *Collapsible gates shall be measured for width from outside to outside of gate in its expanded position and for height from bottom to top of channel verticals. No separate measurements shall be taken for the top and bottom guide rails rollers, fittings etc.*
9. *Coefficients for sliding doors shall be the same as for normal types of doors in the table. Measurements shall be taken outside to outside of shutters, and no separate measurements shall be taken for the painting guide rails, rollers, fittings etc.*
10. *Measurements of painting as above shall be deemed to include painting all iron fittings in the same or different shade for which no extra will be paid.*
11. *The measurements of guard bars, expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings, when fixed in frame work, painting of which is once measured elsewhere shall be taken exclusive of the frames. In other cases, the measurements shall be taken inclusive of the frames.*
12. *For painting open palisade fencing and gates etc., the height shall be measured from the bottom of the lowest rail, if the palisades do not go below it, (or from the lower end of the palisades, it they project below the lowest rail,) up to the top of rails or palisades whichever are higher, but not up to the top of standards when the latter are higher than the top rails or the palisades.*

Width of moulded work of all other kinds, as in hand rails, cornices, architraves shall be measured by girth. For trusses, compound girders, stanchions, lattice girders, and similar work, actual areas will be measured in sq.m and no extra shall be paid for painting on bolt heads, nuts, washers etc. even when they are picked out in a different tint to the adjacent work. Painting of rain water, soil, waste, vent and water pipes etc. shall be measured in running meters of the particular diameter of the pipe concerned. Painting of specials such as bends, heads, branches, junctions, shoes, etc., shall be included in the length and no separate measurements shall be taken for these or for painting brackets, clamps etc.

Measurements of wall surfaces and wood and other work not referred to already shall be recorded as per actual. Flag staffs, steel chimneys, aerial masts, spires and other such objects requiring special scaffolding shall be measured separately.

Precautions

All furniture, fixtures, glazing, floors etc. shall be protected by covering and stains, smears, splashing, if any shall be removed and any damages done shall be made good by the Contractor at his cost.

Rate

Rates shall include cost of all labour and materials involved in all the operations described above and in the particular Specifications given under the several items.

2.15.18 Painting Priming Coat on Wood, Iron or Plastered Surfaces

Primer

The primer for wood work, iron work or plastered surface shall be as specified in the description of item.

Primer for plaster/wood work/iron and steel/Aluminium surfaces shall be as specified below:

Sl No.	Surfaces	Primer to be used
1.	Wood work (hard and soft wood)	Pink conforming to IS:3536
2.	Resin our wood and plywood	Aluminium primer conforming to IS:3585
3.	(A) Aluminium and light alloy (B) Iron, Steel Galvanized steel	Zinc chromate primer conforming to IS:104 Oxide Zinc chromate Primer conforming IS:2074
4.	Cement/Concrete/RCC/brick work, plastered surfaces, asbestos surfaces to receive Oil bound distemper or paint finish.	Cement primer conforming to IS:109

The primer shall be ready mixed primer of approved brand and manufacture.

Where primer for wood work is specified to be mixed at site, it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7 kg: 1 litre. Where primer for steel work is specified to be mixed at site, it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8 kg :1 ltr:1 ltr. The Specifications for the base vehicle and thinner for mixed on site primer shall be as follows:

1. White lead: The White lead shall be pure and free from adulterants like barium sulphate and whiting. It shall conform to IS:103.

2. Red lead: This shall be in powder form and shall be pure and free from adulterants like brick dust etc. It shall conform to IS:102.

3. Raw Linseed Oil: Raw linseed oil shall be lightly viscous but clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30 degree C shall be between 0.923 and 0.928.

Note: The oil shall be mellow and sweet to taste with very little smell. The oil shall be of sufficiently matured quality. Oil, turbid or thick, with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall conform in all respects to IS: 75. The oil shall be of approved brand and manufacture.

4. Double boiled linseed oil: This shall be more viscous than the raw oil, have a deeper colour and specific gravity between 0.931 and 0.945 at a temperature of 30-degree Celsius. It shall dry with a glossy surface. It shall confirm in all respects to IS:77. The oil shall be of approved brand and manufacture.

5. Turpentine: Mineral turpentine i.e., petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate product of oleoresin of conifers) shall be used. It shall have no grease or other residue when allowed to evaporate. It shall conform to IS: 533.

All the above materials shall be of approved manufacture and brought to site in their original packing in sealed condition.

Preparation of surface

Wooden surface

The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any, shall be covered with preparation of red lead made by grinding it in water and mixing with strong glue and used hot. Appropriate filler material conforming to IS:345 with same shade as paint shall be used where specified. The surface treated for knotting shall be dry before paint is applied. After obtaining approval of Engineer for wood work, the priming coat shall be applied before the wood work, is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier’s putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in

stopping and the latter is therefore liable to crack.

The surface shall be cleaned and all unevenness removed as specified. Knots if visible, shall be covered with a preparation of red lead. Holes and indentations on the surface shall be filled in with glazier's putty or wood putty conforming to IS: 419 and rubbed smooth before painting is done. The surface should be thoroughly dry before painting.

Iron & Steel Surface

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.If the surface is wet, it shall be dried before priming coat is undertaken.

The priming coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scraping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.

Plastered Surface

The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations shall be filled up with plaster of Paris and rubbed smooth.

The priming coat shall have dried up completely before painting is started. All dust or dirt that has settled on the priming coat shall be thoroughly wiped away before painting is started.

Application

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The number of coats to be applied will be as stipulated in the item. The painted surface shall present a uniform appearance and glossy finish, free from streaks, blisters etc.,

Treatment on steel for aggressive environment

A second coat of ready mixed red oxide zinc chromate primer may be applied where considered necessary in aggressive environment such as near Industrial

Establishment and Coastal regions where the steel members are prone to corrosion. The second coat (which shall be paid for separately) is to be applied after placing the member in position and just before applying paint. The second coat of primer is not necessary in case of painting with synthetic enamel paint as it is applied over an under coat of ordinary paint.

Painting with Ready Mixed Paint

Ready mixed paints of approved brand and manufacture and of the required shades shall be used. They shall conform in all respects to the relevant IS Specifications.

Painting on New Surface

The surface which has not been painted earlier or the paint had been removed by paint remover, burning, caustic soda etc. shall be considered to be new surface.

2.15.19 Painting Cast Iron Rain Water, Soil, Waste and Vent Pipes and Fittings

The primer shall be prepared on site or shall be of approved brand and manufacture as specified in the item.Paint shall be anti-corrosive bitumastic paint Aluminium paint or other type of paint as specified in the description of the item.

Preparation of Surface

The surface shall be prepared for priming coat as described.

Application

The number of coats of painting over the priming coat shall be as stipulated in the description of the item. Painting shall be done only when the surface is perfectly dry to permit of good absorption. All dirt, dust or other foreign matter shall be removed from the surface to be painted. All roughness shall be sand papered and cleaned.

The preservative shall be applied liberally with a stout brush and not daubed with rags of cotton waste. It shall be applied with a pencil brush at the joints of the wood work. The first coat shall be allowed at least 24 hours to soak in before the second (the final) coat is applied. The second coat shall be applied in the same manner as the first coat. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

Measurements

Measurements will be taken over the finished line of pipe including specials etc. In running meters, correct to a cm. Pipes of different diameters of bore shall be measured and paid for separately. Specials and fittings such as holder bet clamps, plugs etc. will

not be measured separately.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above, including painting of all specials and fittings.

Painting with Wood Preservative

Oil type wood preservative of specified quality and approved make, conforming to IS:218 - 1983 shall be used. Generally, it shall be Creosote Oil Type -1 or Anthracene Oil.

2.15.20 Coal Tarring

Coal tar of approved manufacture conforming to IS:290 shall be used. The tar, to every litre of which 200 gm of unslaked lime had been added, shall be heated till it begins to boil. It must then be taken off the fire and kerosene oil added to it slowly as the rate of one part of kerosene oil to six or more parts by volume and stirred thoroughly. The addition of lime is for preventing the tar from running.

Coal Tarring New Surface - Preparation of surface

This shall be done as specified in Clause 12.22.2 except that sand papering is not necessary. Where iron work is to be painted it shall be freed from scales and rust before painting.

Application

The mixture shall be applied as hot as possible with a brush. The second coat shall be applied only after the first coat has thoroughly dried up. Where possible, the article to be tarred, shall be dipped in the hot mixture for better results. The quantity of tar to be used for the first or second coat shall be not less than 0.16 and 0.12 litre per sqm respectively. Thinning with kerosene oil shall be suitable done to ensure this.

Wall Painting with Plastic Emulsion Paint

The plastic emulsion paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel.

Plastic emulsion paint as per IS: 5411 of approved brand and manufacture and of the required shade shall be used.

The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush, spray or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat

can be applied. The time of drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary, more coats will be applied till the surface presents a uniform appearance.

Precautions

Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc. Splashes on floors shall be cleaned out without delay as they will be difficult to remove after hardening. Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

2.15.21 Painting with Enamel Paint

Enamel Paint (conforming to IS:2933-1975) of approved brand and manufacture and of the required colour shall be used. For the under coat, the paint of same quality but of shade to suit that of the top coat shall be used. Preparation of surface and application shall be as specified for painting of new surfaces or old surfaces, as the case may be.

2.15.22 Painting with Synthetic Enamel Paint

Synthetic enamel paint (confirming to IS:2932) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match top coat as recommended by the same manufacture as for the top coat shall be used.

One coat of the specified ordinary paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall rubbed next day with the finest grace of wet abrasive paper to ensure a smooth and even surface, fee from brush marks and all loose particles dusted off.

Top Coat

Top coats of synthetic enamel paint of desired shade shall be applied after the

undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

2.15.23 Painting with Aluminium Paint

Aluminium paint shall be (conforming to IS: 2339) of approved brand and manufacture. The paint comes in compact dual container with the paste and the medium separately. The two shall be mixed together to obtain proper consistency before use.

Preparation of Surface - Steel Work (New Surface)

All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

Application

The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

As aluminium paste is likely to settle in the container, care shall be taken to frequently stir the paint during used. Also, the paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

Painting with Acid Proof Paint

Acid proof paint of approved brand and manufacture and of the required shade shall be used.

Preparation of surface and application shall be as specified.

Painting with Anti-Corrosive Bitumastic Paint

Ready mixed plant (conforming to IS:158-1981) shall be of approved brand and manufacture. It shall be black, lead free, acid-alkali-heat-water resistant.

Preparation of surface and application shall be as specified for painting on new or old surfaces and the case may be.The drying time between consecutive coats, however, shall be not less than 3 hours.

Varnishing

Ordinary copal varnish or superior quality spray varnish shall be used. The work includes sizing of transparent wood filler.

Varnish (conforming to IS:347 for the finishing and undercoats) shall be of the

approved manufacturer.

Varnishing on new surface

Preparation of surface

New wood work to be varnished shall have been finished smooth with a carpenter's plane. Knots shall be cut to a slight depth. Cracks and holes shall be cleaned of dust. The knots, cracks etc. shall then be filled in with wood putty made as follows:

The fillings when dry shall be rubbed down with a carpenter's file and then the entire surface shall rub down perfectly smooth with medium grained and fine sand papers and wiped with dry clean cloth so that it presents uniform appearance. In no case shall sand papers be rubbed across the grains, as in this case even the finest marks will be visible when the varnishing is applied.

Sizing or Transparent Wood Filler Coat

The surface shall then be treated with either glue sizing or with transparent wood filler coat as stipulated in the description of item.

Sizing

When sizing is stipulated, an application of thin clean size shall be applied hot on the surface. When dry, the surface shall be rubbed down smooth with sand paper and cleaned. It shall then be given another application of glue size nearly cold. The sized wood work shall again be rubbed down smoothly with fine sand paper and cleaned. The surface shall be perfectly dry and all dust shall be removed not only from the surface but also from the edges and joints before varnishing is commenced. If the wood work is to be stained, the staining color shall be mixed with the second coat of the size which must be applied evenly and quickly keeping the color on the flow.

Any joining up with work already dry will show badly. The object of application of the glue size is to seal the pores in wood to prevent absorption of the oil in the varnish.

Glue sizing is inadvisable on floors, table tops and other horizontal surfaces likely to carry wet household utensils which are likely to disturb the size coatings and thus expose bare wood.

Where glue sizing is omitted to be done the rate for the work shall be suitably reduced.

Transparent wood Filler Coat

Where instead of glue sizing, transparent wood filler application is stipulated in the item, then the surface prepared shall be given as application of the filler with brush or rag in such a way that the filler fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours. Then it shall be cut and rubbed with

emery paper so that the surface of the wood is laid bare, with the filler only the pores and crevices of the wood.

Application of Varnish

The number of coats to be applied shall be as stipulated in the description of the item.

The undercoat shall be with a flatting varnish. This dries hard and brittle and when cut and rubbed down to produce a smooth surface enhances the gloss of the finishing varnish. The top coat shall be given with stipulated brand of finishing varnish.

The varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. If the work is vertical the varnish shall be crossed and re-crossed and then laid off, latter being finished on the upstrokes so that varnish, as it sets flows down and eliminates brush marks, the above process will constitute one coat. It the surface is horizontal, varnish shall be worked in every direction, with light quick strokes and finish in one definite direction so that it will set without showing brush marks, in handling and applying varnish care should be taken to avoid forming froth or air bubbles. Brushes and containers shall be kept scrupulously clean.

Rubbing down and flatting the surface shall be done after each coat except the final coat with fine sand paper.

The work shall be allowed to dry away from drought and damp air. The finished surface shall then present a uniform appearance and fine flossy surface free from streaks, blister etc.

Any varnish left over in the small container shall not be poured back into the stock tin, as it will render the latter unite unfit for use.

Special fine haired varnishing brushes shall be used and not ordinary paint brushes. Brushes shall be well worn and perfectly clean.

French Spirit Polishing

Pure shellac conforming to IS:16 varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit. Suitable pigment shall be added to get the required shade. Ready-made polish conforming to IS: 348 can also be used.

Polishing New Surface

Preparation of Surface

The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped

with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 kg of whiting per liter of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

Application

The number of coats of polish to be applied shall be as described in the item.

A pad of woollen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilities this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off the pad shall be covered with a fresh piece of clean fine cotton cloth slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

Lettering with Paint

Black, Japan paint (conforming to IS:341) or ready mixed paint as ordered by the Engineer shall be used. The paint shall be of approved brand and manufacture. Ordinary ready mixed paint shall be of the shade required by the Engineer.

Lettering on New Surface

Application

The letters and figures shall be to the heights and width as ordered by the Engineer. These shall be stencilled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth curves. The thickness of the lettering shall be as approved by the Engineer. Lettering shall be vertical or slanting as required.

Two or more coats or paint shall be applied till uniform colour and glossy finish are obtained.

Measurements

Measurements shall be taken in terms of letter cm (the measurement related to the vertical height of the lettering). The letter heights shall be measured correct to a cm.

Dots, dashes, punctuations and other similar marks or lines shall not be measured for payment.

In Devanagari / Kannada script Dots & Matras occurring with the letters shall not be measured. Half letter shall be measured as full letter. The height of letters shall be

measured excluding the Matras projecting above the heading and Matras below the letters.

Rate

Rate shall include the cost of all labour and materials involved in the operations described above. The rate per cm height of letter shall hold good irrespective of the width of the letters or figures or the thickness of the lettering. The same rate will apply irrespective of whether black Japan or ready mixed paint of any shade as required is used.

2.16 BUND STRENGTHENING AND STABILIZATION WORKS

2.16.1 General

The Contractor shall execute strengthening of the bund to improve structural stability, prevent erosion, and enhance long-term resilience of the waterbody embankment. All works shall be carried out with approved materials, proper line and level, and under the supervision of the Engineer / Employer.

2.16.2 Scope of Work

Bund strengthening shall include, but not be limited to, the following activities:

1. **Trimming and Preparation of Bed and Side Slopes**
    - Trimming of bund bed and side slopes in all types of soil (excluding hard rock) to a uniform thickness of **7.5 cm to 15 cm**, ensuring smooth and compacted surface free from loose material.
    - The trimmed surface shall be dressed with correct slope and alignment to receive subsequent layers including stone pitching or protective lining.
    - Spoil material generated from trimming must be managed and disposed of as per approved directions.
2. **Sectioning and Formation of Bund Slopes**
    - During bund formation using earth-moving machinery, lorries and vibratory rollers, the Contractor shall ensure bund profile meets elevation, cross-section, and slope requirements.
    - A minimum side slope of 1:1.5 (vertical: horizontal) shall be provided, unless otherwise specified in drawings.
    - Watering and compaction shall be carried out in layers to achieve adequate density and avoid differential settlement.
3. **Rough Stone Dry Packing (Stone Pitching)**
    - Rough stone dry packing shall be provided on treated side slopes/bank surface to prevent scouring and erosion.

- Stones shall be hard, durable, non-porous and locally available varieties approved by the Engineer.
- Packing shall ensure interlocking between stones
- Toe support shall be provided at the bottom of the slope to prevent slippage

2.16.3 Compacting Earth Materials

General where compaction of earth materials is required, the materials shall be deposited in horizontal layers and compacted as specified. The excavation, placing, moistening and compacting operations shall be such that the material will be uniformly compacted to the required density throughout the required section, and will be homogeneous, free from lenses, pockets, streaks, voids, laminations or other imperfections.

2.16.4 Compacting Cohesion Less Materials

Where compaction of cohesion less, free draining materials, such as sands and gravels are required, the materials shall be deposited in horizontal layers and compacted to the relative density specified below. The excavating and placing operation shall be such that the materials when compacted will be blended sufficiently to secure the best practicable degree of compaction and stability. Water shall be added to the materials as may be required to obtain the specified density by method of compaction being used.

As envisaged in clause 6.6.2.1 of IS. 4701 – 1982, the thickness of the embankment layer shall not exceed 25 centimeters (loose layer) before compaction and it should be spread over the full width of the embankment and compaction shall be done by tampers or crawler tractors or vibrating rollers. If the compaction is performed by treads of crawler type tractor, surface vibrators or similar equipment the thickness of the layer before compaction shall not be more than 40 centimeters. If compaction is performed by internal vibrators the thickness of the layer shall not be more than the penetrating depth of the vibrator.

As envisaged in clause 6.6.3.1 of IS. 4701 – 1982 the relative density of the compacted materials shall not be less than 70%. When tested in accordance with IS. 2720 part – xiv 1983 Indian code of practice for determination of density index (relative density) of cohesion-less soils.

2.16.5 Compacting Clay and Silty Materials

Where compaction of earth materials containing appreciable amount of clay or silt is required the compaction shall be carried out in accordance with clause 6.6.2 of IS

4701-1982. The materials shall be deposited in horizontal layers. The thickness of each horizontal layer before compaction shall not be more than 25 centimeters (loose layer) and the layer shall be to full width of the embankment. The excavating and placing operation shall be such that the materials when compacted will be blended sufficiently to secure the highest practicable density and best impermeability and stability. If the surface of any compacted layer of earth fill is too dry or too smooth to bond properly with the layer of material to be placed thereon, it shall be moistened and / or scarified in an approved manner to provide a satisfactory bonding surface before the next succeeding layer is placed. All the rollers used on any one layer of fill shall be of the same type and same weight. Prior to and during compacting operations, the embankment materials shall possess optimum moisture content as required in clause 6.6.4 of IS 4701- 1982. The embankment materials shall have optimum moisture content required for the purpose of compaction and this moisture content shall be fairly uniform throughout the layer. As far as practicable the moistening of the materials shall be performed at the site of excavation but such moistening shall be supplemented as required by sprinkling water at the site of compaction, if necessary. If the moisture content is greater than optimum for compaction, the compaction operations shall be delayed until such time as the material has dried to the optimum moisture content or to the level directed by engineer-in-charge. The moisture content of soils shall be determined in accordance with IS 2720 (part ii) 1980.

If the moisture content is not within the limits described above, the compaction operation shall not be proceeded except with the specific approval of the engineer-in-charge, until the material has been wetted or allowed to dry out, as may be required to obtain optimum moisture content and no adjustment in price will be made on account of any operations of the contractor in wetting or drying the materials or on account of any delays occurred thereby. When the material has been conditioned as herein before specified, it shall be compacted by rollers or by hand or power tampers. Where hand or power tampers are used to compact soils in confined areas such as under pipes and at the joints of bank connections with the structures they shall be equipped with suitably shaped heads to obtain the required density.

The dry bulk density of the soil portion in compacted embankment materials shall be not less than 95% of the maximum dry bulk density at optimum moisture content obtained in accordance with IS 2720 (part – vii) – 1980 – Indian code of practice of determination of moisture content, dry density relation using light compaction.

The dry density of soil in field shall be determined in accordance with IS. 2720 part xxviii – 1974. Indian code of practice for determination of dry density of soil in place by sand replacement or by IS. 2720 part – xxix – 1975 Indian code of practice for determination of dry density of soil in place by the core cutter method.

Moisture content of soil shall be determined in accordance with IS. 2720 part – ii – 1980 – Indian code of practice for determination of moisture content. The optimum moisture content is the moisture content the corresponds to the laboratory maximum dry density determined in accordance with IS. 2720 (part – vii) – 1980.

The above compaction tests will be conducted by contractor in the presence of department officers at his cost and the contractor shall ensure compaction, till the engineer-in-charge or his authorized representative is satisfied that the maximum dry density at optimum moisture content is obtained, and permits the laying of next layer.

2.16.6 Strengthening of Bunds

The earthwork required for bringing the existing bund sections to the designed sections shall be laid only after cutting suitable benches on the downstream slopes as well as on the upstream slopes. Additional earth fill shall also be placed, as required, for achieving full compaction. Deployment of the type of compaction equipment shall depend upon the extent of space available for compaction. It may include: 8 – 10 t standard power roller / vibratory power roller or short width (+ 0.90 cm drum width) power roller / vibratory power roller or fuel – operated / electrical – operated vibratory plate compactors of different plate sizes and compaction capacities. A combination of various equipment may be deployed depending upon the site situations. It shall be ensured that full designed section of the bund is compacted and the slopes are also well consolidated to effectively resist erosion and any formation of gullies / rain cuts.

Hydraulic excavators with suitable steel plate attachments to their booms may also be used for compacting / consolidating the side slopes of bunds. In view of the fact that the earthwork involved is for raising & strengthening the existing deficient tank bunds and is not a new construction of bunds, field compaction density tests shall be taken at a frequency of one test per 300cu.m of earth fill and at least one test for every layer in case the quantity is less than 300cu.m in a layer.” Heavy duty soil compacting equipment of 130 hp / 140 hp comprising a smooth steel roller in front and rubber tyred wheels at the rear capable of negotiation steep slopes of 2 (h):1 (v) can also be used for the consolidation of earth fill on the side slopes of the tank bunds. Such roller goes up and down the slopes, thereby, effectively compacting the earth fill speedily.

