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1. Specification & Standards- External Works

1.1. Preliminaries

1.1.1. PURPOSE OF SPECIFICATION

The specification (hardscape, softscape,) defines the requirements and gives guidance for design, implementation and maintenance of the landscape & other works.

1.1.2. SCOPE OF SPECIFICATION

The HARDSCAPE specification describe the general requirements for hard landscape elements in the landscape works and overall improvement works. The works under this section include but are not limited to the following:

EARTHWORKS

Ground works general, protection of existing trees, site clearance, excavation, placing, ground shaping, grading and compacting earth fill, installation of geotextile and earth reinforcement. Earthworks exclude slope protection, compaction and reinforcement;

MASONRY AND WALL CLADDING

The general requirements for stone masonry and wall cladding to Engineer's concrete structure for external wall surfaces and signage etc. on walls, also all allied works including all materials, labour, curing, scaffolding, tools etc.

KERBS AND EDGES

Section includes application of work for kerbs, edges etc., as well as all allied works;

PAVING

Section includes application of work for surface finishes to walkways, paths, bike paths etc. as well as all allied works;

SITE FURNITURE

All furniture elements including seats/benches, signage as well as bins, bollards, recessed manhole covers, water points, tree grates etc.

PAINTING

All paints and coating on floors, walls, landscape structures and all allied works;

The SOFTSCAPE specification describes the general requirements for soft landscape elements in landscape works. The works under this section include but are not limited to the following:

EARTHWORKS

Ground works general, site clearing, supply & soil placement for all planting areas, fine grading, mounding, excavation of pits and erosion control;

PLANTING

Section includes plant procurement, delivery & storage, installation of plant materials, maintenance during execution, plant replacement, gap filling, pruning, tree staking operations, pest and weed control etc.;

POST-CONSTRUCTION

Section includes maintenance during Defects Liability Period, Operations and Maintenance Manual and as-built drawings;

1.1.3. LIST OF RELEVANT DOCUMENTS

This specification to be read in conjunction with:

Schedule C- Project Facilities, Layout design specifications & Table of Recommendations (Schedule of Finishes, Schedule of Furniture-Fittings-Equipment, Schedule of Planting, Schedule of special Items) or the most up to date revision issued thereafter;

Schedule E- Indicative concept Design Drawings package (Landscape & allied services) or the most up to date revision issued thereafter;

Relevant Indian Standards as listed in Subhead 1.2 General Requirements, Section 1.2.8.6 List of standards”;

Note: If work item is not included in Indian Standards, appointed contractor should refer to relevant international standard (BS or equivalent). This should be approved by Client's representative prior to commencing any works on site;

Other documents – any documents not included above but relevant to the tender process.

1.1.4. TERMINOLOGY

In the Specification and other Documents forming part of the Contract, the following expressions and words shall, unless the context otherwise requires, have the meaning hereby respectively assigned to them:

"Approved" or "approval"	means approved by or approval of the Client's Representative
"Submitted" or "submit"	means submitted to or submit to the Client's Representative in writing
"Accepted" or "acceptance"	means accepted by or acceptance of the Client's Representative
"As shown on Drawings"	means all works required to conform with the intent shown on the tender and/or contract drawings
"As required"	means as required in the Specification and other Documents forming part of the Contract
"As directed"	means as directed by the Client's Representative

1.1.5. DEFINITIONS

In the Specification and other Documents forming part of the Contract, the following terms or words shall, unless the context otherwise requires, have the meaning hereby respectively assigned to them:

Authorized Additional Excavation	Excavation below Sub-grade elevations or beyond indicated lines and dimensions as directed by Client's Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Soil Placement & Finish Grading Works.
Backfill	Approved soil material used to fill an excavation above the required sub-grade.
Bad Ground	Ground unsuitable for the purposes of the Works, including filling liable to subsidence; ground full of vegetative matter; ground containing cavities, faults or fissures; ground contaminated by harmful substances including oil, cement and chemicals; ground containing acid sulphate soil; or ground

which is or becomes soft, wet and unstable; and the like.

Earth	Earth shall consist of all materials except rock be it soil, gravel, soft rock, shale or any other material that can be removed, without the use of explosives, or mechanical plant.
Excavation	Removal of material encountered above sub-grade elevations and to lines and dimensions indicated.
Finish Grade	Finished elevation of hard landscape surfaces to required levels as defined in the Drawings.
Rock	Rock shall be boulders more than 0.5cu.m. in size and rock in solid banks or layers or beds of conglomerate of other materials appearing as solid as rock.
Structures	Buildings, footings, foundations, retaining walls, slabs, tanks, kerbs, mechanical and electrical accessories, or other man-made stationary features constructed above or below the ground surface.
Sub-grade	Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill, before placing General Planting Soil Mix.
Unauthorized Excavation	Excavation beyond indicated lines and dimensions without direction by Client's Representative. Unauthorized excavation, as well as remedial work directed by Client shall be without additional compensation.
Utilities	On-site underground services, pipes, conduits, ducts, and cables, as well as underground services within buildings.
Sub-soil	All soil beneath the topsoil layer of the soil profile, typified by the lack of organic matter and soil organisms. Based on site conditions, Softscape Contractor will be responsible for delivery and placement of approved Soil Mix to make-up specified final finish level.

Imported Soil	Approved soil imported from off-site for use to prepare Soil Mix
Local Soil Material	Locally available top soil stored on-site.
Soil Mix	Artificially constituted Planting Soil Mix from available local soil (from on-site top soil dump) or imported soil, soil conditioners, approved fertilizers, soil amendments and/or sand. Approved composition shall be referred to in ' <i>Subhead 1.4. Products & Execution, Section 1.4.3.3. Planting soil mixes</i> '.
Imported Soil Mix	Soil Mix prepared off-site for on-site use, which is evenly textured, fertile, sandy loam free from weeds, deleterious matter and stones larger than 25mm in any dimension and shall not be excessively sandy, gritty or water logged.
Ripping	Controlled mechanical de-compaction of the upper layers of the existing soil (Sub-grade) after Site Clearing and Grubbing to improve the natural percolation of water.
Soil Amendment	Stabilized organic materials added to local soil (from on-site top soil dump) or imported soil to improve soil structure.
Soil Placement Works	The supply and placement of Soil Mix over the existing sub-grade for all areas indicated in the Planting Plans, to the Finish Grade elevations as defined in the Drawings.
Sub-standard Planting Soil	Where the imported Planting Soil does not meet the criteria requirements set out in ' <i>Subhead 1.4. Products & Execution, Section 1.4.3.3. Planting soil mixes</i> '. It may be modified by the addition of soil amendment materials as specified, in quantities to be approved by the Client's Representative to form General Planting Soil Mix.
Topsoil	All soil above the subsoil layer of the soil profile excavated and stockpiled in the on-site top soil dump as defined by Client's Representative.

Balled and Burlapped Stock	Plants dug with firm, natural balls of earth in which they are grown for not less than two growing seasons, and prepared not less than six months in the growing season; wrapped around in burlap and tied, rigidly supported, and drum laced with straw or Coco fibre.
Balled and Potted Stock	Plants dug with firm, natural balls of earth in which they are grown and placed for not less than two growing season, unbroken, in a container.
Clear Trunk Height	Linear measurement starting from root collar to the lowest branch of trees; also called 'branching height'.
Caliper	The diameter of the trunk taken 1 meter up from the root crown.
Container-Grown Stock	Healthy, vigorous, well-rooted plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during transport. Size of contained should be suitable for type and size of plant required.
Exterior Plants	Plants of their nature or acclimatized growing in outdoor environment and include Tree, Palms, Shrubs, Ground Cover, Annuals, Biennials, Perennials, Climbers and Bamboos.
Interior Plants	Plants acclimatized to growing in shaded or indoor environments which include Specimen, secondary and filler plants.
Fertilizer	A chemical compound containing nitrogen (N), phosphorous (P), potassium (K) and/or other specified macro and micro nutrients in adequate quantities to promote plant growth.
Fabric Bag-Grown Stock	Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth,

	and volume for type and size of plant.
Nurseries	Sites of natural ground, which serves as nursing place of tree stock and temporarily storage area for planting materials and bulk materials.
Multi-stem	Where three or more main trunks/stems arise from the ground from a single root crown or at a point right above the root crown.
Root ball	The firmly bound fibrous root with soil that is removed intact with the plant.
Root Crown	The position on the plant stem where the plant naturally forms from the ground when growing in the nursery
Root Pruning	The cutting away of part of the root system to stimulate fibrous root growth with-in a compact root ball.

1.2. General Requirements

1.2.1. SCOPE OF WORK

- (a) The work in this contract covers the design, supply and installation of all landscape works (hardscape, softscape) and allied civil and services work. The Contractor shall furnish all labour, material, tools and equipment necessary to complete the works as indicated on the drawings. Any item not specifically shown in the drawings or specified but normally required to conform to such intent, should be considered part of the work unless raised by the Contractor prior to commencement of works. Contractor shall include and price for such item in the BOQ accordingly;
 - (a) All works indicated in the Drawings by notes are to be provided for, whether or not mentioned in this specification. Any item not specified nor specifically shown in the drawings, but are normally required to conform to such intent, are considered part of the work and deemed to be included in this contract and their execution shall be covered by the contract price, in the same manner as if they have been expressly shown on the drawings and described in the specifications.
 - (b) The works shall be completed within the scheduled time and shall be certified by the Client's Representative in consultation with the PMC upon Practical Completion;
 - (c) The landscape planting shall be provided in the areas shown in the Drawings with plants in a healthy and vigorous growing condition.
 - (d) The Contractor shall submit for approval, his proposed Work Programme based on the criteria of the overall programme showing the intended sequences,
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stages and order of proceeding with the works together with the period of time he has estimated for each and every stage of the progress upon notification of his successful tender price for the project;

- (e) The Contractor shall complete the works within or by the date of completion as set forth in the Contract. The Contractor shall undertake all responsibility for rectification of defects of the landscape (Defects liability period) for a period of twelve (12) months from the issuance of Practical Completion Certificate.

1.2.2. ADJUSTMENTS TO SCOPE

- (a) Client's Representative reserves the right to make field adjustments and reasonable substitutions to ensure implementation of the landscape concept in relation to field conditions.
- (b) The PMC reserves the right to make field adjustments and reasonable substitutions to ensure proper implementation of the landscape concept in relation to the field condition.
- (c) If any material or installation specified is not available or achievable, the Contractor shall submit a written proposal to the PMC within two (2) weeks of award of the contract. This request may present an alternative material or process which fulfils the same design intent, with the proposed adjustment to the contract price for each item due to the change.
- (d) Substitution of materials is not permitted unless authorised in writing by the PMC & Client.

1.2.3. TIMELINES

- (a) The Contractor shall complete the works within or by the date of completion as set forth in the Contract.

1.2.4. DEFECTS AND LIABILITY PERIOD

- (a) The Defects Liability Period shall start from the date of practical completion for a period of twelve (12) months and contractor shall undertake all responsibility for defects of the hard landscape during this period.

1.2.5. DISCREPANCIES

- (a) The Contractor to study the drawings at the time of the tender and notify Client's Representative of any discrepancy at the time of the tender submission.

1.2.6. ERROR AND OMISSION

- (a) The general description of the works mentioned above is only for the guidance of the Contractor and any error or omission shall not constitute ground for claim
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by the Contractor. The onus for investigating and ensuring the actual extent and nature of the works comprised in this Contract prior to the submission of the quotation is solely with the Contractor. Any doubts should be clarified with the Client's Representative before the quotation is submitted. No claim arising out of lack of clarity or availability of information will be entertained post Contract award. Allowance for any or all of these provisions shall be made in the tender BOQ.

1.2.7. SUBMITTALS

1.2.7.1. TENDER STAGE SUBMITTALS

As part of the tender documentation contractor shall submit the following:

Contractor Qualifications	Management structure, employee strength and equipment owned;
List of Subcontractors	If relevant provide the list of subcontractors for specific works;
List of Suppliers/vendors	Provide the list of all the suppliers/vendors for materials and products relevant to the projects;
Material/Product samples	For plant material, submit list of plants with nursery source and quantity available for each representative tree, palm, shrub, climber, bamboo and ground cover species indicating height, spread, calliper, root ball size; Type and number of samples as specified in relevant sections of this document; Product literature for manufactured products should be submitted;
Procurement Schedule	Programme for supply of all materials including all plants with rough quantities as per BOQ; For all plants, indicate quantities with height, spread, caliper, root ball size, growth and nursery source; Lead time required for supply of specialised materials should be indicated here.

1.2.7.2. POST TENDER SUBMITTALS

Prior to starting the works on site Appointed Contractor shall submit the following documentation for approvals:

Detailed
Programme of
Work for all Works

Prepare a detailed programme showing the stages, sequence and timing of all parts of work (including subcontractors involvement/items and itemized items from Outline Programme of Work);

Timelines should be clearly defined. They should include estimated completion date and number of working days;

Programme should include detailed information on resources (manpower, equipment etc.), works by subcontractors etc.;

Schedules are to be coordinated with the main contractor's program and subject to Client's approval;

Method statement for all works, including transport & delivery of materials, site works including earth works, hardworks installation, plant protection, temporary storage etc. should be clearly defined;

Potential risks to programme should be summarised and mitigation methods provided (alternative programme of work if applicable);

Special coordination requirements to be defined.

Procurement Plan

Submit a Procurement Plan based on Client Representative's comments regarding the Procurement Schedule (as submitted with the tender document). The submitted Procurement Plan shall provide clear information on the following;

Procurement schedule for all materials (hardscape, softscape, facade);

Information of Supplier's (hardscape, facade)

Existing and future availability of materials;

Information of Supplier's nursery and/or Contractor's Off- site Nursery (softscape);

Existing and future availability of planting materials (softscape).

Material/Product samples

All samples for non-plant material are to be submitted as required;

Product certificates for manufactured products should be submitted;

Type and number of samples as specified in relevant sections of this document;

All samples need to be approved by Client/ PMC prior to commencement of works on site.

For plant material, re-submit list of plants with nursery source and quantity available for each representative tree, palm, shrub, climber, bamboo and ground cover species indicating height, spread, caliper and root ball size, for final approval by Client's Representative/PMC. Any agreed substitutions to plants species or specifications should be included here.

Contractor to arrange for visit by Client's Representative/ PMC to supplier nurseries to approve selected plant materials prior to procurement.

Site Management Plan

Showing detailed information on site preparation measures to be taken before commencement of works as well as during the works and maintenance period,

Site arrangement layout for temporary structures, storage, water and electricity supply etc.;

PHASING Plan to be submitted for approval to client

representative/PMC prior to commencement of site work. It is to be ensured that at no time during the construction phase, the functioning of the market is to be disturbed or stopped;

Plan should comply with section " *Subhead 1.2. General Requirements, Section 1.2.9. Site Management*" of this Specification;

Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earth work begins.

Health and Safety Plan

Prior to commencing site works the following will be provided to the Client's representative:

Method statements on how risks from hazards will be addressed;

Details of management structure and responsibilities;

Arrangements for issuing health and safety directions;

Procedures for informing other contractors and employees of health and safety hazards ;

Procedures for communications between the project team, other contractors and site operatives;

Arrangements for coordination and cooperation between contractors;

Procedures for carrying out risk assessments and for managing and controlling the risks;

Emergency procedures including those for fire prevention and escape;

Arrangements for ensuring that all accidents, illness and dangerous occurrences are recorded;

Arrangements for welfare facilities;

Procedures for ensuring that all persons on site have received relevant health and safety information and training;

Arrangements for consulting and taking the views of people on site;

Arrangements for preparing site rules and drawing them to the attention of those affected and ensuring their compliance;

Monitoring procedures to ensure compliance with site rules, selection of management procedures, health and safety standards and statutory requirements;

Site Waste Management Plan

Plan should include details on type and quantities of the waste generated – including demolition waste, day to day generated waste etc.;

Detail description of the waste management methods and actions to minimise/reuse/recycle waste,

Recourses required and detail plan of work for waste management team;

Record keeping procedures;

Auditing protocols;

All of the above should be approved by the Client/Client's representative prior to commencement of works on site. No works shall be executed without above mentioned approvals.

1.2.7.3. CONSTRUCTION STAGE

Following items should be submitted by Appointed Contractor during the construction stage of work (if required):

Material/Product samples

All materials/samples to be submitted to the Client representative/ PMC for comments and approval

prior to commencement of works;

Type and number of samples as specified in relevant sections of this document.

Sample panels/
Mock-ups

All sample panel/mock-up to be presented to the Client/Client's Representative for comments and approval prior to commencement of works;

Type and number of sample panels as specified in relevant sections of this document.

1.2.7.4. POST CONSTRUCTION SUBMITTALS

Operations &
Maintenance
Manual

This should include schedule and instructions for all activities to be undertaken for operations and maintenance of established works.

As-built drawings

The Contractor shall prepare As-Built drawings and certify on these drawings that the drawings reflect the actual works installed.

Three sets of these drawings (A1 hardcopy, printed to scale and softcopy – AutoCAD and PDF on a CD) shall be submitted to the client post approval and record.

The sub-contractor shall ensure that this submission of As-Built drawings will not delay subsequent inspections and tests by the relevant authorities; otherwise he shall be fully responsible for any consequence due to his delay.

1.2.8. QUALITY STANDARDS AND CONTROL

1.2.8.1. PRODUCTS AND EXECUTION

INCOMPLETE DOCUMENTATION

- (a) Where and to an extent that products are not fully documented they should be:
 - of standard appropriate to the nature and character of that part of works where they will be used;
 - suitable for the purpose stated or reasonably to be inferred from the project documents;
- (b) Omissions or errors in description or quantity shall not vitiate the Contract nor release the Contractor from any obligations or liabilities.

INSTALLER QUALIFICATIONS & SKILLS

- (a) Operatives should be appropriately skilled and experienced for the type and quality of work.
- (b) Operatives should be able to produce evidence of their qualifications when requested.

PRODUCTS

- (a) Products should be new and unused, properly wrapped, boxed and shipped to site (and approved by the Client/Client's representative);
- (b) Supply of the product should be from the same source or manufacturer;
- (c) Whole quantity of the product should be of consistent kind, size, quality and overall appearance;
- (d) Where critical, measure a sufficient quantity to determine compliance;
- (e) Deterioration should be prevented during the lifecycle of the project, products should be ordered in suitable quantities to a programme and used in appropriate sequence.

EXECUTION

- (a) Generally fix, lay, apply, install products securely, accurately, plumb, neatly and in specified alignment;
- (b) Do not use different colour batches where they can be seen together;
- (c) Check on-site dimensions;
- (d) Finished work should be free of defects, not damaged, disfigured, dirty, and faulty or out of tolerance;
- (e) Adjust joints open to views so they are even and regular.

PROTECTION

- (a) The Contractor shall exercise extreme care in the execution of his work, will provide all necessary safeguards and exercise caution against injury or defacement of existing site. He will ensure that his works in no way shall adversely affect the work of others or adjoining properties;
 - (b) The Contractor/Landscape Contractor will prevent vehicles of any kind from passing over sidewalks, curbs, etc., unless adequate protection is provided. If any
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- damage to existing roads or kerbs occurred, they shall be rectified immediately by the contractor at his own cost to the original or better condition;
- (c) The Contractor/Landscape Contractor is responsible for any damages resulting from hard landscape operations, and will repair all damages and return the area to its previous condition at his own expense.

COMPLIANCE

- (a) Proprietary specifications should be followed;
- (b) Evidence that the proprietary product specified has been supplied and used on site should be retained by Contractor;
- (c) Should specified product being not available, notify the Client's Representative with both available substitution and reasonable explanation for approval of Client's Representative.

INSPECTIONS

- (a) Notify Client's Representative in writing 2 days in advance when reasonable sections of the following stages are ready for inspection on the works quality. Obtain confirmation from Client's Representative before proceeding to next stage. Inspections should be done at the following stages:
 - Delivery of each shipment of materials to site,
 - After spreading and levelling site area,
 - After setting out of trees, planting beds and any additional features,
 - After completion of tree planting pits,
 - At the time of initial installation of trees,
 - Mock-up of paving/edging/other hardscape elements,
 - After completion of all hardscape elements installation,
 - At ready for Substantial Completion inspection,
 - At completion of every three-months of maintenance period.
- (b) Inspection or any other action must not be taken as approval unless confirmed in writing. Written statement should include:
 - Date of the inspection,
 - Part of the work inspected,
 - Characteristics which are approved,
 - Extent and purpose of the approval,
 - Any associated conditions.

RELATED OR NEW WORK

- (a) Provide all traders with necessary details of related types of work;
 - (b) Before commencing new type/section of work ensure previous work is:
 - Appropriately complete,
 - In accordance with project documents,
 - To suitable standard,
 - In suitable condition to receive new work,
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- (c) Ensure all necessary preparatory work has been carried out.

MANUFACTURERS RECOMMENDATIONS/INSTRUCTIONS

- (a) Always comply with manufacturers printed recommendations and instructions current on the date of the invitation to tender;
- (b) If there are any changes to recommendations or instructions – submit details to Clients Representative prior to ordering for approval.

1.2.8.2. SAMPLES AND APPROVALS

GENERAL

- (a) Products or installations should comply with all specification requirements and in respect of the stated or implied characteristics to match a sample expressly approved as a standard for the purpose.

APPROVAL OF PRODUCTS

- (a) Submissions, samples, inspections and tests should be undertaken and arranged to suit the Works programme;
- (b) Do not confirm orders or use the product until approval of the sample has been obtained;
- (c) Approved sample should be retained in good, clean condition on site. Remove when no longer required.

APPROVAL OF EXECUTION

- (a) Submissions, samples, inspections and tests should be undertaken and arranged to suit the Works programme;
- (b) Do not conceal, or proceed with affected work until compliance with requirements is confirmed.

SETTING OUT/ACCURACY

- (a) If tolerances and dimensions likely to be critical to execution or difficult to achieve proposal or site inspection of the appearance should be arranged for as early as possible;
- (b) General tolerances (maximum) should comply with approved local standards.

1.2.8.3. WORK RELATED TO OR AROUND SERVICES

COMPLIANCE WITH REGULATIONS

- (a) Work related to or around any existing or new services should comply with the Bylaws and Regulations of the relevant statutory authority;
- (b) Any relevant documentation required to start the work or at the completion to be submitted to relevant statutory authorities. This should be included in Detailed Programme of Work;
- (c) Site organisation staff must include one or more persons with appropriate knowledge and experience of mechanical and electrical engineering services to ensure compatibility between engineering and the Works generally;
- (d) Submit when requested CVs or other documentary evidence relating to the staff concerned;
- (e) If you have read this document please contact the Clients Representative.

1.2.8.4. SUPERVISION/INSPECTION/DEFECTIVE WORK

KICK-OFF MEETING

- (a) Prior to commencing work, the Contractor/Landscape Contractor will meet the PMC and all other concerned parties on the site to review the work under this section. The Contractor/Landscape Contractor will request this meeting in writing one (1) week prior to the desired meeting time;
- (b) The meeting will define the scope of work of the Contractor/Landscape Contractor, and also identify all key stakeholders involved in the overall site works;
- (c) The sequence and schedule for Works, key contacts and communication protocol shall be discussed;
- (d) Contractor to highlight if any additional information is required by him prior to commencement of works.

SUPERVISION

- (a) In addition to the constant management and supervision of the Works provided by the Contractor's person in charge, all significant types of work must be under the close control of competent site supervisors to ensure maintenance of satisfactory quality and progress. C.V's of proposed Works Superintendent and Site Supervisors with their documented experience to be submitted with Tender documents;
- (b) Replacement of the person in charge on site should be notified to the Client/Client's representative minimum one week in advance and approval in writing received prior to replacement of said person.

OVERTIME WORKING

- (a) Overtime work shall be planned in advance with due consultation of the Client's Representative. Prior to overtime being worked, submit details of times, types and locations of work to be done for approval. Minimum one week notice is required;
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- (b) If works have been executed during overtime for which notice has not been given, it may be required to be opened up for inspection and reinstated at the Contractor's expense.

DEFECTS IN EXISTING WORK

- (a) When defects discovered, immediately give notice. Do not proceed with affected related work until response from the Clients Representative has been received;
- (b) Documented remedial work. Do not execute work which may
 - hinder access to defective products or work;
 - Be rendered abortive by remedial work.

ACCESS FOR INSPECTION

- (c) Before removing scaffolding or other facilities for access, give notice of not less than 48 hours.

TESTS AND INSPECTIONS

- (a) Agree and record dates and times of tests and inspections to enable all affected parties to be represented;
- (b) Confirm each test or inspection minimum 2 days in advance. If sample or test is not ready, agree a new date and time;
- (c) Always submit a copy of test certificates to Clients Representative upon receipt and retain copies on site.

RECTIFICATION OF DEFECTIVE PRODUCTS/ EXECUTIONS

- (a) Immediately after any execution or product is known, or appears, to be not in accordance with the Contract, submit proposals for opening up, inspection, testing, making good, adjustment of the Contract Sum, or removal and re-execution of works;
- (b) Such proposals may be unacceptable and contrary instructions may be issued.

MEASURES TO ESTABLISH ACCEPTABILITY

- (a) Wherever inspection or testing shows that the work, materials or goods are not in accordance with the contract and measures (e.g. testing, opening up, experimental making good) are taken to help in establishing whether or not the work is acceptable, such measures:
 - Will be at the expense of the Contractor;
 - Will not be considered as grounds for extension of time.

QUALITY CONTROL

- (a) Establish and maintain procedures to ensure that the Works, including the work of subcontractors, comply with specified requirements;
- (b) Maintain full records, keep copies on site for inspection, and submit copies on request;
- (c) Records should include:
 - Identification of the element, item, batch or lot including location in the Project Works,
 - Nature and dates of inspections, tests and approvals,
 - Nature and extent of non-conforming work found,
 - Details of corrective action.

1.2.8.5. WORK AT OR AFTER COMPLETION

WORK BEFORE COMPLETION

- (a) Make good (correct/repair) all damage consequent upon the Works;
- (b) Remove all temporary markings, coverings and protective wrappings unless otherwise instructed,
- (c) Clean work site, thoroughly inside and out, including all accessible ducts and voids. Remove all splashes deposits, efflorescence, rubbish and surplus materials,
- (d) Cleaning materials and methods for proprietary products should follow recommendations by manufacturers of products being cleaned, and must not damage or disfigure other materials or construction,
- (e) Substances hazardous to health information sheets to be obtain for all materials used for cleaning and ensure they are used only as recommended by their manufacturers,
- (f) For minor faults - touch up in newly painted work, carefully matching colour and brushing out edges. Repaint badly marked areas back to suitable breaks or junctions,
- (g) Any moving parts of new work should be adjusted, eased and lubricated as necessary to ensure easy and efficient operation.

SECURITY AT COMPLETION

- (a) Leave the Works and storage areas secure with, where appropriate, all accesses closed and locked. Account for and adequately label all keys and hand over to Client.

MAKING GOOD DEFECTS

- (a) For any remedial work arrange access with the Client's Representative,
 - (b) For rectification give reasonable notice for access to the various parts of the Works,
 - (c) For completion notify when remedial works have been completed.
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1.2.8.6. LIST OF STANDARDS

Appointed contractor shall be aware and follow the below listed Indian Standards:

IS 73-2013	Paving Bitumen
IS 1121-2013	Methods of test for determination of strength properties of natural building stones: Part I Compressive strength
IS 1122-1974	Method of test for determination of true specific gravity of natural building stones
IS 1123-1975	Method of identification of natural building stones
IS 1124-1974	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS 1125-2013	Determination of weathering of Natural building stones - Method of Test
IS 1126-2013	Determination of durability of natural building stones - Method of test
IS 1128-1974	Limestone (Slab and Tiles)
IS 1129-1972	Recommendation of dressing of natural building stones
IS 1200 (Part 1)-1992	Methods of measurement of building and civil engineering works: Part 1 Earthwork

IS 1200 (Part 2)-1974	Method of measurement of building and civil engineering works: Part 2 concrete works
IS 1200 (Part 4)-1976	Method of measurement of building and civil engineering works: Part 4 stone masonry
IS 1200 (Part 8)-1993	Method of measurement of building and civil engineering works: Part 8 steel work and iron work
IS 1200 (Part 9)-1973	Method of measurement of building and civil engineering works: Part 9 roof covering (including cladding)
IS 1200 (Part 11)- 2013	Method of Measurement of Building and Civil Engineering Works Part 11 Paving, Floor Finishes, Dado and Skirting
IS 1200 (Part 15)- 1987	Method of measurement of building and civil engineering works: Part 15 painting, polishing, varnishing etc
ISO1595 (Part 1)-1992	Construction of Stone Masonry - Code of Practice - Part 1 : Rubble Stone Masonry
IS 1805-1973	Glossary of terms relating to stones, quarrying and dressing

IS 4101 (Part1)-1967	Code of practice for external facings and veneers: Part I Stone facing
IS 15658- 2006	Precast concrete blocks for paving

1.2.8.7. HEALTH AND SAFETY

GENERAL

- (a) The safe completion of the works is a primary aim of the contract. All works should be executed in compliance with all applicable statutory requirements. Below listed are general requirements and items, contractor should take care of and provide in respect to Health and Safety on site.
- (b) Contractor should always liaise with Client's Health and Safety Representative during pre-construction, construction and post construction/maintenance stage of work.
- (c) Client's Health and Safety Representative responsibilities should include the following;
 - advise and assist the Client, Contractor and Consultants involved in project with their Health and Safety duties,
 - notify details of the project to respective Health and Safety authorities,
 - co-ordinate health and safety aspects of construction work and co-operate with others involved with the project,
 - facilitate good communication between the client, designers and contractors,
 - liaise with the principal contractor regarding ongoing work,
 - identify, collect and pass on pre-construction information,
 - prepare/update the health and safety file on a weekly basis.

1.2.8.8. PRE-CONSTRUCTION HEALTH AND SAFETY INFORMATION

TENDER STAGE

- (a) Health and Safety should be taken into consideration at tender stage. Any major Health and Safety items which may affect the tender should be included in the proposal.

POST TENDER

- (a) Post tender and prior to commencing works on site Contractor to submit detailed Health and Safety Plan (Construction Stage Health and Safety Plan);
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- (b) Health and Safety Plan to be approved by the Client/Client's representative prior to handing the site to Contractor and start of any works.

HEALTH AND SAFETY PLAN

- (a) Health and Safety Plan to be submitted by Contractor to the Client/Client's representative for written approval;
- (b) Following items should be included as part of the plan
- Method statements on how risks from hazards identified in pre-construction information and other hazards identified by the Contractor will be addressed,
 - Details of management structure and responsibilities, with clearly stated point of contact in case of emergency,
 - Arrangements for issuing health and safety directions,
 - Selection procedures for ensuring competency of other contractors,
 - Procedures for informing other contractors and employees of health and safety hazards,
 - Procedures for communications between the project team, other contractors and site operatives,
 - Arrangements for coordination and cooperation between contractors,
 - Procedures for carrying out risk assessments and for managing and controlling the risks,
 - Emergency procedures including those for fire prevention and escape,
 - Arrangements for ensuring that all accidents, illness and dangerous occurrences are recorded,
 - Arrangements for welfare facilities,
 - Procedures for ensuring that all persons on site have all the required safety gear and have received relevant health and safety information and training,
 - Arrangements for ensuring that all visitors to site receive the required safety gear and training prior to entering the site,
 - Arrangements for consulting with and taking views of people on site,
 - Arrangements for preparing site rules and drawing them to the attention of the those affected and ensuring their compliance,
 - Monitoring procedures to ensure compliance with site rules, health and safety standards and statutory requirements.
- (c) In addition, all statutory health and safety requirements should be included as part of the Health and Safety Plan.

1.2.8.9. CONSTRUCTION

SITE PREPARATION - GENERAL

- (a) All health and safety measures and procedures as stated in Health and Safety Plan should be followed during site preparation,
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- (b) Construction site should be fenced off from general public. No unauthorised access should be possible,
- (c) Any fencing and barriers should be clearly visible during the day and night time,
- (d) If public pedestrian/vehicular roads are blocked due to construction works, alternative route should be provided and clearly labelled,
- (e) Any excavated areas, particularly pits and deep excavation, should be fenced off and clearly identified.

GENERAL EXECUTION HAZARDS

- (a) All common hazards during execution should be controlled by good management and common practice.

GENERAL PRODUCT HAZARDS

- (a) When dealing with hazardous substances site personnel exposure levels must not exceed occupational exposure standards (upper limit on the acceptable concentration of a hazardous substance in workplace) and maximum exposure limits stated in the relevant local regulations.

SECURITY

- (a) Safeguard the site, the Works, products, materials, and any existing buildings affected by the Works from damage and theft,
- (b) Take all reasonable precautions to prevent unauthorized access to the site storage areas, site facilities, the Works and adjoining property,
- (c) Liaise with Client's Health and Safety Representative.

STABILITY

- (a) Maintain the stability and structural integrity of the Works and adjacent structures during the Contract,
- (b) When design loads included, obtain details, support as necessary and prevent overloading.

OCCUPIED PREMISES

- (a) Any existing buildings on or along the site will be occupied and/ or used during the Contract as follows need to be secured and provided an access if required,
- (b) All works should be carried out without undue inconvenience and nuisance and without danger to occupants and users.

COMMUNICATION

- (a) Clear communication procedures should be established and followed as per Health and Safety Plan on daily basis,
- (b) Health and Safety information should be provided across the site by clearly marked access points, emergency exits, medical points etc.

EMPLOYEES HEALTH AND SAFETY

- (a) All employees should be given health and safety training prior to start of any new works,
- (b) All employees should be aware of Health and Safety Plan and items related to their work,
- (c) All employees should be provided with health and safety compliant protective clothing and equipment,
- (d) If required contractor shall provide site quarters for Employees. These should be equipped with water, electricity and sanitary facilities (toilets, showers etc.) to comply with statutory Health and Safety regulations.

SITE VISITS BY CLIENT REPRESENTATIVE

- (a) Submit in advance, to the Client/Client's Representative details of safety provisions and procedures (including those relating to materials, which may be deleterious), which will require their compliance when visiting the site,
- (b) Protective clothing and/ or equipment should be provided and maintained on site for the Client/Client's representative and other visitors to the site,
- (c) Visitors to site must be trained in basic site safety procedures prior to entering the site.

TEMPORARY STRUCTURES

- (a) If required the Contractor shall provide adequate offices, toilet and sheds for the protection of equipment and materials from theft and weather conditions,
- (b) Any temporary structures should comply with local Health and Safety regulations.

PROTECT AGAINST THE FOLLOWING

- (a) Noise control
 - Comply with local regulations and minimise the noise level where possible.
 - (b) Pollution
 - Protect the site, the Works and the general environment including the atmosphere, land, streams and waterways against pollution. If pollution occurs inform immediately, including to the appropriate authorities and provide relevant information.
 - (c) Nuisance
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- Prevent nuisance from smoke, dust, rubbish, vermin and other causes. Prevent hazardous build-up on site, in excavations and to surrounding areas and roads,
 - No dumping of material in the surrounding areas is permitted.
- (d) Asbestos containing materials
- Report immediately any suspected materials discovered during execution of the Works. Agree methods for safe removal or encapsulation.
- (e) Fire prevention
- Prevent personal injury or death, and damage to the Works or other property from fire. Comply with local statutory fire regulations.
- (f) Smoking on site
- Smoking on site not permitted.
- (g) Burning on site
- Burning on site not permitted.
- (h) Moisture
- Prevent from wetness and dampness where this may cause damage to the works.
- (i) Contaminated materials
- Where instructed to remove material affected by contamination from the site, minimize the risk of infecting other parts of the site.
- (j) Waste
- Waste includes rubbish, debris, spoil, containers and surplus material. Keep site and works clean and tidy,
 - Remove waste frequently and dispose off site in a manner approved by Waste Regulation Authority and as per Waste Management Plan.

PROTECT THE FOLLOWING

- (a) Existing services
- Notify all service authorities, statutory undertakers and/ or adjacent owners of proposed works not less than one week before commencing site operations,
 - Before starting work, check and mark positions of mains/ services. Where positions are not shown on drawings obtain relevant details from service authorities, statutory undertakers or other owners,
 - To identify services below ground prior to commencing works, use signboards, giving type and depth,
 - Damage to services; If damage to services as results from execution of the Works immediately give notice and notify appropriate service authority/ statutory undertaker. Make arrangements for the work to be made good without delay to the satisfaction of service authority/ statutory undertaker or other owner as appropriate,
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- Marker tapes or protective covers - replace, if disturbed during site operations, to service authority's/ statutory undertakers recommendations.
- (b) Roads and footpaths
- Maintain roads and footpaths within and adjacent to the site and keep clear of mud and debris,
 - If any damage occurs as a result of the Works, make good to the satisfaction of the Client, Local Authority or the Owner.
- (c) Existing topsoil and subsoil
- Prevent over compaction of existing topsoil and subsoil in those areas which may be damaged by construction traffic, parking of vehicles, temporary site accommodation or storage of materials and which will require reinstatement prior to completion of the Works. Before starting work submit proposals for protective measures.
- (d) Retained trees/shrubs/grasses
- Preserve and prevent damage, except those not required. Mature trees and shrubs if uprooted, destroyed, or damaged beyond reasonable chance of survival in their original shape, as a consequence of the Contractor's negligence, must be replaced with those of a similar type and age at the Contractor's expense and as per local government norms,
 - If excavation around existing trees may affect the stability of the plant, make sure trees are secured and protected from falling or causing any hazards.
- (e) Existing features
- Prevent damage to existing buildings, fences, gates, walls, roads, paved areas and other site features, which are to remain in position during execution of the Works
- (f) Existing work
- Prevent damage to existing work, structures or other property during the course of the work.
- (g) Adjoining property
- Obtain permissions as necessary from owners if is required to erect scaffolding on or otherwise using adjoining property.
- (h) Materials for recycling/reuse
- Sort and prevent damage to stated products or materials, clean off bedding and jointing materials and other contaminants,
 - Stack neatly and protect until required by the Employer or for use in the Works as instructed.

1.2.8.10. POST CONSTRUCTION AND MAINTENANCE

MAINTENANCE

- (a) Contractor should follow Health and Safety Plan during the maintenance period.

HEALTH AND SAFETY FILE

- (a) The Health and Safety File should be prepared or revised by Client's Health and Safety Representative, for the project. The file should contain information necessary for future construction, maintenance, refurbishment or demolition to be carried out safely, and should be retained by the client or any future owner of the property.
- (b) All necessary information for Health and Safety File should be provided to Client's Health and safety Representative at the end of works and maintenance.

1.2.9. SITE MANAGEMENT

1.2.9.1. GENERAL

- (a) As below.

1.2.9.2. SITE MANAGEMENT

SITE MANAGEMENT PLAN

- (a) Plan to be prepared by Contractor and approved by the Client/Client's representative prior to handover of the site.
- (b) Plan should be followed during Construction.
- (c) Plan should comply with all relevant statutory regulations as well as Health and safety requirements (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification*).
- (d) Plan should include and detail the following items;
- Detailed information on site preparation measures to be taken up before commencement of works as well as during the works and maintenance period,
 - Clear site arrangement layout for temporary structures, storage, water, electricity supply, vehicular circulation and parking areas etc.,
 - Method statements on how site management will be carried out,
 - Details of management structure and responsibilities, with clearly stated points of contact,
 - Communication procedure within site team,
 - Procedures for informing other contractors and employees of site management issues,
 - Procedures for communications between the project team, other contractors and site operatives,
 - Procedures for keeping the records of site queries, obtained approvals, tests, any documentation that affects the site works etc.,
 - Storage of the materials and equipment on site,
-

- Any additional information required by statutory regulations.

CONTRACTOR'S TEMPORARY STRUCTURES

- (a) Any temporary structures should comply with Health and Safety requirements and relevant statutory regulations.
- (b) Positioning of these facilities shall be on the approval of the Client's Representative and shall be done in co-operation with him.
- (c) Cost of these facilities shall be for the account of the Contractor, unless agreed otherwise.
- (d) The Contractor shall make provision for installation and removal, as agreed, of toilets, and the eventual clearing of the site to the satisfaction of the health inspector. The Contractor shall ensure that the toilets are, indeed used by his staff.
- (e) After the contract is fulfilled, the Contractor shall remove all structures and leave the site in a tidy condition to the satisfaction of the Client's Representative.

STORAGE FOR MATERIALS/EQUIPMENT ON SITE

- (a) The Contractor should allow for a storage area for materials and equipment used on site.
- (b) The Contractor shall ensure that no material is delivered, dumped or off loaded on the site unless the Client's Representative has approved the area for it.
- (c) Storage area should follow Health and Safety requirements as *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety, of this Specification)* in respect to security, protection from weather conditions etc.

SITE BOARD AND INFORMATION BOARDS

- (a) The erection of the site board on the site shall be at the commencement of the contract, and shall be removed when the contract is completed.
- (b) The Contractor shall make provision for Health and Safety information boards across the site.

COMMUNICATION PROCEDURES

- (a) Contractor should communicate with the Client through a single point of contact, as proposed in Site Management Plan.
 - (b) Clear communication procedures between the site team should be established and followed, as per Management Plan.
 - (c) All Employees should be provided with the training on communication on site, site team structure and responsibilities.
 - (d) All design queries shall be communicated and clarified with the Client/Client's Representative and records of the communication should be kept on site.
 - (e) Any major issues affecting the works and programme should be immediately communicated to the Client and mitigation procedures should be established.
-

EXISTING WORKS

- (a) Special precautions shall be taken by the Contractor to avoid damage to existing buildings, structures, sewerage pipes, storm water drains, and pipes, storm water grids, and inlets, manholes, valve casings, water pipes and taps, fire hydrants, irrigation pipes and equipment, cables, completed landscaping works, telephone and light poles, vegetation and other services.
- (b) Contractor to follow Health and Safety requirements, refer (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety*), of this Specification).
- (c) Where manholes, valve castings and other services have to be adjusted to fit in with the construction work or for any other reason, the Client's Representative shall be notified in good time, so that the necessary arrangements can be made. Manholes, valve casings, meter casings, fire hydrants etc., shall always be easy to reach and visible.

PROTECTION OF PROPERTY

- (a) The Contractor shall take all necessary precautions against damage that might occur to any person, animal, building, structure, services, vegetation, vehicles etc. Enough warning signs, railings, lighting etc. shall be placed around excavations, obstacles, and heaps. Foot bridges, shall be placed over trenches, where necessary for the convenience of the public. Construction activity is to be limited to pre-designated areas.

CLEANLINESS & MAINTENANCE OF PUBLIC ROADS

- (a) The Contractor shall maintain the cleanliness of public roads and drains used by his vehicles throughout the Contract Period. He shall be responsible for cleaning up all deposits left by his vehicles on the road and sufficient workers shall be employed for this operation every day.
- (b) Gravel pads are to be constructed at all main exits where the site meets a public road, to dislodge mud, dirt and/or debris from the tyres of trucks and other vehicles before leaving the site. Exit of vehicles should be limited to these exit points only. Size of the gravel pad should be a minimum of 30' x 50', consisting of a 75mm thk. layer of washed gravel, rock or crushed rock of minimum 25mm dia.

TRAFFIC

- (a) Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - (b) Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Client's Representative and authorities having jurisdiction.
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- (c) Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction so that traffic movement around the site is not hampered.

ADJOINING PROPERTY

- (a) Authority for performing site clearing indicated on property adjoining Project site will be obtained by Client's Representative before award of Contract.
- (b) Do not proceed with work on adjoining property until directed by Client's Representative.

WATER LOGGING & CONSERVATION OF WATERWAYS

- (a) The site shall be free from stagnation of water. The contractor shall provide and maintain slopes, crowns and drains on excavations and embankments to ensure satisfactory drainage. Freshly laid out work should be protected from water damage. Where directed by the Client's Representative the contractor shall carry out minor earthworks to top up low-lying area or excavate drain to prevent stagnation of water. Earth for the filling shall be cut from site as indicated on the drawings or from the Contractors own source as indicated and directed.
- (b) The Contractor shall at all times have a capable supervisor of the work in his employment; said supervisor shall receive instruction from the Client's Representative and see that such instructions are executed.

CLEARING UP

- (a) The Contractor/Landscape Contractor will keep all planting areas and other work areas clean, neat and orderly at all times during the period of the Contract and free from accumulation of waste materials or rubbish. No waste materials or rubbish shall be allowed to remain at the areas of work at the end of each working day.
 - (b) Upon completion of the work, the Contractor shall remove all waste materials or rubbish from and around the work areas, together with all tools, equipment and materials, and shall leave said areas in a condition satisfactory to Client's Representative.
 - (c) Carefully remove items indicated to be salvaged and stored the site where indicated. Except for stripped Subsoil or other materials indicated to remain on Owner's property, cleared materials shall become the Contractor's property and shall be removed from the project site, on a periodic basis and on completion of site works.
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1.3. Hardscape: Products & Execution

1.3.1. SITE PREPARATION

Prior to the start of any construction works on site contractor should make sure that the below listed items have been executed.

1.3.1.1. SITE SURVEY

GENERAL

- (a) Prior to commencing the works Contractor shall carry out own survey and inform the Client's Representative/PMCC of any discrepancies with the Design Intent Drawings. Subsequently, appropriate revision to be incorporated in the construction drawings by the Contractor and to be submitted for approval to the PMC/ Client representative.
- (b) Site survey shall be carried out by skilled and experienced team for the type of work.
- (c) If any unforeseen/unrecorded hazards or items have been discovered Contractor shall give notice to the PMC/Client's Representative. No works shall be carried out until the issue has been resolved.

1.3.1.2. SITE INVESTIGATION

GENERAL

- (a) Contractor shall be solely responsible for obtaining all the information on the nature of the site and sub-surface soil conditions for the purpose of preparing tender and the subsequent execution of the contract.
- (b) Site investigation shall provide data to allow Contractor to proceed with works.
- (c) Extent of the investigation shall be determined by the PMC/Client's Representative and the Contractor.
- (d) Site investigation shall include;
 - Establish records of mean water table,
 - Identify all previous known uses of the site,
 - Identify site features to be preserved,
 - Identify areas of limited access, incomplete work by others or any other issues which may hamper the execution of the works,
 - Locate and identify all known land and water contaminants,
 - Locate and identify soil types to a depth of 4.0m below existing ground level,
 - Recommendations for further investigations.

PUBLIC AND SITE SAFETY

- (a) During any temporary works during the investigation, area investigated shall be secured and public access shall be limited.
- (b) Erect temporary fences, footpaths, warning lights etc. Before starting the investigation.
- (c) Area of any investigation shall be kept clean and protected from ground and surface waters.

FIELD TESTS GENERAL

- (a) Each test shall be recorded and following data shall be provided;
 - Project name and reference,
 - Date and time of test,
 - Weather conditions,
 - Soil types and description,
 - Location and detail of the sample,
 - Site photograph,
 - If any feature should be encountered, provide description and depth of:
 - o Changes in soil strata,
 - o Drains,
 - o Foundations/structures,
 - o Hard strata,
 - o Services.

FIELD TEST - SOIL

- (a) Soil test shall be carried out in accordance with relevant local standards;
- (b) Tests shall be carried out at every test pit;
- (c) Method of testing to be proposed by contractor.
- (d) Test shall provide the information on the following:
 - Permeability,
 - Geophysical conditions,
 - Any special features, as advised by Contractor.

SAMPLES

- (a) When taking samples make sure the following;
 - Sample complies with relevant local standards,
 - Method should be proposed by Contractor. It should include information on depth, frequency and locations,
 - Samples should be collected and stored in a manner that prevents exposure to direct heat and sunlight, extreme temperatures,
 - Samples should not be contaminated,
 - Ensure samples are a typical representation of the zone from which they were taken,
 - Retain samples for 28 days post submission of the final report.
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SITE TESTS – WATER

- (a) Tests should identify ground water levels and pressures.
- (b) Method to be proposed by Contractor.

LABORATORY TESTS

- (a) Mechanical and Chemical properties shall be tested.
- (b) Method of testing should be proposed by Contractor.

FINAL REPORT

- (a) Final site investigation report should include;
 - All known land and water contaminants,
 - Identify all previously known uses of the site,
 - Locate and identify soil types to a depth of the 4.0m below existing ground level,
 - Mean water table,
 - Recommendations for further investigation,
 - Features to be included;
 - o All above and below ground features,
 - o All underground services,
 - o Topography.

1.3.1.3. DEMOLITION

GENERAL NOTES

- (a) Contractor to survey and agree with the Client representative/PMC extent of demolition and methodology.
 - (b) Extent of works should be within site boundary, otherwise notify and agree with Client representative/PMC.
 - (c) Contractor to submit details of the demolition works prior to proceeding. The document should include;
 - Location and types of structures, site and surrounding area,
 - Extent,
 - Removal method,
 - Information on adjoining premises which may be affected,
 - Information on below and above ground services, including arrangements for disconnection/removal,
 - Health and safety procedures for protecting public and site workers;
 - Proposed programme of workplace,
 - Any special requirements.
 - (d) Report to be submitted in 3 No A4 printed copies, as well as electronic copy.
-

SERVICES AFFECTED BY DEMOLITION:

- (a) Works should be carried out in accordance with relevant local regulations.
- (b) Any services affected by works, shall be clearly marked and demolition/diversion should be agreed with PMC/Client representative prior to commencement.
- (c) Contractor shall arrange for disconnection (in coordination with Local Authorities) of services if needed.
- (d) Any drains that will not be in future use (redundant) shall be disconnected and removed. Connections shall be sealed.
- (e) Drains to be retained shall be protected and kept clean. This includes; manholes, inspection chambers, gullies, vent pipes, fittings.
- (f) Retained services should be protected from works.

HEALTH AND SAFETY

- (a) Health and Safety procedures should be followed during all demolition works. This includes: public safety, site team safety, health hazards, dust control, gas and vapour risks etc.

TIMING

- (a) Do not proceed with demolition works until commencement of other works in the area is imminent.

MATERIALS ARISING

- (a) All components and materials arising from the demolition works shall be utilised as per Waste Management Plan procedures.
- (b) All components and materials arising from the demolition works shall be removed from site, if they cannot be reused/ recycled.

1.3.1.4. PRESERVATION OF EXISTING SITE FEATURES

All existing features identified as to be retained should be dealt with in accordance with the below listed procedures.

Existing features include hard landscape structures as well as trees and other feature soft landscape elements.

PRESERVATION OF HARD LANDSCAPE

- (a) All hard landscape elements identified as to be retained shall be protected from all on going site works.
 - (b) No structural elements should be removed/ relocated without written permission of Client representative.
 - (c) All protected elements should be kept clean and clear from works area.
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- (d) All protected elements should be clearly identified and labelled, site team should be aware of all the items to be protected.

PRESERVATION OF TREES – GENERAL NOTES

- (e) No existing trees should be cut/ pruned without written permission of Client representative/PMC.
- (f) All works shall be carried out in coordination with experienced horticulturalist.
- (g) All works to trees shall be in accordance with relevant local standards;

TREES TO BE REMOVED

- (a) Any existing trees identified as “to be removed” or any dead trees;
 - Contractor shall cut and fell, as close to the ground as possible,
 - Trunks to be cut to convenient lengths,
 - Root stumps to be removed to a minimum depth of 800mm below ground level,
 - Any debris or material that comes from the above works shall be utilised in accordance with Waste Management Plan.
- (b) All works shall follow Health and Safety procedures.

TREES TO BE RETAINED

- (a) Trees identified as “to be retained”.
 - (b) All retained trees should be clearly identified and information signs should be displayed on site in prominent positions at each entrance.
 - (c) All retained trees shall be marked by visible, durable tags, lettered to tree number or symbol (if any) on the drawings.
 - (d) Trees should be fenced off the works area if possible, in all cases tree trunk and roots should be protected from site works.
 - (e) Protected area should be in a shape of a circle around each tree with radius of 3m or to the width of the canopy line, measured from tree trunk.
 - (f) Do not allow soil compaction to occur under the tree canopy.
 - (g) Do not store any materials or site equipment under or near the trees.
 - (h) Do not allow for any vehicles to be parked near retained trees or to pass under the trees.
 - (i) Prevent damage to tree bark; do not attach any items to trees.
 - (j) Do not expose tree roots.
 - (k) When works under the tree;
 - Do not add or remove topsoil within the drip line of trees, do not fill against tree trunks even temporarily,
 - Open excavation under tree canopy should be carried out for as short period of time as possible. If exposing roots unnecessary temporarily cover with polyethylene sheet to reduce evaporation,
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- Use only hand methods to locate, expose, and cleanly remove the soil around roots on the line of excavation. Root systems should be preserved intact,
- When it is necessary to cut the roots bigger than 25mm diameter, make sure the cutting does not disturb remaining root system. Cut should be smooth with no ragged edges. Clean cut surface should be immediately treated with bituminous fungicidal sealant.

1.3.1.5. SITE CLEARANCE

GENERAL

- (a) The Contractor/Landscape Contractor will clear all planting areas of existing vegetation not specified to remain and all other debris and foreign materials considered a hindrance to the planting operation and considered part of the proposed works.
- (b) The Contractor/Landscape Contractor will maintain previously established grades and swales.
- (c) The Main Contractor will be responsible for cleaning the planting areas after completion of civil and other works in that area, and turning them over to the Contractor/Landscape Contractor in a manner suitable for planting and free from deleterious material. It is to the responsibility of the Contractor/Landscape Contractor to ensure that this is done. Failing this, site works to clean up will be the responsibility of the Contractor/Landscape Contractor.
- (d) The Contractor/Landscape Contractor will arrange to have all cleared materials moved to areas on/off site as directed by the Main Contractor.

TIMING

- (a) Do not clear any area until commencement of other work in the area is imminent.

EXTENT

- (a) Clear only the site areas to be occupied or affected by the Works and any other areas that the Contract specifically requires to be cleared.
- (b) If not included within the areas specified above, clear generally only to the extent necessary for the performance of the Works, if required.
- (c) Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

UTILITY LOCATIONS

- (a) Coordinate with Client's Representative regarding potential utility obstructions and their location before site clearing operations.
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- (b) Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Client's Representative and then only after arranging to provide temporary utility services according to requirements indicated;
 - Notify Client's Representative not less than two days in advance of proposed utility interruptions,
 - Do not proceed with utility interruptions without Client's Representative's and Responsible Authorities written permission.

CLEARING OPERATIONS

- (a) Remove everything on or above the site surface, including rubbish, vegetal matter, construction debris and other unwanted material and dispose off all serviceable material within the Project Site and all unserviceable/ unsuitable material outside the Project Site.

1.3.2. EARTHWORKS

1.3.2.1. GENERAL ITEMS

GENERAL NOTES

- (a) The section refers to excavation and filling of soil across the site as part of the works.
- (b) Contractor should carry out own survey to identify levels and services, prior to start of works and identify any discrepancies in writing to the Clients Representative.
- (c) If significant variations in site levels or ground water levels are identified in comparison to site investigation report or Drawings provided by the Client, Contractor shall notify PMC/Client Representative immediately.

RELEVANT CONTRACT DOCUMENTS

- (a) The section to be read in conjunction below listed Drawings:

DELD- LSCL - 100 - TP - RSN - 3001	Retrofitting Scheme -Existing Site plan
DELD- LSCL - 100 - TP - RSN - 3002	Retrofitting Scheme -Demolition plan
DELD- LSCL - 100 - TP - RSN - 3004	Retrofitting Scheme -Proposed Grading & Details
DELD- LSCL - 100 - TP - RSN - 3007	Retrofitting Scheme -Proposed Services Upgradation

- (b) Contractor to make sure relevant Drawings from other packages are in his possession (e.g. relevant structural details).

SETTING OUT

- (a) Before start of excavation works Contractor shall carry out setting out.
- (a) Contractor will be fully responsible for establishing and locating at site, all grid lines, base lines, levels and limits for project.
- (b) Qualified surveyor should be engaged to prepare the above works.
- (c) All setting out information established by Contractor on site should conform accurately with information in the Drawings.
- (d) Client's Representative shall approve all setting out and locations prior to any excavation works. Written notice of inspection required to be issued to the Client's Representative a min 48 hrs prior to subsequent works commencing.
- (e) Prior to start of further works, Contractor should do a Quality check and any errors/non-compliance with Drawings should be highlighted to the Client's Representative. If the setting out will be a cause of errors in further execution of works, Contractor should seek clarification from the Client's Representative. Any works done without approval from the Client's Representative which cause obstruction to future works, shall be demolished and reconstructed at the expense of the Contractor.
- (f) The Contractor shall follow the datum set out by the Main Civil Works Contractor. Contractor shall be responsible for providing, maintaining and safeguarding the position and levels of all survey pillars/pegs and benchmarks existing on site or added.
- (g) Contractor shall maintain sufficient number of pillars/pegs for checking/monitoring of the works for the entire duration of the project.

1.3.2.2. PRESERVATION OF EXISTING TOPSOIL

STRIPPING TOPSOIL

- (a) For the extent/depth of the topsoil refer to site investigation report
 - (b) Before beginning general excavation or filling, Contractor shall strip topsoil from areas where there will be regrading, paving/roads and other areas shown on drawings.
 - (c) Topsoil shall be removed to an average depth of 300mm, if the depth of topsoil is difficult to determine Contractor shall give notice to PMC/Client's Representative.
 - (d) Stripped topsoil to be reused immediately after stripping or removed from site.
 - (e) Contractor to make sure the following treatment has been applied to removed topsoil;
 - Topsoil not to be mixed with subsoil, stone, hardcore deleterious material, rubbish or material from demolition, other soil or materials containing aggressive weeds or non-soil forming materials, oil, fuel cement or other substances harmful to plant growth.
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1.3.2.3. EXCAVATION

GENERAL NOTES

- (a) All excavation works shall be in accordance with relevant local standards.
- (b) Any features like; pavement wearing surface, concrete paths, kerbs, channels or alike, should be cut by saw to give clean break line along the edge of excavation.
- (c) If excavating next to existing features (metro pillars, ramps, services, trees etc.) Contractor to ensure all health and safety procedures are strictly followed to avoid disturbance of foundations, tree roots etc.
- (d) All excavation shall be carried out by mechanical equipment, unless specified otherwise by Client representative. Contractor can suggest alternative methodology for Client's Representative approval. However any consequent loss or damage will be still under Contractor's liability.

EXTENT

- (a) Excavate over the site to give correct levels and profiles as the basis for construction, paving, filling and other relevant works. Make allowance for compaction and settlement.
- (b) Excavate for footings, pits and alike, to the required size and depths. Confirm the bedding capacity is as specified.

ACCURACY AND PERMISSABLE DEVIATION

- (a) All excavation works shall be taken up to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as specified by Client's Representative.
- (b) All excavation shall be done to minimum dimensions as required for safety, quality and efficiency.
- (c) Any deviation from formation levels beneath mass concrete foundations, ground bearing slabs, embankments and cuttings, external walls etc. shall be consulted with Engineer and approval given in writing prior to works commencing.
- (d) General permissible deviation from linear dimension to be >25mm.

SIDES OF THE EXCAVATION

- (a) Site slopes shall be as steep as will withstand safely for actual site conditions encountered, the Contractor shall obtain instruction from the civil engineer on the extent of the slope to be cut or excavated.
 - (b) Every precaution shall be taken to prevent slips, including temporary shoring, protection of the exposed slope.
 - (c) Should slips occur, the slipped material shall be removed and stacked at the slope dressed to modified stable slope.
 - (d) Removal of slipped earth will not be paid for by the Client.
 - (e) As a general guideline all proposed slopes shall be;
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- For vertical heights less than 1m, 1m vertical to 1.5 horizontal,
- For vertical heights between 1m and 3m; 1m vertical to 2 horizontal,
- For vertical heights exceeding 3m, benching of 3m wide and suitable cut off drain along the benching and cascading drains to be provided.

1.1.1. EXCAVATION TO EXISTING FOUNDATIONS AND STRUCTURES

- (a) Prior to commencing excavation excavate trial pits adjacent to existing foundations to determine extent and formation level.
- (b) Agree with engineer formation level in the new excavation for the safety of the structure.
- (c) Backfill material to excavation to be determined by engineer.
- (d) Provide support to adjacent structures if necessary and written approval by appropriately qualified Engineer provided in writing to Clients Representative, prior to works commencing, sufficient to prevent damage arising from works.
- (e) Supports should be lateral (shoring) and vertical (piling or underpinning).
- (f) If permanent support required give notice to PMC/Client's Representative.

ADJACENT EXCAVATION

- (a) Where excavation encroaches below a line drawn at 45 angle (angle of repose) from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto must be completed before higher excavation is made.
- (b) Provide support to adjacent structures if necessary and written approval by appropriately qualified Engineer provided in writing to Clients Representative, prior to works commencing

EXISTING WATERCOURSES

- (a) Divert water courses which are to be filled, remove vegetable growths and soft deposit.

EXCAVATING IN MADE UP GROUND

- (a) Excavate down to a natural formation of undisturbed subsoil. Notify PMC/Client's Representative if discrepancy identified greater or lesser than given depth.

DEWATERING/DRAINAGE

- (a) All excavations should be kept free of water.
 - (b) Grading to the excavation should be such as to exclude rain/surface water draining into excavated areas.
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- (c) Any water in the excavated areas should be pumped out by Contractor, this should be continued until area is clear of water and up till foundation work is completed and backfilled.
- (d) Do not disturb excavated faces or stability of adjacent ground or structures during pumping. Pumped water should be discharged without flooding adjacent property outside the site. Sumps made for dewatering shall be clear of excavations and fill on completion.

DISPOSAL MATERIALS

- (a) Surplus subsoil to be stockpile in temporary storage heaps. Protection from wind and disturbance shall be provided in the form of covers or vegetation.
- (b) Surplus subsoil should be spread and level on site as per Contractor's proposal.
- (c) Contractor not to raise soil levels within root spread of the existing trees that are to be retained.
- (d) Remaining material to be removed from site, as per Waste Management Plan.

INSPECTIONS

- (a) Contractor to give 5 days' notice for inspections of formations for foundations and filling formations, service trenches, roads and paving.
- (b) Seal the approved formation with blinding concrete within 4 hours of inspection.

1.3.2.4. FILLING

FILL MATERIAL GENERAL

- (a) Submit full details of proposed fill materials, including;
 - Type and source of imported fill,
 - Proposals for processing and reuse of material excavated on site,
 - Test reports as required.
- (b) Submit the above at least 5 working days before commencing back filling works.

FILL MATERIAL PROPERTIES AND TYPES

- (a) Any fill material used for filling should be free of hazardous, aggressive or unstable content. Within the top 1000mm of any area to receive topsoil, do not use fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling.
 - (b) Sulphur content: Do not use filling with sulphur content exceeding 0.5% within 0.5 m of cement bound elements (for example concrete structures or masonry), unless such elements are protected by impermeable membranes or by other suitable means.
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- (c) Where directed, re-use material recovered from excavations on the site. Dry out recovered material as necessary prior to use.
- (d) Fill types recommendations;
 - General fill: Well-graded material, maximum particle size 75 mm, plasticity index $\leq 55\%$.
 - Select fill: Granular material complying with the following properties;
 - o Particle size: 75 mm maximum,
 - o Proportion passing 0.075 mm sieve: 25% maximum,
 - o Plasticity index: $\geq 2\%$, $\leq 15\%$,
 - Soaked CBR: Not less than 15.
 - Road embankment fill: Well graded material with maximum plasticity index 35% and maximum particle size determined by location and layer thickness, but not exceeding two-thirds of the un-compacted layer thickness.
 - Fill sub grade: Use class 3 materials or select fill.

TESTING OF SUITABILITY OF FILL MATERIALS BEFORE START OF FILLING

- (a) If required PMC/Client's Representative may request for a laboratory test of the proposed fill material.
- (b) Samples should be submitted to accredited laboratory by Contractor.
- (c) Report to be submitted by Contractor to Structural engineer.

PREPARATION FOR FILLING

- (a) General: Remove loose material, debris, rubbish, standing water and organic matter.
- (b) Benching;
 - If filling is to be placed against a ground surface that has slopes more than 1:4, bench into the natural surface for at least 1 m at every 1 m change of level to form a key for the filling.
- (c) Underground slabs, pavements and other load bearing elements;
 - For under filling that will support slabs, pavements and other load-bearing elements, compact the stripped surface as for filling. If necessary, loosen the material to a depth of 200 mm and adjust the moisture content.
- (d) Under earth mounds;
 - Cultivate the ground by ripping to a depth of 200 mm before mound formation.
- (e) Rock:
 - Remove any loose or unstable blocks of rock to a depth suitable for construction works to commence.

PLACING FILL

- (a) Place and compact fill material in layers;
 - Place so that only one type of material occurs in each layer,
 - Each layer to be min 150mm, max 300mm thick.
- (b) Site grading shall be carried out as indicated in the drawings and as directed by the Client's Representative.
- (c) Adjacent structures, membranes and buried services;
 - Do not overload, destabilise or damage,
 - Submit proposals for temporary support necessary to ensure stability during filling. Remove support progressively as backfilling proceeds,
 - Allow 14 days (minimum) before backfilling against in situ concrete structures.
- (d) Compaction
 - Compact fill as soon as possible after placing.
 - After compaction surface of each layer must be well closed, showing no movement under compaction plant, and without cracks, holes, ridges, loose material and the like.
 - Defective areas: Remove and re-compact to full thickness of layer using new material.
 - To ensure that the fill has been compacted as specified, the Contractor at his cost shall carry out field and laboratory tests. Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height have been completed. This shall hold good for embankments as well.
 - The fill shall be carried out such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.
- (e) 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 material and make good the slip.
- (f) The Contractor shall make good the slip at his cost.

REUSE OF MATERIAL FOR FILL

- (a) If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 500 mm.
 - After rock filling to the approximate level, voids in rocks shall be filled with finer materials such as earth, broken stone etc., and the area flooded so that the finer materials fill up the 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. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.
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TOLERANCE OF CUT & FILL

- (a) Unless otherwise specified, no portion of the earth cutting shall vary from the specified or proposed level by an amount exceeding <150mm. The tolerance of the fill level or those on slope shall not be more than <75mm from the proposed level. The same tolerance shall be applicable to the limits and lines of cut and fill. All levels are those applicable at the end of the Defects Liability Period. The Contractor should therefore make the necessary allowance for shrinkages, consolidation, settlement and any other losses and to include all expenses for this in his quoted rates.
- (b) Notwithstanding the above, all cut or fill area shall be such that there is no stagnation of water. Should there be any local depressions, the Contractor shall be required to re-grade or fill up the depressions as necessary. The Contractor shall be responsible for making good all settlements or erosion in the filling and cut area whenever the defects occur or as directed by the Client's Representative up to the end of the maintenance period.

INSPECTION

- (a) On completion of the earthwork, The Contractor shall arrange for inspection between his surveyor and the Client's Representative to determine the as-built earthwork.
- (b) The Contractor shall be required to rectify any defects that may be determined and to resurvey as necessary till the Work can be certified satisfactorily.
- (c) The Contractor shall provide all necessary labour, tools, equipment and pegs for the joint surveys, re-surveys and include the expenses in his quoted supply.
- (d) Further joint survey should also be organized at the end of the Defects Liability Period to check all the levels within the contract area and defects, if any, are to be certified.

1.3.2.5. ANTI TERMITE TREATMENT

GENERAL

- (a) This section covers the general requirements for Anti-Termite Treatment measures, chemical treatment of soils for the protection of features & buildings attack of subterranean termites, Chemicals to be used with their minimum rates of application and procedure to be followed for treatment of Foundation.

CHEMICALS

- (a) The chemical used for soil treatment shall be any one of the following;

Chemical	Relevant Indian Standard	Concentration by weight_%

Chlorpyriphos emulsifiable concentrate	IS: 8944-1978	1.0
Heptachlor emulsifiable concentrate	IS: 6439-1972	0.5
Chlordane emulsifiable concentrate	IS:2682-1966	1.0

APPLICATION

- (a) The method of application and the stages it will be applied shall be submitted for approval and this shall conform to relevant IS codes.
 - (b) All works related to application of the Chemicals shall strictly follow Health and Safety procedures. Workers shall be properly protected during application and shall wear the necessary clothes, masks, goggles and other gear to avoid direct contact and inhalation of chemicals ;
 - (c) No work shall be carried out under unsuitable weather conditions, these include:
 - Rain or when the soil is wet due to rain or sub-soil water;
 - Strong winds;
 - Heat waves;
 - (d) Chemicals shall be brought to the site of work in sealed original containers. The materials shall be brought in at a time, in adequate quantity to suffice for the work. The material shall be kept in cool and locked stores. The empties shall not be removed from the work site till the relevant item of work has been completed and permission granted by the Client/ Client's Representative.
 - (e) Chemicals available in concentrated forms with concentration indicated on the sealed containers shall only be used. Chemicals shall be diluted with water in the desired quantity before use, using graduated containers to achieve the desired percentage of concentration.
 - (f) Hand operated pressure pump with graduated containers shall be used to ensure uniform spraying and to facilitate proper penetration of the chemical. Continuous check shall be kept to ensure that the specified quantity of chemicals is used for the required area during the operation.
 - (g) Soil treatment shall start when the foundation trenches and pits are ready to receive mass concrete in foundations. Laying of mass concrete will start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. The above mentioned also applies in the case of treatment to the filled earth surface within the plinth before laying the sub grade for the floor. The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.
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1.3.3. KERBS AND EDGES

1.3.3.1. GENERAL ITEMS

SCOPE

- (a) This section of the Specification covers the general requirements for kerbs and edges and allied works including all materials, labour, curing, scaffolding, tools etc.

RELEVANT CONTRACT DOCUMENTS

- (a) The section to be read in conjunction with below listed Drawings:

DELD– LSCL – 100 – TP – RSN - 3003	Retrofitting Scheme -Proposed Concept plan
DELD– LSCL – 100 – TP – RSN - 3004	Retrofitting Scheme -Proposed Grading & details

- (b) Contractor to make sure relevant Drawings are in his possession (e.g. relevant structural details).

QUALITY ASSURANCE

- (a) All items and works related to the section shall be compliant with relevant local standards;
 - (b) Installer Qualifications: Registered Contractor.
 - (c) All paving materials to be obtained from single source as per approved Supplier's list – submitted by Contractor and approved by Client's Representative;
 - (d) Source Limitations for Other Materials: Obtain each type of cementitious material, mortar, and other material from single source or producer for each aggregate and sufficient quantity ordered to allow for damage and colour variation.
 - (e) Pre-construction Compatibility and Adhesion Testing: Submit the latex-additive manufacturer, for testing indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.
 - (f) Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be non-staining to, installed paving stones and other materials constituting stone paver installation.
 - (g) Pre-installation Inspection: Conduct inspection at Project site with Client's Representative as per approved Works Programme
 - (h) Mockups:
 - Construct Mockups to set quality standards for materials and execution as coordinated and request written approval by Client's Representative prior to continuing works.
 - Kerb mock ups to be incorporated into paving mock-ups.
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DELIVERY, STORAGE, AND HANDLING

- (a) Paving units to be delivered on site in packaging that should not allow for cracks, chippings or discolorations of the material.
- (b) Store materials on elevated platforms, under cover, and in a dry location. Do not use materials that have become damp.
- (c) Store all accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- (d) All materials shall be stored in a secured location and in accordance with Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety”, of this Specification*).

1.3.3.2. PRODUCTS

CONCRETE KERBS

- (a) Concrete type and quality to Engineer's specification and to comply with local standards and regulations;
- (b) Contractor to submit samples of all the concrete kerbs in specified sizes, finishes and with any special features (if applicable) for approval prior to commencement of works;
- (c) All concrete kerbs should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance;
- (d) Kerb sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings. Allow for oversized units;
- (e) Fixing of the kerb and any structural related details to Engineer's specification.
- (f) Contractor to reject any kerb units that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

1.3.3.3. EXECUTION

LAYING CONCRETE KERBS

- (a) All works shall be executed in accordance with relevant local standards;
 - (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety”, of this Specification*) at any time during the works;
 - (c) Do not install in adverse weather conditions. Adequately protect foundations, bedding and haunching against extreme temperatures and rapid drying by wind and sun.
 - (d) Cutting to be neat and accurate, without spalling. Form neat junctions. Minimum cut as specified on Drawings. If minimum cut not possible use oversized unit;
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- (e) Use special corner and radii units at bends, corners and junctions, refer to Drawings for details.
- (f) Units to be positioned true and levelled along top and front faces, in a mortar bed on accurately cast foundations;
- (g) Ends of units buttered with bedding mortar as laying proceeds. Joints completely filled, tightly butted and surplus mortar removed immediately
- (h) After bedding has set, secure units with a continuous haunching of concrete;
- (i) Deviation in finish kerb levels should be no more than 5mm, horizontal and vertical alignment should not exceed 3mm in 3m.

1.3.4. PAVING

1.3.4.1. GENERAL ITEMS

SCOPE

- (a) This section of the Specification covers the general requirements for concrete paving, natural stone paving, bituminous surfaces, tactile paving and allied works including all materials, labour, curing, scaffolding, tools etc.

RELEVANT CONTRACT DOCUMENTS

- (a) The section to be read in conjunction with below mentioned drawings:

DELD– LSCL – 100 – TP – RSN - 3004	Retrofitting Scheme -Proposed Grading & Details
DELD– LSCL – 100 – TP – RSN - 3005	Retrofitting Scheme -Recommended Material Palette

- (b) Contractor to make sure relevant Drawings are in his possession (e.g. relevant structural details).

QUALITY ASSURANCE

- (a) All items and works related to the section shall be compliant with relevant local standards;
 - (b) Installer Qualifications: Registered Contractor;
 - (c) All paving materials to be obtained from single source, as per approved Supplier's list – submitted by Contractor and approved by Client's Representative;
 - (d) Source Limitations for Other Materials: Obtain each type of cementitious material, mortar, and other material from single source or producer for each aggregate;
 - (e) Pre-construction Compatibility and Adhesion Testing: Submit to latex-additive manufacturer, for testing indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.
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- (f) Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be non-staining to, installed paving stones and other materials constituting stone paver installation.
- (g) Pre-installation Inspection: Conduct inspection at Project site with Client's Representative as per approved Works Programme
- (h) Mockups;
 - Construct Mockups to set quality standards for materials and execution as coordinated and approved by Client's Representative.
 - Construct Mockups for each type of paving, each Mockup shall be to scale, and surface areas as dimensioned as stipulated in the Drawings'. Notes for each Mockup to be provided.
 - Contractor to submit the drawing showing layout, location and dimensions for 'on-site' Mockup area, for Client's Representative's approval prior to construction of Mockup.
 - Mockup should include kerbs, recessed manhole covers, paving transitions, interface with lighting and any additional feature as required;
 - Approval of mock-ups should include quality of finish, materials, mortars & P.C.C. and workmanship;
 - Approval of mockups is also for other material and construction qualities that the Client's Representative specifically approves in writing. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Client's Representative specifically approves such deviations in writing.
 - If any major item has been rejected, mockup panel shall be removed or corrected and presented again for approval.
 - If minor items have been rejected, notes shall be taken and followed during the construction programme in respect to mentioned items.

DELIVERY, STORAGE, AND HANDLING

- (a) Paving units to be delivered on site in packaging that should not allow for cracks, chippings or discolorations of the material.
- (b) Store materials on elevated platforms, under cover, and in a dry location. Do not use materials that have become damp.
- (c) Store all accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- (d) All materials shall be stored in a secured location and in accordance with Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification*).

1.3.4.2. PRODUCTS

CONCRETE PAVERS

- (a) Concrete type and quality to Engineer's specification and to comply with local standards and regulations;
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- (b) Contractor to submit samples of all the concrete paver types in specified sizes, finishes and with any special features (if applicable) for approval prior to commencement of works. These to include tactile paving and pathway markers with metal inlay;
- (c) All concrete pavers should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance;
- (d) Paver sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings. Allow for oversized units;
- (e) Fixing of the pavers and any structural related details to Engineer's specification.
- (f) Contractor to reject any pavers that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

NATURAL STONE PAVING

- (a) Stone type and quality to Engineer's specification and to comply with local standards and regulations.
- (b) Contractor to submit samples of all the stone paving unit types in specified sizes, finishes and with any special features (if applicable) for approval prior to commencement of works. These shall include painted pathway markers.
- (c) All stone paving should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance.
- (d) Paving unit sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings. Allow for oversized units.
- (e) Fixing of the paving and any structural related details to Engineer's specification.
- (f) Contractor to reject any pavers that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

BITUMINOUS PAVING

- (a) Bituminous material and quality to Engineer's specification and to comply with local standards and regulations.
 - (b) Contractor to submit samples of all the bituminous surfaces in specified finishes and with any special features (if applicable) for approval prior to commencement of works.
 - (c) All bituminous surfaces should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance.
 - (d) Bituminous paving sizes, colour, finish, pattern, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings.
 - (e) Fixing of the bituminous paving and any structural related details to Engineer's specification.
 - (f) Contractor to reject any products that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.
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THERMOPLASTIC PAINT MARKINGS

- (a) Thermoplastic paint type and quality to Engineer's specification and to comply with local standards and regulations.
- (b) Contractor to submit samples of all thermoplastic paint markings in specified sizes, finish and special features (if applicable) for approval prior to commencement of works.
- (c) All thermoplastic paint surfaces should be smooth and continuous, free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance.
- (d) Thermoplastic paint markings sizes, colour, finish, pattern, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings.
- (e) Fixing of the bituminous paving to Manufacturer's specification.
- (f) Contractor to reject any products that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

1.3.4.3. EXECUTION

LAYING CONCRETE PAVERS

- (a) All works shall be executed in accordance with relevant local standards;
 - (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification*);
 - (c) Do not install in adverse weather conditions. Adequately protect foundations, bedding and haunching against extreme temperatures and rapid drying by wind and sun, heavy rainfall.
 - (d) Sub base and bedding to be laid to Engineer's specification;
 - (e) Bedding to be firm and properly compacted. Rocking or subsidence should not occur or develop.
 - (f) Saturated sand bedding to be removed and replaced, otherwise allow to dry and assess the stability before proceeding with works.
 - (g) Use geotextile sheet around obstructions to prevent washing away of bedding. Lay immediately below sand bedding course for 1.0m perimeter around obstruction. Joint by overlap, lap to be 300mm. When approaching the edge turn the sheet up to form an upstand against the features, height no less than thickness of sand bedding.
 - (h) All masonry cutting to be machine made and neat and accurate, without spalling to form neat junctions with edging and adjoining finishes. Minimum cut as specified on Drawings.
 - (i) Levels and lines of finished surface should be smooth and even with falls as per plan to prevent ponding.
 - (j) When laying on the slope, lay paving units from the bottom of slope, upwards;
 - (k) Paving should appear even and regular with even joint widths and free of mortar and sand stains.
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- (l) Deviation in finish paving levels should be no more than $\pm 5\text{mm}$. Allowed deviation in height of finished paving above features (gullies/drainage channels/kerbs) to be no more than $\pm 3\text{mm}$.
- (m) Sudden irregularities are not permitted. Variation in levels between adjacent block/pavers sets to be no more than $\pm 2\text{mm}$.
- (n) Paving should be clean and free from mortar droppings, oil and other materials likely to cause staining after completion.
- (o) After laying of paving, brush in clean granular sand into all the joints and use vibrating plate compaction machine to level the entire paved area.
- (p) Water down the paved area after compaction and repeat the process until all the joint voids are filled with sand and properly compacted.
- (q) Do not overload previously laid paving with stacks of materials. Avoid damage to unit corners, surfaces etc.
- (r) After laying do not allow for any pedestrian traffic for 24h, vehicular traffic for 28days.