2.16.7 Compacting cohesionless materials containing some clay & silt.

The sub paragraph applies only to cohesionless materials and not to cohesive materials. Cohesionless materials containing clay and silt are not to be free draining. When compaction of cohesionless materials containing clay and silt is required, the materials shall be compacted to a dry density in accordance with either sub-paragraph

(1) and (2) below, using whichever test/that result in higher dry density of the compacted material in the placement.

Dry density determined using procedure enunciated in IS. 2720 (part – vii) – 1980 – (Indian code of practice of determination of moisture content dry density relation using light compaction) prior to and during compaction operation the materials shall possess optimum moisture content as determined in accordance with clause 6.4.1 of IS. 4701 – 1982 and the moisture content shall be uniform throughout each layer. Provided that the moisture content is ensured as required in clause 6.6.4 of IS. 4701 – 1982 the dry density of the soil portion in the compacted material shall not be less than 95% of the laboratory maximum soil dry density compacted. The field dry density shall be determined in accordance with IS. 2720 part xxviii – 1974 or IS. 2720 part xxix – 1975.

Dry density using the relative test as described in is. 2720 part xiv – 1983 Indian code of practice for determination of density index (relative density) of cohesionless soils: - the relative density of the compacted material obtained shall be not less than 70% determined in accordance with clause 6.6.3 of IS. 4701 – 1982, the moisture content shall be maintained as per clause 6.6.4 of IS. 4701 – 1987.

2.16.8 Rollers and other compacting equipment

As shown in appendix c of IS. 4701 – 1982, the following earth compacting equipment may be used for compacting the soils shown against them as detailed below:

Earth Compacting Equipment:

Major Division	Sub - Group	Suitable Type of Compacting Equipment
Coarse Grained	Well Grained Gravel	Smooth Wheel Roller Diesel Road Rollers
Soils	Gravels and mixture little or no fines	of 8 to 10 tons capacity pneumatic tyred roller vibrating smooth wheel roller, power roller.
	Well graded gravel sand mixtures with excellent clay binder	‘
	Uniform gravel with little or no fines	..do..
	Poorly graded gravel and gravel sand mixture little or no fines	..do..

Major Division	Sub - Group	Suitable Type of Compacting Equipment
	Gravel with fines, silty gravel, clayed gravel, poorly graded garvel, sand clay mixtures	..do..
Coarse grained soils, sands & sandy	Well graded sand and gravelly sands, with little or no fines.	Heavy Vibrating, Plate and Frog, Rammer, Power Roller
	Well graded sand with excellent clay binder	..do..
	Uniform sand with little or no fines	..do..
	Sands with fines, salty sands, clayed sands, poorly graded sand clay mixtures	..do..
Fine Grained Soils: Soil having low compressibility	Silts (inorganic) and very fine sands, rock flour, fine sands with slight plasticity	Smooth wheel roller, Diesel Road Rollers of 8 to 10 tones pneumatic tyred roller, power roller
	Clayey silts inorganic	..do..
Soils having medium compressibility	Organic Silts of low plasticity	Sheep foot roller
	Salty & Sandy clays (inorganic) of medium plasticity	Frog rammer, Power rammer
	Clays (inorganic) of medium plasticity	..do..
	Organic clays of medium plasticity	..do..
Soils having higher compressibility	Micaceours or diatomaceous fine sandy & salty soils elastic silts	Smooth wheel roller, Diesel Road Rollers of 8 to 10 tones pneumatic tyred roller, power roller
	Clays (Inorganic) of high plasticity, fat clays	..do..
	Organic, clay of high plasticity	..do..

The compacting equipment shall conform to relevant Indian specification below:

- Smooth wheeled roller should conform to IS 5502 – 1969
- Sheep foot roller should conform to IS 4616 – 1968
- Pneumatic tyred roller should conform to IS 5501 – 1969
- Vibratory plate compactor should conform to IS 5889 – 1970.
- Vibratory roller should conform to IS 500 – 1977.
- The methods of compaction shall conform to clauses 7.2, 7.2.2, 7.2.3 of IS 4701–1982.

Tamping

Rollers will not be permitted to operate within one meter of concrete and masonry structures. In the following locations where compaction of the earth fill materials by means of roller is impracticable or undesirable the earth fill shall be specially compacted as specified further below.

1. Portions of the earth fill in embankment adjacent to masonry structures and embankment foundations designated on the drawing as specially compacted earth fill.
2. Earth fills in embankment adjacent to steep abutments.
3. Earth fills at specially designated locations.

Nallah embankments where Nallah section is less than 3 meters and no space is available for movement.

Earth fill shall be spread in layers of not more than 10 (ten) cms in thickness when loose and shall be moistened to have the required moisture, as specified. When each layer of materials has been conditioned to have the required moisture content, it shall be compacted to the specified density by special roller, pneumatic/hand tampers or by other approved methods/the moisture control and compaction shall be equivalent to that obtained in the earth fill actually placed in the embankment in accordance with the specifications. Hard tampers shall normally be not allowed in exceptional circumstances with the approval of engineer-in-charge.

Turfing

Principles underlying the use of grass on earth slope. Surface stabilization of slopes and the prevention of soil erosion and weathering may be accomplished by the establishment of grass or other herbages. The living grass roots mechanically reinforce the soil, and decaying organic matter improves soil structure. The grass leaves, living or dead, protect the surface against rain and wind. The combination of improved soil structure and protection gives stability against erosion.

Virgin clays and other sub soils are usually deficient in those bacterial organisms which promote healthy growth. The application of top soil to any new slope is usually a pre-requisite for the successful establishment of grass.

Top soiling: The depth of top soil required will vary according to the mature of the sub soil and a depth of about 15 cm. Of good quality soil overlying the sub soil is usually sufficient to sustain plant growth.

Sodding: The sods used shall be cut in rectangular shape 8 to 10cm. Thick and laid so that their edges are in close contact and then welded by being gently rammed till they form a level and compact mat. When old surfaces are to be turfed, they shall be picked up to a depth of about 4 cm to give a hold to the sods. For sodding any grass which forms a thick short turf shall be used.

Turfing: It is difficult to generalize on the type of grass to be used since each particular soil type requires a specific grass. To ensure a satisfactory award it is desirable to consult agriculture department Superintending Engineer, WRD, Palar Basin Circle, Chennai - 5, who would make any necessary analysis of the soil before specifying the type of grass. Also, be a help to study the grasses growing in the neighborhoods and to include the varieties that appear to be most suitable, this of course, largely depend on the top soil being obtained from the same vicinity.

2.17 Inspection Doors

Inspection doors should be made of composite Fibreglass reinforced polymer manhole door with cover for diameter specified in BOQ (circular) Heavy Duty (20 - MT) load capacity of approved brand confirming to BSEN – 124:1994. Product shall have top abrasion resistant layer of decorative grey granite finish confirming to test performed as per IS – 15658:2006. It shall also confirm “Permanent Set” criterion as per BSEN-124. Product should be tested in NABL accredited test lab for load capacity and permanent set. The lifting arrangement should have an insert of 5mm in SS 304 socket type with key hole.

2.18 Silt Catch Pit

The silt catch pit should be constructed at 10m interval along the course of drain as shown in drawing. At every 30 m interval the silt catch pit will be constructed along with Rain Water Harvesting arrangements.

2.19 Rain Water Harvesting Arrangements with Silt Catch Pit

The rain water harvesting arrangement with silt catch pit should be constructed at 30m interval along the course of drain as shown in drawing. At every 30 m interval the silt catch pit will be constructed along with Rain Water Harvesting arrangements.

Payment for the rain water harvesting shall be on unit basis complete as per the drawings, specifications and directions of the Engineer in charge.

2.20 Desilting

Payment for removing silt shall be made for cubic meter of silt removed calculated on the basis of actual levels. Before executing the work, average silt levels shall be taken along the cross section of the drain, at least every 5 m interval - called measurement point. At every measurement point, level measurement shall be taken at bottom of the drain on the centre line and at both sides where the silt surface meets the drain sides. These shall be marked up on a construction drawing and signed off by all concerned. Based on these levels of the silt surface, and the designed or initial cross-section of the drains as applicable, the silt cross sectional area shall be computed at the measurement point. The silt volume between the measurement points shall then be computed by multiplying the average silt cross sectional area between the successive measurement points by the length between them and the cubic contents shall be worked out in cubic meter nearest to two decimal places. The quoted rates shall include cost of all works incidental to the work of desilting such as removing, carrying, loading, unloading and disposing as per the direction of the Engineer.

2.21 Ecological & Vegetation Components

2.21.1 Prosopis / Invasive Species Management

- Clear Prosopis mechanically/manually from bunds & periphery; replant natives to deny regrowth.
- Biannual regrowth inspections (esp. after monsoon); annual/as-needed removals; collaborate with Forest/Horticulture for sustained control.
- Emphasize continuous monitoring and immediate uprooting of new shoots.

2.21.2 Weed Removal

- Combine aquatic de-weeding during capacity works with routine litter/leaf removal along channels/walkways/Waterbodies to keep flow paths open.
- Keep walkway joints free of sediment/vegetation during regular inspection.

2.22 Boundary Protection

- Chain-link fencing defines boundary; restricts unauthorized access, open defecation, cattle, encroachments.
- Maintenance: quarterly inspection for damage/corrosion/missing sections; anti-rust repaints every 2–3 years; responsibility with HCMC.
- Detailed tasks: rust treatment/painting, tightening, replace broken posts/fasteners.

2.23 Permeable Walkways

Permeable walkways utilizing Graded Aggregate Base (GAB) are sustainable, eco-friendly paving systems designed to manage stormwater runoff, minimize puddles, and reduce pollution. They allow water to soak through the surface into an underlying, open-graded stone base, which acts as a reservoir to store water while it infiltrates the native soil

- Demarcate alignment, compact subgrade, lay GAB + sand filter for percolation before pavers; maintain clear access.
- Maintenance: weekly sweeping, monthly inspections to clean joints of sediment/vegetation; monthly checks for benches/fencing/lights; compost landscape waste; quarterly solar panel/battery upkeep where lighting exists.

2.24 Street Lighting

Street lighting needs to offer good illumination. The materials used in street lighting should have good resistance to atmospheric condition and at the same time shall be appealing enough to add to the beauty of roads.

In tune with growing consciousness of society about energy conservation, street lights need to be energy efficient also.

Lighting system has to adequately take care of the security concerns of pedestrians

and motorists at night.

The basic purpose of illumination are as follows:

a. Clear Visibility
b. Divers Comfort
c. Traffic Safety
d. Ease of traffic flow

Besides the conventional High Pressure Sodium Vapour (HPSV) and High-Pressure Mercury Vapour (HPMV) Luminaries Metal halide (HM) Street light Luminaries may also be used.

CFL and FLT Luminaries shall be preferred for access and minor roads. The light sources used generally are high-pressure sodium vapour lamp. The exact choice of light source is governed by functional, economic and aesthetic considerations.

The spacing between the luminaries should be uniform. Light sources may be mounted on one side or on both sides in parallel or staggered arrangement or on the median depending upon the width of the road and required recommended intensity of the lighting.

Special attention should be paid to the lighting of road junctions and crossings so that the kerbs and obstructions are clearly visible.

The pole, bracket and luminaries shall be of good integrated design and it should appear to have been designed as one unit.

2.25 SOLAR LIGHTING

- Ensure dusk-to-dawn via sensors; use to extend safe access; anti-vandal measures & community watch.
- Maintenance: monthly visual checks (poles/wiring/panels); panel cleaning every 2 months (monthly if dusty); annual battery test (replacement 3–5 yrs); weekly LED/circuit checks; annual professional servicing.

2.26 SIGNAGE & AWARENESS BOARDS (ENTRANCE)

- Entrance/signage, keep visible/unobstructed; use weatherproof lettering; keep information accurate; deter vandalism with community monitoring.

- Maintenance: regular cleaning to remove dirt/moss; repaint letters every 2–3 years; structural checks of slab/foundation after heavy rains; trim vegetation that hides boards; repair/replace damaged slabs; apply clear protective coating periodically.

2.27 FENCING

The work comprises of fixing M.S. Posts and providing barbed wire fencing as per Drawings. The M.S. Posts shall conform to IS:226 and shall be of angle iron of size indicated in the Drawings. The angle iron shall be embedded in concrete to a sufficient depth below ground as indicated in the Drawings. The steel shall be fabricated and painted to conform to the specification.

The chain link fencing shall be of galvanised iron and shall conform to IS:278-1978. The measurement shall be in running metre of the finished work.

2.28 STRUCTURAL STEEL

Plates, Sections (Angles, Tees, Beams, channels and flats etc.,): One tensile test shall be made from finished steel for every 40 tones or part thereof from each cast a separate test being made for each class of steel product (namely plates, sections and flats) rolled from a cast).

Where plates; sections, or flats of more than one thickness are rolled from the same cast, one additional tensile test shall be made from the material in each class of product for each variation in thickness of 6 mm above or below the thickness of the test piece first selected in such a class.

Bars (round, square, and hexagonal): one tensile test shall be made from finished steel for every 40 tones or part thereof from each cast and for every class of product. When more than one diameter or thickness of the bar is specified, one additional tensile test shall be made for each diameter or thickness of the bar ordered if so desired by the purchases.

Tensile test pieces: The tensile strength, yield stress and percentage elongation of steel shall be determined from standard test pieces cut length wise or cross wise from

plates and length wise from sections, flats and bars. The tests shall be carried out on Indian Standard test pieces prepared in accordance with IS 1603 – 1960.

Tensile Test the Tensile strength yield stress and percentage elongation, when determined in accordance with IS 1608 – 1960 shall be as given in below Table.

Mechanical Properties of Structural Steel (Standard Quality) (Clasue - 10 -3)				
Class of Steel Product	Nominal Thickness Diameter in mm	Tensile Strength Kgf / mm2	Yield Stress Min	Percentage Elongation Min Gauge
Plates, Sections (for example truss, angles, beams, channels etc) and flats	Below 6	Bend test only shall be required		
	6 upto and including 20	42 to 54	26.0	23
	Over 20 upto and including 40	42 to 54	23.0	23
	Over 40	42 to 54	23.0	23
Bar (round, square and hexagonal)	Below 10	Bend test only shall be required		
	10 upto and including 20	42 to 54	26.0	23
	over 20	42 to 54	26.0	23

In case of sections, the thickness of which is not uniform throughout the profile, the limits shall be applied according to the actual maximum thickness of the piece selected for test.

Should a tensile test piece break outside the middle half of its gauge length (see IS 1608 – 1960) and the percentage elongation obtained is less than that specified the test may be discarded at the manufactures option, and another test made form the same plate, section, flat or bar.

Note: Gauge lengths more than 5.65/S may also be used, in which case the elongation shall be read form IS 3803 – 1967. “Methods for elongation conversions for steel”. * Incase of the plates, sections and flats below 6 mm, the yield stress shall be assumed to be at least the same as that for the thickness between 6 and 20mm. + In case of

bars below 10mm diameter, the yield stress shall be assumed to be at least the same as or bars of diameter between 10 to 20 mm.

2.28.1 Bend Test:

Bend Test shall be conducted accordance with IS 1599 – 1960.

For bend test except in the case of round bars 25mm in diameter and under, the test piece when cold shall without fracture be doubled over, either by pressure or by blows from the hammer, until the internal diameter is not greater than three times the thickness of the piece, and the sides are parallel.

In the case of round bars 25 mm in diameter and under the internal diameter of the bend shall be not greater than twice the diameter of the bar.

2.28.2 Welding

Welding shall be in accordance with any of the following standards as appropriate.

- IS 816 – 1956 – Code of Practice for use of metal in welding for light assemblies in mild steel.
- IS 819 – 1957 – Code of Practice for resistance spot welding for light assemblies in mild steel
- IS 820 – Code or Practice for use of welding in tubular construction.
- IS 821 – Code of Practice for use of welding in Pipelines.
- IS 822 – Code of Practice for inspection of welds.
- IS 823 – Procedure code for metal are welding of mild steel.
- IS 1024 – Code of Practice for welding of structures subject to dynamic loading

2.28.3 Steel Work

Various items of steel work shall be classified and measured separately under following categories work in each classification shall be described. Bolted, riveted and welded structures shall be described as such and measured separately.

Rolled sections (hoist, channels, angles or tee) fixed independently without connecting plates.

Rolled sections fixed with connecting plate or angle cleats as in main and cross-beams hip and jack, rafters, purlins connected to common rafters and the like.

2.29 UN PLASTICIZED PVC PIPES

uPVC Pipes are used in water supply for low- pressure application in distribution mains. These pipes are also used in domestic water supply and plumbing work. There are many manufacturers in India, both in the organized and unorganized sector who manufacture these pipes. The basic Indian standard for u PVC Pipe is IS: 4985 – 1988. PVC pipes are produced by extrusion process and generally come in lengths of 6 meters. A wide range of injection moulded fittings, including tees, elbows, reducers, caps, pipe saddles, inserts and threaded adapters for pipe sizes up to 200 mm. are available.

2.29.1 Manufacture of PVC Pipes

PVC polymer is produced by polymerization of vinyl chloride monomer in a suspension process. The PVC compound should confirm to IS: 10151 – 1982.The extruder employs heat, Shear force and pressure to form uPVC pipes. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard or to impair its chemical and physical properties. The pipes are then cut at required length. One end is post formed to produce an integral socket. The spigot end is inserted into the socket and a chemical solvent does the sealing. Sometimes the socket is formed with an integral groove, which can house a rubber gasket. When the spigot is inserted into this kind of socket, this rubber gasket does the sealing. This type of joint is known as ëRing Fit Joint'.

2.29.2 Product Features

PVC pipes meant for water supply are classified by their pressure rating at 270 C, which are given in Table.

Working Pressure for different Classes

Class of Pipe	Working Pressure (kg / cm2)
Class 1	2.5
Class 2	4.0
Class 3	6.0
Class 4	10.0

Ref: Clause 3 (Classification of Pipes) IS: 4985 – 1988 (Specification for Un plasticized PVC Pipes for Potable Water Supplies – Second Edition)

2.29.3 Dimensions of Pipes

The mean outside diameter, outside diameter at any point and their tolerances is enumerated in (Clause 2, 1, 5.1, 5.2, & 5.1.2) of IS: 4985 – 1988

2.29.4 Tolerances on Diameter

Mean Outside Diameter – The permissible variation (dm - de) between the mean outside diameter (dm) and the nominal outside diameter of a pipe shall be positive in the form + x, where x is less than or equal to greater of the following two values:

- 0.3 mm, and
- 0.033 d_e rounded off to the next higher 0.1 mm.

Diameter at any Point – The permissible variation (dm – de) between the mean outside diameter (dm) and the nominal outside diameter of a pipe shall be positive in the form + x, where x is less than or equal to greater of the following two values:

- 0.5 mm and
- 0.012 dn rounded off to the next higher 0.1 mm.

2.29.5 Tolerances on Wall Thickness

For pipes of minimum wail thickness 6 mm. or less, the permissible variation between the minimum wall thickness (e) and the wall thickness at any point (e1), (e1 – e) shall be positive in the form of + y, where y = 0.1e + 0.2 mm. For pipes of minimum wall thickness more than 6 mm, the tolerance applied to the average wall thickness (to be determined by taking 6 measurements) shall be within the range of 0.1e + 0.2 mm.

2.29.6 Precautions in Handling and Storage

Because of lightweight, there is a tendency of throwing PVC pipes during unloading and stacking. In particular, relating to fracture toughness requirements, uPVC pipe remains sensitive to point loading and impact loading. Since it is notch sensitive, if damaged, may fail under fatigue loading. So care should be taken in handling and storage to prevent surface damages to the pipes. The following precautions are to kept in mind during handling and storage.

1. For pressure application PVC pipes containing any appreciable external scratches should not be used
2. On no account should pipes be dragged along the ground. Pipes should be given adequate support at all times
3. These pipes should not be stacked in large piles, especially under warm temperature conditions, as the bottom pipes may be distorted thus giving rise to difficulty in pipe alignment and jointing
4. For temporary storage in the field, where racks are not provided, care should be taken that the ground is level, and free from loose stones
5. Pipes stored thus should not exceed three layers and should be so stacked as to prevent movement
6. Pipe should be stored away from direct heat source and direct sun to prevent degradation
7. It is also recommended not to store one pipe inside another to avoid internal scratches
8. It is advisable to follow the practices mentioned as per IS: 7634 – Part 1

2.29.7 Operating Conditions for Use of PVC Pipes

PVC pipes may be used for applications where:

1 The maximum pressure in the pipeline inclusive of surge does not exceed the pressure rating of the pipe

2 Amplitude of the pressure fluctuation does not exceed F of the pressure rating of the pipe. However before selecting PVC pipes for any water supply application, following aspects are to be borne in mind.

3 PVC pipes are susceptible to UV Radiation. The deterioration starts with discoloration, surface cracking and ultimately ends with brittleness, and the life of the pipe may be reduced to 15-20 years. So over ground applications should be strictly avoided.

4 Though PVC pipes show excellent chemical resistance, it is however affected by certain chemicals like chlorinated hydrocarbons, ketenes, nitrobenzene, aniline, esters, etc. These chemicals can soften and swell the pipes with associated reduction in strength. So, in areas where these chemicals can be present, installation of PVC pipes should be avoided.

5 PVC pipes should not be laid in ground, which is contaminated with surface-active organic compounds, such as detergents that can increase the risk of brittle fracture.

6 PVC Pipes can also be attacked by certain concentrated oxidizing agents like chlorine gas, nitric acid, etc. so areas where spillage of these chemicals may happen, use of PVC pipes should be avoided.

7 Most of the plastic pipes including PVC have low diametric stiffness. So places where heavy traffic load and high impact load is apprehended, usage should be avoided.

8 Workability of PVC pipes reduces with temperature. Use of PVC pipes should be restricted in places, where sub-zero temperature of temperature above 450 C may be encountered.

2.30 NATURE BASED SOLUTION REQUIREMENTS

2.30.1 General Requirements

1. All plant species shall be sourced from certified nurseries / government horticulture departments / forest nurseries to ensure authenticity, genetic purity, and freedom from pests and diseases.
2. Species selection, quantity and placement shall strictly follow the planting plan approved by the Engineer / Employer.
3. Only healthy and well-developed saplings shall be used
4. Replacement of dead or unhealthy plants during the defect liability/maintenance period shall be at the Contractor's cost.
5. Equivalent species may be proposed only if the suggested species are unavailable; however, prior written approval from the Engineer / Employer is mandatory.

The project integrates a range of Nature-Based Solutions (NBS) aimed at enhancing ecological resilience, improving hydrological performance, and strengthening climate adaptation capacity. These NBS components serve as low-carbon, self-sustaining interventions that complement engineered structures. This section provides the technical specifications for all NBS elements proposed for various project components. The Contractor is required to execute, maintain, and monitor these NBS components in line with the specifications provided below.

2.30.2 Bioswale

Bioswales shall be constructed along selected alignments to intercept surface runoff, enhance infiltration, and filter sediments. They shall consist of a shallow, vegetated channel with a permeable soil mix and a planted strip.

This bioswale system is designed not only to capture and filter surface runoff but also to integrate seamlessly with public seating areas and pedestrian movement, thereby serving both hydrological and social functions.

The bioswale is located adjacent to the road, where stormwater naturally accumulates. It features a total width of 2.5 meters, with the core bioswale trench comprising gravel and vegetated layers to enable filtration and infiltration. Stormwater enters the bioswale through brick wall seating structures, which are perforated to allow lateral

flow of water into the planted trench. This dual-function design ensures that the bioswale performs both as a landscape feature and a stormwater management unit.

The filtered water percolates through a 450 mm-deep media layer and is collected by a 110 mm diameter perforated drainage pipe placed at the base. This pipe is connected to the lake system, allowing excess clean water to be conveyed into nearby drain after it passes through the natural filtration process.

2.30.3 Procurement and Plantation of Native Species

The Contractor shall be responsible for the procurement, transportation, planting and maintenance of landscape vegetation in designated planting zones within the project area. The primary objective is to enhance ecological restoration, slope stabilization, and aesthetic value through the use of native and site-appropriate plant species.

2.30.4 Planting Zones and Recommended Species

The Contractor shall procure and plant species suitable for each zone as indicated below.

List of Tree species for Hosur Parks, Streets and Lakes

Category	**Species**	**Common Name**	**Inference**
Streets/Parks	*Pongamia pinnata*	Indian Beech	Nitrogen fixing, biodiesel seeds, erosion control; avenue
	Delonix regia	Flame of Forest	Vibrant flowers, shade, and a pollution-tolerant street tree.
	Samanea saman	Rain Tree	Wide canopy shade; rainwater harvesting aid.
	Albizia lebbeck	Siris	Fast-growing, timber; butterfly attractor.
	Ficus racemosa	Cluster Fig	Riparian fruit for birds; water purification.
	Terminalia catappa	Indian Almond	Shade, parks and lakes edge.

Category	Species	Common Name	Inference
	Syzygium cumini	Indian Jamun	Edible fruits, birds, bees; fast growth.
	Pithecellobium dulce	Tamarind	Pods for fodder; drought-hardy.
	Gmelina arborea	Beechwood	Quick timber/shade; parks.
	Mimusops elengi	Bakul	Fragrant flowers; urban tolerant.
	Acacia leucophloea	White Babul	Dry soil stabilizer; fuelwood.
	Dalbergia sissoo	Indian Rosewood	Durable wood, shade; roadside.
	Azadirachta indica	Neem	Medicinal, pest-repellent; air purifier
	Cassia fistula	Golden Shower	Flowering chain; pollinators.
Lakes/Parks	*Ficus glomerata*	Gular Fig	Bank binding, figs for wildlife.
	Aegle marmelos	Bael	Medicinal fruits; conservation priority.
	Acacia chundra	Red Babul	Hardwood, blossoms; dry parks.
	Adina cordifolia	Haldu	Timber, soil improver.
	Canthium coromandelicum	Coromandel Canthium	Native shrub-tree; biodiversity.
	Cordia dichotoma	Lasoda	Fruits for birds.
	Crateva religiosa	Sacred Garlic Pear	Riparian, sacred value.
	Santalum album	Sandalwood	Aromatic; protected.
	Chloroxylon swietenia	Satinwood	Threatened; enrich populations.

Category	Species	Common Name	Inference
	Acacia ferruginea	Rusty Acacia)	Vulnerable; habitat restoration.

List of Shrubs and Subshrubs species for Hosur Parks and Lakes

Category	Species	Common Name	Inference
All Sites	*Tephrosia purpurea*	Wild Indigo	Nitrogen fixing, medicinal; butterfly nectar; drought-tolerant groundcover.
	Cassia auriculata	Tanner's Cassia	Flowering, tannin-rich; erosion control on lake banks.
	Dodonaea viscosa	Hopbush	Windbreak shrub; fuel/hedge; urban hardy.
	Carissa spinarum	Kalaka	Thorny barrier; edible fruits; bird attractant.
	Capparis sepiaria	Indian Caper	Salt-tolerant; pickle fruit; lakeside stabilizer.
	Azima tetracantha	Jangli Jaal	Thorny fence; medicinal; Schedule II host potential.
	Allophyllus serratus	Cork Tree	Shade-tolerant; berries for wildlife.
	Breynia rhamnoides	Indian Snowberry	Euphorbiaceae shrub; dry soil binder.
	Calotropis gigantea	Crown Flower	Milkweed; butterfly host (Danaid Eggfly); pollution filter.

Category	Species	Common Name	Inference
	Ziziphus oenoplia	Wild Jujube	Thorny, drought-proof; fruits for birds.
	Pterolobium indicum	Indian Redwing	Legume shrub; soil improver.
	Waltheria indica	Sleepy Grass	Herbal; ground stabilization.
	Cissus quadrangularis	Veldt Grape	Succulent climber-shrub; medicinal; fence support.

List of Herbs, Grasses and Aquatic species for Hosur Parks and Lakes

Category	Species	Common Name	Inference
Lakes	*Typha angustifolia*	Narrowleaf Cattail	Bank stabilization, nutrient cycling, habitat for birds/fish; replace invasives.
	Acorus calamus	Sweet Flag	Rhizome filters pollutants, medicinal; aquatic edge stabilizer.
	Alternanthera sessilis	Sessile Joyweed	Nutrient absorber, fish forage; low-water herb.
	Alysicarpus monilifer	Buffalo Pea	N-fixing legume; soil binder for shores.
	Andrographis affinis	Green Chiretta	Medicinal herb; wetland-tolerant.

	Bergia ammannioides	Mad Channel	Aquatic emergent; oxygenates water.
	Chrysopogon zizanioides	Vetiver	Erosion control, heavy metal uptake, and deep roots for lake banks.
	Cymbopogon citratus	Lemongrass	Aromatic grass; pest-repellent, soil holder.
	Cyperus sp.	Sedge	Wetland grass filters sediments/nutrients.
Parks & Streets	*Achyranthes aspera*	Chaff Flower	Tough groundcover; pollinator magnet.
	Ageratum conyzoides	Billy Goat Weed	Fast-spreading; butterfly nectar source.
	Blumea lacera	-	Medicinal; dry soil colonizer.
	Boerhavia diffusa	Hogweed	Drought-hardy creeper; herbal uses.
	Curcuma longa	Turmeric	Rhizomatous; medicinal, low-maintenance filler.

List of climbers for Hosur Parks and Lakes

Category	**Species**	**Common Name**	**Inference**
All	*Clitoria ternatea*	Butterfly Pea	N-fixing climber; blue flowers attract pollinators; bank erosion control via roots.

Category	Species	Common Name	Inference
	Abrus precatorius	Rosary Pea	Hardy twiner; seeds for birds; stabilizes moist slopes.
	Hemidesmus indicus	Indian Sarsaparilla	Root system binds soil; medicinal; shade-tolerant for lake edges.
	Aristolochia indica	Indian Birthwort	Pipe-shaped flowers; larval host for butterflies; riparian cover.
	Gloriosa superba	Glory Lily	Climbing lily; striking blooms; wetland margin climber (protected).
	Cassytha filiformis	Love-Vine	Parasitic twiner; fills gaps; supports native insect habitats.

2.30.5 Providing Green Filter Strip Along the Bund

The Contractor shall provide a vegetated green filter strip along the bund to enhance soil stability, minimize surface erosion, and improve ecological buffering of the waterbody. The green strip shall serve as a bio-protective barrier to intercept sediment, nutrients, and runoff while adding aesthetic and ecological value to the embankment.

Scope of Work

The work includes procurement, transportation, planting, and establishment of ornamental foliage shrubs in a continuous strip along the bund as per approved layout and drawings. Planting density shall be 6 plants per square metre, ensuring uniform spacing and full ground coverage.

Plant Species and Specifications

The Contractor shall supply and plant:

- ornamental foliage shrub
  - Minimum height: 30–45 cm
  - Supplied in polythene bag 7×8 inch
  - Saplings shall be healthy, well-rooted, free from pests, diseases, or deformities

Note: Equivalent species may be proposed only if the suggested species are unavailable; however, prior written approval from the Engineer / Employer is mandatory.
The Contractor shall maintain all planted areas until establishment, and replace dead or unhealthy plants at his own cost.

Performance and Quality Requirements

- All planting shall conform to horticultural best practices and approved planting schedule
- Green strip shall achieve uniform and dense growth across the bund alignment
- A minimum survival rate of 85% shall be ensured during the maintenance/defects liability period.

2.30.6 Eco Bloc RWH Units

Providing & fixing of reused polypropylene-based rainwater harvesting structure including supply of base plates, end plates etc., of size 800 mm x 800 mm x 360mm with minimum void ratio of 96%.

The module must be of injection molded type in one piece with internal columns. This type must carry the applied loads predominantly by closely spaced internal columns. The individual units must be clipped together, as per the manufacturer's specifications and recommendations, to form a larger tank and also to prevent the units moving in relation to each other during construction.

The external framework must provide support for the geo textile used to surround the tanks. The modular rainwater harvesting units must be combined with compatible shaft units for inspection and access. They must fit in width and length to modular rainwater harvesting units to be included in the formed tanks.

2.30.7 RWH design and shaft design

The modules shall confirm to the following:

a. Each unit of modular rainwater harvesting must withstand the lateral stability 100 kN/m² in x- and y-direction for ultimate compressive strength. Test must be carried out at 23^0C with a constant load rate of 500N/m^2*s.

b. Supply a ratio of vertical strength to lateral strength of at least 3.5:1 and not more than 5:1. The ratio is defined from ultimate compressive vertical strength to ultimate compressive lateral strength and relevant lateral direction must be the weakest.

c. The distance between columns – structural components withstanding the vertical load – must be smaller than 120 mm to distribute the loading to all columns simultaneously. The minimum number of columns per square meter must be 35.

d. The requirements to the design of modular rainwater harvesting unit modules has to be confirmed by short-term and long-term tests.

If shaft modules are built of modular rainwater harvesting units by cut-outs or other modifications, it is necessary to determine ultimate compressive strength in all directions. Any stability degradation of the structure, analyzed by compressive load tests, due to the modifications and cut-outs are not allowed.

There are different shapes and geometrics available. no plate-systems or no systems with more than four assembling parts shall be used.

2.30.8 Materials

The units used in modular rainwater harvesting tank system must be manufactured from recycled or reused polypropylene mineral improved. The Contractor must submit a list of the proposed suppliers and sources of materials required for the execution of the works to the Engineer prior to placing orders for materials.

a. The Manufacturer must demonstrate that they have suitable quality control testing procedures in place to ensure that materials are consistent and will not cause reduction in strength. The properties of the material used to manufacture the units that are tested in compression to determine the design criteria shall be recorded. If materials are used that vary from these baseline properties, the units shall be retested to determine the design parameters.

b. The Manufacturer must have at least 2 in-house hydraulic compression testing facility independently temperature-controlled to demonstrate accompanying quality control during production.

c. The Manufacturer must have experience in stormwater management for more than 20 years and should have an international leading position in this section.

e. modular rainwater harvesting infiltration or attenuation unit should have a storage co-efficient of not less than 95%.

2.30.9 Testing of Materials and Units

a. General

There are a number of international independent testing organizations such as BBA in the UK, CSTB in France and DIBT in Germany have evolved internationally acceptable methodologies. The Manufacturer must have experience in certification processes with at least three listed independent testing organisations mentioned above.

a. Static Load Tests

Static vertical load tests shall be carried out in accordance with the recommendations of EN 17150:2019. The test methodology shall represent unrestrained loading condition – no lateral restraint. A minimum of three samples shall be tested at a load rate of 500 N/s per square meter and at a temperature of 23^0C+/-2^0C.

i. Static horizontal load tests shall be carried out in accordance with the recommendations of EN 17150:2019 when installed in the ground. A minimum of three samples shall be tested at a load rate of 500 N/s per square meter unit surface in x and y direction. In case of high differences f more than >20% between x and y direction it is necessary to inform the engineer about the strong and the weak side. Installation conditions must always consider the weak side.
ii. Creep tests must be carried out in accordance with CIRIA C737 table 4.5, at a temperature of 23°C ± 2°C.
iii. If a full creep data set is unavailable, at least a minimum of 2 creep tests should be undertaken with at least one of the tests achieving creep rupture. In this instance the unit should only be used where the expected imposed permanent load does not exceed the creep test load, taking into consideration the partial factors of safety.
iv. Design Life of the modular rainwater harvesting infiltration SWD tunnel and storage tank must be minimum of 50 years.

b. Characteristic Design Parameters

The characteristic ultimate compressive strength in vertical (z-direction) at 23°C for the geo cellular units shall be a minimum of:

Dynamic loading capacity	
Ultimate compressive Strength	min. 420 kN/m²

Note: This value must be achieved after reducing the mean value by two times standard value.

c. Material Properties

All material properties shall be tested regularly during granule production with high frequency. It is necessary to determine the results of material in production, already included with all additives and stabilizers and not only PP material without additives. Test results have to be recorded and kept for min. five years. Material properties that shall be tested during manufacture are listed in the following table.

	Test parameters		
Characteristic	**Requirement**	**Value**	**Test method**
Density	Temperature	(23 + 2)°C	ISO 1183-1
Tensile strength at yield	Speed Temperature	50 mm/min (23 ± 2)°C	ISO 527
Elongation at break	Speed Temperature	50 mm/min (23 ± 2)°C	ISO 527
Thermal stability (oxidation induction time)	Temperature	200°C	ISO 11357-6
Melt flow rate (MFR)	Temperature Loading mass	230°C 2.16 kg	ISO 1133

Long-term analysis of min 3,000 h recommended is 10,000 h, for mechanical values must be analyzed by notified bodies. Extrapolations and estimations of values for granulate materials are only applicable from smaller concentrations of additives to higher concentrations. It is permitted to extrapolate long-term analysis data of granulate materials without additives instead of granulate material with additives.

In addition to testing the raw materials the units must also be tested as part of the manufacturer's quality control procedures. Typical unit properties that must be measured are listed below:

i. Raw Material properties as per table
ii. Measurement of dimensions.
iii. Assembly test for finished product.
iv. Measurement of mass of unit visual inspection for defects.
v. Short-term compression tests.

d. Manufacturing of Units

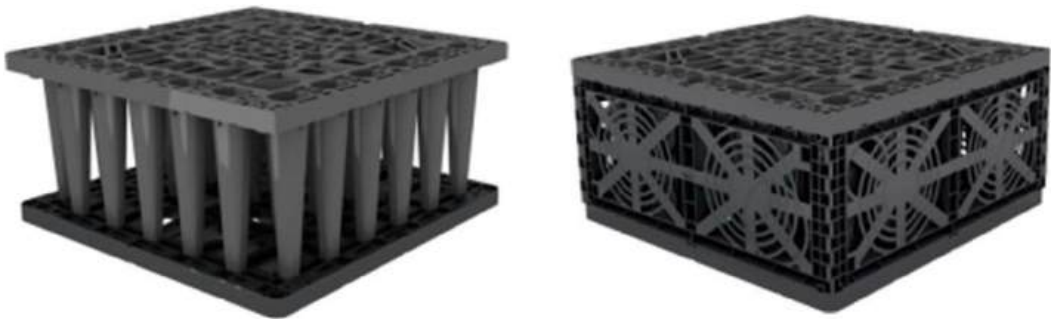
The RWH units shall be manufactured in an ISO 9001 and ISO 50001 certified production site(s). All production site(s) shall be regularly witnessed at least once per year by accredited notified bodies. Witnessing of production sites is a guarantee to deliver high quality units from beginning to the end of each project.

The following documents and product data shall be submitted to the Engineer:

a. Originals of catalogues and engineering data sheets for manufactured items. Each item and option to be provided shall be clearly marked and each item not to be provided shall be deleted.
b. Documentation to show that products provided meet the requirements for material, construction, operation and tests.
c. Manufacturer's installation instructions for all items
d. Certified reports for all tests and inspections designated herein, signed and sealed, showing full compliance with referenced standards and specifications.
e. Stress/ strain curves for vertical and lateral compression.
f. Creep test under sustained long-term loading.

All material shall be permanently marked, by stamp or other marking, before dispatch from the manufacturer, displaying the following information as a minimum (where applicable):

a. The manufacturer's name, initials, or identification mark.
b. The classification of material.
c. The date of manufacture and batch.



2.31 OSR Site Sponge Proposal

OSR Site Categorization

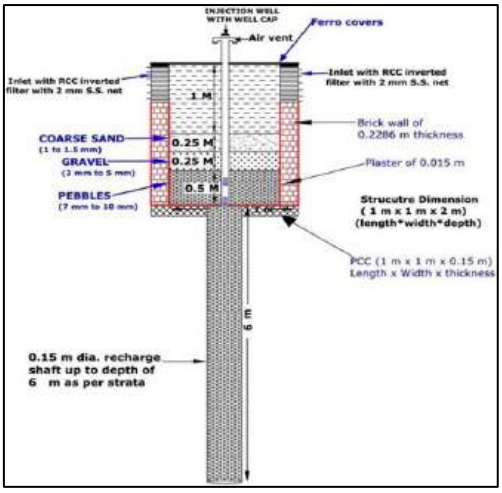
OSR sites are categorized as open space and park based on land records. Based on area of OSR sites, sponge concepts proposed are as follows.

Sl No	Description	Sponge Proposal
A	**Open Space Proposal**	
1	Very Small Open Space area < 0.1 acre	Recharge Pit
2	Small Open Space Area > 0.1 and < 0.5 acre	Recharge Well
3	Medium Open Space Area > 0.5 and < 1.0 acre	Percolation Pond
4	Large Open Space Area > 1.0 acre	Retention Pond
B	**Open Space Park Proposal**	
1	Very Small Park **Area < 0.1 acre**	Recharge Pit
2	Small Park **Area > 0.1 and < 0.5 acre**	Small Park
3	Medium Park **Area > 0.5 and < 1.0 acre**	Medium Park
4	Large Park **Area > 1.0 acre**	Large Park

2.31.1 Very Small Park – Recharge Pit

For very small Park, recharge pit is proposed. A recharge pit is a structure used for rainwater harvesting to replenish groundwater levels. It involves creating a pit and filling it with layers of boulders, gravel, and sand to filter and allow rainwater to seep into the ground. These are suitable for areas with shallow permeable strata and are commonly used for residential and commercial rooftops to prevent waterlogging and conserve water.

Rainwater is collected and channelled into the pit through conduits. A mesh is installed at the inlet to prevent leaves and debris from entering the pit. The pit is filled with a graded filter material, with boulders at the bottom, followed by gravel, and then coarse sand on top. This layering allows the water to filter through the layers, and the silt is trapped on the top sand layer, which can be cleaned periodically. The filtered water then percolates into the ground, recharging shallow aquifers. Best suited for alluvial areas with permeable strata not deeper than 2 to 2.5 meters. Commonly built to 1-2 meters wide and 1.5–3 meters deep. This helps to artificially replenish groundwater, improve water quality, and reduce surface runoff and waterlogging. The top layer of sand needs to be cleaned periodically to maintain the recharge rate.



Recharge Pit

2.31.2 Small Sponge Park

Civil (Soil & Grading) Components

- Civil works involving Site Cleaning, Soil filling & Levelling, Boundary wall with grill/ fencing construction, gate installation, Name Board

Hydrology and Blue green Components

- Permeable paver blocks with storm water drain
- Rain water Harvesting Pit

Vegetation & Planting Components

- Urban forest (Tree and Hedge and shrub plantation)
- Ground cover with native species

2.31.3 Medium Sponge Park

Civil (Soil & Grading) components

- Civil works involving Site Cleaning, Soil filling & Levelling, Boundary wall with grill/ fencing construction, gate installation, Name Board

Hydrology and Blue green Components;

- Permeable paver blocks with storm water drain
- Rain water Harvesting Pit
- Percolation Pond

Vegetation & Planting Components

- Urban forest (Tree and Hedge and shrub plantation)
- Ground cover with native species.

2.31.4 Large Sponge Park

Civil (Soil & Grading) components

- Civil works involving Site Cleaning, Soil filling & Levelling, Boundary wall with grill/ fencing construction, gate installation, Name Board

Hydrology and Blue green Components

- Permeable paver blocks with storm water drain
- Rain water Harvesting Pit
- Bio Swales
- Rain garden
- Detention pond

Vegetation & Planting Components

- Urban forest (Tree and Hedge and shrub plantation)
- Ground cover with native species

2.31.5 Very Small Open Space - Recharge Pit

Refer very small park – recharge pit

2.31.6 Small Open Space - Recharge Well

A "recharge well" is a technique used to replenish groundwater by directing surface water, typically rainwater, into underground aquifers. These wells can be constructed from scratch or by rehabilitating existing, defunct wells. They are especially beneficial in urban areas to combat water scarcity by increasing groundwater levels, which can then be used during dry seasons.

Rainwater is collected from a catchment area and channelled to the well through a piped network. Before reaching the well, the water passes through a filter to remove debris and sediment, ensuring the groundwater remains clean. The filtered water is then directed into the recharge well, which percolates down into the shallow or deep water-bearing layers (aquifers) beneath the ground. This process helps to prevent flooding, augments the local groundwater supply, and promotes sustainable water management by making stored water available during drier months.

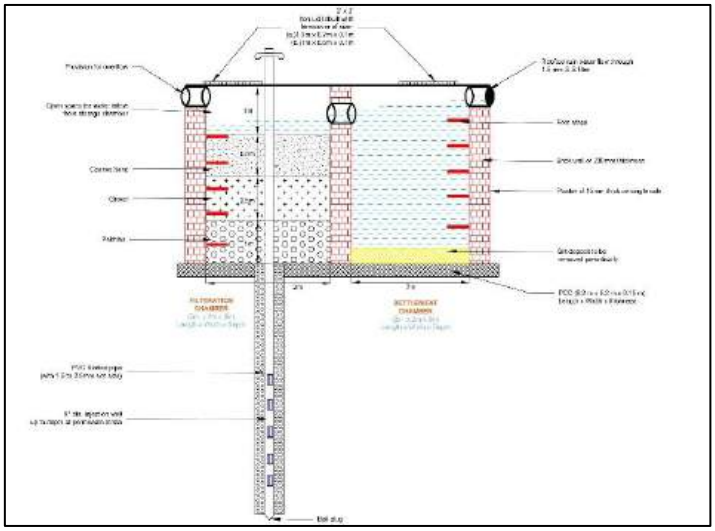


Figure 2-1 Recharge Well

2.31.7 Medium Open Space - Percolation Pond

A percolation pond is a small man-made water storage structure, built across a stream or natural watercourse, to collect and store rainwater runoff. Its main purpose is to allow water to slowly seep into the ground to recharge groundwater, which can then be used by nearby wells and springs. This process also helps prevent soil erosion and provides a water source for livestock and agriculture.

An earthen bund (a wall) is constructed across a stream to hold back the water. Rainwater runoff from the surrounding catchment area is collected and impounded behind the bund. The pond is designed to have a permeable base, the impounded water slowly seeps into the soil, both vertically and horizontally. This infiltration replenishes the underground aquifer, raising the water table in the surrounding area. This recharged groundwater can then be accessed through nearby wells and springs, helping to mitigate water scarcity. The size of these ponds can vary, but they are typically small, often holding up to 15,000 cubic meters of water. They are often constructed in low-lying areas where groundwater recharge is a major concern. Besides groundwater recharge, the stored water can be used for livestock and for irrigating a limited area of dry crops.