LAYING NATURAL STONE PAVING

- (a) All works shall be executed in accordance with relevant local standards;
 - (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety”, of this Specification*) at any time during the works.
 - (c) Do not install in adverse weather conditions. Adequately protect foundations, bedding and haunching against extreme temperatures and rapid drying by wind and sun, heavy rainfall.
 - (d) Sub base and bedding to be laid to Engineer’s specification.
 - (e) Bedding to be firm and properly compacted before proceeding with paving. Rocking or subsidence should not occur or develop.
 - (f) Saturated mortar bedding to be removed and replaced, otherwise allow to dry and assess the stability before proceeding with works.
 - (g) Use geotextile sheet around obstructions to prevent washing away of bedding. Lay immediately below sand bedding course for 1.0m perimeter around obstruction. Joint by overlap, lap to be 300mm. When approaching the edge turn the sheet up to form an upstand against the features, height no less than thickness of sand bedding.
 - (h) Cutting to be neat and accurate, without spalling to form neat junctions with edging and adjoining finishes. Minimum cut as specified on Drawings. If minimum cut not possible use oversized unit;
 - (i) Levels and lines of finished surface should be smooth and even with falls to prevent ponding.
 - (j) When laying on the slope, lay paving units from the bottom of slope, upwards.
 - (k) Paving should appear even and regular with even joint widths and free of mortar and sand stains.
 - (l) Deviation in finish paving levels should be no more than $\pm 5\text{mm}$. Allowed deviation in height of finished paving above features (gullies/drainage channels/kerbs) to be no more than $\pm 3\text{mm}$.
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- (m) Sudden irregularities are not permitted. Variation in levels between adjacent block/pavers sets to be no more than ± 2 mm.
- (n) Paving should be clean and free from mortar droppings, oil and other materials likely to cause staining.
- (o) Do not overload previously laid paving with stacks of materials. Avoid damage to unit corners, surfaces etc.
- (p) After laying do not allow for any pedestrian traffic for 24h, vehicular traffic for 28days.

LAYING BITUMINOUS PAVING

- (a) All works shall be executed in accordance with relevant local standards;
- (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety”, of this Specification)*;
- (c) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and rapid drying by wind and sun, heavy rainfall;
- (d) Sub base and bedding to be laid to Engineer’s specification;
- (e) Bituminous surface to be laid in layers as per Engineer’s specification;
- (f) Levels and lines of finished surface should be smooth and even with falls to prevent ponding;
- (g) Paving should appear even and regular and free of stains;
- (h) Deviation in finish paving levels should be no more than 5mm. Allowed deviation in height of finished paving above features (gullies/drainage channels/kerbs) to be no more than 3mm;
- (i) Sudden irregularities are not permitted.

LAYING THERMOPLASTIC PAINT MARKINGS

- (a) All works shall be executed in accordance with relevant local standards;
- (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety”, of this Specification)*;
- (c) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and rapid drying by wind and sun, heavy rainfall;
- (d) Installation to manufacturer’s specification;
- (e) Markings should appear even and regular and free of stains;
- (f) Sudden irregularities are not permitted.

1.3.5. MASONRY WORKS AND WALL CLADDING

1.3.5.1. GENERAL ITEMS

SCOPE

- (a) This section of the Specification covers the general requirements for masonry works, GRC/FRP wall panels, natural stone cladding and allied works including all materials, labour, curing, scaffolding, tools etc.

RELEVANT CONTRACT DOCUMENTS

- (a) The section to be read in conjunction with below listed Drawings:

DELD- LSCL – 100 – TP – RSN – 3005	Retrofitting Scheme- Recommended Material Palette (Water Feature & Statue)
DELD- LSCL – 100 – TP – RSN – 3006	Retrofitting Scheme- Improvement

- (b) Contractor to make sure relevant Drawings are in his possession (e.g. relevant structural details).

QUALITY ASSURANCE

- (a) All items and works related to the section shall be compliant with relevant local standards;
- (b) Installer Qualifications: Registered Contractor;
- (c) All cladding materials to be obtained from single source, as per approved Supplier's list – submitted by Contractor and approved by Client's Representative.
- (d) All Masonry materials to be obtained from single source, as per approved Supplier's list – submitted by Contractor and approved by Client's Representative and in conformance with applicable Indian Standards IS.
- (e) Source Limitations for Other Materials: Obtain each type of cementitious material, mortar, grouts and other material from single source or producer for each aggregate.
- (f) Pre-construction Compatibility and Adhesion Testing: Submit the latex-additive, for testing indicated below with samples of paving materials that will contact or affect mortar and grout that contain latex additives to approved laboratory.
- (g) Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be non-staining to, installed cladding and other materials constituting cladding installation.
- (h) Pre-installation Inspection: Conduct inspection at Project site with Client's Representative as per approved Works Programme
- (i) Mockups:
- - Construct Mockups to set quality standards for materials and execution as coordinated and approved by Client's Representative.
 - Construct Mockups for each type of cladding, each Mockup shall be to actual scale, and surface areas as dimensioned as stipulated in the Drawings'. Notes for each Mockup to be provided.
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- Contractor to submit the drawing showing layout, location and dimensions for 'on-site' Mockup area, for Client's Representative's approval prior to construction of Mockup.
- Mockup should include cladding, coping, cladding transitions, interface with lighting and any additional feature as required;
- Approval of mock-ups should include quality of finish, materials, mortars & P.C.C. and workmanship;
- Approval of mockups is also for other material and construction qualities that the Client's Representative specifically approves in writing. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Client's Representative specifically approves such deviations in writing.
- If any major item has been rejected, mockup panel shall be removed or corrected and presented again for approval.
- If minor items have been rejected, notes shall be taken and followed during the construction programme in respect to mentioned items.

DELIVERY, STORAGE, AND HANDLING

- (a) Cladding units to be delivered on site in packaging that should not allow for cracks, chippings or discolorations of the material.
- (b) Store materials on elevated platforms, under cover, and in a dry location. Do not use materials that have become damp.
- (c) Store all accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- (d) All materials shall be stored in a secured location and in accordance with Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification*).

1.3.5.2. PRODUCTS

FRP & GRC CLADDING PANELS

- (a) FRP type and quality to Contractor's specification and to comply with local standards and regulations;
 - (b) Contractor to complete the design for all wall tiles and fixings. Ensure design provides adequate information on strength and durability for the purpose and local climate conditions. Contractor to submit Shop Drawings for PMC/Client's Representative approval;
 - (c) Contractor to submit samples of all the panel types in specified sizes, colours, finishes and with any special features (if applicable) for approval prior to commencement of works.
 - (d) All FRP panels should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance;
 - (e) Panel sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings and approved Shop Drawings;
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- (f) Fixing of the panels and any structural related details to Contractor's specification;
- (g) Contractor to reject any panel that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

NATURAL STONE CLADDING

- (a) Stone type and quality to Engineer's specification and to comply with local standards and regulations;
- (b) Contractor to submit samples of all the stone cladding unit types in specified sizes, finishes and with any special features (if applicable) for approval prior to commencement of works.
- (c) All stone cladding should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance;
- (d) Cladding unit sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings. Allow for oversized units;
- (e) Fixing of the cladding and any structural related details to Engineer's specification.
- (f) Contractor to reject any cladding units that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

CEMENT PLASTER

- (a) Cement Plaster mortar type and quality to Engineer's specification and to comply with local standards and regulations. Plastering of the surface to be performed to Engineer's specification.
- (b) Contractor to submit samples of cement, coarse and fine aggregate. 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.

EXTERNAL TEXTURED PAINT + Graffiti

- (a) The paint shall be textured exterior paint of approved brand and manufacture.
- (b) Contractor to submit samples of approved external textured paint with any special features (if applicable) for approval prior to commencement of works.
- (c) This 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. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

EXTERNAL ACP SIGNAGE

- (d) Aluminium composite panel type and quality to Engineer's specification and to comply with local standards and regulations;
- (e) Contractor to submit samples of all the ACP cladding unit types in specified sizes, finishes and with any special features (if applicable) for approval prior to commencement of works.
- (f) Contractor shall submit colour samples of vinyl film & paint to obtain clearance before proceeding with the art/painting work for all relevant signage. Information.
- (g) All signage shall be good for outdoor installation without any shade/cover/protection. All outdoor signage should be designed to withstand all climatic conditions.
- (h) Lights of required wattage and numbers shall be placed to achieve uniform lighting of the signage.
- (i) The signage supplied by the vendor shall conform in all respect to the corresponding Indian standards. All the materials shall be procured from approved manufacturer as per the specification and shall be accompanied by Manufacturer Test certificate. Job scope includes fabrication, transportation and installation at site in all respects.

1.3.5.3. EXECUTION

LAYING OF FRP CLADDING PANELS

- (a) All works shall be executed in accordance with relevant local standards;
- (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification)* at any time during the works;
- (c) Do not install in adverse weather conditions. Adequately protect foundations, bedding and haunching against extreme temperatures and rapid drying by wind and sun, heavy rainfall;
- (d) Fixing of the panels to Contractor's specification.

LAYING NATURAL STONE CLADDING

- (a) All works shall be executed in accordance with relevant local standards;
 - (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification)* at any time during the works;
 - (c) Do not install in adverse weather conditions. Adequately protect mortars, grouts and any other materials against extreme temperatures and rapid drying by wind and sun, heavy rainfall;
 - (d) Mortar and fixing to Engineer's specification;
 - (e) Do not use units with damaged faces or arises;
 - (f) Cutting to be neat and accurate, without spalling to form neat junctions with edging and adjoining finishes. Minimum cut as specified on Drawings. If minimum cut not possible use oversized unit;
 - (g) When laying on the slope, lay cladding units from the bottom of slope, upwards;
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- (h) Cladding should appear even and to pattern as per Drawings with even joint widths and free of mortar stains;
- (i) Sudden irregularities are not permitted. Variation in levels between adjacent cladding units to be no more than 2mm;
- (j) Joints to be neat, of consistent width and evenly filled with mortar/grout, as per Drawings;
- (k) Mortar/grout for joints to Engineer's specification;
- (l) Cladding should be clean and free from mortar droppings, oil and other materials likely to cause staining;
- (m) Do not stack materials against previously clad areas. Avoid damage to unit corners, surfaces etc.

APPLICATION OF CEMENT PLASTER

- (a) All works shall be executed in accordance with relevant local standards;
- (b) Contractor to follow Health and Safety procedures set in Health and Safety Plan
- (c) The mortar shall be prepared using The mix and type of fine aggregate specified in the description of the item shall be used for the respective coats.
- (d) The plaster shall be applied in two coats i.e. 12 mm under coat and then 8 mm finishing coat and shall have an average total thickness of not less than 20 mm
- (e) Generally coarse sand shall be used for the under coat and fine sand for the finishing coat. For finishing coat work the fine aggregate conforming to grading zone V shall be used.
- (f) All plastering surface to be brushed free of dust and loose mortar. All joints shall be raked out properly. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.
- (g) Contractor to reject any cement and aggregate units that do not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.
- (h) 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-in-Charge 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.
- (i) Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

APPLICATION OF TEXTURED PAINT

- (a) All works shall be executed in accordance with relevant local standards; For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes
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etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced.

- (b) Application of Base coat of water proofing cement paint prior to application of external textured paint. The cement Paint shall be (conforming to IS 5410) of approved brand and manufacture. 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.
- (c) Application of Exterior Painting on Wall for first, second and third coat - The paint shall be textured exterior paint of approved brand and manufacture. Paint shall be applied with a brush on the cleaned 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 process shall be repeated for the second coat and third coat. The surface shall be finished as uniformly as possible leaving no brush marks.
- (d) Graffiti painting shall be done with smooth exterior paint of approved brand and manufacture. 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-in-Charge shall be used. Approved designs/wall art shall be painted for the graffiti work.
- (e) 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.

APPLICATION OF ACP SIGNAGE

- (a) All works shall be executed in accordance with relevant local standards and approval of the local
- (b) Do not install in adverse weather conditions. Adequately protect signage from against extreme temperatures and rapid drying by wind and sun, heavy rainfall; Fixing of the panels to Contractor's specification.
- (c) Prototype should be prepared for inspection and approval complete in all respects including fabrication of frame/structure, painting, electrical work, cladding, graphic application, including testing and functioning of the sign complete in all respects. Provision should be made for ease of maintenance.

1.3.6. SITE FURNITURE AND FEATURES

1.3.6.1. GENERAL ITEMS

SCOPE

- (a) This section of the Specification covers the general requirements for all site furniture and features like benches, bins, signage, digital information panel and allied works including all materials, labour, curing, scaffolding, tools etc.

RELEVANT CONTRACT DOCUMENTS

- (a) The section to be read in conjunction with below listed Drawings:

DELD– LSCL – 100 – TP – RSN - 3003	Retrofitting Scheme- Proposed Concept Plan
DELD– LSCL – 100 – TP – RSN - 3005	Retrofitting Scheme- Recommended Material Palette (Site Furniture)

- (b) Contractor to make sure relevant Drawings are in his possession (e.g. relevant structural details).

QUALITY ASSURANCE

- (a) All items and works related to the section shall be compliant with relevant local standards;
- (b) Installer Qualifications: Registered Contractor;
- (c) All materials to be obtained from single source, as per approved Supplier's list – submitted by Contractor and approved by Client's Representative;
- (d) Source Limitations for Other Materials: Obtain each type of cementitious material, mortar, grouts and other material from single source or producer for each aggregate;
- (e) Use manufacturer's standard test methods to determine whether mortar, grout, paint or glue materials will obtain optimum adhesion with, and will be non-staining to relevant site furniture and features and other materials constituting their installation;
- (f) Pre-installation Inspection: Conduct inspection at Project site with Client's Representative as per approved Works Programme;
- (g) Mockups;
- Construct Mockups to set quality standards for materials and execution as coordinated and approved by Client's Representative,
 - Construct Mockups for each type of site furniture, each Mockup shall be to scale, and surface areas as dimensioned as stipulated in the Drawings'. Notes for each Mockup to be provided,
 - Contractor to submit the drawing showing layout, location and dimensions for 'on-site' Mockup area, for Client's Representative's approval prior to construction of Mockup,
 - Mockup should include cladding bin, bench, signage and any additional feature as required,
 - Approval of mock-ups should include quality of finish, materials, metal fixings, mortars & P.C.C. and workmanship,
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- Approval of mockups is also for other material and construction qualities that the Client's Representative specifically approves in writing. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Client's Representative specifically approves such deviations in writing.
- If any major item has been rejected, mockup panel shall be removed or corrected and presented again for approval.
- If minor items have been rejected, notes shall be taken and followed during the construction programme in respect to mentioned items.

DELIVERY, STORAGE, AND HANDLING

- (a) All elements to be delivered on site in packaging that should not allow for cracks, chippings or discolorations of the material.
- (b) Store materials on elevated platforms, under cover, and in a dry location. Do not use materials that have become damp.
- (c) Store all accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- (d) All materials shall be stored in a secured location and in accordance with Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification*).

1.3.6.2. PRODUCTS

FEATURE BENCH

- (e) Material quality and details to Engineer's/ Manufacturers specification and to comply with local standards and regulations;
 - (f) Contractor to submit Shop Drawings for PMC/Client Representative's approval. Shop drawing's to include material detail specifications, fixing details and any other relevant information.
 - (g) Contractor to submit samples of all material types in specified colours, finishes and with any special features (if applicable) for approval prior to commencement of works.
 - (h) All feature benches should be free from chipping, vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance.
 - (i) Feature bench sizes, colour, finish, pattern, jointing, and any other aesthetic characteristics to match submitted Landscape Drawings and Approved Shop Drawings.
 - (j) All special features related to bench design should be executed to the highest quality. Any cracks, discolouration, edge defects must be corrected may lead to rejection of the whole unit.
 - (k) Fixing of the feature bench on site and any structural related details to Contractor's specification. This should be included in Shop Drawing's for PMC/Client's Representative approval.
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- (l) Contractor to reject any feature bench unit that do not comply with the above requirements. Client's Representative reserves the right to reject the inaccurate products.

FEATURE BIN

- (a) Material quality and details to Engineer's specification and to comply with local standards and regulations;
- (b) Contractor to submit Shop Drawings for PMC/Client Representative's approval. Shop drawing's to include material detail specifications, fixing details and any other relevant information.
- (c) Contractor to submit samples of all the material types in specified colours, finishes and with any special features (if applicable) for approval prior to commencement of works.
- (d) All feature bins should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance.
- (e) Feature bench sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings and Approved Shop Drawings.
- (f) All special features related to bin design should be executed to the highest quality. Any cracks, discolouration, edge defects must be corrected and may lead to replacement of the whole unit.
- (g) Fixing of the feature bin on site and any structural related details to Contractor's specification. This should be included in Shop Drawing's for PMC/Client's Representative approval.
- (h) Contractor to reject any feature bin unit that does not comply with the above requirements. The Client's Representative reserves the right to reject the products that do not fulfil requirements.

FEATURE SIGNAGE

- (a) Material quality and details to Engineer's specification and to comply with local standards and regulations.
 - (b) Contractor to submit Shop Drawings for PMC/Client Representative's approval. Shop drawing's to include material detail specifications, fixing details and any other relevant information.
 - (c) Contractor to submit samples of all the material types in specified colours, finishes and with any special features (if applicable) for approval prior to commencement of works.
 - (d) All signage should be free from vents, cracks, fissures, discolouration or other defects deleterious to strength, durability or appearance.
 - (e) Signage sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings and Approved Shop Drawings.
 - (f) All special features related to signage design should be executed to the highest quality. Any cracks, discolouration, edge defects should be avoided.
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- (g) Fixing of the feature signage on site and any structural related details to Contractor's specification. This should be included in Shop Drawing's for PMC/Client's Representative approval;
- (h) Contractor to reject any feature signage unit that does not comply with the above requirements. Client's Representative to reserve right to reject the inaccurate products.

CYCLE DOCKING STAND

- (a) Proprietary product.
- (b) Contractor to submit sample of the product in specified colours, finishes and with any special features (if applicable) for approval prior to commencement of works.
- (c) All cycle docking stands should be free from surface defects including poor welding joints, discolouration or other defects deleterious to strength, durability or appearance;
- (d) Cycle docking stand sizes, colour, finish, pattern, jointing, remarks and any other aesthetic characteristics to follow submitted Landscape Drawings;
- (e) Fixing of the feature cycle docking stand on site and any structural related details to Contractor's specification. This should be approved by PMC/Client's Representative;
- (f) Contractor to reject any cycle docking stand that does not comply with the above requirements. Client's Representative reserves the right to reject the inaccurate products that do not fulfil requirements.

1.3.6.3. INSTALLATION

INSTALLATION OF FEATURE BENCH

- (a) Fixing of the feature bench to Manufacturers /Contractor's specification whichever is higher.
 - (b) All works shall be executed in accordance with relevant local standards.
 - (c) Contractor to follow Health and Safety procedures set in Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification*) at any time during the works.
 - (d) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and strong winds, sun, heavy rainfall;
 - (e) During installation avoid damage to already executed works (paving, edging, wall cladding etc.). Any faults should be corrected to same quality and appearance.
 - (f) Feature Bench to be installed plumb and level and to best practise standards. All adhesives or residue from installation process to be removed prior to staining the surface. Any timbers/ concrete or steel works that are irreparably stained are to be removed and replaced prior to handover.
 - (g) After installation leave the area clean and tidy, do not leave any tools or materials on site. Any waste should be utilised in accordance with Waste Management Plan.
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INSTALLATION OF FEATURE BIN

- (a) Fixing of the feature bin to Manufacturers /Contractor's specification whichever is higher.
- (b) All works shall be executed in accordance with relevant local standards.
- (c) Contractor to follow Health and Safety procedures set in Health and Safety Plan *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification)* at any time during the works.
- (d) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and strong winds, sun, heavy rainfall.
- (e) During installation avoid damage to already executed works (paving, edging, wall cladding etc.). Any faults should be corrected to same quality and appearance.
- (f) Feature Bin to be installed plumb and level and to best practise standards. All adhesives or residue from installation process to be removed prior to staining the surface. Any timbers/ concrete or steel works that are irreparably stained are to be removed and replaced prior to handover.
- (g) After installation leave the area clean and tidy, do not leave any tools or materials on site. Any waste should be utilised in accordance with Waste Management Plan.

INSTALLATION OF FEATURE SIGNAGE

- (a) Fixing of the feature signage to Manufacturers /Contractor's specification whichever is higher.
- (b) All works shall be executed in accordance with relevant local standards.
- (c) Contractor to follow Health and Safety procedures set in Health and Safety Plan *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety", of this Specification)* at any time during the works.
- (d) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and strong winds, sun, heavy rainfall.
- (e) During installation avoid damage to already executed works (paving, edging, wall cladding etc.). Any faults should be corrected to same quality and appearance.
- (f) Feature Bench to be installed plumb and level and to best practise standards. All adhesives or residue from installation process to be removed prior to staining the surface. Any timbers/ concrete or steel works that are irreparably stained are to be removed and replaced prior to handover.
- (g) After installation leave the area clean and tidy, do not leave any elements, tools or materials on site. Any waste should be utilised in accordance with Waste Management Plan.

INSTALLATION OF CYCLE DOCKING STAND

- (a) Fixing of the cycle docking stand to Manufacturers /Contractor's specification whichever is higher.
 - (b) All works shall be executed in accordance with relevant local standards.
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- (c) Contractor to follow Health and Safety procedures set in Health and Safety Plan (*as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety”, of this Specification*) at any time during the works.
- (d) Do not install in adverse weather conditions. Adequately protect against extreme temperatures and strong winds, sun, heavy rainfall.
- (e) During installation avoid damage to already executed works (paving, edging, wall cladding etc.). Any faults should be corrected to same quality and appearance.
- (f) Feature Bench to be installed plumb and level and to best practise standards. All adhesives or residue from installation process to be removed prior to staining the surface. Any timbers/ concrete or steel works that are irreparably stained are to be removed and replaced prior to handover.
- (g) After installation leave the area clean and tidy, do not leave any tools or materials on site. Any waste should be utilised in accordance with Waste Management Plan.

1.4. Softscape: Products & Execution

1.4.1. SITE PREPARATION

Prior to the start of any construction works on site contractor should make sure that the below listed items have been executed.

1.4.1.1. SITE SURVEY

GENERAL

- (a) Contractor shall be solely responsible for obtaining all the information on the nature of the site and soil conditions for the purpose of preparing tender and the subsequent execution of the contract.
- (b) Extent of the investigation shall be determined by the Client's Representative and the Contractor.
- (c) Site investigation shall include:
 - Identify site features to be preserved;
 - Identify areas of limited access, incomplete work by others or any other issues which may hamper the execution of the softscape works;
 - Locate and identify all known land and water contaminants;
 - Recommendations for further investigations

PUBLIC AND SITE SAFETY

- (a) During any investigation works on site, the area investigated shall be secured and public access shall be limited;
 - (b) Erect temporary fences, footpaths, warning lights etc. Before starting the investigation.
 - (c) Area of any investigation shall be kept clean and protected from ground and surface waters.
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FIELD TESTS GENERAL

- (a) Each test shall be recorded and following data shall be provided:
 - Project name and reference;
 - Date and time of test;
 - Weather conditions;
 - Soil types and description;
 - Location and detail of the sample;
 - Site photograph
- (b) Also see 'Section 7. General Requirements, Quality Standards and Control' for Soil Test requirements.

LABORATORY TESTS

- (a) Mechanical and Chemical properties shall be tested.
- (b) Method of testing should be proposed by Contractor.

1.4.1.2. PRESERVATION OF EXISTING SITE FEATURES

GENERAL

- (c) All existing features identified as to be retained should be dealt with in accordance with the below listed procedures.
- (d) Existing features include hard landscape structures as well as trees and other feature soft landscape elements.

PRESERVATION OF HARD LANDSCAPE

- (e) All hard landscape elements identified as to be retained shall be protected from all on going site works.
- (f) No structural elements should be removed/ relocated without written permission of Client representative.
- (g) All protected elements should be kept clean and clear.
- (h) All protected elements should be clearly identified and labelled, site team should be aware of all the items to be protected.

PRESERVATION OF TREES – GENERAL NOTES

- (i) No existing trees should be cut/pruned without written permission of Client representative/PM;
 - (j) All works shall be carried out in coordination with experienced horticulturalist;
 - (k) All works to trees shall be in accordance with relevant local standards;
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TREES TO BE REMOVED

- (l) Any existing trees identified as "to be removed" or any dead trees;
 - Contractor shall cut and fell, as close to the ground as possible,
 - Trunks to be cut to convenient lengths,
 - Root stumps shall be removed to a minimum depth of 800mm below ground level,
 - Any debris or material that comes from the above works shall be utilised in accordance with Waste Management Plan.
- (m) All works shall follow Health and Safety procedures.

TREES TO BE RETAINED

- (n) Trees identified as "to be retained".
- (o) All retained trees should be clearly identified and information signs should be displayed on site in prominent positions at each entrance.
- (p) All retained trees shall be marked by visible, durable tags, lettered to tree number or symbol (if any) on the drawings.
- (q) Trees should be fenced off the works area if possible, in all cases tree trunk and roots should be protected from site works.
- (r) Protected area should be in a shape of a circle around each tree with radius of half the tree's height, measured from tree trunk.
- (s) Do not allow for soil compaction under the tree.
- (t) Do not store any materials or site equipment under or near the trees.
- (u) Do not allow for any vehicles to be parked near retained trees or to pass under the trees.
- (v) Prevent damage to tree's bark, do not attach any items to trees.
- (w) Do not expose tree roots.
- (x) When works under the tree;
 - Do not fill against tree trunks even temporarily,
 - Open excavation under tree canopy should be carried for as short period as possible. If exposing roots is necessary, temporarily line with polyethylene sheet to reduce evaporation,
 - Use only hand methods to locate, expose, and cleanly remove the soil around roots on the line of excavation. Root systems should be preserved intact.
 - When it is necessary to cut the roots bigger than 25mm diameter, make sure the cutting does not disturb remaining root system. Cut should be smooth with no ragged edges. Cut surface should be immediately treated with bituminous fungicidal sealant.

1.4.1.3. SITE CLEARANCE

GENERAL

- (a) The Softscape Contractor will clear all planting areas of existing vegetation not specified to remain and all other debris and foreign materials considered a hindrance to the planting operation and/or unsightly in appearance.
- (b) The Softscape Contractor will maintain previously established grades and swales.
- (c) The Main Contractor will be responsible for cleaning the planting areas after completion of civil and other works in that area, and turning them over to the Softscape Contractor suitable for planting. It is to the responsibility of the Softscape Contractor to ensure that this is done. Failing this, clean-up will be the responsibility of the Softscape Contractor.
- (d) The Softscape Contractor will arrange to have all cleared materials moved to areas on site as directed by the Main Contractor.

TIMING

- (e) Do not clear any area until commencement of other work in the area is imminent.

EXTENT

- (a) Clear only the site areas to be occupied or affected by the Works and any other areas that the Contract specifically requires to be cleared.
- (b) If not included within the areas specified above, clear generally only to the extent necessary for the performance of the Works, if required.
- (c) Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

UTILITY LOCATIONS

- (a) Coordinate with Client's Representative regarding potential utility obstructions and their location before site clearing operations.
- (b) Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Client's Representative and then only after arranging to provide temporary utility services according to requirements indicated.
 - Notify Client's Representative not less than two days in advance of proposed utility interruptions.
 - Do not proceed with utility interruptions without Client's Representative's written permission.

CLEARING OPERATIONS

- (a) Remove everything on or above the site surface, including rubbish, vegetal matter, construction debris and other unwanted material and dispose off all serviceable material within the Project Site and all unserviceable/ unsuitable material outside the Project Site.
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1.4.2. EARTHWORK & GRADING

1.4.2.1. GENERAL

GENERAL NOTES

- (a) The section refers to excavation, grading and filling of soil across the site as part of the works.
- (b) Contractor should carry out own survey to identify levels and services, prior to start of works.
- (c) If significant variations in site levels or ground water levels in compare to site investigation report or Drawings, Contractor shall notify Client Representative.

RELEVANT CONTRACT DOCUMENTS

- (a) The section to be read in conjunction with below listed Drawings:

DELD- LSCL – 100 – TP – RSN - 3002	Retrofitting Scheme – Proposed Demolition plan
DELD- LSCL – 100 – TP – RSN - 3004	Retrofitting Scheme -Proposed Grading & details

- (b) Contractor to make sure relevant Drawings from other packages are in his possession (e.g. relevant structural details).

SETTING OUT

- (a) Before start of excavation works Contractor shall carry out setting out works;
 - (b) Contractor will be fully responsible for establishing and locating at site all grid lines, base lines, levels and limits for project;
 - (c) Qualified surveyor should be engaged to prepare the above works;
 - (d) All setting out information established by Contractor on site should conform accurately with information in the Drawings. Position of individual plants and outlines of all planting areas shall be staked and set out according to the Drawings.
 - (e) The Landscape Architect will approve all planting areas and locations prior to any excavation of planting pits, trenches or beds;
 - (f) In the event that site conditions necessitate relocation of planting areas or locations, due to subsurface utilities, pipes, structures, impervious materials or inadequate drainage, the Landscape Architect will designate new locations;
 - (g) Prior to start of further works, Contractor should do a Quality check and any errors/non-compliance with Drawings should be highlighted to the Client's Representative. If the setting out will be a cause of errors in further execution of works, Contractor should seek clarification from the Client's Representative. Any works done which cause obstruction to future works, without approval from the
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Client's Representative, shall be demolished and reconstructed at the expense of the Contractor;

- (h) The Contractor shall follow the datum set out by the Main Civil Works Contractor. He shall be responsible for providing, maintaining and safeguarding the position and levels of all survey pillars/pegs and benchmarks existing on site or added;
- (i) Contractor shall maintain sufficient number of pillars/pegs for checking/monitoring of the works for the entire duration of the project.

1.4.2.2. EXCAVATION

GENERAL

- (a) All excavation works shall be in accordance with relevant local standards;
 - (b) The work shall include the hauling and satisfactory disposal of surplus excavated or deleterious material;
 - (c) Notify Client's Representative if unexpected rock, hardpan or obstructions detrimental to trees or shrubs are encountered in excavations.
 - (d) Hardpan Layer: Drill 150-mm diameter holes, 600 mm apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.
 - (e) If excavating next to existing features (metro pillars, ramps, services, trees etc.) Contractor to ensure all health and safety procedures are strictly followed to avoid disturbance of foundations, tree roots etc.;
 - (f) Protect, structures, utilities, sidewalks, pavements and other facilities and lawns and existing plants from damage caused by settlement, lateral movement, washout and other hazards created by Excavation Works;
 - (g) Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways;
 - (h) All excavation shall be carried out by mechanical equipment, unless specified otherwise by Client's representative. Contractor can suggest alternative methodology for Client's Representative approval. However any consequent loss or damage will be still under Contractor's liability;
 - (i) Remove any rubbish or debris from the planting surfaces. Grades, which have been established, shall be maintained in a true and even condition;
 - (j) Maintenance shall include any necessary repairs to previous graded areas;
 - (k) Remove obstructions, debris, rubbish, rocks greater than 100mm in diameter, trees, shrubs, grass, and other vegetation to permit installation of soil layers during the Filling works;
 - (l) Side slopes shall be as steep as will withstand safely for actual site conditions encountered for planting beds;
 - (m) The following actions need to be followed during this process;
 - Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
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- Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction. Ensure adequate protection is provided to any exposed roots.
- Grind stumps and remove roots, obstructions, and debris extending to a depth of 450 mm below exposed sub-grade.
- Chip removed tree branches and stockpile or dispose in areas approved by Client's Representative.
- The type of soil to be excavated for pits will cover all soil types such as soft soil, hard moorum and soft rock as is incident on site.

EXTENT

- (a) Position of individual plants and outlines of all planting areas shall be staked and set out according to the Contract Drawings.
- (b) Excavate over the site to give correct levels and profiles as the basis for grading and filling works. Make allowance for compaction and settlement.
- (c) Excavate for trees, palms, shrubs, ground covers and turf areas to the required size and depths.

ACCURACY AND PERMISSABLE DEVIATION

- (a) All excavation works shall be taken up to such widths, lengths, depths and profiles as are shown on the drawings or otherwise indicated in this Specification. In case of discrepancy between the Drawings and Specifications, Drawings shall be followed;
- (b) Any deviation from rough grading levels shall be consulted with the Client's Representative;
- (c) Excavate over the site to give correct levels and profiles as the basis for grading and filling works.
- (d) General permissible deviation from linear dimension to be <25mm.

DRAINAGE

- (a) All excavations should be kept free of water.
 - (b) Grading to the excavation should be such as to exclude rain/surface water draining into excavated areas.
 - (c) The Softscape Contractor must test all planters/planting pits for its drainage capability by filling the planters/planting pits with water. Conditions permitted the retention of water in the planters/planter pits for an excessive period of time must be brought to the attention of the Main Contractor, Client's Representative, Architect and Landscape Architect immediately. The notice must include the proposal and its cost of rectifying the drainage problem. The Softscape Contractor must ensure that the drainage problem is rectified before proceeding with planting works.
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- (d) If the Softscape Contractor fails to inform the Main Contractor, Client's Representative, Architect and Landscape Architect, he will be responsible for the rectification of the drainage problems and replace all damaged plant materials at his own cost.

EXCAVATED MATERIALS

- (a) Soil excavated from planting holes shall be removed and may be re-used in back filling, if instructed by the Client's Representative, by proving it acceptable through amendments to form specified General Planting Soil Mix as provided in this Specification.

1.4.2.3. PRESERVATION OF EXISTING TOPSOIL

STRIPPING TOPSOIL

- (a) Before beginning general excavation or filling, Contractor shall strip topsoil from areas where there will be working;
- (b) Topsoil shall be removed to an average depth of 300mm, if the depth of topsoil is difficult to determine Contractor shall give notice to Client's Representative;
- (c) Stripped topsoil may be reused immediately after stripping or stockpiled in the on-site top soil dump as directed by the Client's Representative for later use;
- (d) Location of stockpile: To be agreed - topsoil shall be stored in an area of the site where it should not interfere with other site operations so that it can be left undisturbed during the construction process.
- (e) Site Clearance: The area that is to be used for storing the topsoil shall be cleared of vegetation and any waste arising from the development e.g. building rubble and fill materials.
- (f) Protection:
- Topsoil not to be mixed with subsoil, stone, granular aggregate, rubbish or material from demolition, other soil or materials containing aggressive weeds or non-soil forming materials, oil, fuel cement or other substances harmful to plant growth.
 - Do not place any other material on top of storage heaps.
 - Do not allow construction plant to pass over storage heaps.
 - Prevent compaction and contamination, by fencing and covering as appropriate.
- (g) Height:
- If the topsoil is reasonably dry and friable, the topsoil shall be heaped to a maximum height of 4m. Compaction of the surface to be done.
 - If the topsoil is moist and plastic, the topsoil shall then be heaped up further to a maximum height of 2m. No further compaction required.
- (h) Stock-piled top soil should be planted with rough grasses etc. to limit erosion of soil.
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DISPOSAL MATERIALS

- (a) Surplus subsoil to be stockpiled in temporary storage heaps or spread and level on site as per Contractor's proposal. Protection from wind and disturbance shall be provided.
- (b) Never rise soil levels within root spread and above the root flare of existing trees that are to be retained.
- (c) Remaining material to be removed from site, as per Site Waste Management Plan, refer *(as per Subhead 1.2. General Requirements, Section 1.2.8.7. Health and Safety*, of this Specification).

INSPECTIONS

- (a) Contractor to give 2 days' notice for inspections of excavated areas and tree/palm pits.

SIZES & DEPTH

- (a) Pits and Trenches: Excavate square or circular pits for trees and palms, and circular pits for large shrubs, with side slopes vertical. Where impractical to do so due to non-cohesive nature of the soil, they shall be so excavated as to provide not less than the specified plan size at the bottom of the excavation. Trim base leaving central area slightly raised to support root ball and assist in drainage. Break base to 100mm depth. Scarify sides of plant pit smeared or smoothed during excavation.
- (b) Fill excavations with water and allow percolating away before positioning trees and shrubs.
- (c) Pest control treatment to be done as required in pits before planting, with approval of Client's Representative.
- (d) The minimum size of tree & shrub pits and planting beds shall be as follows:
 - Trees/ Palms: 1.2m x 1.2m x 1.0m or as specified in the Drawings.
 - Large Shrubs: 0.6m x 0.6m x 0.6m
 - Shrub beds: 0.6m depth x area as per Drawings
 - Ground cover beds: 0.3m depth x area as per Drawings
 - Turf areas: 0.3m depth x area as per Drawings

1.4.2.4. GRADING & FILLING

GENERAL

- (a) The work shall consist of grading, contouring, smoothing or otherwise shaping areas beyond the planting beds and lawns at the locations shown on the drawings, including earth mounds.
 - (b) Roadway shoulders and soil areas left exposed after planting shall be graded as required to leave a generally smooth appearance conforming to the general shape and cross section indicated on the drawings. The final surfaces shall be raked. All objectionable material, trash, brush, weeds and stones larger than
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<50 mm in diameter shall be removed from the site and disposed of in an approved manner.

- (c) Make up any deficiency of existing sub-grade level on site with approved backfill to achieve required sub-grade levels.
- (d) Landscape levels will be tied to existing conditions such as existing trees, palms, landscape features, utility lines, pavement and kerbs, etc. Finished grades will bear proper relationship to such control. The Contractor will adjust all works as necessary to meet the conditions and fulfill the intention of the Drawings.
- (e) For areas below earth mounds, cultivate the ground by ripping to a depth of 200mm before mound formation.
- (f) All grades shall provide for natural run off of water without low spots or pockets, flow lines shall be accurately set and shall not be less than 2% gradient, unless otherwise noted. Grades will be smooth and even on a uniform plane without abrupt changes or pockets and slope it away from all buildings.
- (g) The Contractor will verify the surface drainage of all planting areas and notify the Client's Representative of any discrepancies, obstructions, or other conditions considered detrimental to proper execution of the work and plant growth. The Contractor will adjust finished grading with screened soil as necessary.

RIPPING

- (a) Light and non-cohesive sub-grade: When ground conditions are reasonably dry, rip sub-grade thoroughly to a minimum depth of 300 mm.
- (b) Stiff clay and cohesive sub-grade: When ground conditions are reasonably dry, rip sub-grade thoroughly to a minimum depth of 450 mm.
- (c) Remove stones larger than 25mm in any dimension and sticks, roots, rubbish, weeds and other extraneous matter harmful to plants growth and legally dispose of them outside the Project Site.
- (d) Roughly grade to form free flowing contour without humps and water retaining hollows. Operate along with contour when on slope area to avoid significant alteration of formed sub grade level.
- (e) Ripping on slope:
 - Sub-grade at slope between 15 and 27 degree (2:1) shall be ripped parallel to the contour lines of existing sub grade.
 - Sloped sub-grade exceeding 27 degree (2:1) shall not be ripped.