Figure 2-2 Percolation Pond

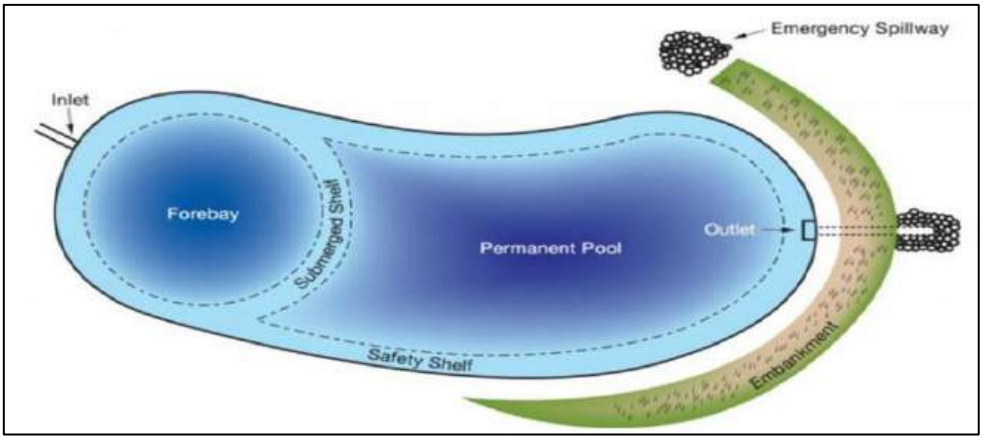
2.31.8 Large Open Space - Retention ponds

A retention pond is an artificial pond designed to manage stormwater runoff by collecting rainwater from buildings and other surfaces to prevent flooding. It holds a permanent pool of water and uses vegetation to slow the flow of water, filter out pollutants, and allow sediment to settle. This process helps protect downstream waterways from erosion and pollution.

By collecting excess runoff, retention ponds prevent it from overwhelming drainage systems and causing downstream flooding or erosion. The permanent pool and surrounding vegetation, which can include aquatic plants and grasses, help filter

pollutants and cycle nutrients from the stormwater. They provide a space for suspended particles in the runoff to settle out, which is a crucial step in the water treatment process. The permanent water body and surrounding greenery create habitats for aquatic and terrestrial wildlife. Retention Pond should contain the following zones:

- a sediment forebay or other form of upstream pre-treatment system (i.e. as part of an upstream management train of sustainable drainage components)
- a permanent pool which will remain wet throughout the year and is the main treatment zone
- a temporary storage volume for flood attenuation, created through landscaped banks to the permanent pool
- a shallow zone or aquatic bench which is a shallow area along the edge of the permanent pool to support wetland planting, providing ecology, amenity and safety benefits.



Retention Pond

2.32 AMBIENT AIR QUALITY MONITORING

The Contractor shall carry out ambient air quality monitoring to assess baseline environmental conditions during the pre-construction and subsequent stages, ensuring compliance with statutory environmental requirements. The monitoring shall be performed by a NABL-accredited / Government-approved environmental laboratory following Central Pollution Control Board (CPCB/TNPCB) guidelines.

Scope of Work

Air quality monitoring shall include collection, preservation, transport, analysis, and reporting of samples from designated monitoring locations. All instruments and sampling methods shall comply with relevant CPCB /TNPCB protocols.

Parameters to be Monitored

The following parameters shall be mandatorily analyzed:

- Particulate Matter: PM_{10}, PM_{25}
- Gaseous Pollutants: SO_2, NOx, CO, NH_3
- Heavy Metal: Pb (Lead)
- Additional pollutants, if any, specified by CPCB /TNPCB during the project execution may also be monitored as required.

Sampling and Analytical Method

- Sampling, handling, and laboratory analysis shall strictly follow methods specified by CPCB/TNPCB and latest applicable standards.
- Calibration and certification of sampling equipment shall be ensured before deployment.

Standards and Regulatory Compliance

Test results shall be compared with:

- National Ambient Air Quality Standards (NAAQS), 2009
- Air (Prevention and Control of Pollution) Act, 1981
- Any other CPCB/TNPCB standards/guidelines in force during the monitoring period

Any exceedance of permissible limits shall be reported immediately to the Engineer / Employer along with corrective mitigation measures.

Monitoring Frequency and Duration

- Frequency: Quarterly (four times per year)
- Sampling Duration: As per CPCB/TNPCB guidelines for ambient air quality monitoring for each pollutant

Monitoring Locations

- Monitoring shall be carried out at a minimum of 8 locations, identified during the pre-construction phase and approved by the Engineer / Employer.
- Sampling stations shall be geo-referenced and positioned considering predominant wind direction, sensitive receptors, work zones, and baseline study requirements.

Reporting Requirements

- A certified analytical report shall be submitted after each monitoring event.
- Reports shall include raw data, test methods, detection limits, meteorological observations, graphical representation of trends, regulatory comparison, and interpretive remarks.
- All digital data and QA/QC records shall be submitted to the Employer.

2.33 AMBIENT NOISE LEVEL MONITORING

The Contractor shall carry out ambient noise monitoring to establish baseline noise levels and assess variations during project execution. The monitoring shall be performed by a **NABL-accredited / Government-approved environmental laboratory** using calibrated instruments and in accordance with prescribed regulatory standards.

Scope of Work

The work includes measurement, analysis, documentation, and reporting of ambient noise levels at identified monitoring locations. All monitoring procedures shall adhere to relevant CPCB/TNPCB and statutory guidelines.

Parameter to be Measured

- Noise levels measured in dB(A) scale

Both **day time and night time** noise monitoring shall be carried out unless otherwise directed.

Sampling Method

- Noise levels shall be recorded in a **free-field condition at 1 meter distance from the equipment** whose noise is being assessed.
- **Equivalent continuous noise level (Leq)** shall be recorded using an **integrated noise level meter** positioned **15 meters from the edge of pavement / work area** or as directed by the Engineer / Employer.
- The sound level meter shall be calibrated before and after monitoring.

Standards for Compliance
Measured values shall be compared against:

- National Ambient Air Quality Standards (NAAQS) in respect of Noise
- Noise Pollution (Regulation and Control) Rules, 2000
- Any subsequent amendments or additional CPCB /TNPCB guidelines in force during the project

Any exceedance shall be reported immediately with suggested corrective measures.

Monitoring Frequency and Duration

- **Frequency:** Quarterly (once in every three months)
- **Duration:** Readings shall be recorded **at 15-second intervals for 15 minutes every hour**, and the data shall be **averaged for analysis** as per standard practice.

Monitoring Locations

- Monitoring shall be conducted at a minimum of one location identified during the pre-construction phase and approved by the Engineer / Employer.
- Locations shall include sensitive receptors (e.g., schools/hospitals), residential areas, major work zones and haul roads as relevant.

Reporting Requirements

Each monitoring report shall include:

- Tabulated raw and processed noise level data (Leq Day & Leq Night)
- Monitoring duration, time, instrument details and calibration certificates
- Graphical representation of results and comparison with standards
- Interpretation of exceedances and recommended mitigation measures (if any)
- Geo-coordinate and photographs of monitoring locations

2.34 Surface Water and Ground Water Monitoring

The Contractor shall conduct periodic monitoring of water quality in both surface water bodies and groundwater sources to evaluate environmental conditions, assess seasonal changes and ensure compliance with regulatory water quality standards. All

sampling and analysis shall be carried out by a **NABL-accredited / Government-approved laboratory** under the supervision of the Employer / PMC.

Scope of Work

The scope of monitoring includes field sampling, laboratory analysis, documentation, and reporting of water quality parameters, as well as comparison against relevant standards and submission of recommendations where exceedances are observed.

Parameters to be Monitored

(Designated best use water quality criteria parameters by CPCB/TNPCB)

Surface water	pH, Turbidity, Total Coliform, Dissolved Oxygen, BOD, Total Suspended Solids, COD, Total Phosphate, NH_3, Fe, F, SO_4, NO_3, NO_2, Cl, Total Dissolved Solids, Total Residual Solids, Chlorophyll-A,
Groundwater	pH, Turbidity, Total Coliform, Dissolved Oxygen, BOD, Total Suspended Solids, COD, NH_3, Fe, F, SO_4, NO_3, NO_2, Cl, Total Dissolved Solids, Total Residual Solids, EC, Dissolved Phosphate.

Sampling Method

- **Grab water samples** shall be collected from designated locations using clean, contamination-free sampling containers.
- Preservation, transportation, and analysis shall follow the **Standard Methods for the Examination of Water and Wastewater** and laboratory best practices.
- Field record sheets shall be maintained with weather conditions, location coordinates, time, and visual observations.

Applicable Standards and Compliance

Laboratory results shall be compared with:

- IS 10500:2012 – Drinking Water Standards
- Any relevant CPCB**/TNPCB** guidelines / directives in force

Exceedances shall be reported immediately with corrective and mitigation recommendations.

Monitoring Frequency and Duration

- **Frequency:** Quarterly (once in every three months)
- **Duration:** As per laboratory test requirements applicable to each parameter

Monitoring Locations
Monitoring shall be carried out at:

- **3 Surface Water Locations** — One location from each water bodies and one location from Nallah depending on water availability at the time of sampling.
- **3 Groundwater Locations** — Selected based on **pre-construction baseline monitoring** and approved by the Engineer / Employer.

Each sampling location shall be geo-referenced; photographs and field logs shall accompany the monitoring report.

Reporting Requirements
Each monitoring event shall include:

- Certified laboratory analytical report with detection limits and test methods
- Raw data sheets and observation logs
- Classified dataset comparing results with regulatory limits
- GIS-based location map
- Interpretation of water quality trends and recommendations for mitigation (if any)

All monitoring records shall be submitted in both hard copy and soft copy format.

2.35 Silt Analysis of Desilted Lake Material

The silt/dredged material proposed to be removed from the lake shall be subjected to comprehensive chemical and microbiological analysis prior to transportation and final disposal. The objective of the analysis is to determine the suitability of the silt for reuse,

land application, or safe disposal in accordance with applicable environmental regulations.

The Contractor shall engage a NABL-accredited ***/*** Government-approved environmental laboratory to analyse representative silt samples collected from designated locations within the lake bed. Sampling, preservation, and transport of samples shall be carried out as per standard protocols (APHA/IS/ASTM or equivalent).

Parameters to be analyzed

The following parameters shall be mandatorily tested:

Category	**Parameters**
Physico-chemical	pH @ 25°C, Electrical Conductivity (EC), Moisture Content, Calorific Value, Colour, Texture.
Heavy Metals	Iron (Fe), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni), Zinc (Zn)
Nutrients	Total Potassium, Total Nitrogen, Total Phosphorous
Microbiological	Faecal Coliform, *E. coli*, Helminth Eggs

Reporting Requirements

- Analytical results shall be provided in a certified laboratory report along with test methods and detection limits.
- The report shall include interpretation regarding compliance with applicable regulatory standards for disposal/reuse
- Any exceedance of permissible limits shall be highlighted with recommendations for safe handling and disposal.

3 MOBILIZATION SCHEDULE

Mobilization shall include obtaining all permits; moving all plant and equipment onto the site; furnishing and erecting plants, temporary buildings, and other construction facilities; implementing security requirements, all as required for the proper performance and completion of the work.

3.1 THE SCOPE OF WORK

a. Forming Site office in the Project area
b. Moving all plants and equipment to start the work
c. Keeping all the drawings and required records
d. Safety and security to the equipment and manpower engaged

3.1.1 Contractor Facilities

Site Offices of the Contractor

The successful Tenderer is to provide and maintain a site office as directed by the Engineer.

The Contractor shall submit to the Engineer his proposed layout of the site office for approval. The site office must be ready for use within 15 days from the date of work order or delivery of materials at site, whichever is earlier.

The Contractor shall store a daily updated progress information on a computer at the site office, for the review of the Engineer/QAQC personnel. Throughout the whole period as specified below during which the site office is being occupied and used by the Contractor, he shall provide, pay for all charges and maintain at his own expense electricity, water and telephone facilities for the site office. The Contractor shall provide sufficient water tanks to ensure constant supply of potable water for the site office at all times.

The Contractor shall provide acceptable septic tank with connections for sewage disposal. This shall be at a distance of more than 10m from any building. The Contractor shall keep the site office clean and tidy.

The site office with all those provisions mentioned above shall be provided and maintained by the Contractor throughout the whole construction period and until three months after the issuance of the Preliminary Handing Over Certificate or until all the work required under the Contract are in the opinion of the Engineer 100% (one hundred percent) completed, which ever period is the later one.

The office and its facilities will not, however, be removed from the site without prior written approval of the Engineer.

3.2 SURVEYING EQUIPMENT

The Contractor shall provide, at his own expense Two approved sets of surveying and measuring equipment for the sole use of the Representative of Engineer/ QAQC Technical Personnel. The set shall consist of (i) One Total Station, (ii) One pogo with reflector, (iii) One big tripod (iv) One small tripod (v) Two fibre glass tape (cased 30 m) (vi) Four steel pocket tape 3 m long (vii) Two surveying umbrellas (viii) Ten ranging rods 2.5 m long (ix) Required numbers of level books and field books.

All accessories and assistance required for setting out, measuring etc. shall be supplied as and when required by the Engineer/ QAQC or his representative.

The contractor shall be solely responsible for the maintenance of all such instruments and equipment's and shall ensure that they are at all times in good working condition.

All the surveying equipment's shall remain the property of the Contractor at the end of the Contract. The Contractor is obliged to replace any instrument or part thereof damaged during the Contract Period.

There will be no direct payment for surveying equipment. It is deemed to be included in the various pay items in the Bill of Quantities.

3.3 DRAWING TO BE KEPT AT SITE:

One copy of the drawings furnished to the contractor shall be kept by the contractor on the site and the same shall at all reasonable time be available for inspection and use by the Engineer-in-Charge / QAQC Technical Personnel and the Engineer-in-Charge's representative and by any other persons authorised by the Engineer-in-Charge in writing.

3.4 TENDER DRAWINGS

The drawings issued with the tender documents are Tender Drawings and they prepared in such a detail to give comprehensive idea of the work. The good for construction drawing will be issued during the construction stage based on the requirements and as per the construction program submitted by the contractor as per the clause CC clause 27.

3.5 WORKING DRAWINGS

The Contract Drawings supplemented by the working drawings or shop drawings prepared by the contractor which are required for the execution of the works. These works shall include the details required for the execution of the work. And any other detail the engineer may ask during construction.

All drawings shall be computerised and shall be submitted both in hard and soft copies as well as digital data.

Approval by the Engineer in charge of the Contracts shall not relieve the contractor from the responsibility for the accuracy of the dimension and detail, nor shall such mutual agreement and compliance to his working drawing shall constitute an acceptance by the employer of the correctness and adequacy of the drawings.

The Drawings are to be submitted for review to the engineer in charge sufficiently in advance. Upon approval of the drawings by the engineer in charge, the construction shall be started. delay of works, due to lack of approval of working or shop drawings are deemed to be risk the contractor is taking with full knowledge and no compensation shall be claimed by the contractor or none given by the employer on account of the delay in such cases.

The cost of furnishing working drawings shall be included in the rates for various paying items given the bill of quantities.

In this respect the contractor shall employ his engineer and auto cad draughts person specifically or planning and preparation of working drawings. The contactor shall also provide as a part of the mobilization to the site, latest computers and software together with new colour printer, for the preparation of his working drawings. The Engineer/ QAQC personnel shall have access to these computers

3.6 SITE ORDER BOOK

An order book shall be kept at the site of the work. As far as possible, all orders regarding the work are to be entered in this book. All entries shall be signed and dated by the Department Officer in direct charge of the work. The findings and observations shall be recorded by QAQC and by the contractor or by his representative. In important cases, the Executive Engineer or the Superintending Engineer will countersign the entries, which have been made. The order book shall not be removed from the work, except with the written permission of the Executive Engineer. The findings of defective works recorded by Engineer in charge or QAQC personnel in the site order book should be rectified by the contractor.

3.7 ADDITIONAL WORKS

Any additional works, instructed during the contract period and within the contract amount will be paid as per bill of quantity rates and it shall not be considered as a cause for the contractor to claim for delay incurred overhead, mobilization etc.,

3.7.1 Protection of the Works during Contract Period

It is clearly understood that any damage occurring to the works (completed or in execution) is the contractor’s responsibility and no extra claims will be entertained by the employer since the matter shall be covered in the relevant insurances.

3.7.2 Discrepancies in the alignment

Discrepancies in the alignment and levels etc., noticed during the construction and on /or completion shall be rectified by the contractor at his own cost. Engineers' approval doesn't relieve him from his responsibilities.

3.7.3 Power and Water Supply

All costs, both for water and power supply and temporary installations for the work shall be borne by the contractor.

3.7.4 Notice Boards

Notice Boards as required numbers shall be provided and erected as directed by the Engineer. The boards shall be maintained and repainted if directed by the Engineer till the final handing over of project.

The Contractor shall submit for approval of the Employer and Engineer working drawing showing all details needed in the board and the location of the board. Cost of providing and installing the notice board is deemed to be included in various items of the bill of quantities.

3.7.5 Safety on Site

Measures to ensure safety of workers and plant at site shall be taken by the Contractor. Excavations shall be protected by proper manner and lighting shall be provided at night to warn pedestrians and vehicles. Traffic diversions shall be arranged as per the Traffic management plans to Engineers approval and traffic regulation compliance of works. The Contractor shall designate a Safety Officer who will be in charge of all Safety Measures. The cost of all safety equipment and the cost of providing a safety officer at site would be deemed to be included in various Items of the Bill of quantities.

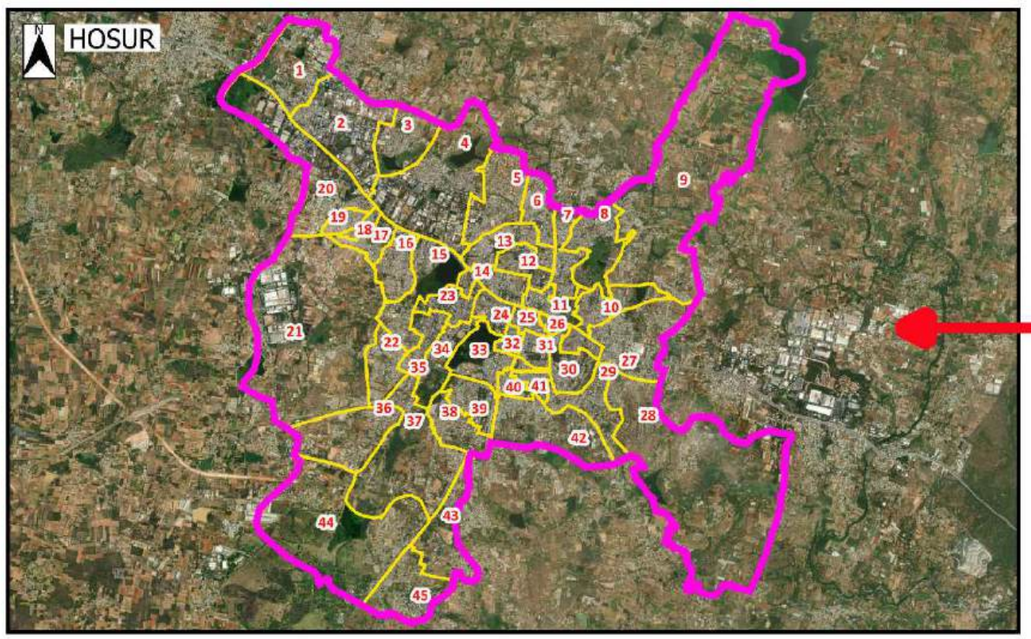
NATIONAL COMPETITIVE BIDDING

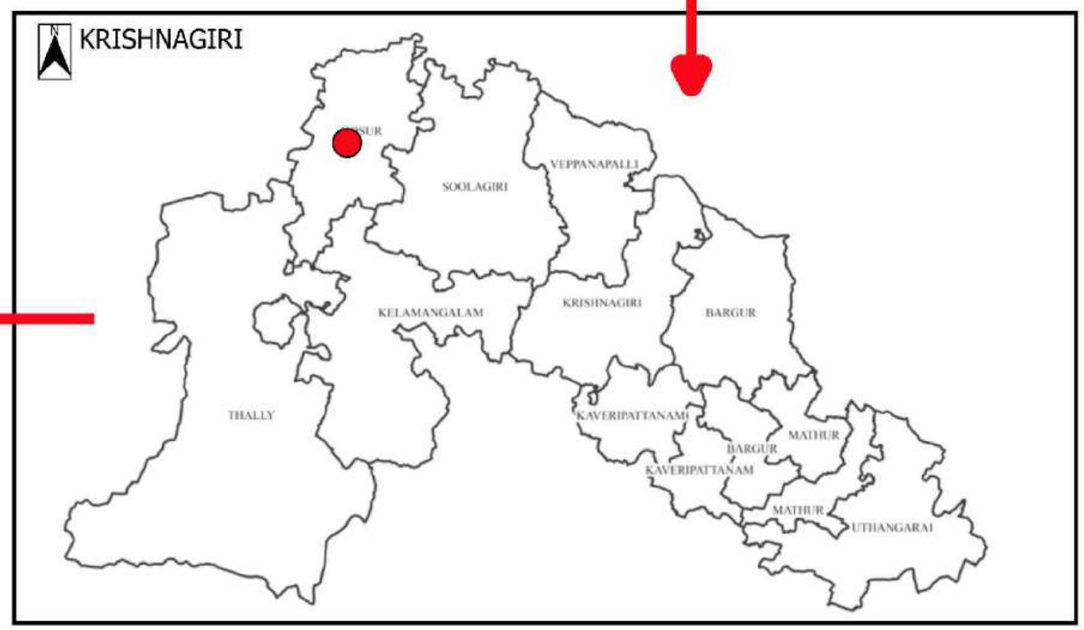
BIDDING DOCUMENT FOR PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