MIXING

- (a) Mixing: Thoroughly blend top soil/ imported sub-standard planting soil applied with the recommended soil amendments and fertilizers to form General Planting Soil Mix. Mixing to be done at approved site area as approved by Client's Representative, before spreading on surface of specific planting area.
 - Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
-

FILLING

- (a) Planting pits and beds shall be filled carefully to fill all voids and to avoid breaking or bruising roots. Pack backfill firm to prevent settlement. When pit or bed is nearly filled, water thoroughly and allow water to soak away. If settling of the fill occurs after watering, add more fill to bring to level.
- (b) Sloped surfaces steeper than 1 vertical to 4 horizontal should be ploughed, scarified, or broken up sloped so fill material will bond with existing material.
- (c) Spread specified Planting Soil Mix corresponding to planting types and as indicated in the Drawings to meet finish grades after natural settlement. Place and compact fill material in layers as follows:
 - Under planted areas, place specified soil material;
 - Over Drainage Cells place specified soil material;
 - In raised planter areas place specified soil material.
- (d) Do not spread if planting soil or sub-grade is muddy, or excessively wet.
 - Spread approximately one-half the thickness of planting soil mix over loosened sub-grade. Compact the layer reasonably. Spread remainder of planting soil mix.
 - Do not mix or spread specified Planting Soil Mix until sample from each blended batch has analysed, reported and is submitted and approved by Client's Representative.
 - Cover and temporarily store prepared plant mix on site area designated by Client's Representative during the period of soil testing; Take measure to prevent degradation, fermentation, puddling and pest of the soil during the period.

FINISHED GRADING

- (a) Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Water the plant bed thoroughly and allow settlement of planting soil mix. Finishing level and finished contouring profile as indicated on the drawings.
- (b) Unless otherwise specified, finishing grade for planting areas shall be:

Planting bed	50mm below hard finish level
Lawn area	25mm below hard finish level when compacted
Raised planters	100mm below adjoining hard finish level
Adjoining soil areas	Merge
- (c) Before planting, restore planting beds if eroded or otherwise disturbed after finished grading.

2.4.1. TOLERANCE

- (a) The tolerance of the fill level or those on slope shall not be more than 75mm from the proposed level. The same tolerance shall be applicable to the limits and lines of cut and fill. All levels are those applicable at the end of the Defects Liability Period. The Contractor should therefore make the necessary allowance for consolidation, settlement and any other losses and to include all expenses for this in his quoted rates.

DRAINAGE COURSE

- (a) Install Drainage Course for raised planters or planting areas over slab with following procedure:
 - Check and ensure drain hole are adequate, in-place and functioning properly.
 - Place Drainage Mat layer, as specified in the Drawings, including upturns.
 - Lay and fix single layer of Geo-textile on top of Drainage Mat.

PREPARATION FOR TURF

- (a) Check and ensure drainage of lawn area is in place and working properly; report to Client's Representative if any irregularity is spotted.
- (b) Fill the planting bed with the Soil Mix to the required depths as per drawings and meet Final Grade as indicated on drawing.
- (c) Level the soil in gradient as indicated and tread or roll to firm up soil to prevent any settling of soil mass but without compaction; never firm up soil when it is wet.
- (d) Rip through the Top soil to remove impurity, materials harmful to plant growth, stones over 25mm in diameter and to form a fine tilth. If carpet or seeding is not installed on the same day, rake the area again just before sod is laid.
- (e) Protect the prepared plant bed from soil erosion or soil compaction if carpet is not installed on the same day of preparation works.

1.4.2.5. TREATMENT OF PITS/ BEDS

PRE-PLANTING WEED CONTROL

- (a) The Softscape Contractor will remove all visible weeds before any soil placement.
- (b) Herbicides and weedicides are not allowed.

ANTI-TERMITE TREATMENT

- (a) Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated:
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Chemical	Relevant Indian Standard	Concentration by weight_%
Chlorpyrifos 20 EC	IS: 8944-1978	1.0
Lindane 20 EC	IS: 632-1978	1.0

- (b) The method of application and the stages it will be applied shall be submitted for approval and this shall conform to relevant IS codes.
- (c) All works related to application of the Chemicals shall strictly follow Health and Safety procedures;
- (d) No work shall be carried out under unsuitable weather conditions, these include:
- Rain or when the soil is wet due to rain or sub-soil water;
 - Strong winds;
 - Heat waves.
- (e) Chemicals shall be brought to the site of work in sealed original containers. The materials shall be brought in at a time, in adequate quantity to suffice for the work. The material shall be kept in cool and locked stores. The empties shall not be removed from the work site till the relevant item of work has been completed and permission granted by the Client's Representative.
- (f) Chemicals available in concentrated forms with concentration indicated on the sealed containers shall only be used. Chemicals shall be diluted with water in the desired quantity before use, using graduated containers to achieve the desired percentage of concentration.
- (g) Hand operated pressure pump with graduated containers shall be used to ensure uniform spraying and to facilitate proper penetration of the chemical. Continuous check shall be kept to ensure that the specified quantity of chemicals is used for the required area during the operation.
- (h) The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

1.4.3. SOILS

1.4.3.1. SOIL MATERIALS

LOCAL SOIL MATERIAL

- (a) Availability: Top soil to be used for planting mixes is to be transported from the on-site top soil dump. The location of the top-soil dump will be provided by the Client's Representative.
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- (b) Composition: Topsoil obtained shall generally be reasonably loose and friable in form containing not more than 10-15% of moisture content. Client's Representative will reject topsoil delivered in a wet and soggy condition. Where required, the Topsoil may be used as sub soil as well.
- (c) Uses: Top soil from on-site dump is to be improved by addition of soil nutrients to comply to form the Soil Mix.
- (d) Testing: Imported Planting Soil shall be tested for N.P.K. value, organic matter content, Cation Exchange Capacity ratio, organic carbon, pH value, physical content of sand, silt and clay and water content. Soil testing shall be arranged by the Contractor and carried out by an approved reputable firm or institute at Contractor's cost, and the Report shall be submitted to the Client's Representative for approval.

IMPORTED SUB-SOIL

- (a) The imported sub-soil shall be evenly textured local soil as per specifications, that meets the following as minimum requirements:
 - pH range of 6.0 to 7.5
 - Free of grass or weed growth of any kind, sticky clays, or stones 100 mm or larger in any dimension and extraneous materials harmful to plant growth
 - Total percentage of stones should be less than 30% in volume
 - Salinity range of 2.0 – 4.0 ECe (dS/m)

IMPORTED PLANTING SOIL

- (a) Availability: Planting Soil is prepared off-site for on-site use. The Contractor has to ensure that the prepared soil is mixed as per the requirements for planting mixes specified in this Specification.
 - (b) Composition: Imported Planting Soil shall be evenly textured, fertile, dark brown or black coloured medium loam free from weeds, deleterious matter and stones larger than 25mm in any dimension and shall not be excessively sandy, gritty or water logged.
 - (c) Uses: Imported Planting Soil may need to be amended per the specification here-in to produce specialty Planting soil Mixes for Palms, seasonals and lawn areas, upon approval of the Client's Representative.
 - (d) Testing: Imported Planting Soil shall be tested for N.P.K. value, organic matter content, Cation Exchange Capacity ratio, organic carbon, pH value, physical content of sand, silt and clay and water content. Soil testing shall be arranged by the Contractor and carried out by an approved reputable firm or institute at Contractor's cost, and the Report shall be submitted to the Client's Representative for approval. The soil analysis report shall be submitted to the Client's Representative at least 6 weeks in advance of the programme date for the start of filling operations. Upon approval by the Project Manager the Contractor would be able to prepare the soil stock mix. .
 - (e) Imported Planting Soil for General Planting Soil purposes shall comply with the following minimums:
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pH value	: 5.5 – 7.5 %
Organic Matter	: not less than 7.5%
% Organic Carbon	: 2.0 – 3.0
% Total Nitrogen	: 0.09 – 0.15
Carbon / Nitrogen ratio	: 25:1 – 45:1
Available P2O5	: 7mg/100 – 10mg/100g
Exchangeable K2O	: 15mg/100g – 30mg/100g
Cation Exchange Capacity	: 16 – 20 m.e. %

Soil Texture

- (a) Sandy loam preferable; soil amelioration to take place only after review of soil reports and approval of Clients Representative.
- (b) Source: The Contractor should submit details of the source of Imported Planting Soil to the Client's Representative. No change in the source of Imported planting Soil shall be allowed at a later date without the prior approval of the Client's Representative based on such tests and samples as specified here-in.

1.4.3.2. SOIL AMENDMENTS

INORGANIC SOIL AMENDMENTS

- (a) Charcoal: Horticultural charcoal, size not more than 10mm.
- (b) River Sand: Clean, washed, natural or manufactured quartz sand, free of toxic materials, brick and other building materials and wastes, plant matter, roots of perennial weeds and any other foreign matter or material or substance that would render the sand unsuitable for use.

FERTILIZER

- (a) N-P-K 15:15:15 chemical fertilizer as per approval and as recommended by soil analysis. Will be uniformed in composition, free flowing and suitable for application with approved equipment. It will be delivered to the site in un-opened containers, each fully labelled and conforming to the applicable fertilizer laws. It will bear the name or mark of the manufacturer.

ORGANIC COMPOST

- (a) Farm yard manure (FYM): Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 13mm sieve; soluble salt content of 5 to 10
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decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

1.4.3.3. PLANTING SOIL MIXES

GENERAL REQUIREMENTS

- (a) Planting soil mix shall be fertile, friable soil. It shall be free draining, non-toxic and capable of sustaining healthy plant growth.
- (b) Planting soil mix shall be reasonably free from calcium carbonate, subsoil, refuse, roots, heavy clay, clods, noxious weed seeds, phytotoxic materials, coarse sand, rocks, sticks, brush, litter and other deleterious substances. It shall have a pH not lower than six or greater than eight.
- (c) The Softscape Contractor shall submit a sample to be approved by the Client's Representative/ Landscape Architect prior to commencement of work. This approved sample shall be used as reference for the whole project.
- (d) Topsoil and all planting media shall be free from any termite infestation, whether sub-terranean termites or dry wood termites. In the event termite infestation is found due to any softscape material (which shall be decided by the Landscape Architect, whose decision shall be final and conclusive), the Softscape Contractor shall carry out all necessary replacements and remedial works and make good all defects, damages or other faults (including but not limited to damage to any adjoining surfaces and /or finishes or any other works and properties caused directly or indirectly by the termite infestation).
- (e) Any other organic matter and additives to balance the pH value of the soil mix will not be more than 15% of the total soil mix.

SOIL MIX A

- (a) For use of tree pits, low shrubs and planting areas, comprise the following components in proportions by volume, which shall be mechanically cultivated to the correct proportions, prior to installation or backfilling:
 - Good quality, loamy topsoil 50%
 - Coco peat 20%
 - River sand (no salty materials) 20%
 - Organic compost 10%
 - NPK 15-15-15 Chemical Fertilizer 5 kg/10m³
- (b) (as per approval by Client's
- (c) Representative/ Landscape Architect)

SOIL MIX B

- (a) For use in raised planters/planting areas over slab, comprises the following components in proportions by volume, which shall be mechanically cultivated to the correct proportions, prior to installation or backfilling:
 - Good quality, loamy topsoil 50%
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- Coco peat 10%
- River sand (no salty materials) 10%
- Organic compost 10%
- Lightweight aggregate 20%
- NPK 15-15-15 Chemical Fertilizer 5 kg/10m³

- (b) (as per approval by Client's
- (c) Representative/ Landscape Architect)

SOIL MIX C

- (a) For use as potting compost in containerized planters the following components in proportions by volume, which shall be mechanically cultivated to the correct proportions, prior to installation or backfilling:
 - Good quality, loamy topsoil 40%
 - River sand (no salty materials) 30%
 - Charcoal 20%
 - Organic compost 20%
 - Water-retention crystals – according to manufacturer's specifications

1.4.3.4. EXECUTION

GENERAL

- (a) The work shall consist of furnishing, hauling and placing general planting soil mix in accordance with the details shown on the drawings and the requirements of these Specifications.
 - (b) Planting soil mix shall be spread uniformly on the designated areas to the required depths. When necessary, the area shall be cultivated to a sufficient depth to break up any materials which may have been compacted as a result of the spreading operations.
 - (c) The finished surface shall be free of all rocks and stones larger than one inch 25 mm in diameter.
 - (d) The Softscape Contractor will mix the soil mix composition thoroughly before placing it into the planting pit.
 - (e) Clean all subsoil areas to be filled free of rubbish and foreign materials and remove all stones exceeding >25mm in diameter and builders' debris from site. Any areas contaminated by petrol, oil or other toxic builders' chemical substances shall be immediately, fully and completely removed from site before filling commences.
 - (f) Excavated silty-clay site materials must not be used in backfilling. Dispose all excavated materials at the location as indicated by the Client's Representative.
 - (g) The soil mix must be free from heavy clay or coarse sand, stones, lumps, other vegetation, roots, sticks and other foreign material larger than <25 mm in diameter.
 - (h) The soil mix will be of the same composition and structure throughout and will not be delivered, handled or placed in a muddy condition.
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1.4.4. PLANTING

The softscape work is intended to achieve an instant, visually lush effect. All plant materials are to be of an instant, well-grown quality that is free from any infestation &/or defects. The installation is to be executed to the best of professional horticultural standards thereby achieving the required visual effect – well-established, lush-looking with full, bushy plant specimens & materials.

1.4.4.1. GENERAL

RELEVANT CONTRACT DOCUMENTS

(a) The section to be read in conjunction with below listed Drawings:

DELD– LSCL – 100 – TP – RSN
– 3003

Retrofitting Scheme- Proposed
Concept plan

(b) Contractor to make sure relevant Drawings from other packages are in his possession (e.g. relevant structural details).

SITE CONDITIONS

(a) Weather Limitations:

- Proceed with plant bed establishment, planting and related works only when existing and forecasted weather conditions permit the works to be performed. Notify Client's Representative of any works delay and/or any deviation from Works Program approved due to weather limitations.
- Planting operations shall be conducted under favourable weather conditions during the next season or seasons which are normal for such work as determined by accepted practice in the locality of the project. At the Softscape Contractor's option and full responsibility, planting operations may be conducted under unseasonable conditions without additional compensation.

(b) Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Client's Representative. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

(c) All planting shall be done during the time specified by the Architect.

(d) Planting shall not be done in soil that is excessively moist or otherwise in a condition not satisfactory for planting in accordance with accepted horticultural practice.

(e) Plants in containers shall be planted and watered the same day the plant is potted.

- (f) Plants shall be removed from containers in such a manner that the root ball is not broken. Plants with broken root balls or with root balls that fall apart while being planted may be rejected.

PRE-PLANTING MEETING

- (g) Contractor shall coordinate a Meeting with the Client's Representative prior to the installation of any of the works here-in.

DELIVERY, STORAGE AND HANDLING

- (a) Dig and immediately deliver plants prepared at the off-site or on-site nursery after site preparation for planting to be completed.
 - (b) Handle plants in protective manner and keeping natural form,
 - Protect bark, branches, and root systems from sunscald, drying, sweating, whipping, and other handling and tying damage,
 - Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape,
 - Provide protective covering and any other measures to plants during delivery to avoid damages,
 - Do not drop plants during delivery and handling,
 - Handle planting stock by root ball, especially as lifting,
 - Tie up fronds of palm trees reasonably to protect fronds and meristem from mechanical damage,
 - Maintain and prevent loss of plant label during delivery,
 - All equipment and transport vehicles required, including cranes required to transport semi-mature trees and large palms, are to be informed to the Client's Representative along with the delivery schedule to ensure adequate access as required.
 - (c) Deliver plants to construction site and/or On-site Nursery as designated by Client's Representative:
 - Provide Procurement Schedule as set out in (*as per Subhead 1.2. General Requirements, Section 1.2.7.2. Post Tender Submittals", of this Specification*).
 - Schedule item delivery date in accordance with the approved overall project schedule.
 - Ensure the provision of watering system is in place and adequate to plants temporarily stored in On-site Nursery and verify with Client's Representative.
 - Notify Client's Representative in writing prior to delivery for on-site material inspection and material confirmation arrangement and of list of material to be delivered.
 - Before on-site material inspection and subsequent approval by Client's Representative, the plants and materials shall not be used.
 - Replace all plants and materials rejected by Client's Representative.
 - Document all plant material damaged, dead or degraded during shipment and notifies Client's Representative.
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- Receive, unload and maintain plants as delivered to site prior to installation.
 - Plants of the same species used in any defined area should be of similar specifications and form.
- (d) If planting is delayed more than six hours after delivery, temporarily store plants and/or turf at On-Site Nursery as specified;
- Store and maintain nursery plants grown in shade conditions in equivalent shade conditions.
 - Plants stored on-site shall be spaced to allow clearance for light and air and shall not be spaced together such that branches might die or wilt.
 - Plants shall be stored on free draining soil surface without deleterious materials.
 - Set balled stock on ground and cover ball with soil, jute bag, sawdust, or other acceptable material to keep moist.
 - Water root systems and crown of plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.
 - Do not remove container-grown stock from containers before time of planting.
 - Trees and palms which are not immediately planted in their respective positions at On-site Nurseries shall be stood upright on level ground, protected and maintained in good condition by the Contractor at location approved.
 - Client's Representative shall reject any plants dead, dried out, wilted or degraded due to improper or prolonged storage.

TURF

- Harvesting to be done using turf cutter;
 - Deliver turf in time for planting within 24 hours of harvesting to avoid stacking. Do not stack to a height of more than 1m;
 - Take all necessary precautions to avoid breakage, drying out and deterioration of turf including covering the stored turf at all times;
 - Store turf in shade area and water turf to keep moist as necessary. Do not use turf that shows any signs of deterioration;
 - Lay on site sample area of 5m² of turf for Landscape Architects approval.
- (a) Delivery of Fertilizer and Bulk Materials:
- Fertilizers shall be delivered to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, and trademark.
 - Bulk materials including organic soil amendment, inorganic soil amendment, mulch, etc. shall be delivered to site in proper containers with certificate that includes manufacturers, quantity, chemical analysis, and trademark.
 - Keep all sacks, bags, containers and the like On-site for inspection by Client's Representative.
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- Stored material, particularly chemicals and fertilizers, are to be covered and enclosed in a defined area, or contained in any other way as required, to prevent mixing with nearby soil or water and causing soil and ground water pollution.
- (b) Storage of soil materials
- Stockpile all soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
- (c) Transportation:
- In preparing plants for moving, all precautions customary in good trade practice shall be taken. Workmanship that fails to meet the highest standards will not be accepted. All plants shall be dug to retain as many fibrous roots as possible. All plants shall be dug immediately before moving unless otherwise specified.
 - Prior to transportation, all plants shall be dug, handled, prepared and packed for shipment with care and skill, in accordance with recognized standard practice for each species. The root systems of all plants shall not be permitted to dry out at any time.
 - Plants shall be protected at all times against the sun and the wind while in transit.
 - During transportation in closed vehicles, plants shall receive adequate ventilation to prevent "sweating". Plants delivered in a wilted, burned or wind damaged condition will be rejected.
- (d) Delivery:
- All plant balls shall be firm and intact. Plants whose stems are loose at the root collar may be rejected
 - Plants delivered, inspected and found acceptable for planting shall normally be planted within 24 hours after delivery to the project site. Plants which cannot be planted within 24 hours after delivery shall be stored at onsite nursery.
 - Plants with broken, loose or tampered root balls will be rejected.
 - All temporarily stored plants shall be protected from extreme weather conditions and roots shall be kept moist.

1.4.4.2. PRODUCTS

GENERAL

- (a) General: Furnish nursery-grown trees and shrubs with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
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- (b) Provide trees and shrubs of sizes and ball or container sizes as indicated. Trees and shrubs of a larger size may be used if acceptable to Client's Representative, with a proportionate increase in size of roots or balls.
- (c) Root flare shall be visible before planting.
- (d) Label one tree and one shrub of each variety in every delivery batches with a securely attached waterproof label indicating their species, size, serial number, nursery source and noted planting location.
- (e) Plant List: A complete list of plants, including a schedule of qualities, sizes and other requirements is shown on the Drawings and shall be included in the Bill of Quantities.
- (f) Nomenclature: Botanical plant names shall be as per the International Code of Botanical Nomenclature. Common names of plants will conform to names generally accepted in the local nursery trade and as interpreted by the Landscape Architect. In all cases of dispute, the decision of the Landscape Architect will be final.
- (g) Quantities
 - The Landscape Sub-Contractor will provide sufficient quantities of plant materials needed to complete the work as shown in the Drawings for the lump sum price items.
 - Quantities indicated in the Drawings for unit price items are approximate only and are provided for the convenience of the Landscape Sub-Contractor. The Bill of Quantities will have precedence over the Drawings.
 - In the event that discrepancies occur between the quantities of plants in the Bill of Quantities and those shown on the drawing, the Bill of Quantity shall take precedence. In any event, it will be the Landscape Sub-Contractors responsibility to make sure that correct quantities provided on site.
- (h) Watering: The Main Contractor will provide water for the period during the installation of the landscape works. The Landscape Sub-Contractor will be responsible for providing hoses, water trucks and necessary equipment to ensure that there is adequate water for the plants and thoroughly water each.

TREES AND PALMS

- (a) Trees: Provide all trees with single sturdy straight trunk (or as indicated on drawing), branching spread equal or greater than indicated in the Plant Schedule (or as indicated on Drawings), well-balanced crown with sufficient branches and spread dimension as indicated on drawing, intact leader, with height, calliper and form as required.
 - (b) Palm Trees: Provide Palm Trees with form according to natural development of species and type or special form requirements as indicated in the Plant Schedule or on the Drawings, with relationship of calliper and height according to health growth stock of species and type, with upright habit (unless otherwise specified) and balanced crown form, with trunk height or total height, spread, number of fronds as specified in the Plant Schedule, with trunk free of lesions, sign of
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deterioration and damaged or deformed leave scale and with a health and sound meristem.

- (c) All Trees & Palm Trees shall fulfil requirement of as listed in the Plant Schedule or as indicated in the Drawings.
- (d) All plants shall be typical of their species or variety. All plants shall have normal, with developed branches and vigorous root systems. Trees and palms will be straight and have uniformed shape without damage. They shall be sound, healthy, vigorous, and free from defects, plant disease, insect eggs, borers, and all other forms of infections. Trees with abrasions on the bark, sunscalds, disfiguring knots or damaged limbs over 25mm diameter which have not been pruned, will be rejected.
- (e) All plants shall be nursery grown unless otherwise stated and shall have been growing under the same climatic conditions as the location of this project after the award of Sub-Contract. Refer to the drawings for specific forms and branching of plant material.
- (f) The minimum acceptable size of all trees after pruning, with branches in normal positions, will conform to the measurement specified in the Planting Schedule or related document unless stated otherwise.
- (g) Calliper measurement will be taken at a point on the trunk 1.0 meter above the ground.
- (h) Plants that meet the specified measurement, but do not possess a normal configuration or balance of height and spread will be rejected. All trees supplied will be branched as specified in the Planting Schedule or related document. Natural form of the trees must be kept after pollarding. De-topped trees will be rejected. All trees supplied must have terminal shoots.
- (i) Plant materials larger in size than specified may be used, but are subjected to the approval of the Landscape Architect. The use of larger plant material will make no change in the contract price. Height will not be substituted for balanced form.
- (j) All plant materials will have a root ball of sufficient size to support the plant's recovery from transplanting. Any plant materials delivered with small or inadequate root balls will be rejected. In all cases, the decision of the Landscape Architect will be final.
- (k) All trees and palms will be transplanted from growing site and planted at project site by mechanical crane whenever possible.
- (l) All specimen trees must have a minimum crown spread of not less than half the size of the overall height.
- (m) All instant trees must have minimum four main branching from the trunk with a minimum crown spread of not less than half the size of overall height.
- (n) In case discrepancy between specification given in the Plant Schedule and indication on the Drawings, Drawings shall take precedent.

SHRUBS

- (a) Shrubs: Provide shrubs grown from transplanted seedling or rooted cutting, pruned to encourage bushiness, with minimum of 3 numbers of canes/stems, with spread dimension at least two-third of height, and with well-developed root system.
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- (b) Shrub sizes indicated are sizes after pruning.

GROUND COVER PLANTS

- (a) Provide ground covers of species, height, spread as indicated in the Plant Schedule or on the Drawings, established and well rooted in pots or similar containers of reasonable size.

SEASONALS

- (a) Provide seasonals of species, height, spread as indicated in the Plant Schedule or on the Drawings, established and well rooted in pots or similar containers of reasonable size.

CLIMBERS

- (a) Provide climbers of species as indicated on drawing and complying with requirements as follows:
- Two-year plants with heavy, well-branched tops, with not less than 3 runners(shoots) 450 mm or more in length (or as indicated on drawing), and with a vigorous well-developed root system.
 - Provide field-grown climbers. Climbers grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

BAMBOO

- (a) Provide healthy, field-grown plants from a commercial nursery, of species, variety and size as indicated on drawing complying with requirements as below:
- Height as per Plant Schedule (or Drawings)
 - Vigorous rhizome system.
 - Minimum 8 numbers of culms (or as indicated in the Plant Schedule) supplied with branches and leaves.
 - Provide field-grown bamboo in pot, container, or fabric bag of adequate size.

TURF GRASS CARPET

- (a) Provide viable carpet of uniform density, colour, and texture, strongly rooted, free of disease, pest and weeds, and capable of vigorous growth and development when planted.
- Turf grass Species: Turf species as indicated in the Plant Schedule;
 - Carpet Dimension: 500mm(Length) x 300mm(Width) x 25mm(Thickness)
 - Tolerance: 10% difference.

FERTILIZER

- (a) Material handling: Chemical fertilizers shall be stored in waterproof sealed bags under shelter away from water and direct sunlight.
- (b) Commercial Fertilizer (Post-planting fertilizer, only if recommended by soils Report): Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- (c) Slow-Release Fertilizer (Pre-planting Fertilizer): Granular or tablet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

GUYING FOR LARGE/SPECIMEN TREES & PALMS

- (a) Guy Cables: 5-strand, 4.8 mm diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 75 mm long, with two 10-mm galvanized eyebolts per Detail.
- (b) Deadman Anchor: Pressure-Preservative (alternate material to be suggested) with thickness by length as indicated, pointed at one end per Detail.
- (c) Hose Chafing Guards: Reinforced rubber hose at least 12 mm in diameter, black, cut to lengths required to protect tree trunks from damage per Detail.

STAKING FOR TREES & PALMS

- (a) Wooden/Bamboo Stakes: Wooden/Bamboo with at least 50mm diameter flat cut at both end with length as per detail.
- (b) Trunk Padding: Rubber sheath cut to lengths to protect tree trunks from damage as per Detail.
- (c) Rubber Ties per Detail.
- (d) Bamboo Stake Foot Plate: For Tree installation with-in Tree Grates.

SUB-SURFACE DRAINAGE

- (a) Drainage mat: The sub-soil drainage modules shall be Versicell cellular drainage modules supplied by Elmich or approved equivalent. It should be a permeable modular structural drainage product manufactured from recycled plastic for filter system, an alternate of drainage gravel, equivalent and or approved material that can perform as aggregate; allow free drain within raised planter, specified planter box or for planting areas over slabs. Refer to Material schedule or relevant document for specification.
 - (b) Geo-textile: Woven or non-woven needle punched, hydrophobic geo-textile membrane laid over drainage mat for raised planters and planting areas over
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slab. 160-180gsm or as specified in the Bill of Quantities, fiberglass mat or equivalent approved. Mat laid at site with appropriate overlaps of 200 mm.

1.4.4.3. EXECUTION

PLANTING - PREPARATION

- (a) Examine areas to receive soil, plants and lawns for compliance with requirements and conditions affecting installation and performance.
- (b) Locate and clearly flag utilities, trees or vegetation to remain or to be relocated
- (c) Proceed with installation only after unsatisfactory conditions have been corrected
- (d) Lay out individual tree and shrub locations and areas for multiple plantings as set out in the Drawings. Stake locations, outline areas, adjust locations when requested, and obtain Client's Representative's acceptance of layout before planting. Make minor adjustments as required.

TREE, PALM AND LARGE SHRUBS

- (a) Trees & Shrubs: Set Trees and Shrubs plumb and in centre of pit or trench with root ball resting on a soil bench as per Drawings.
 - (b) Palms: Set Palms plumb and in centre of pit or trench with top of root ball 25mm below adjacent finish grades.
 - (c) Before planting, verify that root collar is not visible at top of root ball covered by 25mm of soil.
 - Remove covering from tops of root balls and partially from sides, but do not remove from under root balls or carefully remove root ball from container/ fabric bag. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - Place appropriate Planting Soil Mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix. Soil material shall be carefully firmed around the roots or the ball of the plant so as to eliminate air pockets. Soil shall be compacted around the roots or ball of the plants after planting operations to stabilise the rootball and ensure the tree is upright and vertical.
 - Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water, as per detail drawing.
 - Remove any wrapping and tying materials on trees/shrubs.
 - Remove any wrapping and tying materials from palms; if planting is not during planting season, keep fronds tied until establishment at location.
 - Immediately after planting, all plants shall be thoroughly irrigated until the soil fill around and below the roots or the root ball of each plant is saturated.
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- (d) Tree and Palm Planting on Slope: Planting should be carried out as soon as excavation or loosening of the prepared plant bed and immediately is fully supported as specified. Formed saucer indentation around tree or planting basin should be made with fall to drain as indicated on drawing.

SHRUB, GROUND COVER, SEASONALS, CLIMBER, BAMBOO

- (a) Plant Ground Cover, Seasonals, Climber and Bamboo as following as general requirement:
- Set out and space as indicated on drawing.
 - Dig holes large enough to allow spreading of roots and backfill with planting soil type as indicated in the Drawings.
 - Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
 - Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
 - Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

TURFING

- (a) Harvest turf (carpet grass) with turf cutter. Lay turf within 24 hours of harvesting. Do not lay turf if dormant or if ground is muddy.
- (b) Lay turf pieces to form a solid mass with tightly fitted joints. Butt ends and sides of each piece; do not stretch or overlap. Stagger turf strips or pads to offset joints in adjacent courses. Avoid damage to sub-grade or turf during installation. Tamp and roll lightly to ensure contact with sub-grade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of turf if and when shrinkage occurs; remove excess to avoid smothering turf and adjacent grass.
- (c) Laying on slopes:
- Lay turf pieces across angle of slopes exceeding 1:3.
 - Anchor turf pieces on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by the grass carpet manufacturer, not less than 2 anchors per carpet strip to prevent slippage.
- (d) Saturate turf with fine water spray within half hour of planting. During first week after planting, water as necessary to maintain moist soil and moisten 100-150mm deep of soil below turf layer as watered every time.
- (e) The top dressing media for all turf will consist of the following:
- 100% good quality, loamy topsoil
 - 5kg/m³ of NPK 15-15-15-fertilizer

GUYING & STAKING

- (a) Guying for Large Palms and Semi-Mature Trees: Unless otherwise indicated, securely attach no fewer than 3 guys to stakes 500 mm long, driven to grade.
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- For trees more than 150 mm in calliper, anchor guys to pressure-preservative-treated Deadman, 100 mm in diameter and 500 mm long buried at least 450 mm below grade. Provide turnbuckle for each guy wire and tighten securely.
 - Secure trees with guy wire looped as detailed with-in reinforced rubber hose at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - Paint turnbuckles with luminescent white paint.
- (b) Stakes for Standard Trees & Palms: Unless otherwise indicated, provide bracing system with stakes around perimeter of trunk as form of tripod to secure until established.
- Place 2 X 2 stakes on either side of the tree trunk. Supporting point should be at one third of the trunk height. Firmly press end of all four bamboo stakes against finished grade and into the ground for stability but without disturbing root ball area. Care should be taken that the stakes remain firm and stable throughout the staking period.
 - Cushion contact area between stake and trunk with 5mm thick, 150 x 150 rubber tire trunk protection sheath.
 - Secure Bamboo stakes together where they join at contact area at trunk with rubber ties in an '8' profile, as detailed in the drawings and mock-up approved by the Landscape Architect/ Client's Representative.
 - For Tree Grate installations, secure stakes to Stake Foot Plate as per detail.
- (c) Staking for Climbers: For staking against walls, pergolas and other as indicated.
- Provide 25mm diameter by 2000 ht. Bamboo poles driven 300mm depth to soil.
 - Attached and twist runner of climbers around bamboo pole.
 - Tie climbers to building wall or vertical members of pergola or railing as available.
- (d) Bamboo on slope: For bamboo planted on slope area or over 2 meter in height; provide support by tying and staking with bamboo poles of minimum 50mm diameter.

SUB-SOIL DRAINAGE IN RAISED PLANTERS OR OVER SLAB AREAS

- (a) The sub-soil drainage system shall be provided and endorsed by an engineer or specialist with a reputable track record in quality assurance.
 - (b) Proprietary materials supplied shall be identified clearly with the product's name and product information.
 - (c) All installed subsoil drainage panels shall be joined with no gaps between them. The ends shall be properly sealed with geotextile to ensure soil particles cannot enter the subsoil drainage panels.
 - (d) Prior to installation, the Contractor shall submit Method Statements and/or Shop Drawings endorsed by the manufacturer for the installation of the sub-soil drainage system. The latter shall be on at least A3 size paper and in a CAD-recognizable format.
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- (e) The subsoil drainage panels installed vertically shall be temporarily supported in position either manually or by props until backfilling takes place.
- (f) Suitable planting soil mix shall be used for backfill and laid in lightly compacted layers to an elevation of 100 mm below top of planter, allowing natural settlement.
- (g) Care should be taken not to damage the subsoil drainage panels or the geotextile covering during backfill.
- (h) Clay material shall not be used as backfill. The disposed clay soil shall be replaced with sand backfill. Sharp stones that may puncture the geotextile shall be removed from the backfill material before backfilling.
- (i) The contractor shall organize a full inspection of the subsoil drainage panels prior to completing the drainage system and backfilling unless otherwise directed.
- (j) The installed subsoil drainage panels shall be protected during all stages of construction traffic, be maintained and be free of accumulation of silt, debris or other foreign material until the time of final Inspection.

TREE AND SHRUB PRUNING

- (a) Remove only dead, dying, or broken branches. .
- (b) Prune, thin and shape trees and shrubs as directed by Client's Representative.
- (c) Prune, thin and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Client's Representative, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character or achieve desired form as specified in the drawing.
- (d) Clean all wounds with an approved fungicidal.

TRANSPLANTING

- (a) Transplant trees and shrubs designated for relocation to locations shown on the Drawings.
- (b) Prune, dig, ball and burlap, and move designated trees for relocation to the designated plant storage area for storage of materials until final planting areas are prepared, if required.
 - Maintain plants in storage areas by bracing plants in vertical position and setting balls in enclosed berms of topsoil or bark. Water as required for maintaining adequate root moisture.
 - Re-burlap plant balls if required before final transplanting operations.
 - Move to final locations shown on the drawings and plant in accordance with specified tree planting requirements.

DISPOSAL

- (a) Disposal: Remove surplus soil material, unsuitable Subsoil, obstructions, demolished materials, and waste materials including trash and debris, and
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legally dispose of them off Owner's property only upon the direction and approval of Client's Representative.

- (b) Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to an approved recycling facility or dumpsite.

COMPLETION INSPECTION

- (a) When all the works are to be completed and ready for inspection for issuance of Completion Certificate, the Contractor should notify the Client's Representative at least 7 days in advance to confirm completion and any outstanding works items.

1.5. Softscape: Maintainance

1.5.1. Maintainance

1.5.1.1. General

Maintain and establish plantings by carrying out the Maintenance Works as described here.

SCOPE

- (a) Planting Maintenance will continue for twelve (12) months upon receiving the Handover Certificate from the Landscape architect under the Main contract.
- (b) Care of the plant materials during installation is not considered part of the maintenance period.
- (c) The Contractor shall be responsible for the care and protection of trees, shrubs and plants planted. He will maintain all installation areas in optimum growing condition and appearance at all times. Such care and protection shall include, but not be limited to, the watering of stock, removal of trash and debris, controlling weeds, repairing, adjusting or replacing stakes and guying, furnishing and applying sprays and dust to combat diseases and insects and taking such precautions as necessary to prevent damage from sunburn or other hazards.
- (d) The Landscape Sub-Contractor shall remove and replace, at his expense, all dead plants and all plants that show signs of failure to grow or which area so injured or damaged as to render them unsuitable for the purpose intended, as determined by the Architect.

SUBMITTALS

- (a) Operations & Maintenance Manual: This should be submitted upon commencement of the maintenance period and shall include schedule and instructions for all activities to be undertaken for operations and maintenance of established works.
 - (b) As-built drawings:
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- The Contractor shall prepare As-built drawings and certify on these drawings that the drawings reflect the actual works installed.
- The As-Built Drawings shall be submitted to the PMC/Client representative at Practical Completion for checking before submission.
- Three sets of these drawings (hardcopy and softcopy) shall be submitted to the client post approval and record.
- The Contractor shall ensure that this submission of As-Built drawings will not delay subsequent inspections and tests by the relevant authorities; otherwise he shall be fully responsible for any consequence due to his delay.

MAINTENANCE SCHEDULE AND MONTHLY STATUS REPORT:

- (a) Provide Maintenance Schedule and Monthly Status Report, including, but not limited to, the following:
 - Name of maintenance Foreman or person filing report.
 - Period covered by report and other key dates.
 - Names of crew persons working on job. Client's Representative to be notified of changes in personnel within 2 weeks.
 - Work performed and completed to date and projected work for the next month.
 - Synopsis of weather conditions for the month noting extremes in wind, rain, temperature, etc.
 - Application of agricultural chemicals and fertilizers used on site including type, rates, purpose for applications, and results of application.
 - List of maintenance equipment used on site.
 - Condition of plant materials, specifically noting physical abnormalities related to temperature, moisture, insects, diseases, poor drainage, death and replacement, etc.
 - Include reports or recommendations by outside or consulting agencies.
 - Report vandalism.
 - Irrigation schedule, changes and current status.
- (b) The Contractor will assume the responsibility of maintenance including watering, fertilizing, spraying, weeding, forking, repairing and straightening stakes, etc. upon completion of planting until the end of the Maintenance period.
- (c) Contractor shall visit and walk around the site with the Client's Representative to observe and document existing site condition and to clarify scope of maintenance in addition to routine maintenance works.

RECORDS

- (a) Ensure that approved supervisor reports to the Client's Representative before and after carrying out each day's Maintenance Works and makes a signed record each day:
 - Stating works carried out.
 - Indicating the percentage completed for each day's operation.
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- Obtaining countersignatures from the Construction Manager's site staff and keeping records available for inspection.

VANDALISM

- (a) Provide proof on dead or damages of plants due to vandalism in writing with photographic record to Client's Representative within 3 days after occurrence.

PRE-MAINTENANCE INSPECTION

- (a) At the completion of all contract operations and prior to the beginning of the formal maintenance period, the Pre-Maintenance Inspection will be held. At the completion of the formal maintenance period, the Final Inspection will be held.
- (b) The Contractor will request these inspections of the Landscape Architect in writing five (5) working days prior to the completion of work in order that a mutually agreeable time for inspection may be arranged.
- (c) The Architect, Landscape Architect, Contractor and Client/Client's Representatives, will be present at the inspection.
- (d) At the time of inspection, the Contractor will have all the areas under the sub-contract neatly cultivated, raked and kept free of weeds, dead leaves and debris. All stakes, guys and plant basins will be in good order. Lawn will be cut neatly and all clippings removed.
- (e) If all or certain portion of the works are not acceptable under the terms and intent of the Drawings and Specification, the formal maintenance period for the unacceptable works and any related item will be extended at no cost to the Client. All rectification works must be accepted by the Landscape Architect.
- (f) The Landscape Architects decision as to what constitutes compliance with requirements and suitability shall be final and binding, the true intent and meaning of the contract being that the whole of the contract works shall be completed to the satisfaction of the Landscape Architect. No rejected item shall be considered as a reason for failure to meet the completion date.
- (g) If, after the Pre-Maintenance Inspection, the Landscape Architect is of the opinion that not all works are acceptable, a Landscape Defects List must be drawn up and defects completed within seven (7) days, unless otherwise stated, and the Landscape Architect will set the final inspection date to verify the rectification works.
- (h) On inspection, if it is the opinion of the Landscape Architect that the rectification works carried out are not acceptable, the Client's Representative will issue a direction to the Contractor to make good the defects, which need to be completed in seven (7) days, unless otherwise stated. If the Contractor fails to do so, the Client may employ other Contractors to give effect to the direction. The extra cost (if any) of doing so shall be deducted from any monies otherwise due or recover the same from the Contractor.

FINAL INSPECTION

- (a) Inspection of the planting to determine its final acceptance will be made at the end of the Maintenance period by the Landscape Architect. If after the Final Inspection, the Landscape Architect is of the opinion that all works have been performed satisfactory, and in accordance with the maintenance schedule as stated in the Bill of Quantities, the Client's Representative will issue the Contractor a Handover Certificate.
 - (b) Submit a written request to Client's Representative for inspection at least 10 working days prior to end of the Maintenance Period.
 - (c) Prior to final approval of works, do the following:
 - Re-turf or replant areas where necessary to obtain full and even coverage.
 - Remove all debris resulting from works of this Section.
 - Fill all depression and eroded channels with sufficient planting soil mix to adjust grade to ensure proper drainage, compact lightly, and replant filled areas in accordance with drawing indicated.
 - (d) Soft works (landscape installation) shall not be considered complete if the Contractor fails to complete any one of the items below:
 - Each plant shall be alive, vigorous and thriving, showing signs of growth and no signs of stress disease or other weakness. Plants not meeting these conditions shall be replaced.
 - Items listed as defective are completed and approved by Client's Representative.
 - Final grades approved in accordance with drawing indicated.
 - Site free of weeds.
 - All plant materials including trees, palms, shrubs, groundcovers, lawns installed in accordance with drawing indicated or as per site instructions of Client's Representative.
 - All materials fertilized and soil amendment completed and in place.
 - (e) If, after the Final Maintenance Inspection, the Landscape Architect is of opinion that not all works are acceptable, a Landscape Defect List will be issued to the Contractor. Rectification works on the Landscape Defect List must be completed within seven (7) days, unless otherwise stated, and the Landscape Architect will set the final inspection date to verify the works.
 - (f) On inspection, if it is the opinion of the Landscape Architect that the rectification works carried out are not acceptable, the Client's Representative will issue a direction to the Contractor to make good the defects, which need to be completed in seven (7) days, unless otherwise stated. If the Contractor fails to do so the Client may employ other Contractors to give effect to the direction. The extra cost (if any) of doing so shall be deducted from any monies otherwise due or recover the same from the Contractor.
 - (g) Perform corrective work and materials replacement in accordance with drawing and specification indicated at no additional cost.
 - (h) After corrective work is completed, the Contractor shall again request a review for final inspection as outline above.
 - (i) Continue maintenance for the project until such time as corrective measures have been completed and accepted.
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- (j) The Landscape Architect has the right to shorten the maintenance period by issuing a landscape Handover Certificate to the Contractor upon which the Client has the right to terminate the maintenance service by the Contractor and the remaining period shall cease.
- (k) Locations of plants that are replaced during the Maintenance Period shall be recorded by the Contractor and submitted to Client's Representative as a set of record drawings. These plants shall remain under warranty for one complete growing season after their installation to ensure their survival; this period shall be a minimum of 4 months and a maximum of 12 months after installation, depending on the timing of replacement. At the end of said growing season, Client's Representative and the Contractor will inspect the plants for health and vigour.

1.5.1.2. CARE AND PROTECTION OF PLANTS

TOOLS AND EQUIPMENT:

- (a) Do not use tools and equipment at the site which has not been thoroughly cleaned of mud, sap, residue etc., after previous use elsewhere.
- (b) Sterilize pruning tools previously used on diseased plant materials at other sites prior to their use at the site. When pruning diseased plant materials at the site, sterilize equipment after each cut to prevent the spread of disease.

DAILY INSPECTIONS:

- (a) Daily inspection should be part of the maintenance routine. In addition, a comprehensive inspection should be conducted on a monthly basis to analyse plant materials for signs of stress, damage and potential form the following:
 - Infestation: Moles, rats or other gnawing rodents, snails, slugs, insects, etc.
 - Disease: Withering of leaves, die-back, blackened or galled branches, wilt, fungus growths, cancer, bleeding bark, root rot, stunted growth, discoloured or blotchy foliage.
 - Loss of vigour: In normal healthy plants, this is seen as a failure to thrive, a dropping of unopened flowers, leaves that are small for the species, or thin or leggy growth. These symptoms may have many causes: heat stress, desiccation, wind damage, improper irrigation, incorrect installation, damage from construction or maintenance vehicles, or altered growing condition. Treat each instance individually when determining cause of decline and treatment.
 - Fertilizer or soil chemical imbalance: Fertilizer 'burn' at leaf margins, unusually light green or yellowish-green leaf colour (chlorosis), yellow/brown salt 'burn' at leaf margin, or other symptoms. Make sure that spraying an application of fertilizers and soil chemical is done discriminately and in accordance with manufacturers' recommendations and confined to the areas affected.
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CLEARING UP

- (a) Remove dead and/ or over hanging branches of existing trees, palm, shrubs and groundcovers.
- (b) Remove any garbage and unsightly foreign materials.
- (c) Remove dead vines and plant materials.

WEEDING

- (a) Keep planting areas free of weeds and undesirable grasses through daily weeding if required. Remove the entire root system of all weeds.
- (b) Dispose off all weeds in appropriate trash container and remove from site.

PRUNING

- (a) Pruning Procedures: Carry out pruning using sharp tools to give a clean cut, free form ragged edges and:
 - Prune all trees as directed by the Landscape Architect to establish desired form, habit and appearance.
 - Ensure cuts are immediately above buds or branches and slope away from an outward facing bud.
 - Prune back branches, to the main stem to encourage bushy growth and improve flowering.
 - Remove dead, damaged or crossing branches and dead flower heads.
 - Retain the individual habit and shape of the plant, unless otherwise directed or the intention of the design is to form a clipped hedge.
 - Prune flowering shrubs by removing the shoots bearing the dead flower heads and/or the new growth dependant on species.
- (b) Do not clip shrubs into balled or boxed forms unless specifically called for in the design. Only shrubs designated as "hedges" are to be sheared. Periodically pinch back 'wild' growth on shrubs to maintain uniform habit.
- (c) Immediately dispose of pruning and trimming debris from trees and shrubs off site at an approved dumpsite.
- (d) Edge groundcover adjacent to walks to keep in boundary. When appropriate, trim top growth in spring by mow in order to renew growth, improve density and attractiveness, and to achieve an overall even appearance. Do not mow until plants have been firmly established and have formed a dense mat. The Client's Representative will determine mowing height. Dispose of groundcover clippings off site.

THINNING

- (a) Where instructed by Client's Representative reduced the number of plants due to overcrowding as follow:
 - Dig up plants, transport and replant in locations as directed or remove from site as approved by Client's Representative.
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- Backfill the excavated void with Planting Soil Mix.

AERATION

- (a) Shrub areas, including bamboos, climbers, and perennial: immediately after fertilizing, cultivate the soil by hand using fork to a depth of 100mm.
- (b) Ground cover areas: immediately after fertilizing lightly break up the soil by hand using a fork to a depth of 75mm.
- (c) Grass areas: immediately before fertilizing aerate the soil by inserting a fork to a depth of 100mm at 200mm centres.

WATERING

- (a) The contractor shall be supplied with non-toxic water for irrigation at pre-defined locations by the client. The Contractor shall provide at all times a supply of non-toxic water to the planting area from the provided water source. The Contractor shall make due allowance in this rates for importing non-toxic water during periods of restrictions or pipe work failure if a piped supply has been laid on.
- (b) Water all planted areas so as to maintain a moist soil (not saturated) through the depth of the soil profile adequate to ensure satisfactory establishment and as minimum:
 - Adjust watering as per rainfall and weather conditions.
 - Water desert origin plants at a much lower frequency to keep their growing medium reasonably dry to suit their species-specific habit; avoid over watering which might cause rotting of root and trunk
 - Carry out watering either early mornings or late afternoon or both.
 - Regulate watering as necessary to avoid erosion and gulling.

CONTROL OF PEST AND DISEASE

- (a) Fertilize as needed in accordance with the manufacturer's recommendations and five days prior to the Final Inspection.
 - (b) Regularly inspect any sign pest invasion, fungal growth or disease outbreak, report and take immediate counter-action to prevent further spread and reduce damages to plants.
 - (c) Immediately effect remedial measures by spraying with solution of pesticide or germicide approved in strict accordance with the manufacturer's instruction
 - (d) Remove by corrective pruning plant material infested by pest or disease immediately after being identified.
 - (e) Transport diseased or infested plant materials or plant material cuttings completely off the site immediately after their removal. Do not permit pruned materials from diseased planting to be stockpiled anywhere on site at any time.
 - (f) Inspect new plant materials for signs of insect infestation or disease upon delivery to the site. If possible, quarantine new materials in the nurseries for 3 weeks prior to installation.
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- (g) Immediately wash off sprayer drippings and materials accidentally spilled on plants.
- (h) Exercise caution, proper supervision and take necessary measures to avoid scorching of plants.

LAWN MAINTENANCE

- (a) Maintain all lawn areas by watering, fertilizing, weeding, mowing, aeration, replanting, and other operations. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.
- (b) Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 100 mm.
- (c) Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
- (d) Water lawn with fine spray as required unless rainfall precipitation is adequate.
- (e) Mow the lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:
 - Mow the grass to a height of 25 mm whenever the average height exceeds 50mm
 - Grass will be cut according to the contours of the ground.
 - All clippings must be removed on the same day.
- (f) Lawn installations shall meet the following criteria as determined by Client's Representative:
 - Satisfactory Lawn: At the end of maintenance period, a healthy, well-rooted, even-coloured, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
 - Use specified materials to re-establish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

TREE STABILIZATION MATERIALS

- (a) Re-stake, straighten, tighten, repair, reset guys and stakes to proper grades or upright position for any plants that are not in their proper growing position.
- (b) Remove all tree stabilization materials toward the end of maintenance period upon approval of the Client's Representative.

DEFECTIVE PLANTS & MATERIALS

- (a) The expense of replacement of defective materials during the maintenance period will be borne by the Landscape Contractor and shall be included for in his price for this section of the work. The Landscape Architect shall be at liberty to reject any installation, materials and workmanship not complying with the requirements of the sub-contract specification or which are in any way unsuitable and to order their removal and replacement, without increase to the contract sum.
- (b) All plants shall be guaranteed to remain alive and healthy for the Maintenance period.
- (c) Plant materials with pest infestations and/or in diseased conditions during the maintenance period shall have additional warranty period of twelve (12) months from the end of the Maintenance Period. The Landscape Architect shall determine the non-conformance of the plant materials and notify the Contractor.
- (d) Upon receipt of written notice from the Landscape Architect of rejection of any plant materials during the warranty period due to death, diseased or unacceptable/ defective growth pattern, the plant materials will be promptly replaced with the same species as originally planned. The replacement made will be of similar size as if normal growth had occurred since the original planting. Replacement will be subjected to all requirements as stated in this Specification and Bill of Quantities. All replacement works shall be completed within seven (7) working days from the date of the end-Maintenance Inspection.
- (e) When plants are replaced, the Contractor will advise the Landscape Architect, in writing, of the necessary establishment maintenance which must be performed. If this information is not provided, the Contractor will be liable for the total cost of replacement should the replaced plant die.

1.5.1.3. SCHEDULE OF MAINTENANCE

GENERAL

- (a) For Maintenance during and after issuance of Completion Certificate, carry out the maintenance works as per schedule in accordance with Works Programme as required. (Anticipated labour numbers; timing for maintenance schedule to be coordinated with Client's Representative)
- (b) In the event of the scheduled operation requiring amendment due to the site and weather conditions prevailing during the Maintenance Period, seek approval, at least four weeks before the operation on site, with full justification to exceed the numbers specified.
- (c) In the event of emergency, the Contractor must carry out the landscape maintenance works immediately according to the Owner's instruction.
- (d) Maintenance schedule is below, to be verified with the Client's representative:

Maintenance Work	Timing
Watering	As often as necessary to ensure that planting

	medium does not dry out
Weeding	Fortnightly
Fertilizing: - Tree - Shrubs/ground cover - Turf	Once every 3 months Monthly Once every 3 months
Soil aeration	Monthly
Firming up	Immediately after strong winds and/or every 4 months
Tying climbers to supports and climber wires	Check monthly ties as necessary
Pruning and shaping trees	As and when required
Trimming shrubs/ground covers	Monthly, or as and when required
Guying & staking	As and when required
Grass cutting	Fourteen (14) days interval or as specified
Control of pests	Check fortnightly, treat immediately as per manufacturer's instructions
Control of diseases	Check monthly, treat immediately as per manufacturer's instructions
Top dressing for turf/shrubs	Monthly, and until the soil is level
Removal of dead leaves in landscape areas	Daily
Storm damage: assessment & repair	After each incident

1.5.1.4. LIABILITY

GENERAL

- (a) Contractor agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period and to bear all costs therein.
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- (b) Failures include, but are not limited to the following:
 - Death and unsatisfactory growth.
 - Structural failures including plantings falling or blowing over.
 - Pest, fungal and disease infestation.
 - Damage by Vandalism.
 - Faulty operation of tree stabilization.
 - (c) Warranty Periods from Date of Substantial Completion:
 - All plants: One year.
 - (d) Include the following remedial actions as a minimum:
 - Remove dead plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - Replace plants that are more than 25 percent dead or in an unhealthy condition at the end of warranty period.
 - (e) Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.
 - (f) The Contractor is responsible for the use of all material, labour, equipment and any injury to plant material caused by such material, labour and equipment will be repaired or replaced by the Contractor at his/ her own expense.
 - (g) The Contractor will not be held liable for loss of materials after the issue of 'Handover Certificate' due to vandalism and/ or act of Nature.
 - (h) The liability under the warranty period will include the repair of damages to the owner's, Main Contractor's and/or other Contractor's property caused by the failure of the work performed under this Section. All provision of this Section applies to work performed to satisfy the requirement of this warranty.
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2. Specification & Standards- Utilities Infrastructure

2.1. Pipelines and Specials for Pressurised networks Potable Water Supply, Irrigation and Fire Fighting

2.1.1. Applicable Codes

The Codes and Standards listed herein are not comprehensive but only generic. All design and specifications shall be based on latest Bureau of Indian Standards' (BIS) Codes of Practice and its Publications including all applicable official amendments and revisions.

Table 1.1: List of Codes for Pressurized Network

S. No.	Code No.	Description
1.	IS: 376	Safety Code for Excavation Work
2.	IS: 10500	Drinking water specification
3.	IS: 14846	Sluice valve for water works purposes
4.	IS 13095	Butterfly Valves
5.	IS: 4984	High Density Polyethylene pipes for water supply
6.	IS: 8360	Specification for fabricated HDPE Fittings
7.	IS 8008	Specification for moulded HDPE Fittings
8.	IS 2530	Methods of test for polyethylene moulding materials and polyethylene compounds GRP pipes, joints, and fittings for use for Potable Water Supply
9.	IS 4905	Methods for random sampling
10.	IS 7328	High Density Polyethylene materials for moulding and extrusions
11.	IS 7634	Laying and Jointing of Polyethylene (PE) pipes
12.	ISO 4427	Polyethylene Pipes for water supply-specifications
13.	IS: 8329	Specification for centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage
14.	IS: 9523	Specification for ductile iron fittings for pressure pipes for water, gas and sewage

S. No.	Code No.	Description
15.	IS: 11906	Recommendations for cement mortar lining for cast iron, mild steel and ductile iron pipes and fittings for transportation of water
16.	CPHEEO	Manual on Water Supply and Treatment, III edition, Ministry of Urban Development
17.	IS 2041	Steel Plates for Pressure vessels used at moderate and low temperatures
18.	IS 2825	Code for unfired pressure vessels

2.1.1. Ductile Iron and Fittings

Ductile iron pressure pipes and fittings (Class K9) shall be IS 8329 and IS 9523 marked. All fittings shall be socketed unless specified otherwise.

2.1.2. Handling, Transportation and Storage of Pipes

Handling, transportation and storage of DI pipes shall conform to relevant IS codes.

2.1.3. Installation

Supplying, laying, jointing, testing and commissioning of pipes shall conform to relevant IS codes, as applicable. At road crossings pipes should be encased M15 RCC of minimum 150 mm thickness. The alignment of pipelines shown in drawings of the tender documents is only indicative and the exact alignment will be as per approved design by the Engineer.

2.1.4. Joints

2.1.4.1. Spigot and Socket Joints:

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS 12820.

2.1.4.2. Flanged Joints:

Flanged joints shall comply with dimensions and drilling details shall be to BS EN 1092-2. All flanged joints between steel and ductile iron pipe work shall be electrically isolated joints. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts.

2.1.5. Internal Linings

Ductile iron pipes and fittings shall have a cement mortar lining, in accordance with IS 11906 or ISO 4179. The minimum thickness of the lining shall not be less than 4 mm.

2.1.6. External Coating

Ductile iron pipes and fittings shall be zinc coated with bitumen over coating in accordance with the following specifications. Buried and Exposed pipes above ground and fittings shall also have a - factory applied polythene sleeving.

Zinc coating shall comply with ISO 8179 and shall be applied as a spray coating. The mass of sprayed metal shall not be less than 200 g/m² as described in Clause 5.2 of ISO 8179.

Bitumen coating shall be of normal thickness 0.07 mm unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II.

2.1.7. Bedding of Pipes

Bedding shall be as per CPHEEO guidelines. Under dry soil conditions, the pipe shall be laid over sand bedding. The thickness of bedding shall be 150 mm or 0.25x (Outer dia.) whichever is more. The pipe shall be supported from sides and covered up to a depth of 15 cm above the pipe crown with fine sand. The bedding material shall be well graded fine sand as per IS 383 suitably compacted/rammed for pipe. Under sub-soil water/sub merged conditions the pipe shall be laid over 15 cm thick bed of graded rounded gravels 100 % passing through 20 mm sieve, 20-25 % passing through 10 mm sieve and 100 % retained on 6 mm sieve and shall also be encased with 15 cm thick layer of graded rounded gravels. This cover of graded rounded gravels all around the pipe shall act as a filter.

2.1.8. Flushing and Disinfection

Pipeline carrying potable water and Irrigation water shall be suitably disinfected before commissioning. The main shall be flushed prior to disinfection. After initial flushing, the hypochlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of 'slug' of chlorinated water that will as it passes along the line expose all interior surfaces to a concentration of at least 300 mg/l for at least 3 hours.

Underground mains and lead-in connections to system risers shall be flushed before connections made to piping in order to remove foreign materials which may have entered

underground during the course of installation. The flushing operation shall be continued until water is clear.

Underground mains and connections shall be flushed at a flow rate of not less than 1620 ltrs. per minute. The pump, water and other equipment necessary for the flushing shall be arranged by the contractor at his own cost.

2.1.9. Hydro testing of pipes

Hydro pressure testing shall be done on the completed pipe length for a minimum pressure of 1.5 times the designed pressure for retaining period of 4 hours. The acceptance criteria for hydrostatic test are no permanent deformation of any part of the pipeline fitting or equipment's and there shall not be any leakage through any of the joints. The hydro testing shall be done in the presence of Engineer and a report shall be made by the contractor and the same shall be signed by the contractors representative and Engineer and submit the same to Employer after the successful completion of the hydro test. All the necessary consumables, equipment, tools & tackles required for the testing & inspection shall be arranged by the contractor and no extra cost shall be paid for the same.

2.1.10. Installation of Valves

The installation of valves in the trench shall be such that it's top of spindle/hand wheel will always be at least 150 mm below from the ground level and precast cover in the chamber and as per appropriate IS codes.

2.1.10.1. Sluice Valves:

Sluice valves shall generally conform to IS 14846. All valves shall be resilient seated Sluice valve PN 16, non-rising type. Flanges dimensions shall be as per ASME B16.5 150#.

Hydro pressure testing has to be done for all the valves as per IS 13095 – 1991 including its latest, at the manufacturer's end and a report has to be submitted to Engineer.

S. No.	Components	Material
1	Body and Doors	Cast Iron : IS:210 Gr FG 220
2	Spindle	Stainless Steel: BS:970 Gr 431
3	Wedge Gate	CI (Fully vulcanized with EPDM rubber)
4	Bonnet Gasket	EPDM
5	O-Rings(Stem Sealing)	EPDM
6	Shoe and channel linings	Stainless Steel : BS:970 Gr 304
7	Internal Fasteners	SS 316

2.1.10.2. Butterfly valves:

Butterfly valves shall be of double eccentric and resilient seated type generally as per BS EN 593 and IS 13095. The valves in the pump rising main shall be electrically/pneumatically operated resilient seated mounted flanged/ wafer type Butterfly valve as per IS 13095:1991 PN 16/BS:5155 PN16 non-rising stem, as per specifications below:

S.No	Pressure Rating	PN 16
1	Type	Flanged/wafer/lugged wafer type
2	Body	Ductile Iron ASTM A536 Internally and external Electro-statically applied epoxy resin of 250 microns min
3	Disc	316 Stainless Steel A STM A351, Type CF8M
4	Body Seat Ring	EPDM
5	Shaft and hand wheel	SS-410
6	'O' Ring	EPDM
7	Internal hardware	SS-316

Disc pins shall be stainless steel. Rings shall be bi-directional self-adjusting suitable for pressure or vacuum service. Removal and replacement of seals shall be possible without removing the operating mechanism, valve shaft and without removing the valve from the pipeline. Valve shafts shall be a one-piece unit extending completely through the valve disc, or of the "stub shaft" type, which comprises two separate shafts inserted into the valve disc hubs.

All valve spindles and hand wheels shall be positioned to give good access for operational personnel. Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The gear box shall be of worm and worm wheel design type, totally enclosed, grease filled and weather proof. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head of 1.15 times the specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 200 N. All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

The disc shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The disc shall be contoured to ensure the lowest possible resistance to flow and shall be suitable for throttling operation.

Valves shall be capable of closing against the maximum flow that can occur in system. The shaft shall be designed to withstand the maximum torque that will be imposed by the operator. It shall be secured to the discs by tapered stainless steel cotter pins.

Valves shall be provided with position indicator to show the position of the disc, mounted on the driven shaft end.

Rigid adjustable stop mechanism shall be provided within the gear box or elsewhere on the valve to prevent movement of the disc beyond the fully open or closed position (i.e. set points).

2.1.10.3. Ball Valves

The Ball Valves shall conform to API 6D/ API FA. The flange end shall be ANSI B 16.5 150#. The port shall be full bore bi-directional type.

Material of construction shall be as follows:

Body: ASTM A 216 GR WCB

Ball: ASTM A 217 GR CA 15 (Solid)

Seat: PTFE

Stem: ASTM A 276 GR 410

2.1.10.4. Air Valves

Air valves shall be of the kinetic, double orifice type, tamper proof suitable for releasing or admitting air in large volume when pipe is being charged or emptied and to release accumulated air under pressure. Air valves shall comprise of cast iron body having faced and drilled flange at inlet and with two chambers each housing a ball. One chamber shall have small orifice plate and other a large orifice plate. Balls shall be of injection moulded plastic with high impact strength.

Material of construction of air valve shall comply with following requirement:

S. No.	Components	Material
1.	Body and cover	CI
2.	Stem	High tensile brass
3.	Float	Polycarbonate up to 50 NB / SS 304- above 50 NB
4.	Vent valve	Brass
5	Low Pressure seat ring and face rings	EPDM

6	Gasket, seal ring, sealing face	EPDM
7	Nut/Bolts	Stainless steel-304
8.	Coating	Electro-statically applied epoxy resin- Internally and externally (min 250 micron)

2.1.10.5. Non-Return Valve

The valve shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.

Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.

Dual plate check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The spring action shall optimize the equal closing rates of each plate especially when the friction coefficients are uneven due to one plate resting upon one another. The plates shall not drag on the seat while opening. The plates shall not vibrate under full or partial flow condition. Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.

The minimum body-wall thickness shall conform to those given in Table 1B of API Standard 594.

The face-to-face dimensions of valves (including valves with ring-joint facings) shall conform to those mentioned in Table 2B of API Standard 594.

The valve body shall be furnished with a clearly visible forged, machined-in, or die-stamped arrow to indicate the direction of flow through the valve.

Maximum permissible seat leakage is 7cc/Hr/cm nominal diameter of valve.

Material of construction of valves shall comply with following requirements:

S. No.	Components	Material
1.	Body	ASTM, A 395
2.	Plate	ASTM, A 351 Gr CF8M
3.	Hinge Pin /Stop Pin/wetted parts	SS. AISI 316
4.	Springs	SS. ASTM A 313
5	Seat	SS AISI 316

S. No.	Components	Material
6	Retainer	SS-304

2.1.11. Civil Works

All the civil work shall be carried out in accordance with civil and structural specifications provided in tender and latest CPWD specifications.

2.1.12. Testing and Commissioning of Pressurized Networks

Testing and commissioning of pipeline and other associated structures should be carried out as per applicable standards and IS codes. Testing and commissioning shall be coordinated with the Engineer.

2.2. Sewage System

2.2.1. Codes

The Codes and Standards listed herein are not comprehensive but only generic. All design and specifications shall be based on latest Bureau of Indian Standards' (BIS) Codes of Practice and its Publications including all applicable official amendments and revisions.

Table 2.1 Codes for Sewer Network

S.No.	Code No.	Title / Specification
1.	IS: 14333	Specification for High Density Polyethylene pipes (HDPE) and fittings for the use for Sewerage
2.	IS: 7634 Part 2 and 3	Code of practice for Laying and Jointing of High Density polyethylene pipes (HDPE) piping system
3.	IS: 783	Code of practice for laying of Concrete Pipes

2.2.2. HDPE Pipes and Fittings

All pipes shall be IS 14333 (latest edition) marked. HDPE Pipes shall be PE-80; PN-6. HDPE shall be used for sewage collection. The pipes shall be ISI marked suitable for making butt fusion joints. High density polyethylene (HDPE) used for manufacture of pipes shall conform to designation PEEWA-45-TA-006 of IS 7328 1992. HDPE pipes shall be rodent proof.

HDPE pipes should be manufactured using virgin pre-compounded black PE resin as per ISO/TR 9080: 1992, which complies with the following requirements:

The resin also should have been certified by an independent laboratory of international repute like Bodycote/ Slevan/ Advantica for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10MPa. There should not be any brittle knee at 80 Deg C before 5000 hours. Internal certificate of any resin manufacturer will not be acceptable.

The resin must have passed the resistance to Slow Crack Growth test as per ISO 13479. It should be certified by independent laboratories of international repute like Bechtel or Bodycote.

Resin should fully conform to the requirements of ISO 4427.

The resin shall be compounded with carbon black. The carbon black content in the material shall be within $2.5 \pm 0.5\%$ and the dispersion of carbon black shall be in line with relevant international standards.

HDPE Pipes should be with non-detachable, detectable feature as specified under and should be capable of working with industry standard radio detection equipment.

Copper Wire Diameter: 1.20 mm +/- 0.02

Copper Wire Resistance: < 10.0 Ohms/Km. at 27 deg. C

2.2.3. Handling, Transportation and Storage

Handling, Transportation and Storage of HDPE pipes shall be done as per IS 7634.

2.2.4. Installation

Supplying, laying and jointing of pipes shall conform to relevant IS codes, as applicable. At road crossings pipes should be encased in RCC pipes of larger diameter. The alignment of pipelines shown in drawings of the tender documents is only indicative and the exact alignment will be as per design approved by the Engineer. The HDPE Pipes shall be laid in accordance with the latest IS 7634.

2.2.5. Fittings and Specials

All HDPE fittings/ specials shall be fabricated in accordance with IS: 8360 (Part I & III). PE Injection moulded fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be fabricated or injection moulded at factory only.

2.2.6. Jointing

HDPE pipe shall have electro-fusion welding for diameter up to and equal to 160 mm and for higher diameters pipe shall be joined by butt-fusion welding as per applicable standards and manufacturer's instructions. Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634.

2.2.7. Bedding

Bedding shall be as per CPHEEO guidelines. Under dry soil conditions the pipe shall be laid over 15 cm thick sand bedding. The pipe shall be supported from sides and covered up to a depth of 15 cm above the pipe crown with fine sand. Under sub-soil water/sub merged conditions the pipe shall be laid over 15 cm thick bed of graded rounded gravels 100 % passing through 20 mm sieve, 20-25 % passing through 10 mm sieve and 100 % retained on 6 mm sieve and shall also be encased with 15 cm thick layer of graded rounded gravels. This cover of graded rounded gravels all around the pipe shall act as a filter.

2.2.8. Flushing

Pipeline carrying sewage shall be suitably flushed in order to remove foreign materials which may have entered underground during the course of installation. Flushing operation shall be continued until water is clear.

The pump, water and other equipment necessary for the flushing shall be arranged by the contractor at his own cost.

2.2.9. RCC Pipes (NP3) with Polyethylene (PE) Lining

The RCC pipes with minimum 3mm thick PE lining. Manufacturing/ supplying, laying and jointing of all Reinforced Cement Concrete (RCC) NP3 pipes with PE lining shall be done in accordance with standard CPWD specifications and applicable IS codes and other standards. The pipes shall be manufactured as specified in IS 458: 1988 (latest amendment).

2.2.10. Handling, Transportation and Storage of Pipes

Handling, Transportation and storage of pipes shall be as per relevant IS codes.

2.2.11. Supplying, Laying and Jointing

Supplying, laying and jointing shall conform to relevant IS codes, as applicable. At road crossings pipes should be encased in RCC pipes of larger diameter. The alignment of

pipelines shown in the drawings of tender documents is only indicative and the exact alignment will be as per design by the contractor after approval from the Engineer.

2.2.12. Joints

Unless otherwise approved by the Engineer joints on spigot and socket concrete pipes shall be flexible and sealed with a rubber ring or flexible gasket which shall be approved by the Engineer and shall withstand the various tests specified for pressure and non-pressure pipelines.

The physical characteristics of the rubber ring shall be appropriate to the type of pipe and joint supplied and in accordance with IS: 5382 and IS: 12820 (latest amendments).

2.2.13. Bedding of Pipes

The bedding for pipe shall be provided as per relevant CPWD standards, IS codes, CPHEEO manual and directions of Engineer. The trench bottom shall be even and smooth with the help of 150mm thick sand so as to provide a proper support for the pipe over its entire length, and shall be free from stones, lumps, roots and other hard objects that may endure the pipe or coating. Holes shall be dug in the trench bottom to accommodate sockets so as to ensure continuous contact between the trench and the entire pipe barrel between socket holes.

Concrete cushion and encasement applicable only at jointing with cement concrete of specified grade, shall be constructed as per the details given in approved drawings or as directed by the engineer. The thickness of concrete shall be as specified as directed by the Engineer.

2.2.14. Flushing

Pipeline carrying sewage shall be suitably flushed in order to remove foreign materials which may have entered underground during the course of installation. Flushing operation shall be continued until water is clear.

The pump, water and other equipment necessary for the flushing shall be arranged by the contractor at his own cost.

2.2.15. Manholes and Chambers

The manhole spacing in general shall be as per CPHEEO, which shall be specified in the construction drawings and at every junction, change in direction or change in diameter of pipe. The manhole dimensions and other details shall be as per CPHEEO.

2.2.16. Excavation

The excavation shall be true to dimensions and levels shown on the plan and in accordance with the specifications provided for Civil Works or as directed by the Engineer.

2.2.17. Reinforced Cement Concrete (RCC) Work

R.C.C work for Manhole and slabs shall be as per cement concrete civil and structural specifications provided in tender, unless otherwise mentioned in concept drawings.

2.2.18. Foot Rests

Steps shall be provided inside the manhole for depth more than 1.2 m. These shall be of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12mm dia. steel bar conforming to IS: 1786 having minimum cross section as 23mm x 25mm and over all minimum length 263mm and width as 165mm. Foot rest should have tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length of 138mm and suitable to withstand the bend test and chemical resistance test as per specifications and having manufacture's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6.

2.2.19. Manhole Cover and Frames

All manholes shall be provided with S.F.R.C covers and frames and generally shall conform to IS-19292 (Part 1 and 2) and embedded in reinforced cement concrete slab. The frames of manhole shall be firmly embedded to correct alignment and level in RCC slab or plain concrete as the case may be on the top of masonry otherwise. The details for construction of manholes and spacing etc. should be followed, as given in relevant standards. The manholes cover details as below:

S.No.	Manhole Type	Load withstanding capacity	Suitable Locations
1.	L.D (Light Duty)	2.50 MT	Footpaths, Two wheelers
2.	M.D (Medium Duty)	10.00 MT	Light four wheelers
3.	H.D (Heavy Duty)	20.00 MT	Heavy vehicles
4.	E.H.D (Extra Heavy Duty)	35.00 MT	Heavy traffic roads

2.2.20. Drop Connections

S. No.	Code No.	Description
1.	IS : 636	Non-percolating flexible fire fighting delivery hose
2.	IS : 884	Specification for First Aid Hose Reel for fire fighting
3.	IS : 901	Specification for first aid hose reel for fire fighting
4.	IS : 902	Specification for couplings, double male and double female, instantaneous pattern for fire fighting
5.	IS : 903	Suction hose coupling for fire fighting purposes
6.	IS : 904	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner
7.	IS : 905	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes
8.	IS : 907	Specification for delivery breechings, dividing and collecting instantaneous pattern for fire fighting purposes
9.	IS : 908	Specification for suction strainers, cylindrical type for fire fighting purposes.
10.	IS : 909	Specification for underground fire hydrant, sluice valve type
11.	IS : 910	Specification for combined key for hydrant, hydrant cover and lower valve.
12.	IS : 1648	Code of practice for fire safety of building (general) : Fire fighting equipment and its maintenance.
13.	IS : 2871	Specification for branch pipe, universal for fire fighting purposes.
14.	IS : 2878	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted)
15.	IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises
16.	IS : 5290	Specification for landing valves
17.	IS : 5714	Specification for hydrant, stand pipe for fire fighting
18.	IS : 8090	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting
19.	IS : 8423	Specification for controlled percolation type hose for fire fighting
20.	IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted)
21.	IS : 11460	Code of practice for fire safety of libraries and archived buildings
22.	IS : 13039	External hydrant system – provision and maintenance – Code of practice.
23.	IS : 12469	Fire Fighting Pumps

24.	IS : 2052	Steel plates for pressure vessels for intermediate and high temperature service including boilers
25.	IS : 2825	Code for unfired pressure vessels
26.	IS : 4682 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining
27.	IS : 5600	Specification for sewage and drainage pumps
28.	IS : 8034	Specification for submersible pump sets for clear, cold, fresh water
29.	IS : 10001	Diesel Engines Pump
30.	IS : 10002	General Purpose

Drop connections shall be provided between branch sewer and main sewer or in the main sewer itself in steep ground when the difference in invert levels of the two exceeds 60cms. Drop connections from branch sewer to main sewer shall be made outside the manhole wall with CI pipe tee connections, vertical pipe and bend at the bottoms. The top of the tee shall be finished up to the surface level and provided with a C.I. hinged type frame and cover 30cms x 30cms. The connection shall be embedded in cement concrete (1:2:4 mix) 15cms all-round the pipe and tee up to the surface chamber of the tee. For 450MM Dia. and above a steep slope can be provided to join in the last line. If the difference between the incoming and branch line is upto 1.5 m, the crown of both pipes should be at same level.

2.2.21. Civil Works

All the civil work shall be carried out in accordance with civil and structural specifications provided in tender and latest Central Public Works Department (CPWD) specifications.

2.2.22. Testing and commissioning of Sewer Network

Testing and commissioning of sewers, manholes and other associated structures should be carried out as per applicable standards and IS codes. Testing and commissioning shall be coordinated with the Engineer.

2.3. Fire Fighting System

2.3.1. CODES AND STANDARDS

Table 3.1 Codes for Fire fighting system

2.3.2. FIRE FIGHTING EQUIPMENTS

2.3.3. EXTERNAL FIRE HYDRANTS

External Yard Hydrants shall be of 'Stand Post' type conforming to IS:908-1975 and comprise of stand post for single outlet, duck foot bend, flanged riser and single headed brass/gunmetal valve conforming to type A of IS. 5290-1977.

The stand post column shall be cast iron, cast in one piece, conforming to Grade 20 of IS:210-1970. The internal diameter at the top shall be at least 80mm.

Where external hydrants below ground level are specifically indicated, they shall be enclosed in RCC structure of size 75 cm square and 8cm above ground level. The hydrant shall be within 8 cm from the top of the enclosure.

The outlet of yard hydrants shall be angled to the ground with an instantaneous spring lock type gunmetal female coupling of 63mm dia for connecting to the hose pipe.

2.3.4. GROOVED COUPLING JOINTS

Pipes and fittings for MS piping larger than 50mm may be required to be joined using factory galvanized mechanical roll grooved fittings and mechanical joints suitable for fire protection services as desired by client /consultant without any extra financial implications. Fittings, gaskets and mechanical couplings shall be UL listed and FM approved.

Flexible grooved coupling joints as per NFPA-13 shall be provided at building expansion joints.

2.3.5. HOSE CABINETS

Hose cabinet shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged single/double door partially glazed door with suitable locking arrangement, stove enameled fire red paint with 'Fire Hose' written on it prominently. Glass panes shall be 4 mm thick.

The hydrant cabinet shall hold double headed hydrant, 2 nos. Hoses and 1 no. branch pipe.

The cabinet shall have two pipe studs of 200 mm dia in MS with base which shall be fixed to the back of the cabinet and shall be used to hold the RRL hose.

2.3.6. HYDRANT VALVE

Stainless steel Hydrant valve shall be of oblique pattern provided as per IS: 5290 complete with hand wheel, quick coupling connection, spring and blank cap and chain.

The double headed hydrant shall have flanged inlet of 100 mm dia and single headed hydrant shall have flanged inlet of 80 mm dia and 63 mm female instantaneous type outlet. The hydrant shall have a rubber plug with chain fixed to the main body of the Hydrant.

2.3.7. RRL HOSES

The hoses for the internal and external hydrant system should be rubber impregnated woven jacketed type conforming to IS:636 Type-B. Each fire hose shall be provided with quick coupling, branch pipes, nozzles, spanners etc.