DRAWING

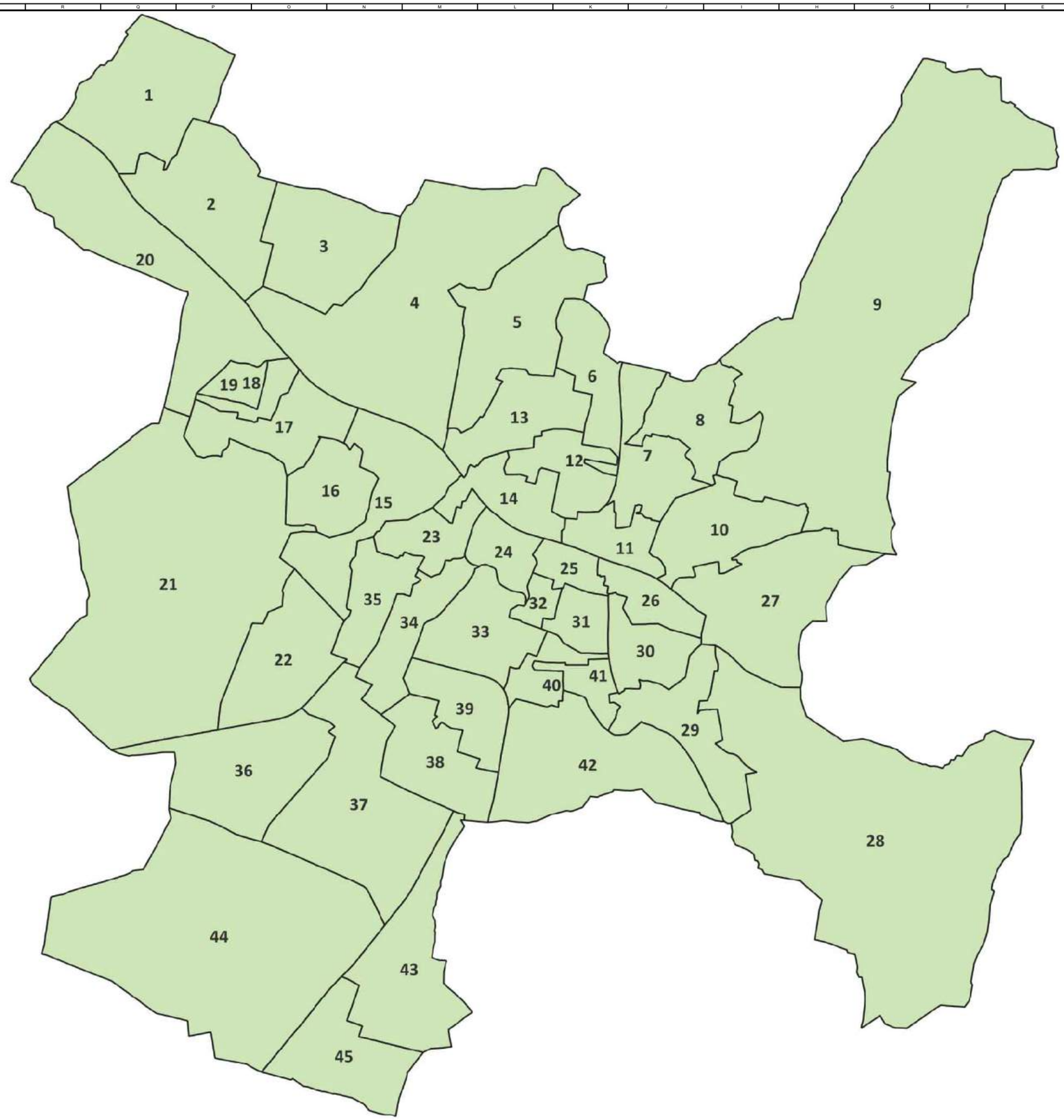
VOLUME - IV

HOSUR CITY MUNICIPAL CORPORATION				
PREPARATION OF FINAL REPORT (FR) FOR PROVIDING INTEGRATED STORM WATER DRAINS (ISWD) FOR HOSUR CITY MUNICIPAL CORPORATION				
PHASE 1 - PACKAGE 7 - LIST OF DRAWINGS				
S.No.	**DRAWING NAME**	**SHEET SIZE**	**DWG. NO**	**SHEETS**
1	HOSUR CITY MUNICIPAL CORPORATION - PROJECT AREA	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-01	1
2	HOSUR CITY MUNICIPAL CORPORATION - WARD MAP	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-02	1
3	FLOOD HOTSPOTS LOCATION MAP	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-03	1
4	PHASE 1 PLAN	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-04	1
5	PACKAGE 7 - PLAN SHOWING PROJECT COMPONENTS	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-05	1
6	EXISTING NALLAH IN HOSUR CITY MUNICIPAL CORPORATION	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-06	1
7	PACKAGE 3 - MAJOR NALLAH / PRIMARY DRAIN - PROPOSAL PLAN	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-07	1
8	MAJOR NALLAH / PRIMARY DRAIN - ENLARGE VIEW OF PROPOSAL PLAN	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-08	6
9	LIST OF WATER BODIES - HOSUR CITY MUNICIPAL CORPORATION	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-09	1
10	KESAVAKUTTAI ERI - PROPOSED LAYOUT	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-10	1
11	KRISHNARAV LAKE (LOOK INDIA OPP) - PROPOSED LAYOUT	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-11	1
12	VARATHARAYAN ERI - PROPOSED LAYOUT	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-12	1
13	PATTALAMMAN ERI - PROPOSED LAYOUT	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-13	1
14	REJUVENATION OF WATER BODIES - TYPICAL DETAILS OF BUND STRENGTHENING	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-14	1
15	REJUVENATION OF WATER BODIES - TYPICAL DETAILS OF RECHARGE WELL	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-15	1
16	REJUVENATION OF WATER BODIES - TYPICAL DETAILS OF INLET CHANNELS	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-16	1
17	REJUVENATION OF WATER BODIES - TYPICAL DETAILS OF WEIR	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-17	1
18	REJUVENATION OF WATER BODIES - TYPICAL FENCEING DETAILS	A3	VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-18	1





NAME OF THE WORK: PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7		SHEET SIZE: A3	SCALE: NTS
CLIENT: COMMISIONERATE OF MUNICIPAL ADMINISTRATION HOSUR CITY MUNICIPAL CORPORATION		TITLE: HOSUR CITY MUNICIPAL CORPORATION PROJECT AREA	
		DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-01	R0
		TENDER DRAWING	SHEETS: 01 / 01



NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

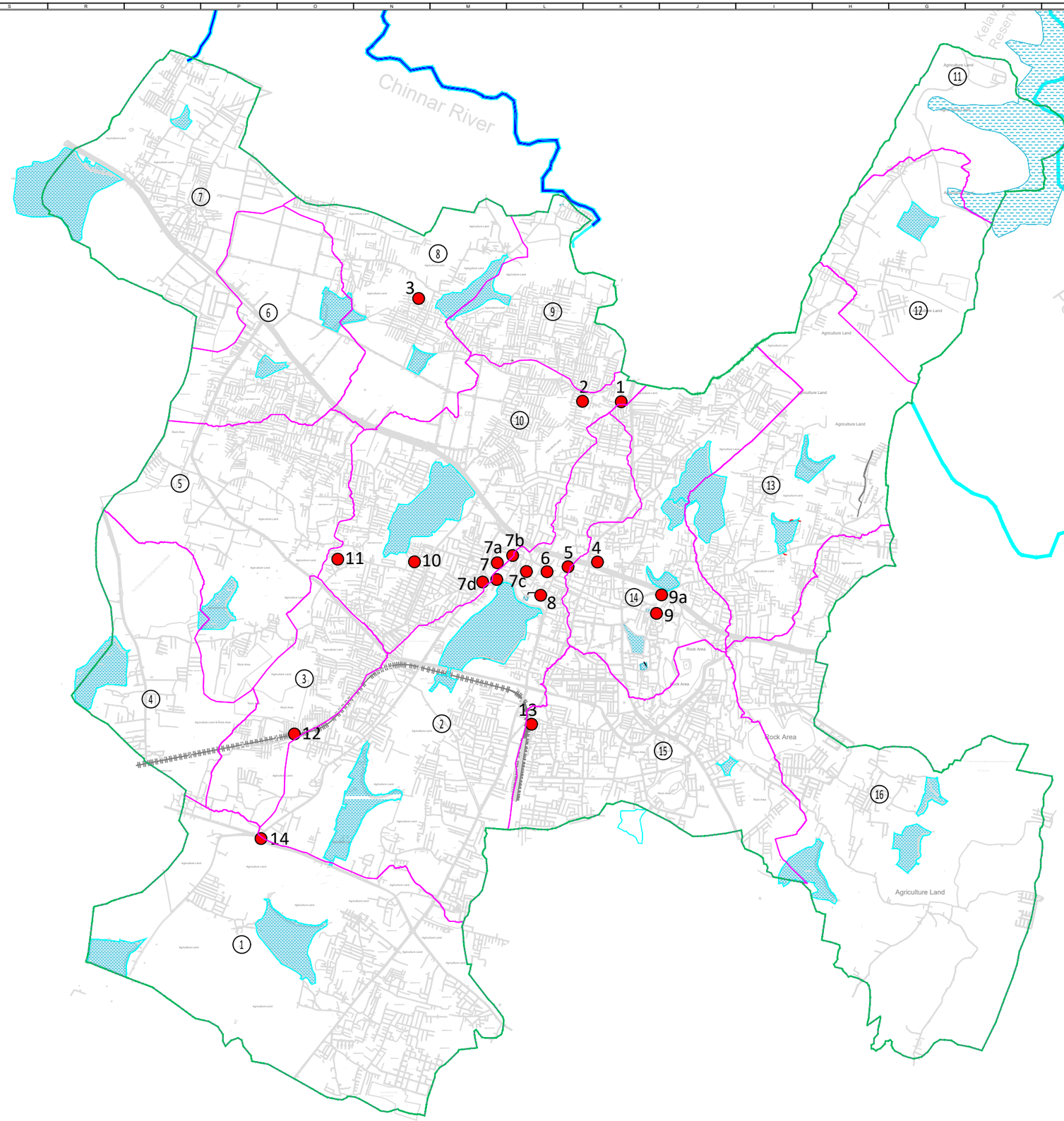
CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
HOSUR CITY MUNICIPAL CORPORATION
WARD MAP

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-02 | R0

TENDER DRAWING | SHEETS: 01/01



S.no	Location name
1	KCC Nagar
2	Kurinji Nagar
3	Bedrapalli Outlet
4	GRT Bagalur Road
5	Hosur Bus Stand
6	OLd Bengaluru Road
7	Ram Nagar - 1
7a	Ram Nagar - 2
7b	Ram Nagar - 3
7c	Ram Nagar - 4
7d	Ram Nagar - 5
8	Ramanaiken Lake Outlet
9	Kalegunda & Kalegunda Indian Oil Bunk
9a	Roadside Drain Along National Highway
10	Mahalakshmi nagar Near Dharga Lake
11	Manjunath Nagar
12	Annai Nagar - Railway Under Pass
13	Railway Under Pass - Hosur Railway Station
14	Anthiwadi

Legend :

Hosur Boundary

Flood Hotspots

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
FLOOD HOTSPOTS LOCATION MAP

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-03 | R0

TENDER DRAWING | SHEETS: 01/01

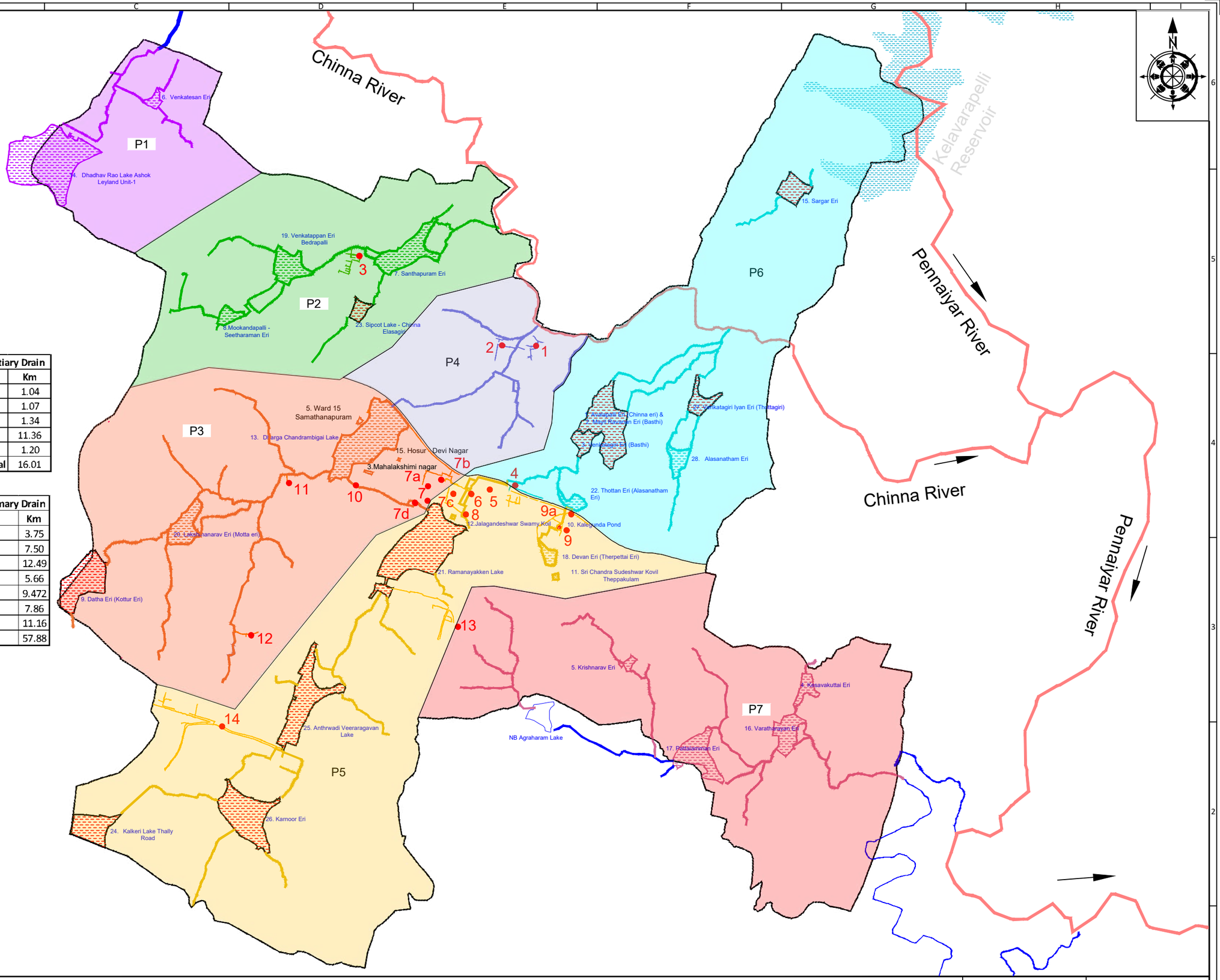
WATER BODY NO	LIST OF WATER BODY	PACKAGE
6	VENKATESAN ERI	1
14	DHADHAV RAO LAKE ASHOK LEYLAND UNIT-1	
7	SANTHAPURAM ERI	2
19	VENKATAPPAN ERI BEDRAPALLI	
8	MOOKANDAPALLI - SEETHARAMAN ERI	
13	DHARGA CHANDRAMBIGAI LAKE	3
20	LAKSHMANARAV ERI (MOTTA ERI)	
12	JALAGANDESHWAR SWAMY KOIL	5
18	DEVAN ERI (THERPETTAI ERI)	
11	SRI CHANDRA SUDESHWAR KOVIL THEPPAKULAM	
22	THOTTAN ERI (ALASANATHAM ERI)	6
28	ALASANATHAM ERI	
4	KESAVAKUTTAI ERI	7
5	KRISHNARAV ERI	
16	VARATHARAYAN ERI	
17	PATTALAMMAN ERI	

PARK NO	LIST OF PARK	PACKAGE
15	HOSUR DEVI NAGAR	3
3	MAHALAKSHMI NAGAR	
5	SAMATHANAPURAM	

S.no	Location name
1	KCC Nagar
2	Kurinji Nagar
3	Bedrapalli Outlet
4	GRT Bagalur Road
5	Hosur Bus Stand
6	OLd Bengaluru Road
7	Ram Nagar - 1
7a	Ram Nagar - 2
7b	Ram Nagar - 3
7c	Ram Nagar - 4
7d	Ram Nagar - 5
8	Ramanaiken Lake Outlet
9	Kalegunda & Kalegunda Indian Oil Bunk
9a	Roadside Drain Along National Highway
10	Mahalakshmi nagar Near Dharga Lake
11	Manjunath Nagar
12	Annai Nagar - Railway Under Pass
13	Railway Under Pass - Hosur Railway Station
14	Anthiwadi

Secondary and Tertiary Drain	
Packages	Km
2	1.04
3	1.07
4	1.34
5	11.36
6	1.20
Total	16.01

Major Nallah/ Primary Drain	
Package	Km
1	3.75
2	7.50
3	12.49
4	5.66
5	9.472
6	7.86
7	11.16
Total	57.88



LEGENDS:

- PACKAGE 1
- PACKAGE 2
- PACKAGE 3
- PACKAGE 4
- PACKAGE 5
- PACKAGE 6
- PACKAGE 7
- DEVELOPED WATER BODIES
- HOT SPOT NUMBER
- RIVER
- PROJECT BOUNDARY

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
MASTER PLAN
NALLAH, WATERBODY, PARK AND
SECONDARY AND TERTIARY DRAIN

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-04 | R0

TENDER DRAWING | SHEETS: 01 / 01

Sl No.	Description	Quantity
1	Major Nallah/ Primary Drain	11.16 Km
2	Water Bodies Rejuvenation	4 Nos 1.Kesavakuttai Eri 2.Krishnarav Eri 3.Varatharayan Eri 4.Pattalamman Eri

S.no	Location name
1	KCC Nagar
2	Kurinji Nagar
3	Bedrapalli Outlet
4	GRT Bagalur Road
5	Hosur Bus Stand
6	OLd Bengaluru Road
7	Ram Nagar - 1
7a	Ram Nagar - 2
7b	Ram Nagar - 3
7c	Ram Nagar - 4
7d	Ram Nagar - 5
8	Ramanaiken Lake Outlet
9	Kalegunda & Kalegunda Indian Oil Bunk
9a	Roadside Drain Along National Highway
10	Mahalakshmi nagar Near Dharga Lake
11	Manjunath Nagar
12	Annai Nagar - Railway Under Pass
13	Railway Under Pass - Hosur Railway Station
14	Anthiwadi

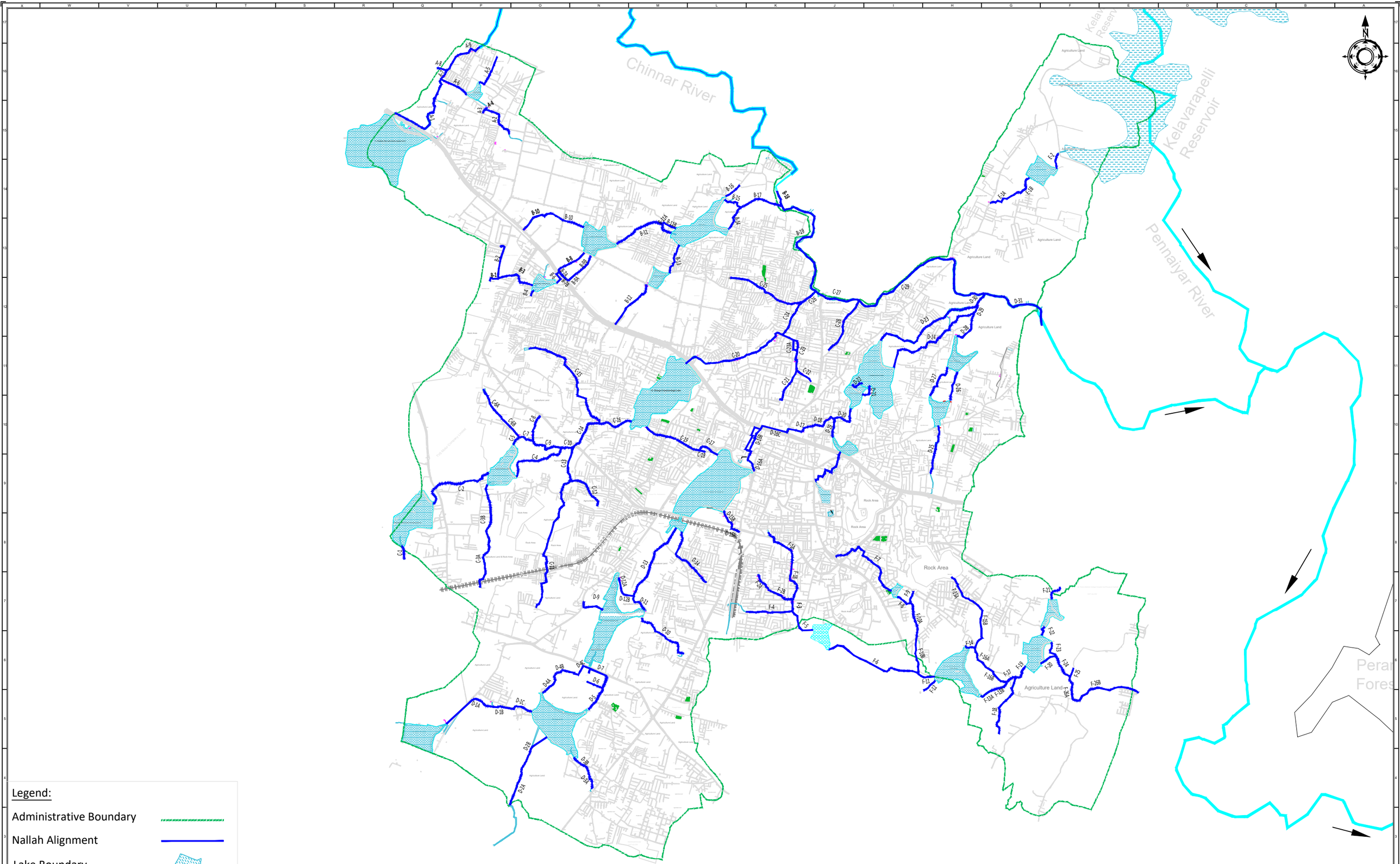
LEGENDS:

- PACKAGE 7
- OTHER PACKAGES
- OTHER WATER BODIES
- DEVELOPED WATER BODIES
- HOT SPOT NUMBER
- RIVER
- PROJECT BOUNDARY

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3	SCALE: NTS
TITLE: PACKAGE 7 NALLAH, WATERBODY AND PARKS	
DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-05	R0
TENDER DRAWING	SHEETS: 01 / 01



NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

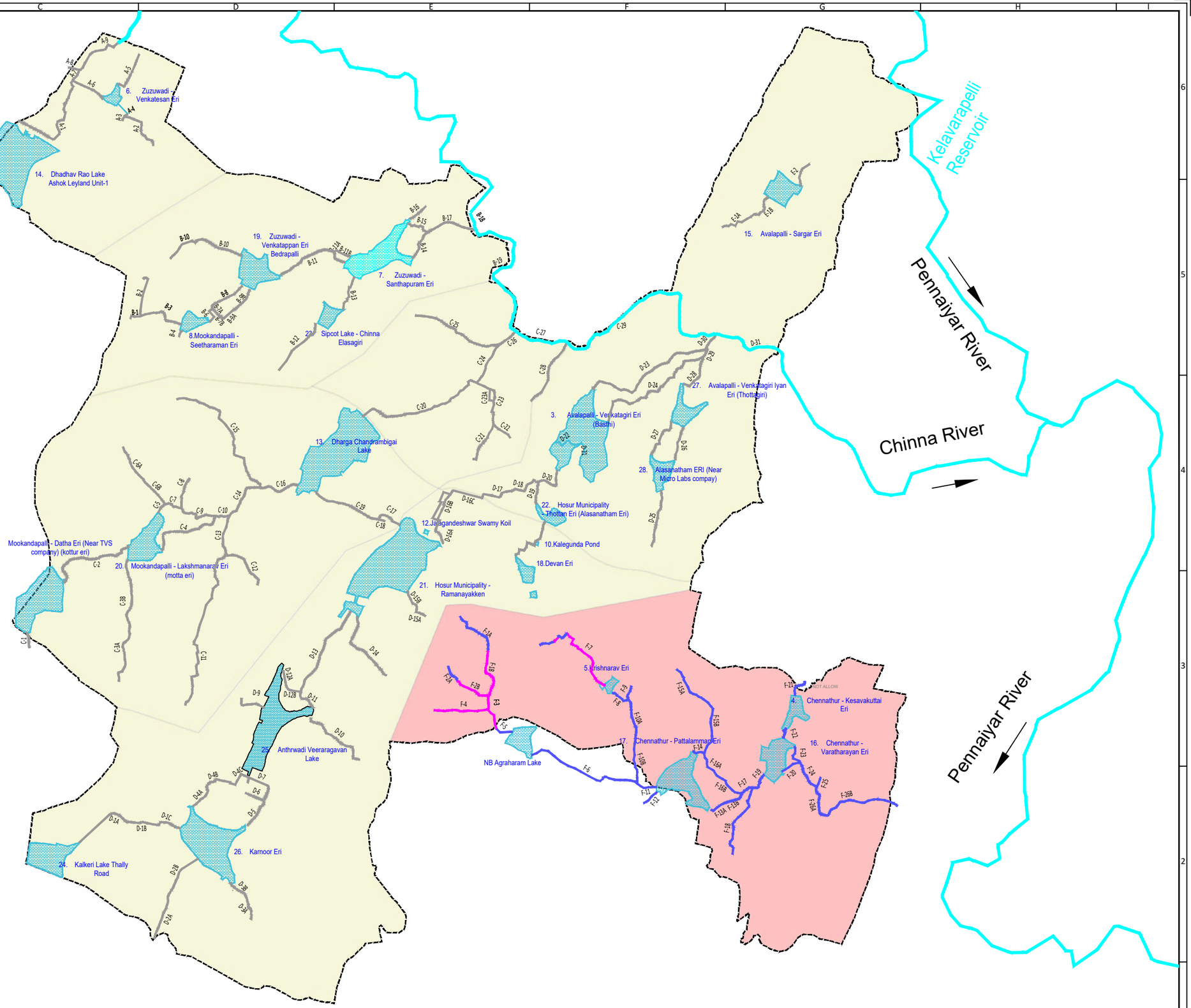
SHEET SIZE: A3 | SCALE: NTS

TITLE:
EXISTING NALLA IN
HOSUR CITY MUNICIPAL CORPORATION

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-06 | R0

TENDER DRAWING | SHEETS: 01/01

Sl.No	Nallah Profiles	Width	Depth of Side wall	Total Length (m)	Earthen Bund (m)	Existing Retaining wall (m)	Total Length (m)
1	F1A	3	1.5	569.9	569.9	0	569.9
2	F1B	5	1.5	586.5	586.5	586.5	586.5
3	F2A	2	1.2	299.8	299.8	94.15	299.8
4	F2B	3.5	1.2	335.2	335.2	335.2	335.2
5	F3	8	1.8	158.69	158.69	158.69	158.69
6	F4	1.2	1	616.55	616.55	616.55	616.55
7	F5	10	2	448.74	448.74	257.89	448.74
8	F7	5	1.5	1232.96	1232.96	919.55	1232.96
9	F8	8	1.6	224.08	224.08	0	224.08
10	F9	3	1.5	169.55	169.55	0	169.55
11	F10A	10	1.5	463.2	463.2	0	463.2
12	F10B	16	1.5	512.9	512.9	0	512.9
13	F13A	18	1.5	226.2	226.2	0	226.2
14	F13B	20	1.8	204	204	0	204
15	F14	5	1.2	133.25	133.25	0	133.25
16	F15A	7	1	598.1	598.1	0	598.1
17	F15B	13	1.2	587.1	587.1	0	587.1
18	F16A	13	1.5	427.5	427.5	1	427.5
19	F16B	13.5	1.6	253.9	253.9	2	253.9
20	F17	20	1.9	143.15	143.15	0	143.15
21	F18	5	1	883.33	883.33	0	883.33
22	F19	22	1.8	243.15	243.15	0	243.15
23	F20	20	1.5	229.06	229.06	0	229.06
24	F22	8	1	145.8	145.8	0	145.8
25	F23	3	1	239.67	239.67	0	239.67
26	F24	20	1.5	355.09	355.09	0	355.09
27	F25	2.5	1	117.63	117.63	0	117.63
28	F26A	22	2	415.7	415.7	1	415.7
29	F26B	28	2	334.3	334.3	2	334.3
Total Length (m)				11155	11155	2974.53	11155



LEGENDS:

- HOSUR WATER BODIES
- PACKAGE 7
- OTHER PACKAGES
- EARTHERN BUND
- EXISTING RETAINING WALL
- PROJECT BOUNDARY

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
PACKAGE 7
MAJOR NALLAH / PRIMARY DRAIN PROPOSAL PLAN

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-07 | R0

TENDER DRAWING | SHEETS: 01/01

21. Hosur Municipality - Ramanayakken

11. Sri Chandra Sudeshwar Kovil
(Therpettai Street) - Theppakulam

5. Chennathur
Krishnarav Eri (Look India Opp)

nthrwadi Veeraragavan Lake

17. Chennathur - Pattalamman Eri

D15 D14 D13 D12 D11 D10 D7

F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12

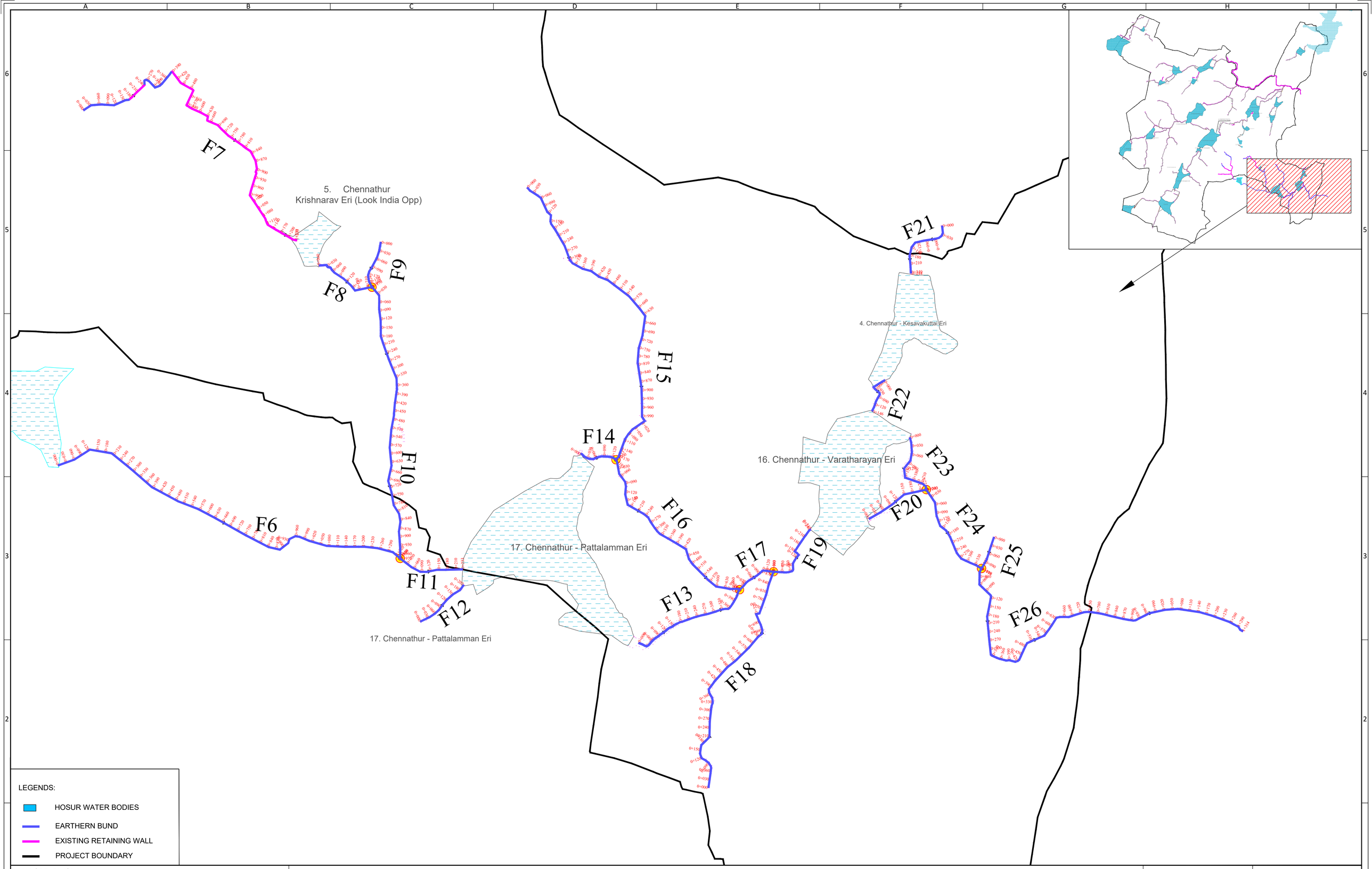
LEGENDS:

- HOSUR WATER BODIES
- EARTHERN BUND
- EXISTING RETAINING WALL
- PROJECT BOUNDARY

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3	SCALE: NTS
TITLE: MAJOR NALLAH / PRIMARY DRAIN ENLARGE VIEW OF PROPOSAL PLAN	
DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-08	R0
TENDER DRAWING	SHEETS: 01 / 02



NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

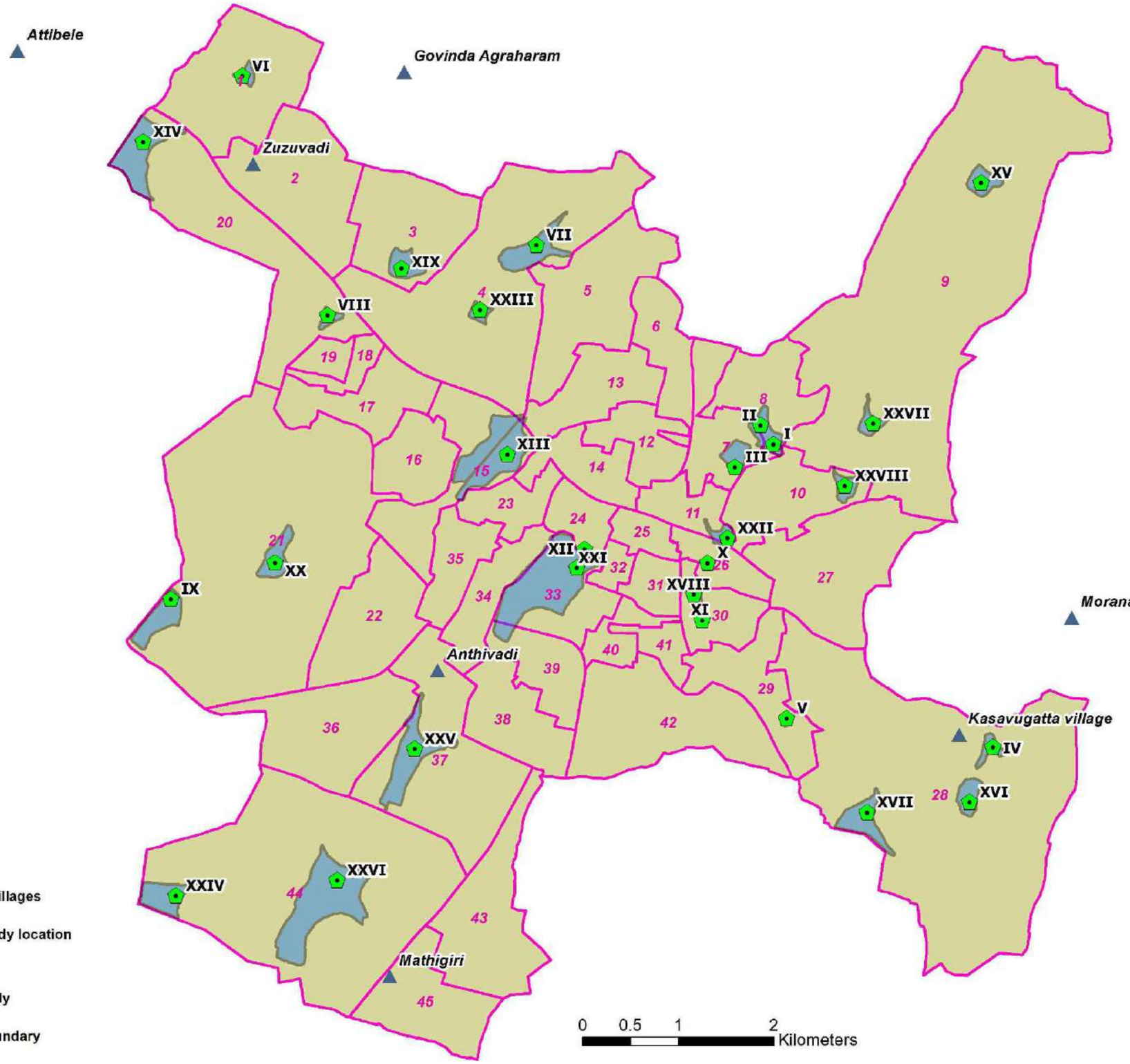
CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
MAJOR NALLAH / PRIMARY DRAIN
ENLARGE VIEW OF PROPOSAL PLAN

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-08 | R0

TENDER DRAWING | SHEETS: 02 / 02



S.No.	Waterbody Name
I & II	AVALAPALLI ERI (CHINNA ERI) & MAYIL RAVANAN ERI (BASTHI)
III	VENKATAGIRI ERI (BASTHI)
IV	KESAVAKUTTAI ERI
V	KRISHNARAV ERI (LOOK INDIA OPP)
VI	VENKATESAN ERI
VII	SANTHAPURAM ERI
VIII	SEETHARAMAN ERI
IX	DATHA ERI (KOTTUR ERI)
X	KALEGUNDA POND
XI	SRI CHANDRA SUDESHWAR KOVIL THEPPAKULAM
XII	JALAGANDESHWAR SWAMY KOIL (RAMANAIKAN ERI)
XIII	DHARGA CHANDRAMBIGAI LAKE
XIV	DHADHAV RAO LAKE ASHOK LEYLAND UNIT-1
XV	SAGAR ERI
XVI	VARATHARAYAN ERI
XVII	PATTALAMMAN ERI
XVIII	DEVAN ERI (THERPETTAI ERI)
XIX	VENKATAPPAN ERI (BEDRAPALLI)
XX	LAKSHMANARAV ERI (MOTTA ERI)
XXI	RAMANAYAKKEN LAKE
XXII	THOTTAN ERI (ALASANATHAM ERI)
XXIII	SIPCOT LAKE - CHINNA ELASAGIRI
XXIV	KALKERI LAKE THALLY ROAD
XXV	ANTHRWADI VEERARAGAVAN LAKE
XXVI	KARNOOR ERI
XXVII	VENKATAGIRI IYAN ERI (THOTTAGIRI)
XXVIII	ALASANATHAM ERI

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

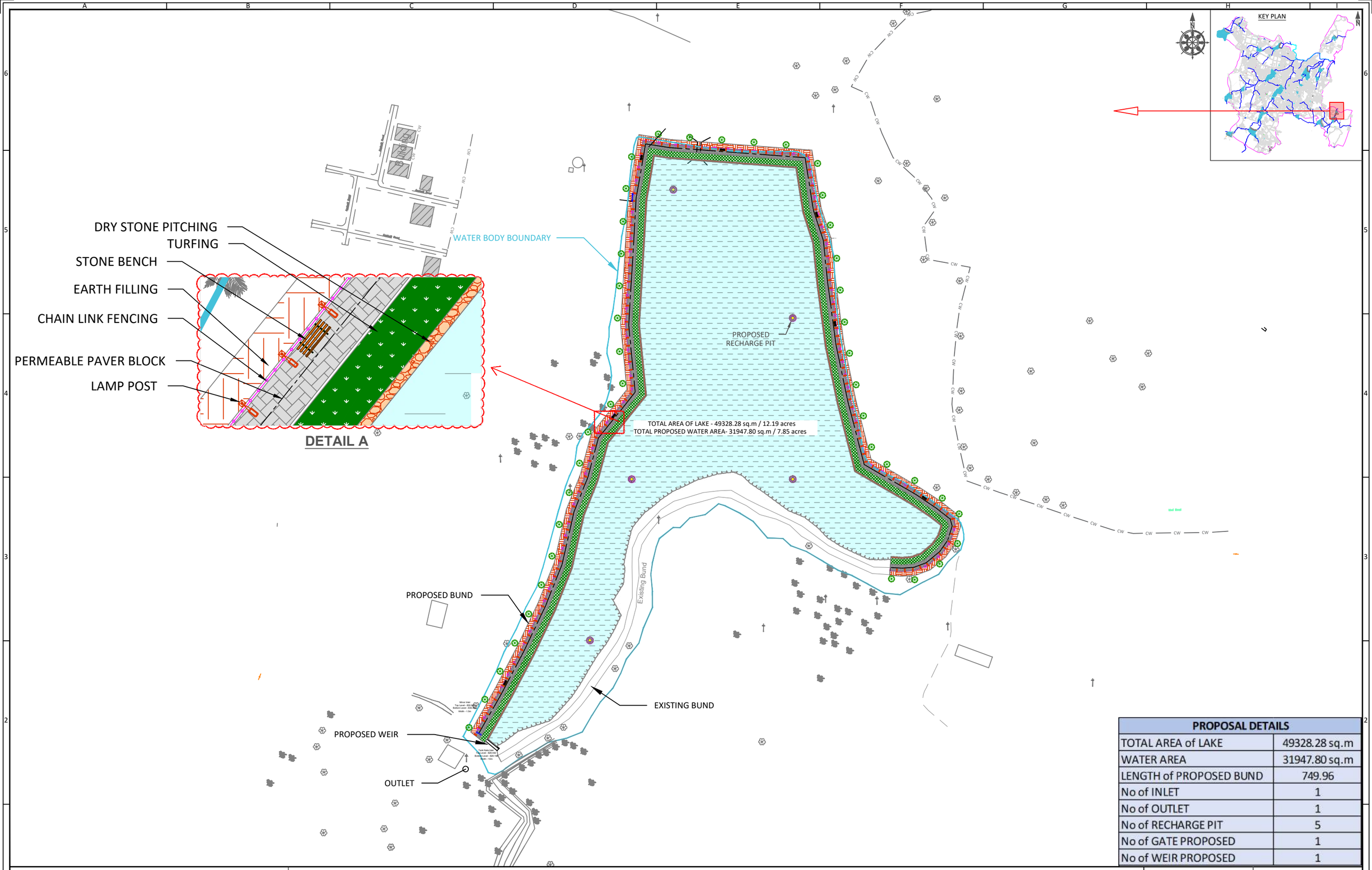
CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
HOSUR CITY MUNICIPAL CORPORATION
LIST OF WATER BODIES

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-09 | R0

TENDER DRAWING | SHEETS: 01 / 01



PROPOSAL DETAILS	
TOTAL AREA of LAKE	49328.28 sq.m
WATER AREA	31947.80 sq.m
LENGTH of PROPOSED BUND	749.96
No of INLET	1
No of OUTLET	1
No of RECHARGE PIT	5
No of GATE PROPOSED	1
No of WEIR PROPOSED	1

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

LEGEND:

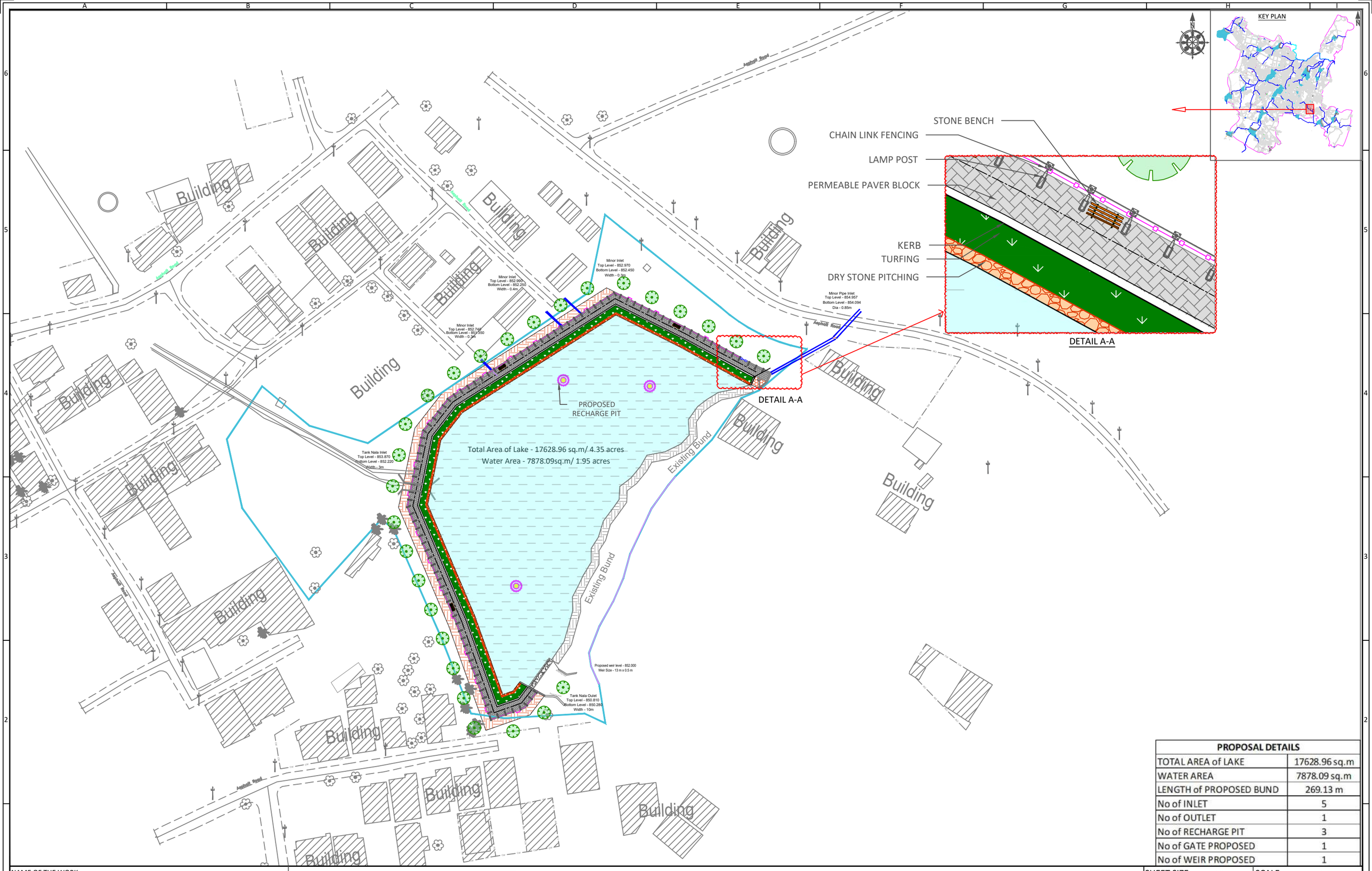
- WATERBODY BOUNDARY
- PROPOSED FENCING
- PROPOSED STREET LIGHT
- PROPOSED TREE
- PROPOSED EARTH FILLING
- PERMEABLE PAVER BLOCK
- PROPOSED STONE PITCHING
- PROPOSED TURFING AREA
- PROPOSED WATER AREA
- PROPOSED RECHARGE PIT