Hose pipes of all types shall be capable of withstanding an internal water pressure of not less than 35 Kg/Sq.cm without bursting. It must also withstand a pressure of 21 Kg/Sq.cm without undue leakage or sweating.

Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.

2.3.8. BRANCH PIPES AND NOZZLE

Stainless steel Standard Branch Pipe shall be used conforming to IS : 903 with Stainless steel nozzle of 16mm dia to fit standard instantaneous type 63mm dia hose coupling. Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends.

2.3.9. AIR VESSEL

Air vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air, which will be under compression when the system is in normal operation.

Air vessel shall be fabricated from MS plate conforming to IS : 2002 grade 2A having 10mm thickness shell with 12 mm thick dished ends and suitable supporting legs. It shall be provided with a 80 mm dia/100 mm dia flanged connections from pump, one 25 mm drain with ball valve and 15 mm sockets for pressure gauge and pressure switches. The air vessel shall be hydraulically tested to 30 kg/cm² pressure for 30 minutes.

The pressure vessel shall be provided for hydrant system. The pressure switches shall be mounted on the header of air vessel. The air vessel shall also be provided with safety valve mounted at the top.

2.3.10. FIRE BRIGADE CONNECTION AND TANK FILLING

2.3.11. FIRE BRIGADE INLET (4 WAY) TO HYDRANT RING

Stainless Steel (SS 304 grade) four way fire brigade inlet connection having 63 mm dia instantaneous type inlet and 150 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia MS (heavy duty pipe) and flanges, nuts and bolts etc.

The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.

Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired glass with "FIRE SUPPLY TO RING MAIN" painted on the inner face of the glass in 50 mm size block letter.

Each such box shall be provided with a steel hammer with chain for breaking the glass.

The inlets shall be provided with ABS quality plastic blank caps with chain.

2.3.12. FIRE BRIGADE TANK FILLING CONNECTION

Stainless Steel (SS 304 grade) four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia MS (heavy duty pipe) and flanges, nuts and bolts etc.

The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.

Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired glass with "FIRE SUPPLY TO TANK" painted on the inner face of the glass in 50 mm size block letter.

Each such box shall be provided with a steel hammer with chain for breaking the glass.

The inlets shall be provided with ABS quality plastic blank caps with chain.

2.3.13. DIESEL ENGINE PUMPS

The engine rating shall be decided considering the de-rating factors which are based on Site conditions as per BS : 5514.

The diesel engine shall be of multi cylinder type four/six stroke cycle with mechanical (airless) injection, cold starting type.

The Engine shall be direct injection type, capable of being started without use of wicks, cartridge, heater plugs at an engine room temperature of 7oC and shall accept full load within 15 second from the receipt of the signal to start.

The Engine shall be turbo-charged and water cooled.

The Engine shall be capable of operating continuously on full load at the site elevation for a period of 8 hours and no major overloads before 300 hours of operation.

The Engine shall be provided with an adjustable governor to control the Engine speed within 10% of its rated speed under any condition of load upto the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.

The Engine shall be provided with an in-built tachometer to indicate R.P.M. of the Engine.

Engine, after correction for altitude and ambient temperature, shall have bare engine horse power rating equivalent to the higher of the following two values :-

20% in excess of the maximum brake horse-power required to drive the pump at its duty point.

The brake horse power required to drive the pump at 150% of its rated discharge.

The coupling between the Engine and pump shall allow each unit to be removed without disturbing the other.

The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.

2.3.14. STARTING

The engine shall be capable of both automatic and manual start. Generally the engine shall start automatically, but in case of the auto-start system failure the engine shall be capable of manual start.

Provision shall be made for two separate methods of Engine starting viz.

Automatic starting by means of a battery powered high torque D.C. electric starter motor incorporating the axial displacement type of pinion, having automatic repeat start facilities initiated by a fall in pressure in the water supply pipe to the hydrant installation.

Manual starting by Electric Starter motor. The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting.

Engine shall be able to start without any preliminary heating of combustion chamber; manual cranking mechanism shall also be provided. All controls/mechanisms, which have to be operated in the starting process, shall be within easy reach of the operator.

The high torque D.C motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid type of 12 V, 180 Ah capacity.

The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle & boost chargers. After start of the engine the charger shall be disconnected. The battery being fed from the engine alternator.

2.3.15. GOVERNING SYSTEM

The engine shall have a speed control device, which will control the speed under all conditions of load. The governor shall be suitable for operation without external power supply. The Governor shall offer following features:

An adjustable governor to regulate engine speed within a range of 10% between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.

An over speed shutdown device to shut down the engine at speed approximately 20% above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

2.3.16. FUEL SYSTEM

The Engine fuel oil shall be of quality and grade specified by the Engine manufacturer.

The diesel engine shall be suitable to run on High Speed Diesel (HSD), the tank provided being enough to hold the volume required for 8 hours (minimum) continuous operation. The tank shall be of MS sheet of 3.0 mm thickness.

The fuel tank shall be of welded steel construction to relevant Indian Standard. The tank shall be mounted above the Engine fuel pump to give gravity feed otherwise recommended by the manufacturer. The tank shall be fitted with an indicator showing the level of the fuel in the tank.

2.3.17. COOLING SYSTEM:

The engine shall be water cooled with cooling water drawn from the discharge side of the pump and with pressure reducing valve, strainer and all necessary accessories.

A heat exchanger, the raw water being supplied from the fire pump discharge (taken off prior to the pump discharge valve) via a pressure reducing device, if necessary, to limit the applied pressure to a safe value as specified by the engine manufacturer. The raw water outlet connection shall be so designed that the discharged water can be readily observed. The water in the closed circuit shall be circulated by means of an auxiliary pump driver from the engine and the capacity of the closed circuit shall not be less than that recommended by the engine manufacturer. If the auxiliary pump is belt driven there shall be multiple belts so that should half of the belts break, the remaining belts shall be capable of driving the pump.

2.3.18. TACHOMETER

A tachometer shall be provided to indicate revolutions per minute of the engine.

2.3.19. OIL PRESSURE GAUGE

The engine shall be provided with oil pressure gauges indicating lubricating oil pressure.

2.3.20. TEMPERATURE GAUGE

The engine shall be provided with a temperature gauge to indicate cooling water temperature.

2.3.21. AUTOMATIC CONTROL WIRING :

All connecting wires for automatic controllers shall be harnessed or flexibly enclosed, mounted on the engine and connected in an engine junction box to terminals numbered to correspond with numbered terminals in the controller, for ready wiring in the field between the two/sets of terminals.

2.3.22. SIGNAL FOR ENGINE RUNNING AND CRANK TERMINATION

The engine shall be provided with a speed sensitive switch to signal engine running and crank termination. Power for these signals shall be taken from a source other than the engine generator.

2.3.23. ENGINE EXHAUST PIPES

The exhaust pipe shall be galvanized steel pipe and sized in accordance with the manufacturer's recommendations. The exhaust pipe shall be insulated with 50 mm of fibreglass with aluminium jacket for its entire length.

A stainless steel flexible connection shall be provided between the engine exhaust outlet and the exhaust pipe. An exhaust silencer shall be provided as required to satisfy the acoustic requirements.

2.3.24. BATTERY CHARGING

The means of charging the batteries shall be by a 2-rate trickle charger with manual selection of boost charge and the batteries shall be charged in position. Where separate batteries are provided for automatic and manual starting, the charging equipment shall be capable of trickling charging both the batteries simultaneously. Equipment shall be provided to enable the state of charge of the batteries to be determined.

2.3.25. INSTALLATION

Installation of the Diesel Engine shall be carried out exactly as per manufacturer recommendation.

2.3.26. FOUNDATION AND ANTI VIBRATION MOUNTING

The foundation shall be constructed as per the requirement of Diesel Engine Manufacturer.

Anti-Vibration Mounting: Suitable vibration mounting duly approved by the authorized representative shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

2.3.27. ACCESSORIES

The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided to the big end and main bearing, camshaft and governor drives,

water jackets etc. The engine shall be provided with inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air at location as desired by the employer.

The contractor shall provide all accessories, fittings and fixtures necessary and required for a complete operating engine set.

2.3.28. INSTRUMENTATION

The diesel engine shall be provided with instrumentation as under:-

Engine Starting System:

It shall be with lead acid batteries heavy duty of minimum 180 AH capacity, higher if so required by the engine manufacturer, 2 Nos. and self-starter switch.

Engine Instruments and Standard Control Panel:

It shall be complete with required connections and comprising of following items:

Inlet and outlet water temperature gauge (dial type) with key.

Lubrication oil pressure gauge.

Lubrication oil temperature gauge.

Automatic start stop device (push button type).

Auto /Manual Selector switch shall also be provided.

Manual: the Engine can be manually operated by means of Push Buttons.

Start Stop and failure control device.

Start key for manual starting.

Stop Push Button for manual stopping of engine.

Starting failure indication by lamp and horn unit.

Engine temperature control with failure indication by red lamp indication.

Engine temperature 'very high' indication by audio alarm and automatic stopping of engine.

Engine set is 'running' and 'in operation' indication by green lamp.

Mains supply available indicated by yellow lamp.

Push Button for Audio Alarm reset.

Push Button Failure indication by lamps.

The Panel shall also have an auto/manual/test/off selector switch.

2.3.29. JOCKEY PUMPS

The jockey pump capacity and pressure shall be as per design.

Pump shall be 2900 rpm vertical inline multistage, electric, complete with pressure relief valve.

Pump controller shall be factory pre-wired and tested. Pressure switch shall sense low pressure in the fire pump system. Set cut-in pressure and cut-out pressure shall be as per design. Provide minimum run timer to operate the pump for a minimum of 3 minutes.

Control panel to contain a fusible 3-pole disconnect switch, magnetic motor contactor and thermal overload relays with external reset. Enclosure to be wall mounted with hinged door.

2.3.30. COMMISSIONING & TESTING

2.3.31. FIRE BRIGADE TANK FILLING CONNECTION

Pressurise the fire hydrant system by running the main fire pump and after attaining the required pressure in different pressure zones under check shut off the pump.

Open bye pass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts out at the pre-set pressures. If necessary, adjust the pressure switch for the jockey pump. Close bye-pass valve.

Open hydrant valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the pre-set pressure and should not cutout automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However, the jockey pump should cut-out as soon as the main pump starts.

Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.

When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting which is found to be incompatible and does not fit into the other

properly shall be replaced by the contractor. Landing valves shall also be checked by opening and closing under pressure.

2.3.32. CIVIL WORKS

All the civil work shall be carried out in accordance with civil and structural specifications provided in tender and latest CPWD specifications.

2.3.33. TESTING AND COMMISSIONING OF PRESSURIZED NETWORKS

Testing and commissioning of pipeline and other associated structures should be carried out as per applicable standards and IS codes. Testing and commissioning shall be coordinated with the Engineer.

2.4. SUBMERSIBLE PUMPS

Pumps shall be submersible type of non – clog & for smooth passage and solid handling capability of 50-mm size. Maintenance-free anti- friction bearing, deep grooved permanently greased filled ball bearings shall be provided to take care of all the axial and radial forces at any point of operation. The pump installation design shall be such as to facilitate automatic installation and removal/ lifting arrangement of pumps during installation, O&M wherever applicable HOT (< 1 Ton) and EOT (> 1 Ton). The motor shall be squirrel cage type, suitable for three phase supply continuous duty with class 'F' insulation. Motor shall have integral cable parts and the cable entries shall be sealed. The cables must be leak tight with respect to liquids and firmly attached to the terminal block. The motor shall be designed for non-overloading characteristics. There shall be thermal protection against overheating of the motor winding. The pump design shall ensure that seal does not come directly in contact with the liquid being pumped as well as cooling / lubrication by oil is provided. The moisture sensor of the tripping unit shall be located inside the oil chamber. The pump unit shall be supplied along with the special duck foot bend, flanged elbow, lifting chain with shackles, enough guide wire / pipe, sufficient tough rubber sheeted water proof cable, as well as stainless steel foundation bolts and nuts. Alternatively pump unit can be with SS wire rope guiding system and pedestal cart integrated with the discharge head. All pumps shall be of positive suction type and minimum 50 % standby unless specified otherwise.

The motor winding shall be suitable for star delta/soft starter. The motor shall be designed for minimum 10 starts/stops per hour, irrespective of whether it is DOL start or otherwise. The motor shall operate satisfactorily at all operating levels in wet well. The pumps shall be epoxy painted.

Each pump shall be provided with submersible cables of equal length for power and control so that the pump positions can be interchanged with each other. The cable shall be

terminated in a common weatherproof junction box. The motor shall be integral part of the pump. The enclosure for motor shall be IP-68. Each phase of the motors shall be provided with thermostat.

Material of Construction:

Pump Casing: C.I. IS 210 Gr. FG260

Impeller: SS ASTM A743 Gr CF8M

Motor Housing: C.I. IS 210 Gr. FG260

Rotor Shaft: SS AISI 431

Mechanical Seal – Pump side: Sic

Mechanical Seal - Motor side: Carbon Steel

Fastener in Liquid: SS AISI 316

Auto Coupling with Bend: C.I. IS 210 Gr. FG260

Lifting Chain and guide pipe: SS 316 L

2.4.1. PRESSURE GAUGES

Pressure gauges shall be complying with IS: 3624. Glycerin filled dial shall be provided where the gauge is subjected to pressure pulsation and / or vibrations. The internal parts of pressure gauge shall be stainless steel.

The minimum diameter for round pressure gauges shall be 150 mm unless specified otherwise or where the gauge forms part of a standard item of equipment

The accuracy of the pressure gauges shall be $\pm 1\%$ of full scale, accessories such as snobbery, isolation valve & drain valve shall be provided. Impulse tubing and fittings as required shall be provided.

2.4.2. Electro-Magnetic Flow Meters

The electro-magnetic meters shall comprise of flow tube, flow transmitter cum computing unit with LCD display, panel mounted digital flow indicator cum integrator and any other item required to complete the flow measurement system. The flow tube shall be of SS 316 construction with Teflon lining. Other wetted parts shall be of SS 316 construction.

The overall accuracy of the flow measurement loop shall be $\pm 1\%$ of the measured value or better.

2.4.3. Flow Meter

Table 7.1 Detail Of Electromagnetic Flow Meter

S. No.	Parameter	Requirement
1	Tube Material	Carbon Steel or 304 Stainless
2	Liner Material	Polyurethane or Comply to the IP Requirement of Chemical/ Biological Impact
3	Electrode Type	Flush Mount for 600 Mm And Below
4	Electrode Type	Removable for Meters Over 600 Mm
5	Electrode Material	316 Stainless or Equivalent
6	Electrode Cleaning	As Recommended By Manufacturer
7	Enclosure Class	Nema 4x, Ip 68
8	Power Supply	240 V Ac, 50 Hz- No External Power Supply
9	Grounding Type	Strap And Ring

2.4.4. Transmitter

Table 1.2 Detail of Level Transmitter

S. No.	Parameter	Requirement
1	Type	Intelligent, Foundation Filed Bus Based
2	Mounting	Wall or Floor Stand
3	Transmitter Range	Varies, See Process Data.
4	Enclosure Class	Nema 4x
5	Power Supply	240 V Ac, 50 Hz
6	Analog Output	4 - 20 M ADC
7	Elect. Class	General Purpose
8	System Accuracy	+/- 0.15% Of Flow Rate
9	Sys. Repeatability	+/- 0.1% Of Full Scale
10	Empty Pipe Detect.	Required
11	Local Indicator	Required, 0 - 100%
12	Local Totalizer	Required, 6 Digit, Non-Reset
13	Cable Length	Approx. 20 Meters (As Required)
14	Input Impedance	12 Ohms Or Greater
15	Process Connection	IP 68

2.4.5. Pressure Transmitter

Pressure Transmitter in the system shall be provided with following specification.

Table 9.1 Detail of Pressure Transmitter

S. No.	Parameter	Requirement
1	Type	Intelligent, Microprocessor Based, to IP68 Protection.
2	Element	Capacitance Cell, Resonant Wire Or Piezoresistive Sensor. The Diaphragm Material Shall Be Hastelloy Or 316L Or Ceramic
3	Remote Calibration	Zero And Span Via Handheld Terminal, Without Additional Hardware, At Any Termination Point In Loop
4	Transmittal/Terminal	Two Way Communication Via Loop Wiring (See Note A)
5	Self-Diagnostics	Continuous
6	Ambient Temp. Comp.	Automatic
7	Power Supply	240 V Ac
8	Output Signal	4 - 20 Ma DC OR DIGITAL
9	Dir/Rev Acting	Direct
10	Turn Down	6:1
11	Span	See Table
12	Accuracy	+/- 0.1% Of Calibrated Span
13	Repeatability	+/- 0.05%
14	Local Indicator	Required
15	Indicator Display	Digital; Engineering Units, Signal Output And Diagnostics
16	Bypass Manifold	REQUIRED, 2 VALVE TYPE, 316 LSS (SEE NOTE B)
17	Span (Elev/Suppr)	Up To 500% Of Calibrated Span
18	Enclosure	Nema 4x/Ip65/Nema 7 Class I Div 1 Groups A, B, C, D Locations, And Nonincendive For Class I Div 2, Groups A, B, C, D Locations
19	Elec. Class	As Per The Electrical Zones
20	Mounting	Wall Or Pedestal
21	Process Connections	½ Inch Npt

Materials of Construction

S. No.	Parameter	Requirement
1	Body	Low Copper Aluminum
2	Wetted Parts	316L SS. For Corrosive Chemicals Provide Tantalum Diaphragm And Teflon Gaskets and Hastelloy Body, Process Flange and Sensor With Teflon Gaskets. The Diaphragm Material Shall Be Hastelloy Or 316L Or Ceramic
3	Fill	Silicon Oil. for Oxygen Service Use Fluorinert

Service Conditions

S. No.	Parameter	Requirement
1	Fluid	Water
2	Ambient Temp.	to 50 °C

2.4.6. Level Transmitter (Ultrasonic Type)

Ultrasonic level transmitter shall be provided in all tanks for measurement of level in the tanks of WTP, STP, and Reservoirs. Ultrasonic level measuring system shall comprise a level sensor, level transmitter cum computing unit, prefabricated cable connecting the sensor and transmitter, panel mounted digital level indicator and any other item required for completing the level measurement system.

The level sensor shall be suitable for flange or bracket mounting as required and have a minimum protection conforming to IP-68. It shall have ambient temperature compensation and adjustable datum setting facilities.

The overall accuracy of the level measurement loop shall be $\pm 0.5\%$ of the measured value or better.

The level transmitter cum computing unit shall be provided in an enclosure conforming to IP-68 it shall be programmable with an integral programming keyboard. LCD display, relays for alarm, control and system fault and shall provide an isolated 4 to 20mA DC output signal proportional to the level.

The design and application of ultrasonic level meters shall take into account the vessel or channel construction, the material, size, shape, environment, process fluid or material, the presence of foam, granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

If turbulence exists, shielding, stilling tube or other measure shall be provided to avoid effects on the measurement.

Table 10.1 Detail of Level Transmitter

S. No.	Parameter	Requirement
1	Type	ULTRASONIC
2	Display	REMOTE LCD IP65 NEMA 4X
3	Display Units	4 DIGIT W/ DECIMAL POINT
4	Measuring	0-7 M

S. No.	Parameter	Requirement
	Range	
5	Agitator Filters	REQUIRED
6	Input Power	24 V DC
7	Output	4 - 20 m ADC ISOLATED
8	Resolution	2.5mm (0.1 INCH)
9	Accuracy	+/- 0.5% OF SPAN
10	Adjustments	DIRECT SETTING BCD IN INCHES
11	Alarms	LOSS OF ECHO AND NEAR ZONE USER CONFIGURABLE FOR HIGH OR LOW LEVEL CURRENT
12	Material	ALUMINUM
13	Mounting	INTEGRAL OR REMOTE
14	Temp	-40° TO 70° C
15	Enclosure	IP65 NEMA 4X, CLASS 1 DIVISION 1
16	Enclosure	INTEGRAL OR REMOTE WITH ELECTRONIC UNIT
17	Material	CPVC, PFA
18	Mounting	50mm NPT CONDUIT CONNECTION OR FLANGE
19	Frequency	53 KHz
20	Temperature Comp	INTEGRAL WITH TRANSDUCER
21	Interconnect. Cable	15M (50 FEET) OR GREATER SO THE TRANSMITTER CAN BE MOUNTED FOR OPERATOR ACCESS

2.4.7. List of Recommended Vendors

S. No.	Items	Vendors
1	Electric Hoist / Chain Pulley	Indef Engg.
		Reva Engineering
		W.H.Brady & Co. Ltd.
2	Submersible Pumps	Flyght
		ABS
		Grundfos
3	Horizontal Centrifugal Pumps	Mather & Platt
		ABS
		Grundfos
4	Sluice Valve	Kirloskar Brothers Limited
		Indian Valves Company
		VAG
5	NRV	Kirloskar Brothers Ltd.
		Indian Valve Company
		VAG

S. No.	Items	Vendors
6	CI & DI Pipes & Specials	Tata
		Jindal Saw Ltd.
		Electro Steel Castings
7	MS Pipe	Jindal
		Surya
		Tata
8	UPVC Pipes	Supreme
		Finolex
9	Electromagnetic flow meter	Forbes marshall
		Yokogawa
		Siemens
		Endress Hauser
10	Level Transmitter, Level Switch	Siemens
		Endress Hauser
		ABB
		Forbes Marshall
11	Pressure Gauge	H. Guru
		Waaree
		FEIBIG
		A.N. Instruments
12	Fire/Jockey Pumps	Mather & Platt
		ABS
		Grundfos
		Kirloskar
13	Diesel Engine	Catterpillar
		Kirloskar
		Cummins
		Clarke
14	Hydrant Valve, Branch Pipes, Hose Reels/Nozzles/	Minimax
		Newage
		Vijay
		Lifeguard
15	Fire Brigade inlet/drawout, Hose reel drum, shut off nozzle, Branch Pipe, Fire Man Axe Male & Female Coupling, Water Monitor	Minimax
		Newage
		Vijay
		Lifeguard
16	Rubber pipe for hose reel	Dunlop
		Good Year
		Lifeguard
		National

2.5. Storm Water Drainage

2.5.1. General

Design and Construction of storm water Drainage includes Construction of RCC channels for conveyance and disposal of storm water including catch basins/pits, road crossing works by RCC NP3 pipes.

2.5.2. Scope of Work

The detailed scope of work is given below. The work under the contract shall include but not limited to the following:

- (a) Design and Constructing Reinforced Concrete – M25 grade RCC Road drains with DI Gratings including road gully chambers/catch basins , with DI gratings including dressing of sides and ramming of bottoms, getting out the excavated soil and returning the suitable soil as required as per defined in concept design basis/ parameters requirement, specifications, concept drawing, applicable codes and as employer requirement.
- (b) Connection between road gully /catch pit chambers and RCC storm water drain, with RCC pipe or uPVC pipes as per specifications.
- (c) Construction of various components and appurtenant structures.
- (d) Submission of As-built drawing, including L-section and cross-section.

The scope also covers associated civil works such as encasing of pipes at road crossing points. All work shall be done as per the specifications. The Contractor shall prepare the Detail Design calculation, sizing coordination with other utilities and work plan before starting the work. The Contractor should note that the indicative concept provided as in the tender drawings are given to serve as a brief concept /indicative guidance purpose only. The contractor shall carry out site investigation and studies required including verification existing storm water drains and condition assessment prior to commencement. The Contractor should execute the works as per these specifications, bill of quantities and drawings for various items of Works.

2.5.3. Design Requirement:

2.5.3.1. Rainfall Intensity

The Storm water network shall be designed for a rainfall intensity of 12 mm/hr.

2.5.3.2. Storm water Channels

(i) Earth Work

After construction, the contractor shall carry out backfilling/sand filling in the trench in layers not exceeding 300 mm, For channels, the constructed pit is to be kept in working condition till the storm water drain coming and leaving the channel are constructed in position and tested and then a connection between channel and storm water drain is made. Backfilling for the channel is carried out in layers not exceeding 300 mm with approved backfilling material.

(ii) RCC Concrete

Storm water drain is to be constructed of Reinforced Concrete of M25 grade in Channels, walls, slabs, and foundations etc. including shuttering, handling of concrete, curing etc. as per specifications.

Dimensions: W mm x D mm (depth) clear interval

Minimum Size: 450 mm x 400 mm (clear internal dimensions)

Base: 100 mm thick minimum PCC M10

Depth of Channels will be measured as the distance from top of Channels to the invert level. The Channels are composite members consisting of PCC bedding, walls and a precast cover and frame resting on the cast-in-situ walls, to be fixed in line and level as per the adjacent top finished level. The Shuttering required is to be fabricated from steel or wall forms. The contractor shall fabricate the shuttering with all the cutouts/openings as required, after obtaining approval for the complete shuttering scheme from the Engineer-in-charge. Adequate numbers of shuttering Sets are to be mobilized to complete the works in stipulated time frame.

The cutouts/reservations/openings of various diameters pipe with margin can be kept in Steel or Plywood as directed by the Engineer.

(iii) Connection between Storm water Catch-Pits and Channels:

RCC NP-3 pipes of 150/200 mm (typical) diameters shall be used for the connection between catch pits and storm water drain.

The cut-outs /reservations /openings of various diameters pipe with margin can be kept in Steel or Plywood as directed by the Engineer.

2.5.4. Civil Works

2.5.4.1. Materials

All materials used in the work shall be subjected to mandatory tests in accordance with relevant IS codes and as specified in respective clause. Before incorporating the materials in the permanent Works, test reports shall be submitted to the Engineer-in-charge for seeking his permission.

2.5.4.2. Formwork

Formwork, shuttering, centering, scaffolding etc. shall be of steel or plywood, lined with MS-sheets. Joints should be sufficiently tied to prevent loss of cement slurry from the concrete. All forms, shuttering shall be levelled, aligned, and thoroughly cleaned, before they are used for concreting.

Formwork shall be removed after specified days of curing with the prior written permission of the Engineer-in-charge. The surface of RCC after removal of formwork / shuttering shall be smooth, even and without honeycombing or undulations.

2.5.4.3. Reinforced Cement Concrete (RCC)

All concrete shall be "Controlled Concrete" as defined in IS: 456 and SP: 23, Handbook for Design Mix Concrete.

Cement shall be used as per the Standard Specifications and conforming to IS: 12330 and as directed by the Engineer. Unless and otherwise specified, 53 Grade of Cement shall only be used for the construction work. All reinforcement used shall be of Tor steel (Fe 500) ISI mark, and shall be clean and free from loose mill scales, rust and coating of oil or other coatings which may destroy or reduce bond. Minimum size of reinforcement bars shall be of 8 mm.

Where steel shuttering shall be used, the shuttering shall be new, or in a good condition without holes or dents. It has to be approved by the Engineer-. The construction joints should be minimum and, these have to be executed with utmost care. Before concreting on contact joint, loose material has to be removed, and they have to be cleaned properly. Honeycombing has to be avoided by suitable fixing of shuttering and proper use of vibrators.

The exposed surfaces of concrete shall be kept continuously in a wet condition by ponding or covering with a layer of sackings, canvas, hessian or similar materials and kept continuously wet for at least 21 days from the date of placing of concrete.

RCC grade shall be as specified in the Drawings or, Bill of Quantities. In case of any difference in the two, Engineer-in-charge's decision will be final.

2.5.4.4. Portland Cement Concrete (P.C.C)

Portland Cement Concrete shall be as per the Standard Specifications for Procurement of Project Works.

2.5.4.5. Final Finishing

The contractor will ensure that the entire structure along with all its installations is in a finished, and in new and fully operative condition, when handed over. He shall have repaired and removed all signs of damage that might have been done during the course of construction of channels and pipelines.

He shall also see that the entire exterior has been finished properly and the entire site is cleared of all extra construction material, debris, and excavated soil. This shall be done to the satisfaction of the Engineer.

2.5.5. Applicable Codes

Table 12.5: Applicable Codes

S. No.	Code	Description
1	IS:269	Specification for 33 grade ordinary Portland cement
2	IS:8112	Specification for 43 grade ordinary Portland cement
3	IS:12330	Specification for sulphate resisting Portland cement
4	IS:383	Specification for coarse and fine aggregates from natural sources for concrete
5	IS:432	Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement. (Part 1 and 2)
6	IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
7	IS:1566	Specification for hard-drawn steel wire fabric for concrete reinforcement
8	IS:456	RCC works
9	IS:458	RCC pipeworks
10	IS:2645	Specification for integral cement water- proofing compounds

2.5.6. Design Guidelines

S. No.	Code	Description
1	Type and material	RCC Rectangular drain
2	Construction	As per scope, Civil specification
3	Minimum velocity	0.6 m/sec
4	Maximum velocity	3.0 m/sec
5	Minimum depth	400 mm
6	Minimum rectangular drain width	450 mm
7	Free board	100 mm minimum or matching with ground level

2.5.7. Protection of Utilities

The Contractor is required to carefully examine the location of the Works and their alignments and, to make special enquiries with all authorities, concerning all existing utility lines such as water supply, sewers, gas pipe, telephone (underground and/or overhead) lines, electric cable (underground and/or overhead) etc.

Contractor should also determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records. The Contractor shall be wholly responsible for the protection and/or facilitating relocation of such utilities 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.

2.5.8. Tests during Construction

For ensuring the requisite quality of construction and as per the contractor's QMP, the Materials and Works shall be subject to the quality control tests, as described in Standard Specifications as applicable and as directed by the Engineer. 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 and accepted in practice, to the directions of the Engineer.

3. Specification & Standards- Electrical Infrastructure

3.1. General Information

3.1.1. EXISTING POWER DISTRIBUTION

- (a) Power supply to the Market area is fed from 220/66/11 KV Substation at Ferozpur Road, Ludhiana through 11 KV Overhead line. In some areas, 11 KV Cable tied along the 11KV pole of 11 KV overhead line.
- (a) There are approximately 10 nos. 11KV/415 V transformers feeding the LT consumers. There is 11 KV consumers. Most of 200 KVA transformers are installed on two pole structure and 500 KVA transformers are installed on foundation.
- (b) The capacity of most of the 11KV/415 Volt transformers is 200 KVA and some are of 500 KVA.
- (c) In few places, PSEB has installed new 500 KVA transformers by the side of the existing 200 KVA transformer. The existing 200 KVA transformer will be removed once the 500 KVA transformers are commissioned.
- (d) 415 volt supply (LT Supply) is distributed through overhead lines and the individual consumer is fed through service wire connected from 415 V LT poles.
- (e) Street lights are provided installed on the same LT poles carrying 415 V Overhead line.
- (f) The LT consumers of both sides of road are fed from same 415 V LT poles. There are about 185 LT consumers and one 11 KV consumer (500 KVA).
- (g) Telephone connections to consumers are fed from telephone post.
- (h) Energy meter is mechanical type, very old and bulky.
- (i) Street lights are of sodium vapour / mercury vapour lamps and the energy
- (j) Energy Consumption of lights is very high.

3.1.2. PROPOSED SYSTEM

The proposed system envisages the following:

- Installation of 11/0.443 KV Compact Substations consisting of Ring Main Unit (RMU), oil type Transformer and LV compartment in one enclosure with Feeder Remote Terminal Unit (FRTU) and SCADA connectivity in place of pole mounted oil filled transformers so as to monitor the distribution system very effectively.
 - Design, supply and Installation of buried HDPE duct for laying 11KV, 415 Volt, telephone and communication system.
 - Design. Supply and Laying of XLPE/ PVC cables/ telephone/ fibre optic cables in ducts for distribution of power in 11KV and 433 V which replaces the 11KV, 433V and other overhead lines.
-

- Design, Supply and installation of a 11KV four way Ring main Units shall be installed in market area to provide 11 KV power to connect the transformers maintained by private consumers.
- Installation of feeder 433 Volt feeder pillar for providing service connection to individual consumers through underground cables.
- Installation of Smart Energy meters.
- Installation of Lighting poles, LED lights, Smart poles will have provision to install CCTV camera, Wi-Fi and Lights in one single pole.

3.1.3. SCOPE OF WORK

To implement System Improvement & Augmentation Scheme for existing Electrical Network in Sarabha Nagar market area, Ludhiana in Punjab on "Turnkey basis".

The scope of works includes execution of the project on turnkey basis. The contractor's scope of work includes but not limited to: Survey, network design, manufacturing, shop testing, inspection, packing, dispatching, loading, unloading and storage at site, transit/storage and construction insurance, assembly, erection, civil structural work, complete pre-commissioning checks, testing & commissioning at site, obtaining statutory clearance & certification from State Electrical Inspector, Municipal Corporation Department etc. and handing over to the Owner after satisfactory commissioning of complete augmentation of existing Electrical Network in Ludhiana Smart city Project area.

Design, Supply, installation, testing and commissioning of the Following:

Renovation of existing 11 KV and 415 V Overhead lines, Distribution transformers in Sarabha Nagar market area with 11KV/433 V Compact Substations in place of existing oil type transformers and capable of being monitored and controlled by the Central SCADA via FRTU with Punjab State Power Transmission Corporation so as to connect the Compact Substations and feeders in ring main.

11KV four way Ring main Unit shall be installed in market to provide 11 KV power to connect the transformer maintained by private consumer.

11 KV, 433 V, Fibre optic cable/ communication cables under Ground cables through Duct banks/ RCC cable trenches, Cable trays, covering slabs.

UPS, starter batteries, leads, terminals, complete with supply laying and termination of suitable size of Aluminium Conductor, XLPE and PVC insulated, PVC sheathed, armoured cables of approved make and using heat shrink type cable, joints, terminations of approved make for terminations.

Feeder pillars, submain Distribution boards and smart energy meters for distribution of LT supply to consumers.

Providing service Connection to existing electrical consumers using UG cables through HDPE cable ducts from feeder pillar.

Supply and installation of suitable rating Star Delta starter and Direct On Line starters to provide power supply connection to new fire water pumps, jockey pumps and existing tube well water pumps from feeder pillar using underground cable.

Road/ yard Lighting with Feeder pillars /Lighting Distribution Boards, Galvanized Iron Poles/ smart poles with LED lamp fixtures of suitable wattage, control panels, junction box, cable laying through duct banks, 433 volts 3 phase, 50 Hz, 0.8 pf of approved make complete with Lighting Control Panel and Automatic control of lighting circuits.

Earthing of substations, Compact substations and Transformer body, neutral and metal parts, feeder pillars, lighting poles at each 5th pole, control panels and junction box, cable trays as per standards and specifications within market area.

Supply, installation, testing and commissioning of SCADA system 11kV /0.433V compact substation (RMU+ Transformer+ LT Side) using fibre optic cable lay through HDPE pipe and with suitable Remote Terminal Units and required Hardware and software complete in all respects.

Supply, laying and commissioning of HDPE pipes / pipes and all other materials like cement, steel, sand gravels of suitable size as required shall be in the scope of contractor.

De energization, dismantling of existing 11 KV Overhead lines, transformers and 433 V overhead lines after obtaining work permit from the Electricity authority and dismantling of the transformers, 11KV /433 structures, poles, overhead lines, cables, insulators, cross arms, lighting arrestors, cables, telephones lines, lighting poles, light fixtures, energy meters and all accessories carefully and handing over the materials to the Store of Punjab Electricity Authorities.

The Compact Sub Station (CSS) to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years. The CSS shall be outdoor type, compact, maintenance free, easy to install reliable, safe and easy to operate and complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not. It is not the intent to specify herein complete details of design and construction. The offered equipment shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. These specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with

the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.

The Tenderer/Supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices. It shall also encompass all necessary project management, data engineering, acceptance testing, training, documentation, warranty services, and installation site surveys including submission of a detailed plan aimed at installing the new RMUs as efficiently as possible with minimum interruptions of power to Employer customers.

Liaison with Central/state Government Departments/PSPCL/ CEIG or any other authorities concerned on for matters like work entrustment, vendor approvals, drawing approvals, PTCC, TA&QC approvals and any other matters connected with the work and gets the approvals within the specified time for successful completion of work for all matters including obtaining approved designs & drawings, and commissioning of the Project including all incidental costs incurred thereon. Ludhiana Smart City Limited, however, will provide only all the required administrative supports to the contractor in this regard and also would reimburse to the Contractor all the statutory charges paid to the departments like /CEIG on production of official receipts thereon.

Civil foundations as recommended by the manufacturers of Compact Substation, feeder pillars, lighting pole and mounting arrangement for Control panel and junction box etc shall be in the scope of the contractor.

All the civil works such as excavation of earth, laying of Hume pipes/ HDPE pipes/ DWC pipes in concreting, back filling of cable trench, providing man holes as required for cable laying and jointing as per standards.

The quoted price should include all expenses proposed to be incurred by the bidder for dismantling the existing transformers, 11KV/415 volt poles, lines and structures, light fittings and all equipment with care and handing over them to safe custody of concerned authorities.

Field conditions, the bidder may in its own interest, before submitting the bid, inspect and examine the area involved and satisfy them regarding the existing system.

Electrical Power Supply and Water for construction purpose shall be arranged by vendor.

3.1.4. CODES AND STANDARDS

The distribution system shall be planned considering the latest version of applicable Indian and International Codes and Standards, Climate and Isokeraunic Conditions, and basic electrical data.

The following primary standards and codes (latest editions/ revisions/replacements) shall be used for planning and design of the electrical system:

TABLE 9-1: CODES AND STANDARD

	Description	
	Guidelines	
	<p>Guidelines of Electricity Board and other statutory authorities.</p> <p>BIS: Bureau of Indian Standard</p> <p>IEC: International Electro technical Commission standards</p> <p>IEEE: Institute of Electrical and Electronics Engineers standards</p> <p>Regulations laid down by Indian Electricity Act and Rules</p> <p>National Electrical Code (SP 30, 2011) of India</p> <p>Indian Bureau of Energy Efficiency (BEE) Guidelines</p> <p>Guidelines issued by Central Electricity Authority (CEA)</p> <p>CBIP Publications</p> <p>Any other regulations by the local or state/central government authorities,</p> <p>Regulations issued by tariff advisory committee / fire insurance regulations</p> <p>MES load norms as per scales of accommodation</p>	
	Electrical Codes	
	IS 3043/IEEE-80	Code of Practice for Earthing
	IS/IEC-60947	LV Switchgear
	IEC 62271-202	HV Prefabricated Sub-Station (CSS)
	IS 3427 / IEC-62271-200	Metal Clad Switchgear

	Description	
	IS 13118/ IEC-62271 -100	HV Circuit Breakers
	IS 1180 Part 1	Oil Type Distribution Transformers
	IS 5578	Arrangement For Switchgear Bus bars, Main Connection And Auxiliary Wiring
	IS 2705	Current transformer
	IS 3156	Potential transformer
	IS 2544	Bus bar support insulators
	IS 3231	Electrical Relays For Power System Protection
	IS 13703	HRC FUSES
	IS 3646	Code of Practice for interior illumination
	IS 1944	Code of Practice for road lighting
	IS 2309	Protection of buildings and allied structures against Lightning code of practice
	IS 7098	Specification for XLPE insulated PVC sheathed cables
	IS 1554	Specification for PVC insulated cables
	IEC: 62259	Secondary cells and batteries containing alkaline or other non-acid

	Description	
		electrolytes-Nickel-cadmium prismatic secondary single cells with partial gas recombination
	IEC: 60623 / IS 10918	Secondary cells and batteries containing alkaline or other non-acid electrolytes-vented Nickel Cadmium prismatic rechargeable single cells
	IS 9000	For Basic climatic and mechanical durability tests for components for electronic and electrical equipment
	IS 6619	For Semiconductor rectifier equipment code
	IS 2026	Power transformers
	SP 72 : 2010	National Lighting Code
	1944 (Parts 1 Code of practice for lighting of and 2)	Public thoroughfares: Part 1 General principles; Part 2 Lighting of main roads
	1944 (Part 5) : 1981	Code of practice for lighting of public thoroughfares: Part 5 Lighting of grade separated junctions, bridges and elevated road (Group D)
	1944 (Part 6): 1981	Code of practice for lighting of public thoroughfares: Part 6 Lighting of town and city centres and areas of civic importance (Group E)

	Description	
	CEA	Manual on Transmission planning Criteria

Other International codes and standards shall be considered if the same are, at least equivalent to, Indian Standards or any other international standard which yields a more desirable outcome.