SHEET SIZE: A3 | SCALE: NTS

TITLE:
KESAVAKUTTAI ERI - PROPOSED LAYOUT

DRG NO.VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-10 | R0

TENDER DRAWING | SHEETS: 01 / 01



PROPOSAL DETAILS	
TOTAL AREA of LAKE	17628.96 sq.m
WATER AREA	7878.09 sq.m
LENGTH of PROPOSED BUND	269.13 m
No of INLET	5
No of OUTLET	1
No of RECHARGE PIT	3
No of GATE PROPOSED	1
No of WEIR PROPOSED	1

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

LEGEND:

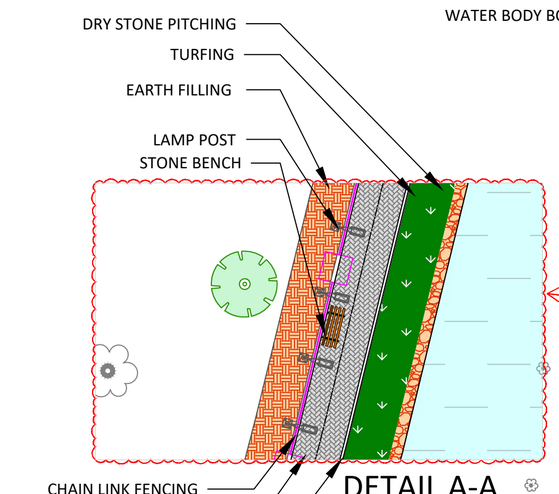
- WATERBODY BOUNDARY
- PROPOSED FENCING
- PROPOSED STREET LIGHT
- PROPOSED TREE
- PROPOSED EARTH FILLING
- PERMEABLE PAVER BLOCK
- PROPOSED STONE PITCHING
- PROPOSED TURFING AREA
- PROPOSED WATER AREA
- PROPOSED RECHARGE PIT

SHEET SIZE: A3 | SCALE: NTS

TITLE:
KRISHNARAV LAKE (LOOK INDIA OPP) - PROPOSED LAYOUT

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-11 | R0

TENDER DRAWING | SHEETS: 01 / 01



DETAIL A-A

WATER BODY BOUNDARY

Total Area of Lake 104954.2029 Sq.m
Proposed Water Area- 73458.91 Sq.m

PROPOSED
RECHARGE PIT

Existing Bund

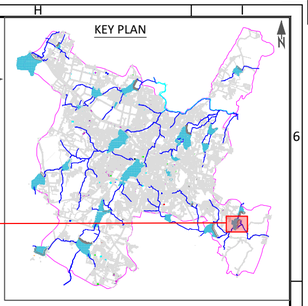
Weir Road

Weir Fence

Building

Weir
Top Level=826.770
Bottom Level=825.000
Size=18.0mX .6m

KEY PLAN



PROPOSAL DETAILS	
TOTAL AREA of LAKE	104954.20 sq.m
WATER AREA	73458.91 sq.m
LENGTH of PROPOSED BUND	927.31 m
No of INLET	2
No of OUTLET	3
No of RECHARGE PIT	5
No of GATE PROPOSED	1

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

LEGEND:

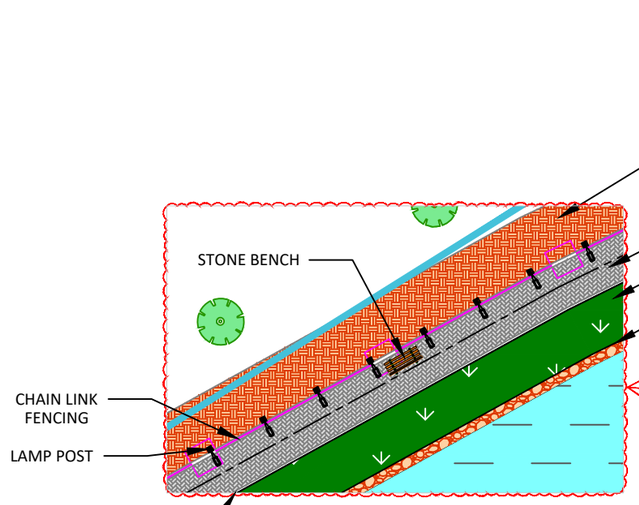
- WATERBODY BOUNDARY
- PROPOSED FENCING
- PROPOSED STREET LIGHT
- PROPOSED TREE
- PROPOSED EARTH FILLING
- PERMEABLE PAVER BLOCK
- PROPOSED STONE PITCHING
- PROPOSED TURFING AREA
- PROPOSED WATER AREA
- PROPOSED RECHARGE PIT

SHEET SIZE: A3 | SCALE: NTS

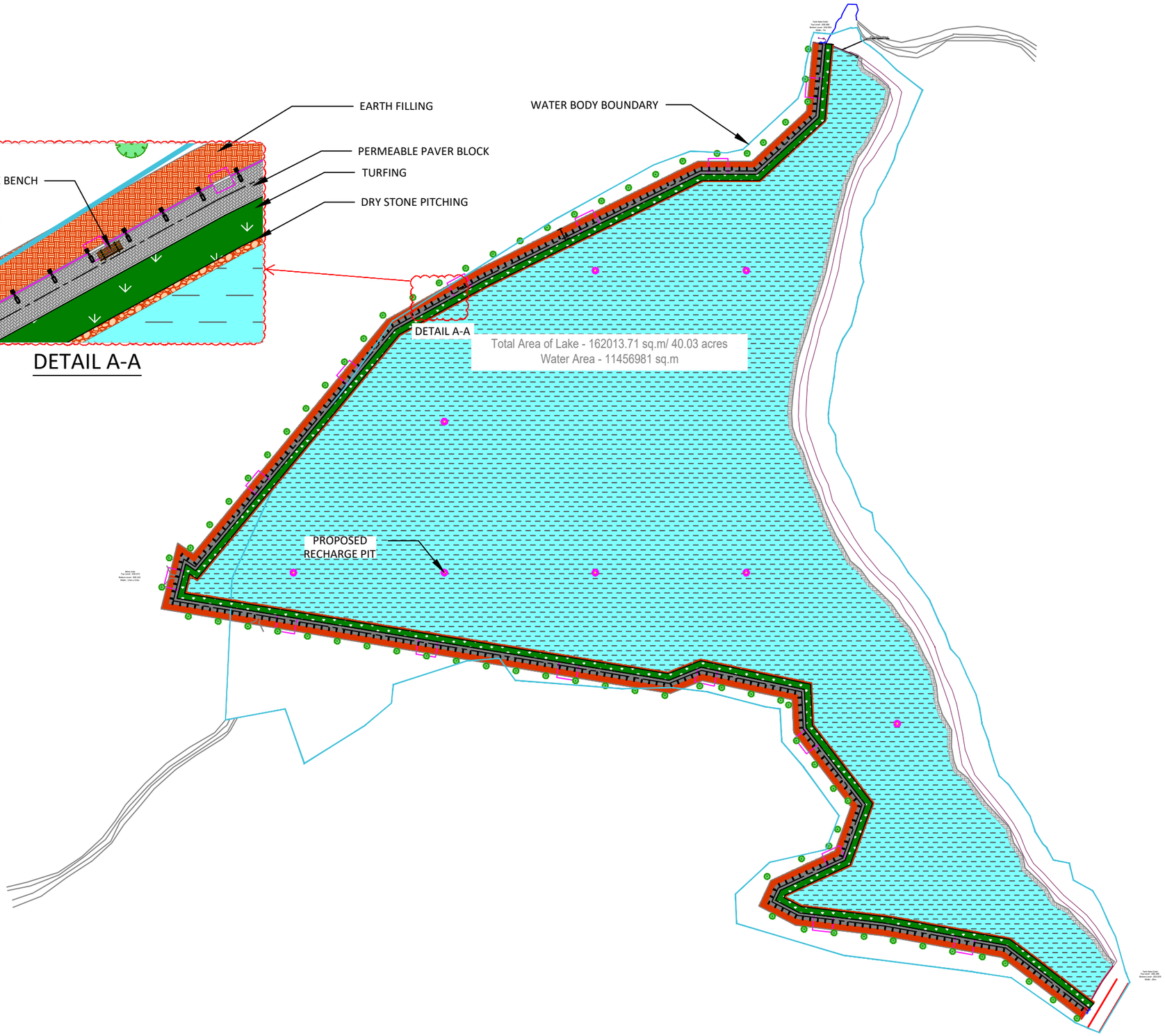
TITLE:
KRISHNARAV LAKE (LOOK INDIA OPP) - PROPOSED LAYOUT

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-12 | R0

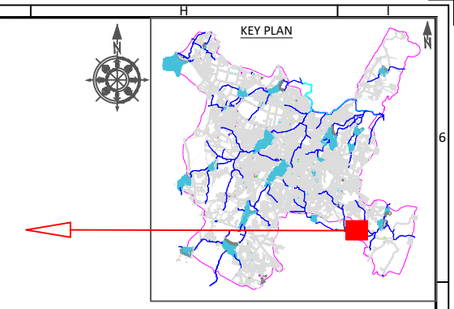
TENDER DRAWING | SHEETS: 01 / 01



DETAIL A-A



Total Area of Lake - 162013.71 sq.m/ 40.03 acres
Water Area - 11456981 sq.m



PROPOSAL DETAILS	
TOTAL AREA of LAKE	162013.71 sq.m
WATER AREA	11456981.0 sq.m
LENGTH of PROPOSED BUND	1441.07 m
No of INLET	2
No of OUTLET	2
No of RECHARGE PIT	8
No of GATE PROPOSED	2

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

LEGEND:

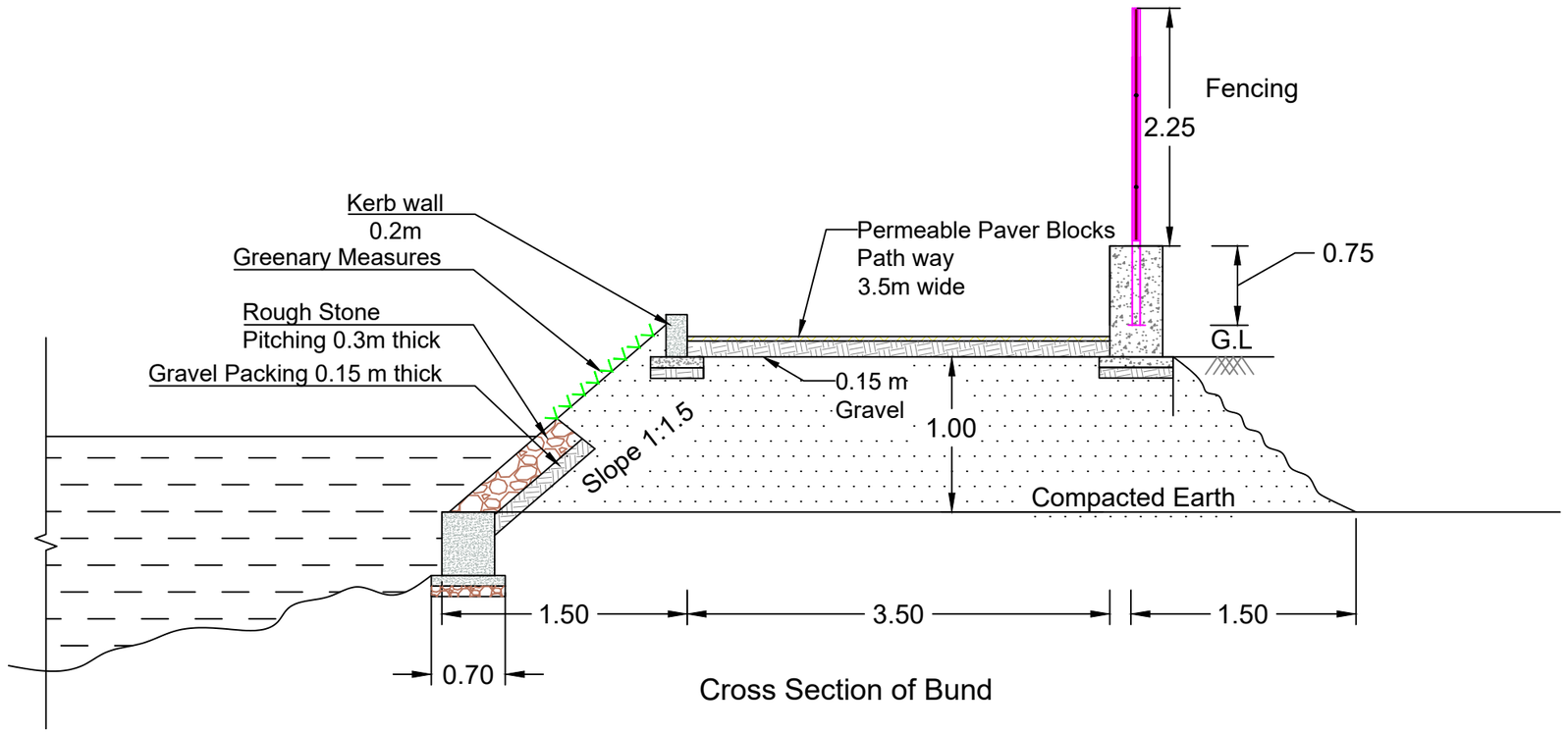
- WATERBODY BOUNDARY
- PROPOSED FENCING
- PROPOSED STREET LIGHT
- PROPOSED TREE
- PROPOSED EARTH FILLING
- PERMEABLE PAVER BLOCK
- PROPOSED STONE PITCHING
- PROPOSED TURFING AREA
- PROPOSED WATER AREA
- PROPOSED RECHARGE PIT

SHEET SIZE: A3 | SCALE: NTS

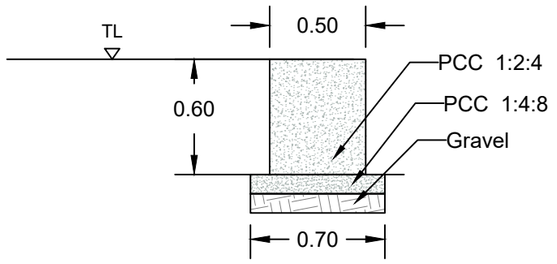
TITLE:
PATTALAMMAN ERI - PROPOSED LAYOUT

DRG NO:VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-13 | R0

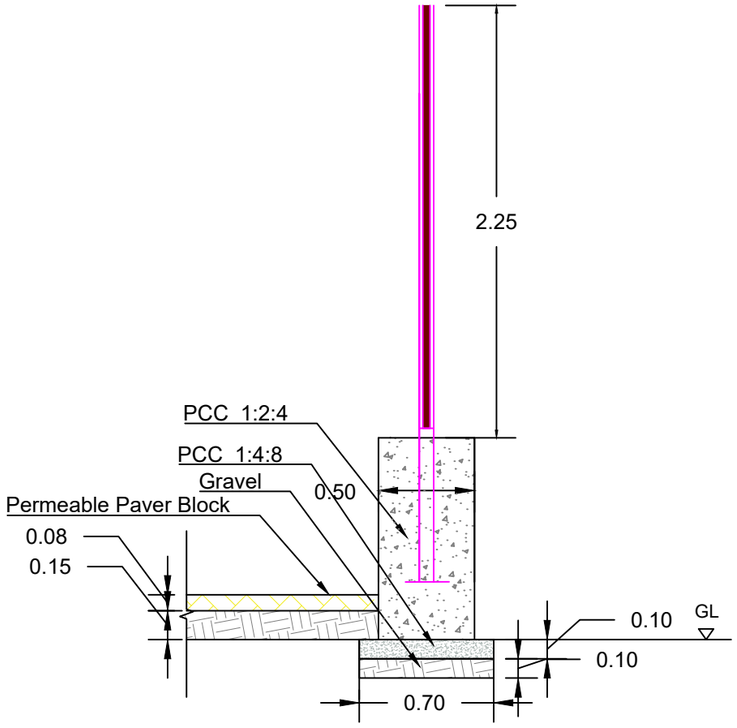
TENDER DRAWING | SHEETS: 01 / 01



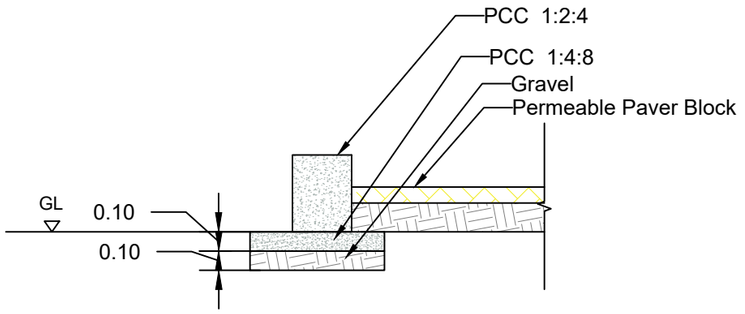
Cross Section of Bund



CROSS SECTION OF TOE WALL



CROSS SECTION OF FENCE



CROSS SECTION OF KERB WALL

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

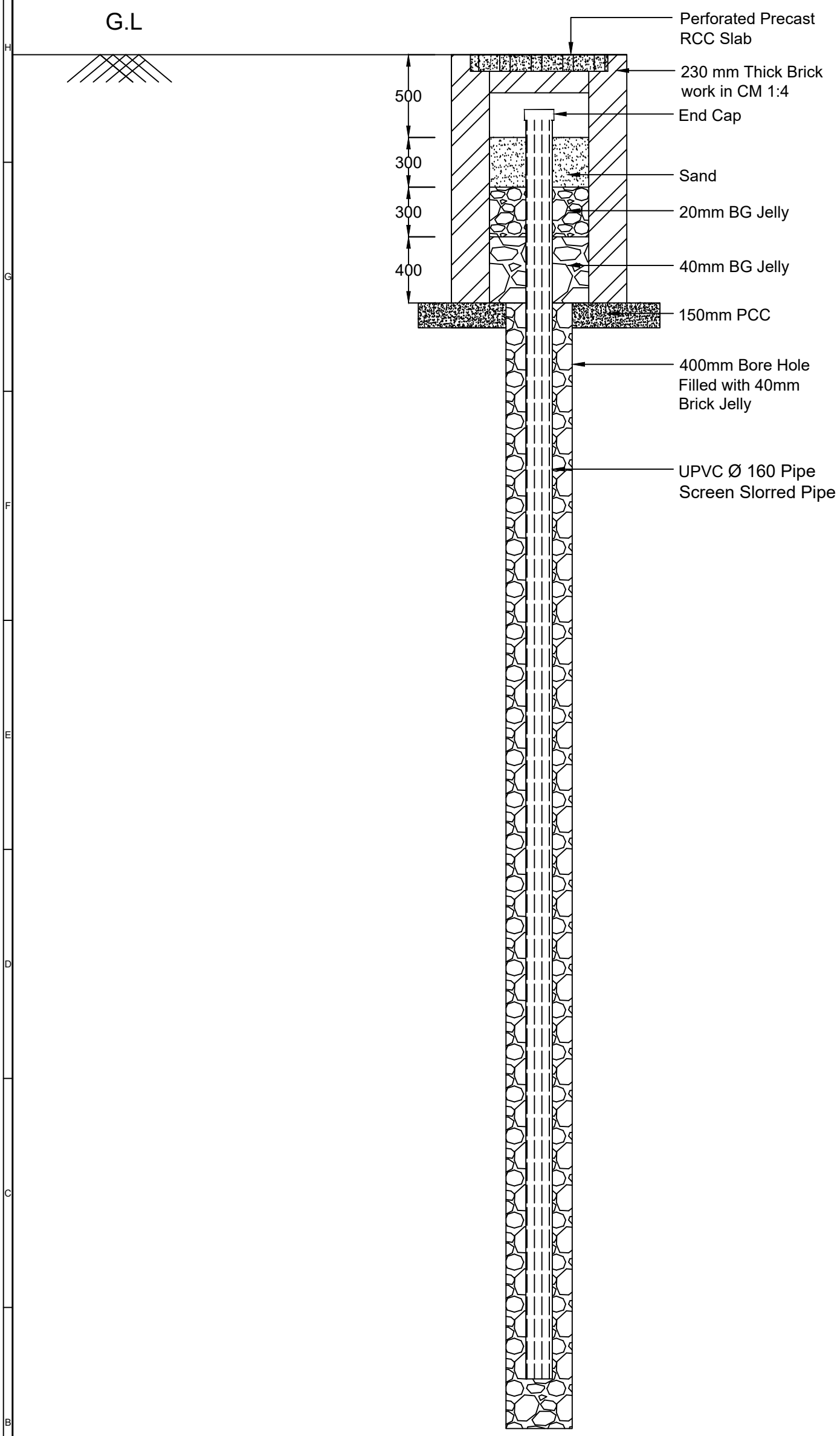
CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