3.1.5. CLIMATIC CONDITIONS

For the Project in Ludhiana Smart City Area, the electrical equipment selected shall be such so as to give trouble free operation during the life of the equipment, under the most stringent atmospheric conditions prevailing at site.

Ludhiana experiences a semiarid climate that has all four season with distinctive features. During the summer months, from April till June, the city remains excessively hot with the average high of 38 °C while the low hardly drops to high teens. June, the hottest month of the year, gets more than 43 °C of average high. Monsoon season that starts in July and lasts till September brings more than 700 mm of rainfall in the city. July is the wettest month when Ludhiana gets around 330mm of precipitation. On the other hand, winter in Ludhiana remains chilly as the temperature fluctuates between 6 °C -20 °C.

Ludhiana, a city and a municipal corporation in Punjab, India enjoys a semiarid climate with three major seasons.

Summer

Ludhiana remains extremely hot with the average high temperature of 38 °C during the summer months. The season that starts in April and lasts till June brings a little rain but it does not help reduce the scorching heat as the average minimum temperature hardly drops to 22°C. June is the hottest month of the year when the city gets more than 40 °C of average high.

Monsoon

Monsoon season that runs from July through September in Ludhiana brings more than 800 mm of rainfall for its inhabitants. July is the wettest month of the year when Ludhiana receives around 300mm of precipitation. Although the average low temperature fluctuates between 20- 24, the average high climbs to 34°C. Pack your raincoat or an umbrella so that you can enjoy outdoors well.

Winter

December through February the city is blessed with the winter season. During this time, the maximum temperature drops gradually and stands at 20°C while the low remains somewhat chilly with the average temperature of 7°C. The season gets a little rainfall that often deteriorates the situation for the visitors. January is the coldest month of the year when the average low temperature in Ludhiana stands at 6°C.

a) Typical atmospheric data at Ludhiana site is as below:

Maximum daily average Temperature	> 40°C
Minimum daily average Temperature	7°C
Maximum Humidity	80%
Rainy months	July to Sept
Snow storm	yes
Average annual Rainfall (IMD)	800mm
Seismic Zone	Zone IV
Annual Thunderstorm days	12

b) Wind velocities reaching 160 km/hour and an average of twelve thunderstorm days per year can be expected.

3.1.6. TROPICALISATION

All electrical insulation, fibre panels or spacers, wood and other materials, which could be damaged by fungus, termites or other parasitic growths, shall be marine rated or be suitably protected. Enclosures containing electrical control and switching equipment and instruments shall be equipped with electric heaters for moisture control. The construction of the enclosures and the placement of heaters shall ensure effective circulation of air and prevent damage to equipment by overheating. Heaters shall be of PTC type, without the use of thermostats.

3.1.7. SYSTEM SUPPLY

- a) As per prevailing practice at smart city Site, main HV supply from the substation and distributed within site shall be at 11kV.
 - b) LV supply at the consumer premises shall be 240/433V \pm 6% as per latest Indian Standard IS: 12360. Compact Sub-Station (CSS) are proposed in many locations. The distribution transformers shall be at no load LV = 250/433V as per CEA/CBIP recommendation.
 - c) The frequency shall be 50Hz \pm 3% as per Indian Electricity Rules and IS: 12360.
-

d) 11kV supply variation shall be within +6% & -9% as per Indian Electricity Rules.

3.1.7.1. INSULATION COORDINATION

Standardised levels for the highest system voltages U_m related to the rated voltages are defined in IEC 60071-1. According to these levels the test voltages for the insulation of high voltage equipment are defined. The following levels have been selected out of IEC 60071-1, IEC 60364 & IS-SP39.

Table 9-2: Standardised Levels for the Highest System Voltages

Rated Voltage	U_n (kVrms)	0.4	11	33	110
Highest system voltage	U_m (kVrms)	1	12	36	123
Power frequency withstand voltages 50 Hz, 1 min, to earth	U_{pf} (kVrms)	2	28	70	230
Lightning impulse withstand voltage 1.2/50 μ s to earth	U_{li} (kVpeak)	8	75	170	550

IEC 60815 defines 4 different pollution levels from light to very heavy pollution. To each pollution level the corresponding minimum nominal specific creepage distance is defined. The equipment to be installed in project area will be exposed to salt, fog conditions and to pollution due to exhausts. To consider this situation the pollution level "very heavy" according to IEC will be selected. This pollution level implies a minimum creep age distance of 31.0 mm/kVrms.

3.1.7.2. SYSTEM NEUTRAL POINT

The choice of the system neutral points has been made to conform to the existing system. The treatment of the neutral point has been selected according to the following table.

For star connected LV windings of transformers the neutral point of the LV systems is generally solidly earthed.

Table 9-3: System Neutral Point

System	Neutral Point
11kV	Solidly earthed
0.4kV	Neutral of transformers Solidly earthed

3.1.7.3. Short Circuit Levels

The following short circuit levels shall be adopted for switchgear:

11kV	:	25KA
400V	:	50KA

3.1.7.4. Distribution Transformers

All distribution transformers shall be of Oil Type rating 11kV/433V with Dyn11 vector group with off-load tap changer with $\pm 5\%$ variation in steps of 2.5%. LV star winding shall be solidly grounded. Distribution transformer shall be chosen from standard ratings, typically 1000KVA and 500 KVA. As a matter of policy only two ratings shall be standardised to reduce the number of stocked spares ease in replacement.

Color Coding

Bus bars, bare copper connections, earthing bars, cable cores and mimic diagrams shall be provided with the following colours:

Table 9-4: colour coding

System	Colour	
Three Phase AC System	R	Red
	Y	Yellow
	B	Blue
	N	Black
	Ground	Yellow/Green
DC System	Positive	Light Blue
	Negative	Grey

3.1.7.5. POWER FACTOR

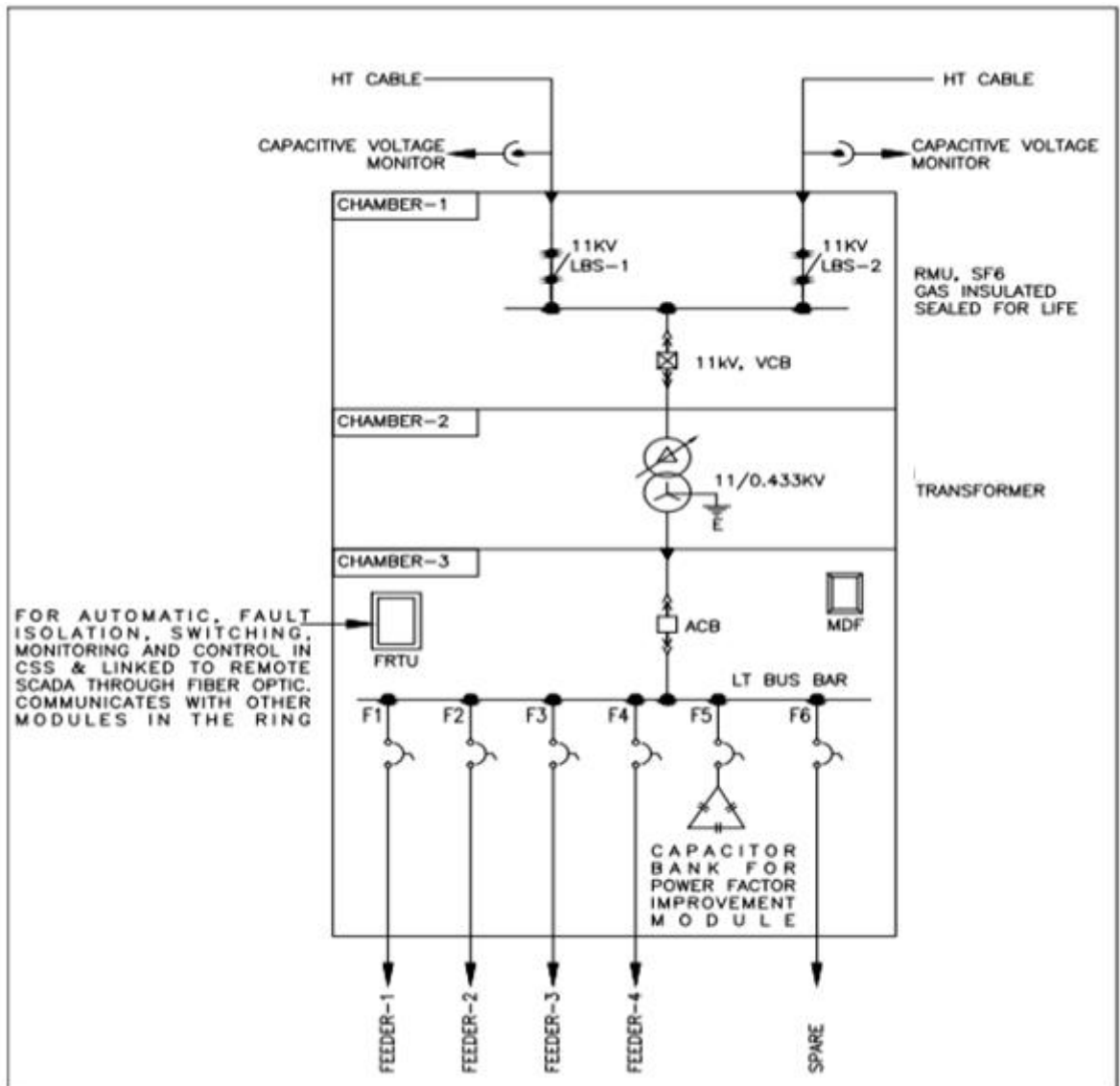
For LV distribution loads average power factor of 0.85 shall be considered for designing the electrical system. Power factor improvement system shall be designed to have a power factor of 0.95, by using Automatic Power Factor Control via a switching capacitor bank at LV.

3.1.7.6. HV DISTRIBUTION

HV distribution system shall be designed as an economical and technically viable distribution system. Since the present HV system existing in Smart City project is at 11kV, the same shall be maintained for new design. For each location, HV supply shall be provided with two number 11kV feeders in ring formation, with an open point, so as to operate the system as radial feeders. In case of fault in any one radial feeder, the other shall be able to take the full load of those locations. Thus under normal conditions each feeder shall be operating at 50% of its full capacity, thereby ensuring 100% redundancy of power. HV supply from 11kV main shall be distributed in the following way:

- a) To a dedicated switching station (SS) for concentrated and high quality loads such as for this project. The design of the switching stations and electrical distribution systems are covered in the scope of works.
 - b) As betterment to the DPR concept, Compact Sub-Stations (CSS) are proposed to be used in project areas which shall form a part of the open ring system. These CSS shall be equipped with an 11kV SF6 insulated switchboard, Oil type transformer with off load tap changer and LV board with switched capacitor bank. All these items shall be enclosed in a rust proof enclosure.
 - c) All HV/11KV power distribution to secondary substations (CSS) shall be installed in underground concrete duct banks. The size, cross section, location and configuration of the duct banks shall be determined during preliminary and detailed design phases. Electrical cables on the low voltage side, from the 11KV transformer to the final building/facility location, shall be installed in appropriate conduit (as specified in technical specifications) but will not be required to be encased in protective concrete.
 - d) 11kV HV supply shall be stabilised at the source substation which feeds the main, through on load tap changer (OLTC), with $\pm 10\%$ voltage variation in steps of 1.25%.
 - e) Each CSS shall include its own power supply unit (including required auxiliary power transformer, batteries, and battery charger), which shall provide a stable power source for not only the CSS, but also the FRTU and Ethernet switch that the it must be capable of housing.
-

3.1.8. CSS DESIGN



3.1.9. APPLICABLE STANDARD

Table 9-5: standard

STANDARDS	STANDARD DESCRIPTION
IEC 60529	Classification of degrees of protection provided by enclosures of electrical equipment
IEC 60298 A.C	metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV
IEC 1330	High voltage/Low voltage prefabricated substations
IEC 60694	Common specification for HV switchgear standards
IEC 60265	High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52 kV
IEC 6081	Monitoring and control
IEC 60185	Current Transformers
IEC 60186	Voltage transformers
BS 159	Busbar
IEC 60137	Bushings
CP 1013(British Code of Practice)	Earthing
IEC 60255	Specification for Static Protective Relays
BS 6231	Wires and wiring
BS 729	Galvanising
IEC 61000	Electromagnetic compatibility Standard Description
IEC 60129	Alternating current Disconnecter (isolators) and earthing switches
IEC 62271-100	Circuit Breakers
IEC 60060-1 BS 923	High Voltage test technique
IEC 60056	Vacuum Interrupter
IEC 60034-1	Motors
IEC 60623	Open Ni-Cd prismatic rechargeable cell

STANDARDS	STANDARD DESCRIPTION
IEC 60947-4-1	Control Gears
IEC 376	Filling of SF6 gas in RS 1.6 Environmental Conditions
IEC 62271-202	HV Prefabricated Sub-Station (CSS)
IS 1180 Part 1	Distribution Transformer from 250KVA to 2500KVA

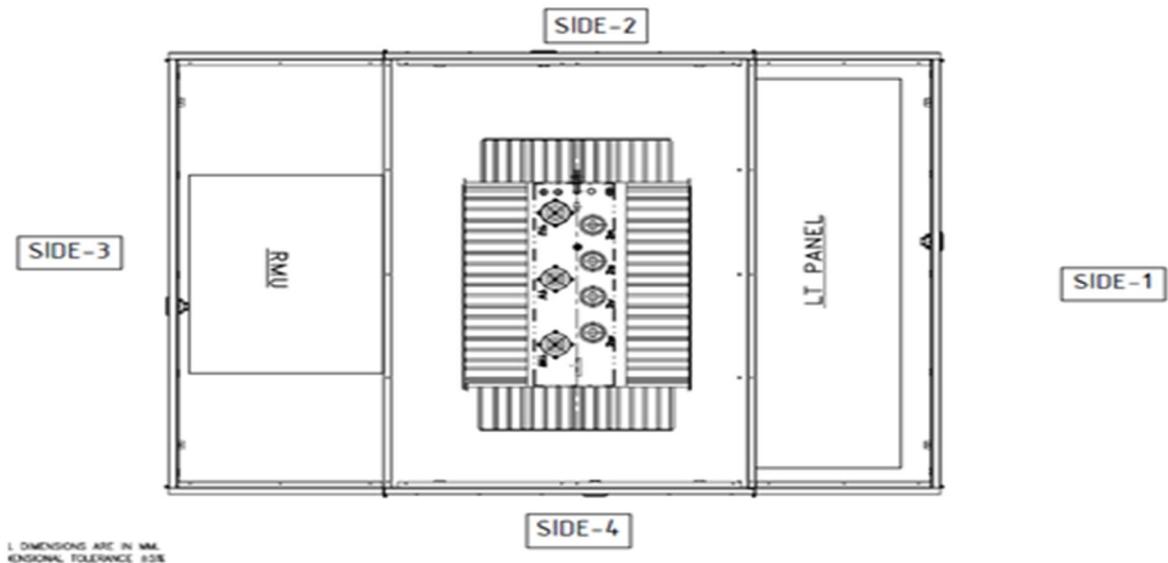
3.1.9.1. SPECIFICATION FOR ENCLOSURE FOR CSS

The Compact substation shall have the following features.

- i) Enclosure for the entire package substation shall be made of 2 mm thickness of Galvanised Sheet steel tropicalized to meet Indian weather conditions including all the partition sheets & door, . The base of the enclosure shall be of 4.0 mm thickness Hot Dip Galvanized Sheet Steel to ensure rigidity for easy transport & installation.
 - ii) Pre-Fabricated Substation shall be factory assembled and factory fitted only. No site assembly shall be allowed.
 - iii) Separate compartment for 11 kV RMU, Distribution Transformer & LT Switchgear
 - iv) Door of the HT and LT compartment shall be designed such as it require minimum space while opening. Transformer compartment shall not have direct access with door arrangement, to ensure not to allow any unauthorised person to come in direct contact with 11kV line.
 - v) The painting specification and color shade of the enclosure RAL7032, however shall be approved by the purchaser.
 - vi) There should be proper earthing arrangement for the entire substation i.e. 11 kV RMU, Distribution Transformer, LT Switchgears along with the enclosures. Earthing should be tested for short circuit to ensure for its continuity and safety.
 - vii) Design of Transformer Compartment shall be such to accommodate oil type hermetically sealed Oil type 500KVA and 1000 KVA distribution 11kV/0.415kV transformer. Transformer compartment shall have Type test report for K10 class enclosure to ensure for optimum utilization of the transformer.
 - viii) Flexible connections shall be provided for connections between busbars of transformers &
 - ix) busbars of ACB.
 - x) Non-metallic barrier shall be provided between MCCB.
 - xi) Non-metallic phase separator shall be provided between the three phases connected to MCCB.
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- xii) Layout of package substation shall have approval of Chief Electrical Inspector.
 - xiii) Suitable cut out or provision shall be provided on LT compartment for installing meter (meter and its details will be provided by purchaser).
 - xiv) CT's & potential connection for metering shall be provided in the LT compartment.
 - xv) Connection between LT terminals of transformer to ACB & ACB to MCCB shall be by aluminium busbar.
 - xvi) The Factory Assembled Pre-Fabricated Substation should have adequate arrangements of ventilation and should be inclusive of all safety accessories like voltage detection rod, fire extinguishers, gloves etc. Adequate illumination is to be provided for Factory Assembled Pre-Fabricated Substation. There should be provision for providing enclosure around the entire Factory Assembled Pre-Fabricated Substation. There should be partition for RMU section, Transformer section and LT Switchgear section for safety purpose. There should be access to all these three compartments independently.
 - xvii) The Factory Assembled Pre-Fabricated Substation should have ample arrangement to meet the requirements of protection of all electrical equipments. The clearances between live parts and minimum clearances to earth have to be maintained to the respective standards. The size of the substation should be compact to meet the traffic and road requirements.
 - xviii) The total weight of the Factory Assembled Pre-Fabricated Substation shall be specified in the quotation.
 - xix) Doors of HT & LT compartment: Separate Lockable doors shall be provided for the HT and LT Compartments to prevent unauthorized access to personnel.
 - xx) The Factory Assembled Pre- Fabricated Substation should have passed all the tests as per specification. The short circuit capacity of the neutral bus bars shall be in line with IS: 13947/IEC 60947. LT side shall be type tested for short circuit and test report shall be furnished.
 - xxi) All bus bars shall be insulated with heat shrink PVC sleeves of 1100V grade, red yellow and blue colours shall be used for phase bus bars and black color shall be used for neutral bus bars. Removable type shrouds shall be provided for joints.
 - xxii) Minimum clearance between live parts, between live parts / neutral to earth shall be 19mm. However clearances between terminals at components shall be as per applicable individual standard for components. Interconnections between the main bus bars and individual units shall be made by using vertical aluminium bus bars of adequate rating. These interconnections of the vertical bus bars shall be in separate compartment and fully shrouded. Vertical bus bars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. Vertical bus bar for MCC panel shall be of uniform cross section. Size of vertical bus bars for MCC panels shall not be less than 50 X 10mm aluminium per phase. All joints surfaces at aluminium to copper joints shall be silver / tin plated, alternatively cup – al – washers (bimetallic washers) may be used. Minimum size of busbar for starter / feeder power connections above 100Amps rating shall be 20 X 6 mm aluminium.
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3.1.9.2. TYPICAL (CSS) ARRANGMENT AND COMPONENTS



RMU shall consist of two Load Break Switches (LBS) and one Vacuum Circuit Breaker (VCB). LBS and VCB shall be motorised type. The 11kV incoming supply shall be via LBS whereas the VCB shall be feeding the 11/0.433kV oil type distribution transformer. LV side of the transformer shall be connected to a LV board. The RMU (LBS-1, LBS-2, Busbar and VCB) shall have rated current of 630A, shall be enclosed in a SF6 chamber and sealed for life to comply with IEC standard. RMU shall be Internal arc tested for 20KA , 1 sec for both cable box and tank to ensure person safety at site. Whereas the transformer and LV board shall be in air. Each of these three items shall be in separate chambers in a common enclosure. Degree of protection (Min) for HV & LV shall be IP-54 and for transformer IP-23 or better. CSS enclosure should be internal arc tested for 20KA for 1 second for both Category A & B. All these CSS shall be looped and connected to two 11kV outgoing feeder in the Ring Main Unit (RMU) configuration from the main with an open point in between, so as to run each 11kV feeder as a radial feeder. In case of a fault in any one circuit occurs, the main circuit breaker at the main shall be tripped by automatic protective relays. With SCADA monitoring and control capability and fault passage indication (FPI), the faulty cable will be isolated and supply restored by shifting the open point of the radial supply system to another location and closing the tripped breaker in the main. Typically this process shall be executed in less than 60 seconds to restore back the supply .Self-healing Grid logic shall be incorporated for faster restoration of supply even in the absence of control centre SCADA. Typical arrangement of supply to the CSS, connected in open ring, shall be as shown in drawing no. CSS units shall be equipped with SCADA monitoring and control capability and will be monitored and controlled from a central monitoring and control station located at the SUBSTATION.

Fault Passage Indicator (FPI)

The FPI shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The FPI should be self-powered and should have internal lithium battery for external indication and setting of FPI in the absence of current.

The FPIs shall include:

- Fault detection - Phase to phase and Phase to earth faults.
- One potential-free output contacts for hardwiring to FRTUs. On this basis, the SCADA/DAS will be able to monitor phase / earth fault condition.
- Local fault indications - LCD display on FPI front panel along with LED indication on front panel of RMU enclosure.
- Multiple reset option –
 - End of time delay, Remote reset (Via potential free input contact of FPI)
 - Manual reset (Reset button on front panel of FPI) ,Automatic reset on current restoration.

The FPI should indicate load current on display to understand loading of RMU.

FPI shall be of proven type and in the manufacturing range of RMU supplier.

Feeder Remote Terminal Unit (FRTU)

The CSS remote control interface shall include all the functions required to monitor and control MV and LV cubicles in the CSS.

Since, requirement is for Motorized RMU, and looking at integration issues same vendor to supply FRTU and RMU, in order to avoid teething technical issues of integration while execution.

The monitoring and control enclosure shall meet following main requirements:

- Monitoring and control of medium voltage cubicles.
 - Detection of amperometric faults, adjustable for each feeder.
 - Load current measurement on the line fitted with a fault detector.
 - Data transmission to the remote control centre.

 - It shall be possible to view the most important information locally on the front panel of the enclosure and remotely from the control centres.
 - Possible to view LBS/breaker status from the front mimic of FRTU with the help of green/red led indication.
 - Possible to issue control command from the front panel of the FRTU with security button.
 - Possible to retrieve and display on a laptop PC the time-stamped events recorded at the enclosure. Possible to retrieve information from the remote control centre also.
-

- The minimum storage capacity shall be 40000 events.
- The FRTU shall have local / remote switch on its front panel.

In remote control mode, the enclosure shall ensure:

- Transmission of remote measurements and time-stamped events.
- Possibility of electrical remote control.
- Inhibition of local electrical control pushbuttons.

In local mode, the enclosure shall ensure:

- Transmission of remote measurements and time-stamped events.
- Possibility of local electrical control of opening and closing operations by simultaneously pressing a pushbutton to select the unit to be operated and a validation pushbutton.
- Inhibition of opening/closing remote control.

Power Supply:

- Power from FRTU shall be sufficient to supply 24 V to at least all the switch cubicles, the radio and the electronics in the enclosure.
- The standby energy shall be provided by a 12 V 24 Ah battery with a minimum autonomy of at least 9 hours for 10 opening and closing cycles.
- The batteries shall be checked at regular intervals by the slave station and an alarm shall be generated and transmitted to the remote control centre in the event of a fault.

The FRTU power supply shall be protected against overvoltages and overcurrents. The dielectric characteristics of the supply voltage input in accordance with IEC 60 25564 shall be available in the station is single-phase 220 V AC.

- Any change of information status shall generate a stored time-stamped event.
- The measurement storage conditions (configured individually) can be combined. The minimum storage capacity shall have min. 20000 measurements.
- The control unit shall have following communication protocols:
- IEC 870-5-101 / 104 protocol to transfer information to control center SCADA.
- Modbus protocol to communicate with field MFM (Multi-Functional Meters) on RS485.

The control unit shall have following communication ports:

- One Ethernet port for interfacing with the IP compatible communication equipment.
- One Modbus RS485 port to connect field IED's / Energy Meters on RS485.
- One RS232 port for connecting external modem.

FRTU should have web interface facility for remote downloading and accessibility feature. The Standard FRTU shall be capable to monitor and control 3 Way / 4 ways RMU.

Stations shall process at least the following information for remote indication and/or local display purposes:

- open/closed position of each Isolator & VCB,
- earthing status of each MV direction,
- absence of AC voltage,
- local/remote control operating mode,
- detection of phase-to-phase or earth fault current flow,
- load current measurement
- charger fault & battery fault
- motor drive 24 V supply fault
- internal fault
- detailed diagnosis of the status of the uninterruptible power supply (charger, batteries).
- Transformer Healthiness check : WTI & OTI Alarm etc.
- Status of LT Side (ACB & MCCB)

Self-Healing

The FRTU must have PLC programming, in order to incorporate self-healing grid logic for faster restoration of supply in absence of control centre SCADA.

Self-healing grid feature require multiple communication support from FRTU (Simultaneous communication of FRTU with SCADA along with Peer to Peer communication between FRTU's). FRTU must support this configuration of communication to achieve SHG feature.

Demonstration of self-healing grid capability must be shown during bid evaluation for qualification.

3.1.9.3. LV DISTRIBUTION SYSTEM

- a) The distribution transformer loading shall be designed such that each transformer is not loaded beyond approximately 80%. However in case of emergency 100% continuous loading shall be permitted.
 - b) Under normal conditions, all the CSS shall be unmanned and kept locked to prevent the entrance of unauthorised persons. All the authorized persons shall have a common master key, thus ensuring easy accessibility to concerned personnel.
 - c) As "Mini SCADA" is proposed for the monitoring and possibly control, switching arrangements shall be designed to give maximum operational safety and minimum delay in load transfers for restoring the power supply.
 - d) To utilize minimum space and to reduce the civil works, 'kiosk' type factory assembled package CSS shall be used, so that the same can be placed on a raised platform.
-

- e) The 433 V sides of the CSS shall be connected to the LV bus bars through an air break circuit breaker. ACB shall be fixed type, moulded case design ,breaking capacity 4P, 50kA (Ics =Icu = Icw for 1 sec) have Long Time , Short Time and earth fault protection with current & time adjustability. ACB shall distinct fault LED indication of OL, SC & EF. ACB shall have LCD display with current measurement and release shall have 3 phase LED/LCD bar graph of % loading of each phase. However further distribution of power to the mini pillar boxes should be through Moulded Case Circuit Breakers (MCCB). MCCB Category B ,fixed type, 4P 36kA (Ics=100% Icu), up to 250A thermal magnetic type and above 250A microprocessor type shall have positive isolation as per IEC , class II front facia and current limiting feature .We propose not to use fuses anywhere in the LV system as their replacement is always a problem and they create loose contacts in the fuse base and damage the terminal contacts. **Earth fault indication is required to reduce the downtime in case of fault diagnosis.**
- f) LT Incomer side shall have meter to measure I,V, Energy, Power , Power Factor, Hz, %THD and Individual harmonics up to 15th Level as per IEC 62271-52
- g) In case of dispersed housing construction all the outgoing distributors emanating from LV distribution board shall be connected to a mini pillar box which shall be installed near a group of houses. All these mini pillar boxes shall be of standard size in the project area.
- h) Service lines to consumers shall be laid through underground mains from the mini pillar boxes. These shall be directly connected to the house energy meter.
- i) Means shall be adopted by installing capacitor banks at LV as well as on HV at SUBSTATION to improve the system power factor to 0.95 minimum.
- j) For LV system, to cater to the unforeseen fault condition in the transformer in the CSS LV supply of adjacent LV boards in CSS should be looped.
- k) For residential consumers, power supply from the CSS shall be fed to the distribution board (feeder pillar box) in the nearby location of houses through underground cables place in protective ducts (not concrete duct banks).

3.1.9.4. TECHNICAL SPECIFICATION OF OIL TYPE TRANSFORMER

11KV/ 433 Volts distribution transformer shall be a part of Compact substation which will be housed in the enclosure.

The Oil type distribution transformer loading shall be designed such that each transformer is not loaded beyond approximately 80%. However, in case of emergency 100% continuous loading shall be permitted.

Two type of CSS shall be used, 11kV / 0.415kV , ONAN 500KVA with OCTC and 1000KVA with OCTC Oil type hermetically sealed transformers.

The transformers shall be installed in hot, humid tropical atmosphere. All equipment accessories and wiring shall be provided with tropical finish to prevent fungus growth.

The transformers shall be capable of continuous operation of rated output under the operating conditions of voltage and frequency variations as per statutory limits governed by relevant Indian Standard and Indian Electricity Rules, 1956 / IEC with latest amendments in force.

To be used to ensure high endurance of core. Fully automated core cutting line that ensures uniform cutting of core resulting in low burr level and hence low core degradation ensures lower maintenance cost. Boltless, Step lap core design carried out automatically on Hydraulic Platform that avoids multiple handling thus ensuring low losses.

Automated Foil Winding for LV coils that make coil capable of withstanding higher thermal & mechanical stresses.

11kV/433V ONAN Transformer double wound, Dyn11, core type with copper conductor. Oil immersed ONAN suitable for Compact substation housed in a enclosure with corrugated tank arrangement hermetically sealed.

Voltage Ratio: No load voltage 11000/433 volts within tolerance as stipulated in IS: 2026.

Insulating material shall be of proven design. The insulating materials shall be class "A" for ONAN

Temperature Rise: The maximum temperature rise at the specified maximum continuous output shall not exceed 40°C by thermometer in the hottest portion of the oil or 50°C measured by resistance of winding above ambient temperature.

Type of Load: The transformer shall be suitable for carrying load within temperature rise indicated in the Indian Standard specification IS: 6600 'Guide for loading of oil immersed Transformer'.

Overloads: The transformers shall be suitable for carrying overload within temperature rise indicated in IS: 6600 'Guide for Loading of oil immersed Transformer'.

Connections: H.V. Delta and L.V Star connected with neutral brought out on the secondary side for connection to earth; Vector group DYn11 of IS: 2026.

The standard tapping ranges, when taps are provided, shall be as follows:

- Winding tapped : HV
- Number of tap positions : 7
- Voltage variations : + 5 percent to –10 percent in steps of 2.5 percent for variation of HV

Table 9-6: Losses as per IS1180 (2014)

No.	Transformer Rating	%Z	Maximum Load Loss (KW)	
			At 50% Load	At 100% Load
1	500 KVA	4.50%	1.6	4.75
2	1000 KVA	5%	3	9

List of Fittings:

- OTI with alarm & trip contact for oil type transformer only
- WTI with alarm & trip contact.

3.1.9.5. POWER FACTOR IMPROVEMENT

Generally a HV consumer shall have to maintain a power factor of 0.9 or as desired by the utility. Accordingly, we propose to maintain a minimum power factor of 0.95 at the SUBSTATION. In this regard the following measures shall be adopted:

- To maintain a power factor of 0.95 for all LV system, capacitor banks shall be installed on the LV bus in each CSS and these shall be switched ON and OFF automatically by an Automatic Power Factor Controller (APFC).
- A study shall be carried out during detailed engineering to ascertain the requirement of HV capacitors at the 11kV bus at the main by considering the net reactive loading due to the large number of distribution transformers in the system and the capacitance of the 11kV cabling system. Depending upon the study outcomes, if required an 11kV capacitor bank with automatic switching relay shall be provided at the main substation.

3.1.9.6. COMPACT SUBSTATION TESTS

Following routine tests shall be conducted PSS during inspection as IEC 62271-202

- Visual Inspection of Compact Sub-Station.
 - Dimensional Verification as per General Arrangement drawing of CSS
 - Bill of Material verification of CSS
 - Functional operation test for mechanical and electrical for MV & LV Equipment.
 - Insulation resistance for MV & LV
 - Power frequency test for 1 min. on MV & LV part of CSS
 - Voltage Ratio, Vector Group and Magnetic balance test on transformer in CSS.
 - Primary current injection test on MV
-

Type Tests Report:

- RMU shall be Internal arc tested for 20KA , 1 sec for both cable box and tank
- CSS enclosure should be tested for internal arc tested for 20KA for 1 second for both category A & B.
- LT side shall be type tested for short circuit and test report shall be furnished.
- Enclosure must be type tested for Ingress protection on each compartment as per IEC
- Transformer compartment shall have temperature rise [Type test report for K10 class enclosure.](#)

3.1.10. FEEDER PILLAR

Feeder Pillar specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing; forwarding, supply and unloading at store/ site of feeder pillar panel with MCCBs & MCBs of the ratings as mentioned in the specification below.

The equipment covered by this specification shall conform to the requirements stated in latest edition of relevant applicable IS/IEC and other applicable standards and shall conform to the regulations of local statutory authorities

Table 9-6: Specification

	TITLE	SPECIFICATION AS PER INDIAN STANDARD
	Supply Voltage	3 Phase neutral, AC 415 Volt +/- 10%
	Location of panel	Outdoor weather proof & Rigid construction , on footpath or Roadside
	Type of Panel	Double door with canopy , High impact, corrosion & temperature resistant
	Supply Frequency	50 HZ +/- 5%
	Pollution	Heavily Polluted and Dry
	Maximum/ Minimum	95% / 10%

	Humidity	
	Max./Min. Ambient Temperature	Max. 50 deg. C. / Min. 0 deg. C.
	Average Ambient Temperature	40 deg. C.
	Incoming Supply to feeder panel	Outgoing feeders from CSS
	Cable entry	From bottom Only
	Ingress protection class for enclosure	IP 54 as per IS 12063
	Material	Hot dip Galvanized sheet CRCA. The ground parts shall have heavy duty corrosion protection.
	Sheet steel Thickness	2.5mm – support frames (Load Bearing Sections) 2mm Galvanized – Covers, Doors & Canopy
	Base Frame	3mm MS Channel of minimum height 300mm with side covers of FRP or galvanized MS painted in black.
	Canopy on Top	With minimum 10 degree slope, extended 100mm. outside from panel on front and rear.
	Door Type for access	Front access Central opening double leaf with insulating rubber grip handle. No door at rear side. Panel to be access only from front.
	Double leaf doors	Right hand side leaf can be opened only after left hand side leaf.
	Door Hinges	Minimum three anti theft type hinges. Hinges shall not be visible from outside and hence not removable.

		Tight fit brass tube-100mm ID, 12.7mm OD & 20mm length. All accessories such as hinges, screws shall be of non-corroding material.
	Door Opening	<p>Minimum 150 degree</p> <p>Direct screens printed SLD shall be provided on the internal side of the doors.</p> <p>The door shall be fitted with gaskets made of non-inflammable and self-extinguishing EPDM rubber. The gaskets used for the pillar shall be self-pressurized type.</p>
	Locking facility on door	<p>The door (S) shall have three point locking arrangement. Special type tampered heavy duty built-in inter-locks shall be provided. Two nos. master keys for locking device shall be supplied for each feeder pillar. All the feeder pillar boxes locks shall be operational by the master key. Locking system with handle and up & down arrangement shall be provided on the front. Operating handle shall be swing type made with insulating material. The door shall be provided with pad-locking facility also. The arrangement of the locking device shall be such that self-locking of doors is avoided and door shall be locked/un-locked by appropriate key only.</p>
	Tower bolts at top and bottom of door	On left hand side door
	Base plate/ Gland plate	The Pillar shall be provided with removable split type base plate to facilitate cable jointing. The

		<p>base plate shall be split along the corner line. It shall be possible to temporarily detach the front side half portion of the base plate for purpose of installing outgoing cables at site. The cable should enter through twin leaf cable clamps mounted on the earthing channel. The Cable gland plate shall be of 3mm thickness and shall be provided with knockout punches for I/C and O/G cables. Gland plates shall have appropriate rubber bellows to prevent the ingress. Proper support shall be provided for holding the I/C and O/G cable. Thus, cable support arrangement shall be provided to take the load of the cable.</p>
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3.1.10.1. FEEDER PILLAR CONFIGURATION

NO.	FEEDER PILLAR	INCOMING FEEDER	B BUSBAR	OUT GOING FEEDER
1.	15 Way	1 no. 250A 4P MCCB	Aluminum Busbar	14 nos. MCBs in combination of 40A, 63A and 100A for DP & TP configuration

Quantities of MCBs of each rating in each feeder pillar shall be decided by contractor, maximum load in each feeder pillar shall not exceed 80kw.

Up to 8 KW the load is treated as single phase and above 8 KW the load is 3 phase. There about 180 consumers with 70 number of single phase consumers and balance are three phase consumers. The MCBs are selected in such way to provide as many number of single phase and three phase consumers in a locality.

3.1.10.2. MOULDED CASE CIRCUIT BREAKER (MCCB)

- The circuit breakers shall comply with the requirement of IEC 60947 / IS 13947 : 1993. MCCBs shall be suitable for nominal voltage of 3 phase 415 Volts AC 50 HZ supply.
- The circuit breaker shall comply with the isolation function requirement of IEC 60 947-2 section 7.1.2 to be marked as suitable for isolation / disconnection to facilitate safety of operating personnel while the breaker is in use.
- The circuit breaker shall provide class II insulation between the front cover and internal power circuits to avoid any accidental contact with the live main current carrying path with the front cover open.
- MCCB shall be suitable for min electrical life of 10,000 operations without maintenance
- The MCCBs shall current limiting type ,with double break contact mechanism for faster tripping
- MCCB shall comply with RoHS & WEEE norms.

MCCB shall also comply to below specifications:

- Utilization Category: A
- Type of MCCB : Fixed type Manually Operated (mounted in outdoor type panel)
- No. of Poles: 3P
- Rated Operational Voltage: 415V AC
- Rated Insulation Voltage : 690VAC
- Rated ultimate short circuit breaking capacity (Icu) : 35kA
- Rated service short circuit breaking capacity (Ics): 100% of Icu
- Type of Releases: Thermal Magnetic type
- Rating (A): 250 A
- Over Load Release setting: 0.7-1 In

3.1.10.3. MINIATURE CIRCUIT BREAKERS (MCB)

- Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898 and IEC 60947-2 standards.
 - The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.
 - The MCB's shall have a short circuit capacity of 10 KA
 - MCBs shall carry ISI and CE marking and shall be suitable for 16A, 40A, 63A & 100A rating
 - MCBs shall be line-load reversible with no derating.
-

Circuit-breakers shall be capable of operation under ambient temperature up to 50 °C, without derating of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

The material used to manufacture MCB shall be 100% recyclable and must comply

Green Premium certificates RoHS, REACH standards.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification.