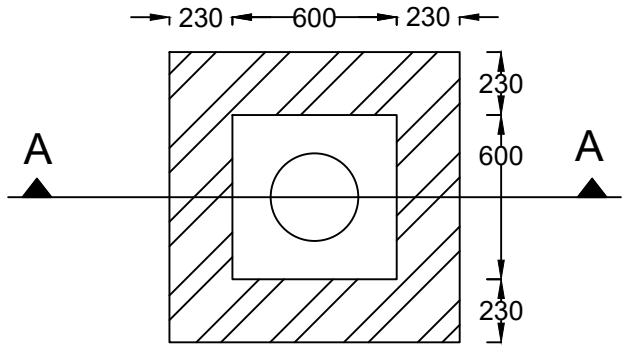
TITLE:
REJUVENATION OF WATER BODIES
TYPICAL DETAILS OF BUND STRENGTHENING

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/FR/P7-14 | R0

TENDER DRAWING | SHEETS: 01/ 01

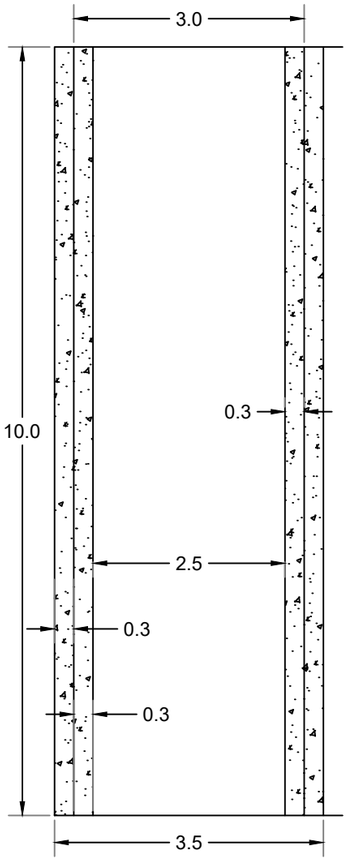


SECTION A-A

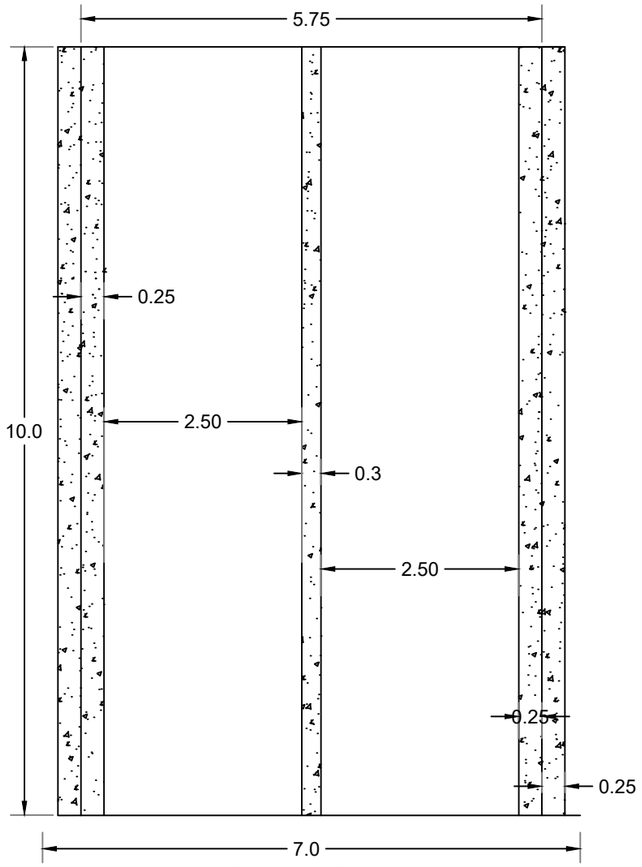


PLAN

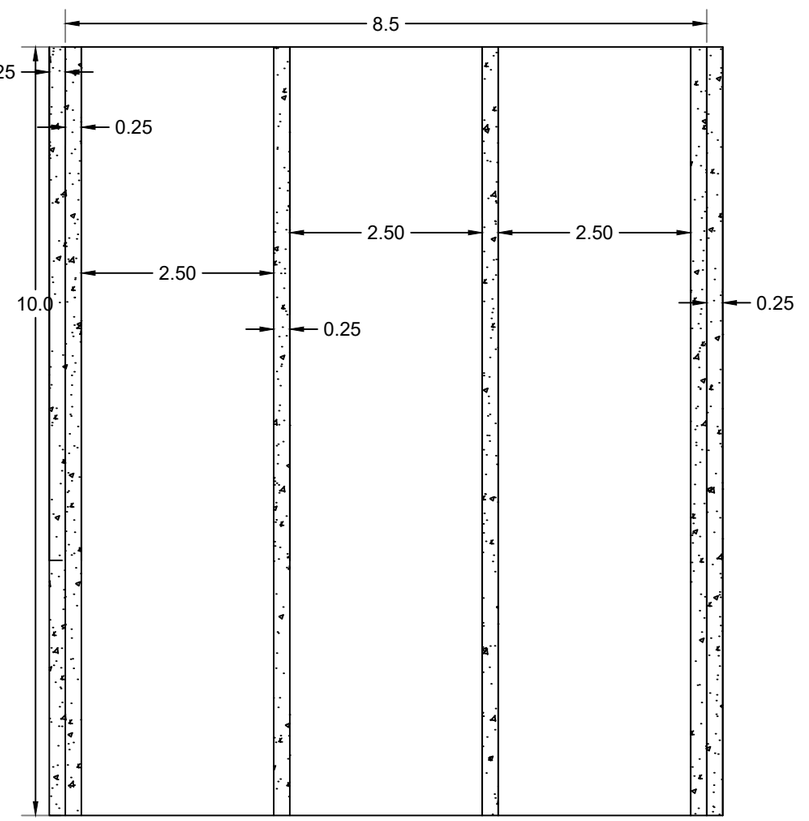
NAME OF THE WORK: PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7	SHEET SIZE: A3	SCALE: AS SHOWN
	TITLE: REJUVENATION OF WATER BODIES TYPICAL DETAILS OF RECHARGE WELL	
CLIENT: COMMISIONERATE OF MUNICIPAL ADMINISTRATION HOSUR CITY MUNICIPAL CORPORATION	DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-15	R0
	TENDER DRAWING	SHEETS: 1 / 1



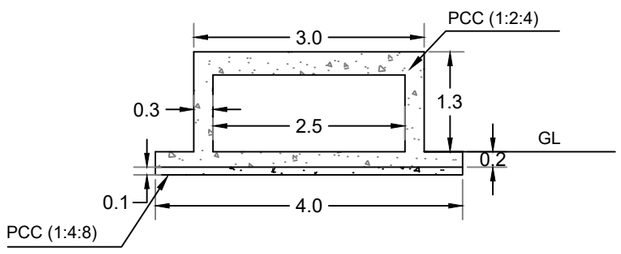
TOP VIEW OF INLET - 1



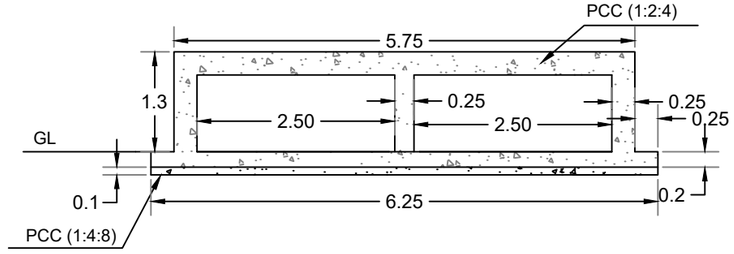
TOP VIEW OF INLET - 2



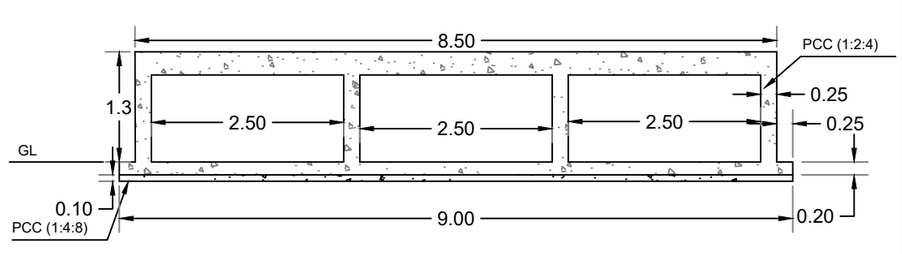
TOP VIEW OF INLET - 3



CROSS SECTION OF INLET - 1



CROSS SECTION OF INLET - 2



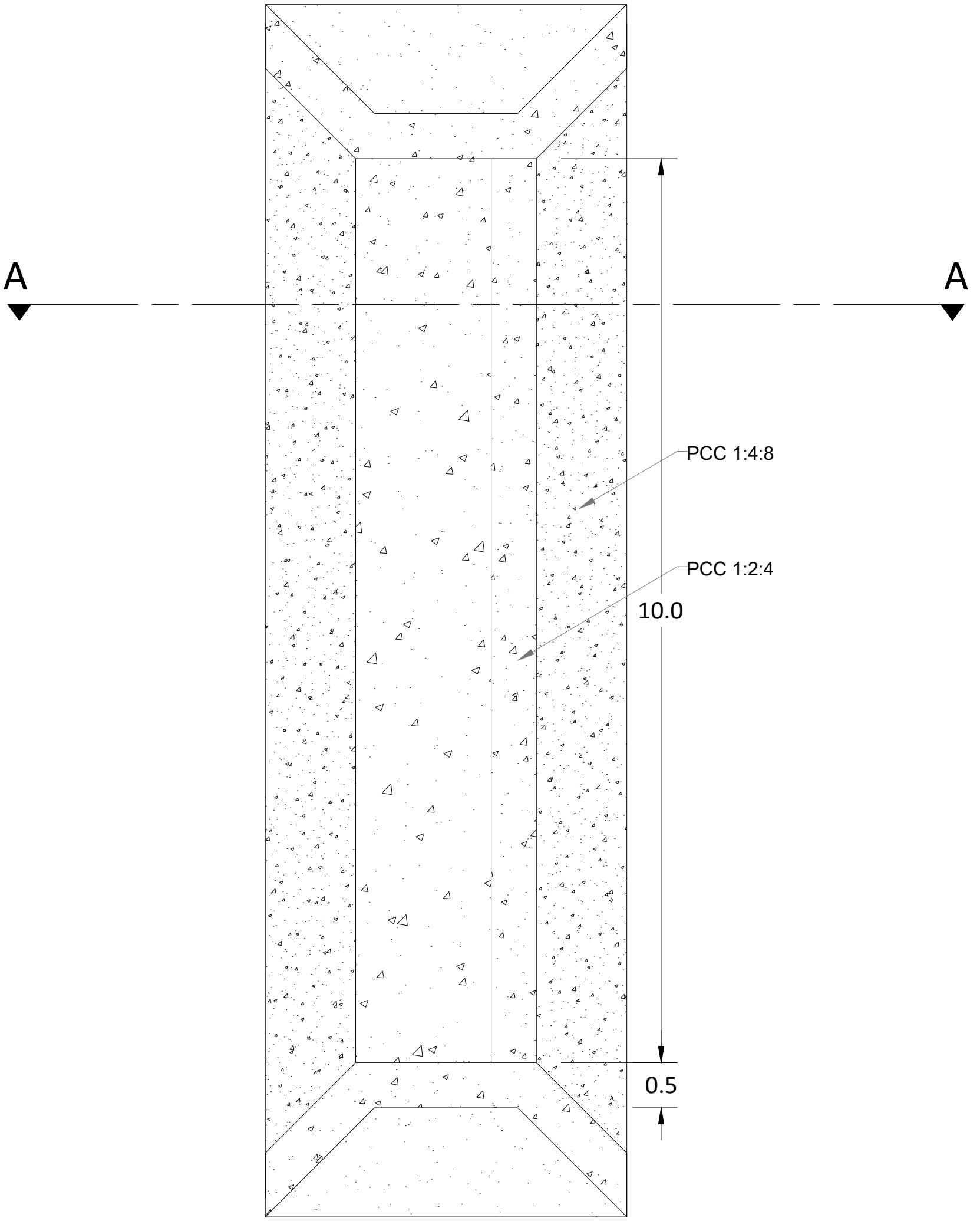
CROSS SECTION OF INLET - 3

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

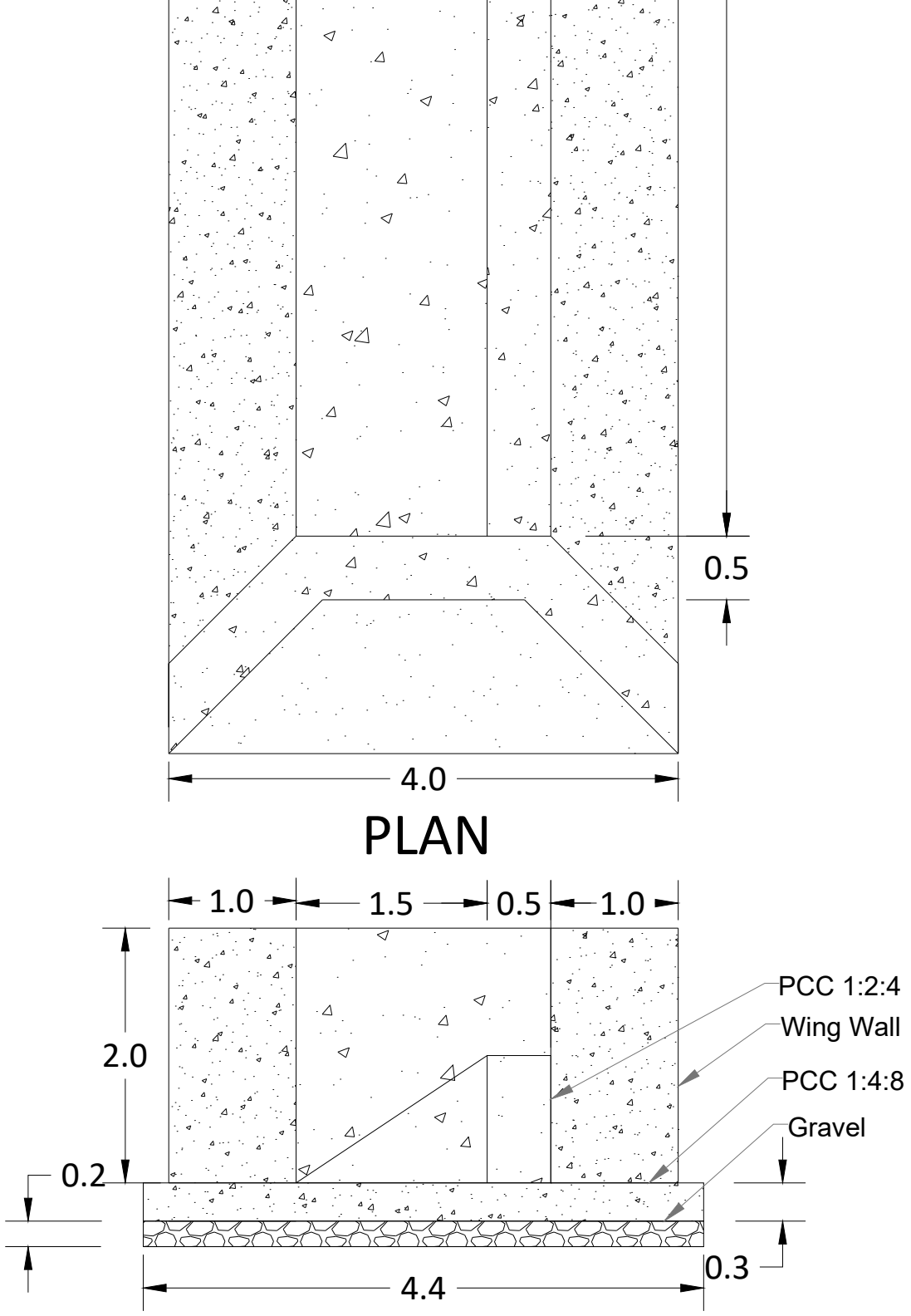
CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

NOTE: All the dimensions are in meters

SHEET SIZE: A3	SCALE: NTS
TITLE: REJUVENATION OF WATER BODIES TYPICAL DETAILS OF INLET CHANNELS	
DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-16	R0
TENDER DRAWING	SHEETS: 01/ 01

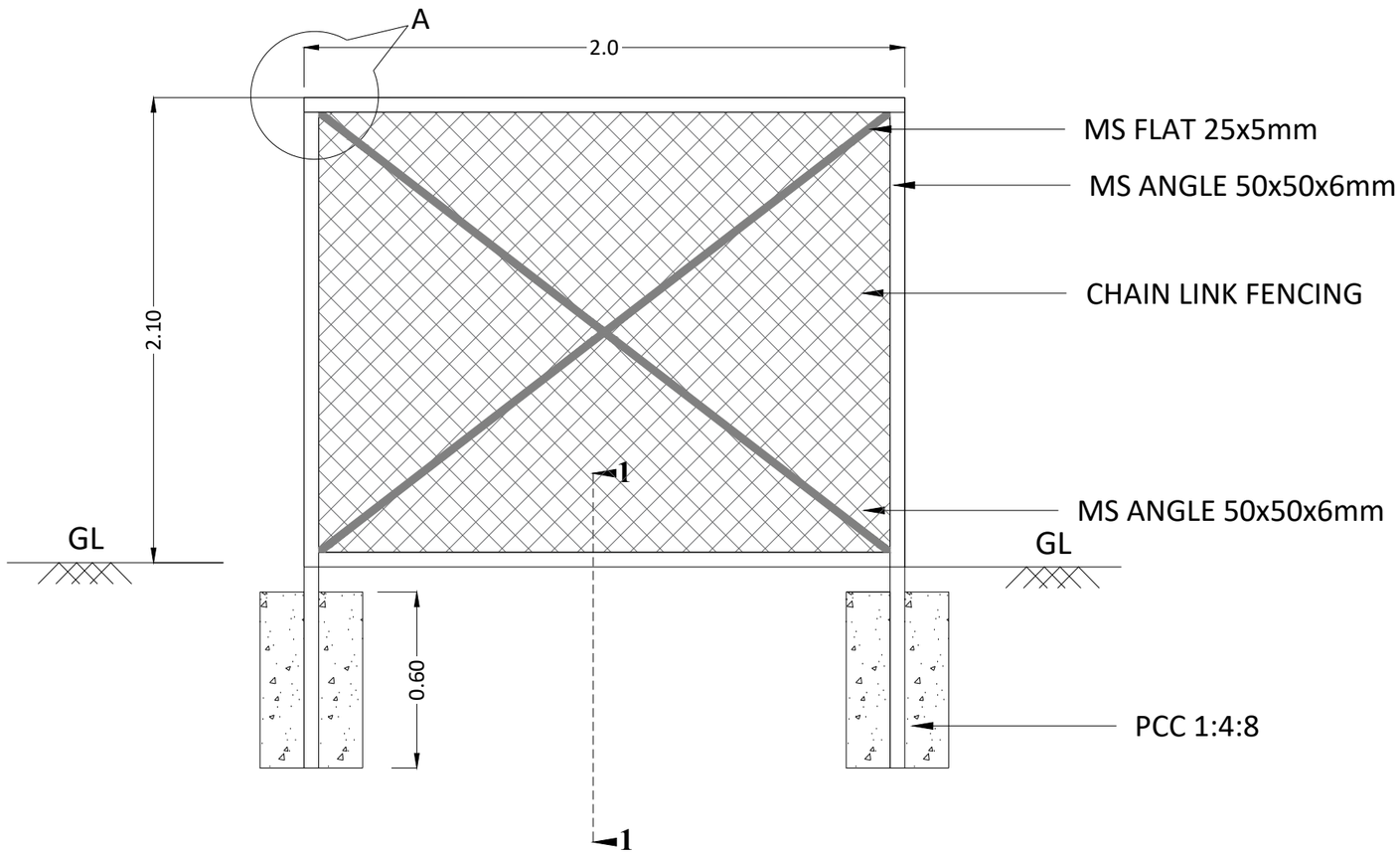


PLAN

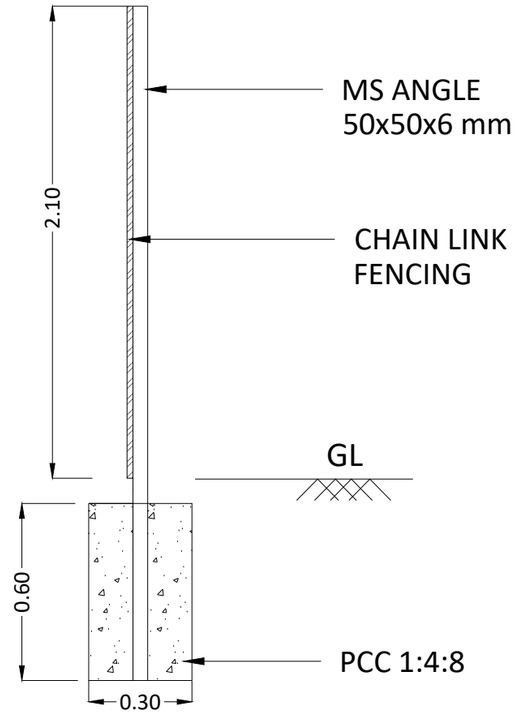


SECTION A-A

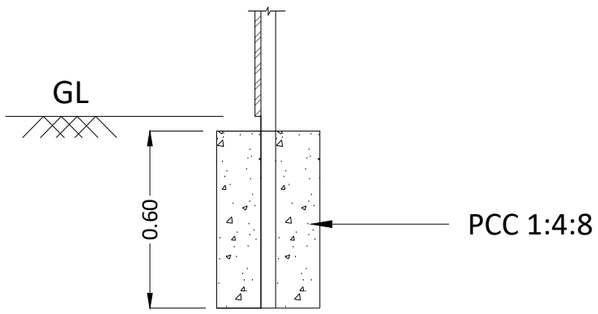
NAME OF THE WORK: PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7	SHEET SIZE: A3 / SCALE: NTS
CLIENT: COMMISIONERATE OF MUNICIPAL ADMINISTRATION HOSUR CITY MUNICIPAL CORPORATION	TITLE: REJUVENATION OF WATER BODIES TYPICAL DETAILS OF WEIR
	DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-17 / R0
	TENDER DRAWING / SHEETS: 01 / 01



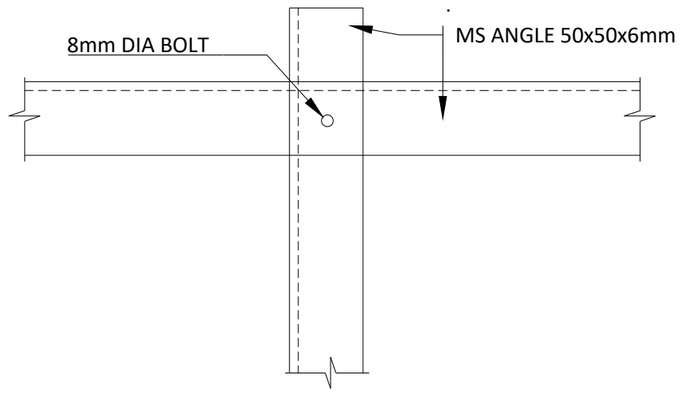
ELEVATION



SIDE ELEVATION



SECTION 1-1



DETAIL - A
TYPICAL FIXING ARRANGEMENT OF
HORIZONTAL AND VERTICAL ANGLES ON
TOP AND BOTTOM

NAME OF THE WORK:
PROVIDING STORM WATER DRAINS INTEGRATED WITH WATERBODIES IN HOSUR CITY MUNICIPAL CORPORATION - PACKAGE 7

CLIENT:
COMMISIONERATE OF MUNICIPAL ADMINISTRATION
HOSUR CITY MUNICIPAL CORPORATION

SHEET SIZE: A3 | SCALE: NTS

TITLE:
REJUVENATION OF WATER BODIES
TYPICAL FENCEING DETAILS

DRG NO: VSPL/WSD/2324-059/HCMC/ISWD/TEN/PA7-18 | R0

TENDER DRAWING | SHEETS: 01/01