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

- suitability for isolation (section 7.2.7)
- rated insulation voltage (section 4.3.1.2): 500 V
- pollution degree (Part 1, section 6.1.3.2): 3

3.1.10.4. JUNCTION BOXES

- a) Shockproof and rustproof
- b) Rot-proof and termite resistant
- c) Cable entry from bottom and/or sides
- d) 100% weatherproof
- e) Pole mounting arrangement
- f) Tamper proof
- g) Pilferage proof
- h) Restricts unauthorised tapping
- i) Maintenance-free
- j) Fire retardant - Class FV-0 as per IS:11731 Part-II or V-0 as per UL-94
- k) High heat distortion temperature (200°C as per IS:10192)

3.1.10.5. METER BOX – STANDARD FEATURES

- a) Ingress protection to IP65
 - b) Weatherproof & rigid construction, suitable for outdoor use
 - c) High impact, corrosion & temperature resistant
 - d) Lift-off type chrome plated brass hinges
-

- e) Awning type canopy above the door
- f) Meter viewing window
- g) Key locks, zinc die cast & chrome plated - 2 nos
- h) Studs on back wall for mounting plate fixing
- i) Wall thickness 3 mm generally & 5 mm at stress points
- j) Fire retardant, self extinguishing to BS 476:Part 7: 1997 Class 2
- k) External finish: Plain semi gloss light grey gelcoat finish to RAL 7035
- l) Long life & high temperature resistant EPDM rubber door seal

All hardware of galvanized steel or non-corrosive material

3.1.11. CABLE SYSTEM

The 11 KV overhead line and 415 V overhead lines and service connections to consumer are replaced by underground cable system. The supply from the Low Voltage section of Compact substation to feeder pillar is taken through 1100 V grade UG cable laid in cable trenches. Similarly from feeder pillar to energy meter of consumer is connected through UG cable and duct pipes.

3.1.11.1. CABLE TRAY AND DUCT PIPES

The 11 KV supply from feeder of substation to individual transformer is taken through 11 KV UG cable in RCC cable trench /HDPE Duct Pipes as advised by the engineer-in-charge with precast cover slab along the foot path area of road. The cable trench is 1200mmX1400 MM (width X depth) with GI cable trays in 3 to 4 layers. The bottom most cable tray carries 11 KV cable, next one carries 415 Volt cables and top layer for communication/scada system. The spacing between different voltage grades shall be maintained in the cable trench and cable duct system as per relevant IS standard. The duct pipe of suitable dimension and grade shall be used to take cable from cable duct to service connection and shall be as per as per IS specifications.

At Road Crossing 200 mm HDPE pipes of suitable numbers shall be provided for laying cable in light vehicle passing area. In the road crossing where heavy vehicle are passing, prefabricated RCC duct bank with HDPE pipe will be provided.

In some areas, where the number of consumers is less or the area is very congested, the cables will be laid through buried HDPE pipes.

RCC Cable trench – Common for 11 KV, 415 V and communication / SCADA : The cable trench is of size 1200x1400mm (width x depth) with GI cable trays fixed on it. And the bottom most tray carries 11 KV cable and next layer for 415 V and topmost layer for

communication and scada cable. 300 mm gap is maintained between 11 KV and 415 V cable trays and that with 415 V and communication cable. Every 25 -30 meters manholes are provided along cable trench for inspection and maintenance.

RCC Cable trench – 415 V and communication / SCADA: The cable trench is of size 1000x1000mm (width x depth) with GI cable trays fixed on it. And the bottom most trays carry for 415 V and topmost layer for communication and scada cable.

The localities where road width is every 3 M or so, the 415 V cable will be running through HDPE pipe buried on earth and manholes for connecting the cables to Feeder pillar and inspection chambers / manholes shall be provided.

3.1.11.2. POWER SUPPLY TO LT CONSUMERS:

Power supply to LT consumers fed from Feeder pillar along the road. The 415 V supply from LT main board is taken to feeder pillar using UG cable. Underground cable of suitable size will be laid from Feeder pillar to consumer's energy meter.

3.1.12. SCADA SYSTEM (SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM)

The work related to SCADA covers design, supply, installation, testing and commissioning of SCADA and Telecommunication Systems for the Compact Substations, 11kV Breakers. installation of all equipment and works necessary to interface with controls, indications, alarms, measurement and metering data from Sarabha Nagar substations to the SCADA / EMS system.

In particular the project comprises of:

- a) ABD area in consultation with PSPCL with all necessary interface with the substation equipment which are to be installed or extended at 11 KV substation at Sarabha Nagar and all Compact substations.
- b) Integration of all the FRTUs of Compact Substations of in Sarabha Nagar Market area to the existing PSPCL's central SCADA/EMS system
- c) Establishment of telecommunication network for transmission of SCADA data fibre optic cable links.
- d) Installation of a complete 48V dc power supply system that serves both SCADA and communication systems of each station.

The design of the equipment and cubicles shall be made in such a way that maintenance, such as troubleshooting, regular maintenance, replacement of defective units, putting into use of units, etc. can be carried out as safely as possible.

This requires that;

- a) Readily accessible test and /or break points to facilitate fault isolation. The placement of components shall allow access for test probes and connectors.
- b) Provisions (e. g. labels) to facilitate identification and interchange of interchangeable units or components.
- c) Panels, cubicles and marshalling racks shall generally be free standing and shall be constructed of folded sheet steel of adequate thickness to provide rigid support for the control and monitoring equipment which shall be mounted thereon.
- d) Panels shall be mounted on channel base frames. Panels and cubicles designed for personnel access shall be provided with metal floors and shall be suitably ventilated. Doors shall be provided with a lock which may be opened by a person within the panel without the use of a key. It shall be possible to open all panels associated with one unit by the use of one master key. Adequate lighting and power points for hand tools shall also be provided.
- e) Cable connections to panels and cubicles shall be equipped with suitable seals so as to prevent the ingress of dust or vermin or the propagation of possible fires. During installation, a provisional sealing of cable penetrations is required.
- f) Cable entry shall be through gland plates in the base and the top of the cubicles, the use of the latter being subject to the Owner's approval. Cable entries shall be protected against insects and rodents.

3.1.12.1. FUNCTIONS

A typical SCADA system for electrical systems shall normally perform the following functions:

- a) Monitoring and control of all electrical networks from Control room.
- b) Fault isolation and restoration for HT network in CSS (including self-healing feature) and monitoring of LV Network in the system.
- c) Pre-warning of the fault in the system by monitoring of different parameters and preventive action.
- d) Energy auditing of the system so as to identify losses.
- e) Reduce accidents of the electrical network by interlock in the system.
- f) Unmanned substations.

Under SCADA, Feeder Remote Terminal Units (FRTU's) are to be installed at each CSS. The operator at the control room will be able to open and close the CSS breakers, through the computerised control system besides automatic restoration of supply in case HV cable faults feeding various RMU's in the CSS. Complete monitoring, graphic representation, fault analysis, data storage etc. A small mimic shall also be installed indicating the status of the network. This would considerably help maintenance personnel during system isolation to

plan the whole arrangement at a glance. The control hierarchy will consist of the following levels:

Level 1: System control from centralised control room.

Level 2: Control at the local substation with station control unit.

Level 3: From the switchgear mechanism box.

3.1.12.2. MONITORING & CONTROL SUBSTATION LEVEL

Following parameters are expected to be monitored & controlled at CSS level:

RMU Circuit breaker shall have following Digital inputs and Digital outputs
Digital Inputs
CB : closed
CB : open
Earth switch : closed
Earth switch : open
Overcurrent relay : operated Earth fault relay : operated CB : local/remote
status
Digital Output
CB : close
CB : open
Protection relay
Communication on MODBUS through RS-232/485 ports
Multi Function meter
Communication on MODBUS through RS-232/485 ports
Other DI required
SF6 manometer
SF6 Pressure Low
Battery
Battery voltage Low
AC fail and DC fail
Transformer Inputs:
OTI & WTI indication and Trip alarm
LT Side:
ACB & MCCB ON/OFF & Trip status
DT side Multifunction meter data

Following parameters are expected to be monitored & controlled 11kV Panel boards and Power Transformer

11kV panel boards integration for Breaker monitoring and control, integration of Relay and meter data

Battery Voltage Low
AC & DC Power Fail Alarm

3.1.12.3. SUBSTATION AUTOAMATION

SCADA system be capable of monitoring and control CSS data via FRTU 11kV system data via RTU on IEC -104 protocol.

SCADA System shall be NERC Compliant.

The SCADA software shall consist of an operator interface subsystem(s) and various server subsystems for centralized processing. As a minimum, this includes:

- ✓ I/O Communications Subsystem(s)
- ✓ Monitoring, alerting, distribution and acknowledgement of alarms
- ✓ Collection, storing and distribution of historical trends
- ✓ Processing, storing and distribution of reports
- ✓ Web browser based clients

To handle the variety of stations on which development, testing, operating, local monitoring, remote monitoring and maintenance are performed, the SCADA software package proposed shall support all of the following Microsoft[®] operating systems;

- ✓ Windows[®] 8/10
- ✓ Windows Server[®] 2012
- ✓ 32 & 62 Bits

SCADA System shall have capability to replay the historical data in true graphical mode selecting date time and duration, which shall have to display all the values as Movie replay.

The SCADA software is intended to support development and runtime implementations on all of these operating systems simultaneously. The SCADA software must support implementations involving a combination of any of the previously listed operating systems, for example a SCADA server may be implemented on a Windows server 2012 platform, the clients on a Windows 8 platform and the development performed on a Windows 7.

For appropriate protocols (e.g. IEC61850, IEC 60870-5-101/104), the I/O Device Subsystem shall be capable of receiving data time-stamps from the field device, as well as historical data in the form of alarms and data log files. This information shall be automatically populated into the SCADA historical records without any user configuration or intervention.

The software shall support Primary and Standby I/O Servers to provide automatic redundancy in the event of a Primary I/O Server failure without any user intervention or scripting required. This switch over from a Primary to a Standby I/O Server shall be accomplished in on average under 1 second when a communication failure is detected.

Detailed diagnostics shall also be provided inherently by the system, providing information on the communications path and communications to each processor. No configuration or scripting will be required to access the diagnostics information. As a minimum, these diagnostics shall provide statistics on:

- ✓ Number of Retries
- ✓ Number of Timeouts
- ✓ Controller reads and writes
- ✓ Controller minimum, maximum and average response times

The SCADA software vendor shall have a package available to users that provides the facility for user-written device drivers. The package shall supply examples including source code for sample types of working drivers, that are similar to the requirements of the user (e.g. Serial Driver, TCP/IP Driver, report by exception, proprietary board etc).

The graphics system shall support a screen resolution of up to 4000 x 4000 pixel resolution and shall support multiple monitors on the one computer. This support shall include separate windows on each monitor, or a single window across multiple monitors.

The graphics system shall support full 32 bit (65 million) colors, and be capable of displaying images imported from third party packages for use within the SCADA displays, including animating and color flooding the image.

The software must support Historical Trend Graphs as part of a graphic display, with a minimum of 8 tags available per graph. The number of trend graphs per page shall not be limited and it shall be possible to lay trend graphs on top of each other to provide comparisons.

Color change shall support all of the following types:

- ✓ On-off: On color and off color changes based on the result of an expression.
 - ✓ Multi-state: A definable color shall display for each possible Boolean result of up to five conditions.
 - ✓ Integer: A definable color shall display for each different integer value. Up to 255 different colors shall be definable.
 - ✓ Threshold: A definable color shall display based on multiple threshold expressions. For example, a fill color should change to red when the speed of a motor is greater than or equal to 4500 rpm, and to white when less than or equal to 100 rpm, but remains gray for all speeds in between.
 - ✓ Gradient: Color shall change through the spectrum according to the value of an analog tag.
 - ✓ It shall be possible to define a starting and ending color.
-

With appropriate privileges, it shall be possible to display or acknowledge any alarm and/or the most recent alarm on any page.

Sound indication for each alarm category shall be configurable. This must be possible at each station. It shall be possible to have the alarm sound either by internal or external speaker.

The software shall be capable of logging historical trend information at configurable sample periods from 1 millisecond to 24 hours. Trend data shall be stored in a circular file system with the number of files, the size of each file, the sample period, file location, privilege and area configurable for each Trend Tag. Storage file names and paths shall support file names up to 255 characters in length.

Trend displays shall comprise line graphs with time on a linear, continuous horizontal or vertical axis and the trended value on the vertical or horizontal axis. Resolution of each graph shall be to within 0.1% of full scale. Where more than one tag is graphed, the graph of each tag and associated information shall be displayed in a different color.

Trend displays shall support both analog and digital pens on the same graph. Trend pen assignments shall be user definable and retrievable in runtime to allow easy creation and management of favorite trend groups.

The software shall provide "zoom" and "pan" facilities for both the trended tag range and the time axis range. The "zoom" facility shall allow an operator to compress or expand the axis range whilst the "pan" facility shall allow an operator to shift the origin of the axis. The software shall allow a user to define any zoom area by dragging a mouse across the trend.

Process operations are a continuous interaction of various signals, including analog, discrete and alarms. To fully understand these interactions it is important to be able to analyze all of these types of signals on a single display. Therefore there shall be the provision in the SCADA software to display alarm states in parallel with the analog and discrete trend pens on a timeline chart. This chart shall support all the trend requirements described above, in addition to those described below.

The alarm pen shall clearly indicate the active/inactive/acknowledged state of the alarm through visual cues, as well as providing detailed information at any point which the operator selects. For example, High or Deviation states should be shown upon operator interrogation.

The alarm pens shall scroll similarly to trend pens to provide a real-time view of the alarm state. The operator shall be able to select which alarm pens to monitor with which trend pens to build up a complete 'view' of a particular process unit or area on the historical display.

When accessing historical data, the alarm pens shall display their historical states on the historical display in parallel to trend pen histories. The operator shall be able to make a single request for a specific date and time for historical display and all pens configured for display, both alarms and trends, shall be retrieved for that time.

In addition to the ability to control events and activities through operator commands and scripting languages, the SCADA software shall have a facility that allows the scheduling of activities on a Calendar basis. This facility shall typically be used to perform routine activities which help minimize power usage such as turning off lights and heating out-of-hours and on public holidays.

The solution offered shall seamlessly integrate with the SCADA software for data acquisition via the SCADA Server I/O subsystem. It is not acceptable for the solution to acquire or write data directly from the field devices, increasing both the network and processing load for the field controllers.

The scheduler functionality shall be configured from a Calendar view using simple point-and-click configuration. It shall not be necessary to program code to configure the scheduler. It shall support daily, weekly, monthly or annual recurring events. It shall support up to 20 special days during the year to account for irregular events, such as public holidays. It shall support up to 200 different programs which can each be called from multiple schedules. It shall be capable of interacting and adjusting SCADA tags via expressions within a scheduled event.

3.1.13. REMOTE TERMINAL UNIT (RTU)

3.1.13.1. DESIGN STANDARDS

The RTUs shall be designed in accordance with applicable International Electro- technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

3.1.13.2. RTU FUNCTIONS

RTU shall be installed at 66kv/11kv Substation Sharaba Nagar, all functional capability described herein shall be provided by the Contractor even if a function is not initially implemented. The term master station is used to denote the SCADA systems. As a minimum, the RTUs shall be capable of performing the following functions:

RTU shall integrated 11kv Numerical Relays on RS485 modbus and local hardwired DI/Dos as required.

11kv Numerical Relays shall have required DI/Dos to integrated breaker status and other data at panel level and all the relays shall connect on daisy chain on RS 485 protocol.

RTU shall communication to SCADA system on IEC 104 protocol.

3.1.14. 11KV SF6 INSULATED COMPACT RING MAIN UNIT

11KV, 20 kA/3 Sec SF6 insulated Ring Main Unit (RMU) (for outdoor application), should comprise of 630A Load break Switches & 630 A Vacuum "T" OFF Circuit Breaker with self-powered (3 O/C & 1E/F) Relays. Various combinations of Load break switch and Circuit

Breaker shall be possible to configure the switchboards as per BOQ. Minimum three functional units (cable switch/ Circuit Breaker) can be accommodated in one single tank so as to make it more compact and reliable.

3.1.14.1. LOAD BREAK SWITCH (630A)

Load break switch should have the following

- a) Manual/Motor operated 11 KV, 630A three position load break switch with disconnecter and earthing switch.
- b) Operating mechanism with two separate operating shafts or common shaft for load break function and earthing function.
- c) Cable bushings horizontal in front, Interface with integrated capacitor for voltage indication.
- d) "Live Cable" LED Indicators through Capacitor Voltage Dividers mounted on the bushings.
- e) Mechanical ON/OFF/EARTH Indication.
- f) Anti-reflex operating handles.
- g) Cable Testing facility inside cable boxes without disconnecting the Cable terminations.
- h) Cable boxes suitable for 1 X 3C x 300 & 1 X 3C x 400 sq mm XLPE Cable with right angle Cable Termination Protectors.
- i) Cable boxes should be Arc Proof and interlocked with respective Earthing Switches. For safety of operator it should not be possible to open the cable box unless the earth Switch is ON.

3.1.14.2. VACUUM CIRCUIT BREAKER (630A)

Circuit Breaker should have the following:

- a) Manually/motor operated 630 A Vacuum circuit breaker having two position double spring mechanism.
 - b) Three position disconnecter/earthing switch downstream vacuum circuit-breaker.
 - c) Three position single spring mechanism for disconnecter/earthing switch.
 - d) Anti-reflex operating handles.
 - e) "Live Cable" LED Indicators thru Capacitor Voltage Dividers mounted on the bushings.
 - f) Green (ON)/ Red (OFF) push buttons to operated VCB.
 - g) 3O/C + 1E/F relay with Low and high set for Over current and Earth Fault. Relay should have facility to display the maximum loaded phase current also. Relay shall differentiate between over-current & Earth Fault. Relay shall record min five fault records with time stamping.
-

Separate single pole earth fault with instantaneous element, trip circuit supervision relay along with master trip relay .Relay shall have RS485 port with Modbus protocol.

- h) Control circuit voltage shall be same that of scada system.
- i) Mechanical ON/OFF/EARTH/Spring charge Indication.
- j) Cable boxes suitable for 1 X 3C x 300/ 400 sq mm XLPE Cable with right angle Cable Termination protectors.
- k) Cable boxes should be Arc Proof and interlocked with respective Earthing Switches. For safety of operator it should not be possible to open the cable box unless the earth Switch is ON.

3.1.14.3. CONTROL CABINET FOR FRTU

The RMU shall be outfitted with a separate enclosure, referred to herein as the Control Cabinet, to house the following equipment as a minimum:

- a) SCADA terminal blocks
- b) Power Supply Unit including Charger and Batteries
- c) FRTU compatible with Existing SCADA (in Grid Station) on IEC 104 protocol
- d) Other equipment according to manufacturer's design

The Control Cabinet shall be similar in style and finish as the other RMU enclosures. This shall include having a minimum protection class of IP 54. It shall be tested in accordance with the latest IEC 60529 standard.

The cabinet shall have a hinged front access door with a three-point latch locking system and a latch operating lockable handle. The door shall be fitted with a perimeter flange and gasket (rubber or neoprene) to prevent the entrance of water. In addition, a means of monitoring and indicating that the door is open shall be provided.

A metal screen with holes shall be provided on the top and bottom of the control cabinet to provide ventilation aimed at avoiding condensation inside. Venting however shall in no way reduce the effectiveness of the control cabinet's water-tight, dust-tight, and corrosion-resistant characteristics. To augment the cabinet's effectiveness in preventing the ingress of dust, insects, vermin, and small objects, all electronic parts within the control cabinet shall be enclosed in modules. Such parts and modules shall be separated from the power supply modules as also installed in the cabinet.

Design details to be finalized during project implementation notwithstanding, the Control Cabinet shall include a weather-sealed hole with a double compression cable gland, approximately 30 mm in diameter, on the top of the cabinet for routing an antenna cable. This same contractor will use the cable to connect the RTU/PLC housed in the control cabinet made out of 2 mm thick CRCA sheet.

3.1.14.4. DISTRIBUTION AUTOMATION SYSTEM INTERFACE

The RMU shall be equipped so that it can be monitored and controlled via the DAS which shall interoperate with the RTU that will be housed in the RMU Control Cabinet. The RTU in turn will interoperate with the DAS via the communications system linked with fibre optic media.

The RMU shall have provisions for opening and closing its switches using output from the FRTU. The RMU shall also supply status signals to the FRTU for monitoring the condition of the RMU's distribution network circuits as well as the components of the RMU.

RMU shall be Internal arc tested for 20KA , 1 sec for both cable box and tank .

FRTU specifications shall be referred from CSS section.

A list of input/output points required for RMU configurations is presented in Table below.

RMU Circuit breaker shall have following Digital inputs and Digital outputs
Digital Inputs
CB : closed
CB : open
Earth switch : closed
Earth switch : open
Overcurrent relay : operated Earth fault relay : operated CB : local/remote
status
Digital Output
CB : close
CB : open
Protection relay
Communication on MODBUS through RS-232/485 ports
Multi Function Meter
Communication on MODBUS through RS-232/485 ports
Other DI required
SF6 manometer
SF6 Pressure Low
Battery
Battery voltage Low
AC fail and DC fail

3.1.14.5. DESIGN PARAMETERS

Sr. No	<i>Rated voltage</i>	KV	12
1	Power frequency withstand voltage	KV	28
2	Impulse withstand voltage	KV	75
3	Rated frequency	Hz	50
4	Rated current bus bars	A	630
5	Rated current (cable switch)	A	630
6	Rated current (T-off)	A	630
<i>Breaking capacities:</i>			
7	active load	A	630
8	closed loop (cable switch)	A	630
9	off load cable charging (cable Switch)	A	135
10	earth fault (cable switch)	A	200
11	earth fault cable charging (cable switch)	A	115
12	short circuit breaking current (T-off VCB)	kA	20
13	Rated making capacity	kA	50
14	Rated short time current 3 sec.	kA	20
<i>General data, enclosure and dimensions</i>			
1	Standard to which Switchgear complies	IEC	
2	Type of Ring Main Unit	Outdoor/Indoor, Metal Enclosed	
3	Number of phases	3	
4	Whether RMU is type tested	Yes	
5	Whether facility is provided with pressure relief	Yes	
6	Insulating gas	SF6	
7	Nominal operating gas pressure	min. 1.3 bar abs. 20° C	
8	Gas leakage rate / annum %	0.1 % per annum	
9	Expected operating lifetime	30 years	

10	Whether facilities for gas monitoring	Yes, temperature compensated manometer can be delivered
11	Material used in tank construction	Stainless steel sheet preferably
	<i>No. of Operations, degree of protection and colours</i>	
1	Means of switch operation	separate handle
2	Means circuit breaker operation	separate handle and push buttons
3	Rated operating sequence of Circuit Breaker	O –3sec-CO-15sec-CO
4	Total opening time of Circuit Breaker	approx. 60 ms
5	Closing time of Circuit Breaker	approx. 70 ms
6	Mechanical operations of switch	CO 1000
7	Mechanical operations of earthing switch	CO 1000
8	Mechanical operations of circuit breaker	CO 2000
9	Principle switch / earth switch	3 position combined Switch
	<i>Degree of protection:</i>	
10	High Voltage live parts,	SF6 tank IP 67
11	Front cover mechanism	IP 2X
12	Cable covers	IP 3X
13	Outdoor Enclosure	IP 55 for Outdoor RMU
	<i>Colours:</i> RMU shall be epoxy or PU painted of approved shade. The probable color shade could be as under: -	
14	Front cover	RAL 7035
15	Cable cover	RAL 7035
16	Outdoor Enclosure	RAL 9002

3.1.15. TECHNICAL SPECIFICATION FOR HT (11KV) CABLE

3.1.15.1. GENERAL

The high tension (3.3 K V & above) cable shall have 'Aluminium' stranded & shaped conductors, extruded Semi-conducting Shield for the conductor, Cross Linked Polyethylene

(XLPE) insulated, extruded Semi-conducting core shielded, Cu tape screened, Core identification taped, Filler, inner sheath PVC extruded, GI strip armoured and over all PVC sheathed with extruded construction.

3.1.15.2. RATING

The cables shall be rated for 11000 volts, earthed, 3 phase, 50 Hz. System.

3.1.15.3. STANDARDS

The H T cables shall conform to the requirements of the following I S

Standards (latest editions):

IS: 7098, pt-1, 1985	: XLPE Cables
IS. 1554-1988	: PVC insulated heavy duty cables
IS. 5891-1970	: Recommended short circuit rating of high Voltage PVC cables
IS. 10810-1988	: Methods of testing for cables
IS. 1255-1983	: Code of practice for installation & Maintenance of power Cables
IS. 10418-1982	: Drums for electrical cables
IS. 8130, 1984	: Conductors for insulated electric cables
IS. 5831, 1984	: PVC insulation and sheath of electric cables
I S: 708, 1973	: Rating and Tests of cables

3.1.15.4. CORE IDENTIFICATION

Cores shall be identified by numbers '1, 2 & 3' printed on their insulation.

3.1.15.5. CURRENT RATING

The current rating shall be based on the following conditions:

a) Max. Conductor temperature (normal)	: 90oC
- During short circuit	: 250oC

- b) Ambient Air temperature : 46oC
- c) Ground temperature : 38oC
- d) Depth of laying in ground : With in RCC Trench
- e) Thermal resistivity of soil : 150oC cm / W

3.1.15.6. SHORT CIRCUIT RATINGS

Short circuit rating for the cables shall be as per IS: 7098 (Latest Edition). However, the rating shall be based on the following:

- a) Max. Conductor temperature (full load) : 90oC
- b) Max. Conductor temperature (Short circuit): 150oC

3.1.15.7. CONSTRUCTION:

The conductors shall be made of 'aluminium' wires of electrical grade as per IS 8130. The conductor shall be sector shaped made of stranded conductors to form circular shape for 3 core cable.

INSULATION: High quality XLPE unfilled insulating compound of natural color shall be applied on the conductor by extrusion process and chemically cross linked by continuous vulcanization process.

SHIELD: Both conductor and its insulation shall be provided with extruded semi-conducting compound for cables rated above 3.3 KV. Metallic tape (cu) shall be provided over the semi-conducting shield on core insulation. Inner conductor shield, XLPE insulation and outer core shielding shall be extruded on one operation to ensure perfect bonding.

INNER SHEATH (Common covering): For multi-core cable, cores covered with identification tapes, shall be stranded together with non-hygroscopic fillers and provided with extruded inner sheath.

ARMOUR: For multi-core cable flat GI strip armour shall be provided.

OUTER SHEATH: PVC compound (Type ST2 as per IS: 5831) outer sheath extruded over the armour with embossing of the name of manufacturer, size of cable, voltage grade etc. as per the requirements of BIS Standards.

3.1.15.8. FACTORY TESTS

The cables shall be tested for 'Type test' (if required) and 'Routine tests' as per I S: 7098 (Pt. II) for the following:

- (k) Conductor Resistance Test.
- (l) Partial Discharge Test.
- (m) High Voltage Test.

3.1.16. TECH. SPECIFICATION FOR CABLE TERMINATION KIT

3.1.16.1. SCOPE

This specification covers the design, manufacture, assembly and testing of heat shrinkable type terminations suitable for 11 KV , XLPE insulated, screened, armoured, with aluminium conductor cables three core suitable for earthed system and conforming to IS:7098(Part-II)-1985 with latest amendment, if any.

3.1.16.2. STANDARDS

The performance as well as type test requirements of all type of kits referred under scope shall conform to stipulations of IS : 13573/1992 or VDE-0278 with latest amendments, if any.

All the electrical & physical parameters of terminations should also conform to the corresponding parameters of XLPE cables referred under 'SCOPE' of this specification, as per IS: 7098 (Part-II)-1985 (with latest amendments, if any) or equivalent international standards.

3.1.16.3. CLIMATIC CONDITIONS

Location - IN THE STATE OF PUNJAB (LUDHIANA)

3.1.16.4. REQUIREMENT

The heat shrinkable type terminations offered shall be of proven design and make, which have already been extensively used and fully type tested.

3.1.16.5. GENERAL REQUIREMENT

The purpose of this specification is to specify the performance requirements of termination kits for the use on 50 C/S 3 phase system with earthed neutral for working voltage of 11 KV. Earthing arrangement shall be as per relevant standard and details of earthing arrangement offered shall be submitted along with the tender.

The material to be used should be inert and capable of resisting degradation during the service of cable system. The kit shall be provided with protection against rodents and termite attack.

3.1.16.6. HEAT SHRINKABLE TYPE (TERMINATIONS)

The term heat shrinkable refers to extruded or moulded polymeric materials which are cross-linked to develop elastic memory and supplied in expanded or otherwise deformed size/shape, subsequently heating in a non-constrained state to a temperature above the shrink temperature resulting in the material recovering or shrinking to its original shape.

Since the sealant or adhesives (to be used for environment sealing) between the heat shrinkable materials and XLPE cables shall be exposed to high electrical stresses, they must be track resistant.

The heat shrinkable polymer materials being used for external leakage insulation between the high voltage of conductors and grounds should be weather resistant.

All cuts/nicks inadvertently occurred to XLPE insulation must be rendered discharge free by using suitable discharge suppression compound.

The heat shrinkable tubing may be either extruded or moulded type.

Higher thickness of heat shrinkable sleeves shall be preferable to counter erosion due to pollution.

3.1.16.7. OTHER REQUIREMENTS

Proper stress control, stress grading and non tracking arrangement in the terminations shall be offered by means of proven methods, details of which shall be elaborated in the offer. Detailed sectional view of assemblies shall be submitted along with the offer.

The kits offered shall provide the total environment sealing, the details of which shall be offered along with the offer.

Provision for effective screening over each core be made and bidders shall categorically conform this aspect in their offer.

The material and components not specifically stated in the specification, but which are essential for satisfactory operation of the equipment shall be included without any extra cost.

The terminations shall be of better tracking resistant properties and fully reliable earthing system to maintain continuous contact with screening/armouring as the case may be.

The armour earthing arrangement shall form part of the termination.

Terminations shall have provision for shield connections and earthing.

The kits shall be suitable for storage without deterioration at a temperature upto 50oC for more than 5 years.

The fault level (as well as duration) withstand capability of terminations should be strictly matching with these parameters of cables for which the kits are intended to be used.

The words LSCL along with trade name of manufacturer, month/year of manufacturer, size etc. shall be embossed/engraved or suitably marked with indelible ink/paint for the purpose of identification.

Suitable creepage extension/rain protection sheds for outdoor termination shall be provided.

The adequate provisions for eliminating the chances of entrapment of air at the steps formed by semicon screen shall be made.

The gripping tubing (termination boot) for the cable where trifurcation takes place, shall also be part of kit and covered under scope of this supply of this specification.

Name of sub-Contractor for the raw material and standard according to which their raw materials are tested, must be furnished along with the offer.

Detailed kit contents, whether manufactured by the bidder or bought from outside (with name of sub vendor) for each component must be indicated in the offer.

The terminations shall be supplied in kit forms. All insulating and sealing materials, consumable items, conductor fittings, earthing arrangements and lugs etc. shall be included in the individual kit.

An instruction manual in English, indicating the complete method/procedure to be adopted for installation of kits, preferably with more and more diagrams/pictorial presentation shall be supplied with each kit. Various items quantity thereof against each kit must be indicated in the instruction manual.

3.1.16.8. GUARANTEED TECHNICAL PARTICULARS

The terminations shall have same electrical and thermal characteristics as those of cables with which these are intended to be used. The tenderers must furnish the guarantee technical particulars for each type/size of kit;

3.1.16.9. DRAWINGS

Complete detailed dimensional drawings showing all details of kit contents/bill of material for each size type shall be submitted with the tender.

3.1.16.10. TESTS

TYPE TESTS

The termination kits of offered design should have been got tested from NABL accredited laboratory as per relevant standards with latest version.

Acceptance Tests

Initially the following tests shall constitute as acceptance tests:-

- (a) Dimensional checking as per approved drawings.
- (b) Volume resistivity test for various components.
- (c) AC High voltage test after installation of terminations (as per IS : 13573/1992 or VDE-0278) on appropriate cable.
- (d) Dielectric strength of major components.
- (e) D.C. High voltage test.
- (f) Tracking resistance.
- (g) Ultimate Elongation.

The scope to include more type tests as acceptance tests shall be decided after processing the offers of various bidders/after knowing the details of testing facilities for type tests available with various tenders.

IMPORTANT : The tenderers must specifically mention in their offer about the details of testing facilities for various type test as per IS : 13573/1992 and or VDE-0278, available at the manufacturers works, failing to do so, the offer is liable to be rejected on the presumption that adequate testing facilities are not available with them.

Routine Tests

The following tests shall constitute routine test:

- (a) Dielectric strength.
 - (b) Density.
-

- (c) Heat shock.
- (d) Shrinkage ratio.

The tenderer must specify the details of routine tests (being conducted at the manufacturer's works) along with the standard applicable, in their offer. The routine test certificates shall be furnished along with the inspection call for each offered lot.

3.1.16.11. PACKING AND TRANSPORT

The Contractor shall be responsible for suitable packing of all the kits of material and marking on the consignment, so as to avoid any damage during transport and storage and to ensure correct dispatch to the destination.

3.1.16.12. WARRANTY PERIOD

The Contractor shall be responsible to replace, free of cost, with no transportation or insurance cost to the purchaser, up to destination, the whole or any part to the material which in normal and proper use proves the defective in quality or workmanship, subject to the condition that the defect is noticed within 24 months from the date of receipt of material in stores or 18 months from the date of commissioning whichever period may expire earlier. The consignee or any other officer of LSCL actually using the material will give prompt notice of each such defect to the Contractor. The replacement shall be effected by the Contractor within a reasonable time, but not, in any case, exceeding 45 days. The Contractor shall, also, arrange to remove the defective within a reasonable period, but not exceeding 45 days from the date of issue of notice in respect thereof, failing which, the purchaser reserve the right to dispose of defective material in any manner considered fit by him (purchaser), at the sole risk and cost of the Contractor. Any sale proceeds of the defective material after meeting the expenses incurred on its custody, disposal handling etc., shall however be credited to the Contractor's account and set off against any outstanding dues of the purchaser against the Contractor. The warranty for 18/24 months shall be one time.

3.1.17. TECHNICAL SPECIFICATION FOR LT PVC POWER CABLE

3.1.17.1. SCOPE

The specification covers, manufacture, testing, packing and delivery of 1100 Volts grade, Aluminium/copper conductor, PVC insulated multi core power cables and control cables.

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under hot and humid tropical climate, conducive to rust and fungus growth.

3.1.17.2. STANDARDS

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the LT PVC cables shall conform to the latest revisions available at the time of placement of order of all the relevant standards as listed in, but not limited to Annexure-I.

3.1.17.3. GENERAL TECHNICAL REQUIREMENTS

a) Armoured Aluminium Power and Control Cables

1100 Volts Grade L.T. cable with stranded H2/H4 grade aluminium conductor , PVC insulated (Type-A), colour coded, laid up, with fillers and/or binder tape where necessary provided with extruded PVC inner sheath , single galvanised round steel wire armoured and provided with PVC outer sheath . Both inner and outer sheaths shall be of Type ST-1 as per IS: 5831-1984 and cable shall be conforming to IS: 1554 (Part-1) - 1988 (amended upto date) and bearing ISI mark . In case of single core cable armouring shall be of aluminium.

b) Unarmoured Aluminium Power And Control Cables

1100 Volts Grade L.T. cable with stranded H2/H4 grade aluminium conductor , PVC insulated (Type-A), colour coded, laid up, with fillers and/or binder tape where necessary, provided with extruded PVC inner sheath and provided with PVC outer sheath. Both inner and outer sheaths shall be of Type ST-1 as per IS: 5831-1984 and cable shall be conforming to IS: 1554 (Part-1) - 1988 (amended upto date) and bearing ISI mark.

c) Unarmoured Copper Control Cables

1100 Volts Grade L.T. control cable with stranded untinned copper conductor, PVC insulated (Type-A), colour coded upto 5 cores and number coded above 5 cores, laid up, with fillers and/or binder tape where necessary, provided with extruded PVC inner sheath and provided with PVC outer sheath . Both inner and outer sheaths shall be of Type ST-1 as per IS: 5831-1984 and cable shall be conforming to IS: 1554 (Part-1) - 1988 (amended upto date) and bearing ISI mark.

d) Armoured Copper Control Cables

1100 Volts Grade L.T. cable with stranded untinned copper conductor, PVC insulated (Type-A), colour coded upto 5 cores and by number coded above 5 cores, laid up, with fillers and/or binder tape where necessary, provided with extruded PVC inner sheath, single galvanised round steel wire armoured and provided with PVC outer sheath. Both inner and outer sheaths shall be of Type ST-1 as per IS: 5831-1984 and cable shall be conforming to IS: 1554 (Part-1) - 1988 (amended upto date) and bearing ISI mark.

Insulation, Inner Sheath and Outer Sheath:

Insulation, inner sheath and outer sheath shall be applied by separate extrusion. Inner sheath shall be applied by extrusion only. Bedding of PVC tape for inner sheath is not acceptable. Colour of outer sheath for L.T. PVC Power cable and control cable shall be black.

The quality of insulation should be good and insulation should not be deteriorated when exposed to the climatic conditions.

Sequential Marking of Length on Cable:

Non erasable Sequential Marking of length shall be provided by embossing on outer sheath of the cable for each meter length.

Continuous A.C. Current Capacity:

Continuous a.c. current capacity shall be conforming to IS: 3961 (Part-II)-1967 (amended upto date).

Short Circuit Current

Short circuit current of L.T. PVC cable shall be as per Table given below. Duration of Short Circuit in sec.	Area of Al. Conductor	Short circuit current in kA
T	A	$I=0.07575 \times A/\text{sq.rt}(t)$
1	1.5 sq.mm	0.114
1	2.5 sq.mm	0.189
1	4 sq.mm	0.303
1	6 sq.mm.	0.455
1	10 sq.mm	0.758
1	16 sq.mm.	1.212
1	25 sq.mm.	1.894
1	35 sq.mm.	2.651
1	50 sq.mm.	3.788

Short Circuit in sec	Area of Cu. Conductor	Short circuit current in kA
T	A	$I= A/(8.7 \times \text{sq.rt}(t))$
1	2.5 sq.mm	0.287

3.1.17.4. TESTS AND TESTING FACILITIES

Type Tests:

All the type tests in accordance with IS: 1554 (Part-1)-1988, amended upto date. Type test certificates of similar cabled done not earlier than 5 years from the date of this order shall be submitted.

Routine Tests:

All the Routine tests as per IS: 1554 (Part-1) - 1988 amended upto date shall be carried out on each and every delivery length of cable. The result should be given in test report.

Acceptance Tests:

All Acceptance tests as per IS: 1554 (Part-1) - 1988 and modified upto date including the optional test should have been carried out on similar cables.

The following additional acceptance test should be carried out on PVC compounds used for outer sheath and copies of certificates thereof shall be submitted.

- (a) Hot Deformation Test as per IS: 5831 - 1984 (amended upto date)
- (b) Flammability Test as per IS: 1554 (Part- 1)-1988 (amended upto date)

3.1.17.5. PACKING AND MARKING:

Cables shall be supplied in standard length of 500 meters with plus minus 5% (five percent) tolerance wound on non-returnable wooden drums of good quality.

The following particulars shall be properly legible embossed on the cable sheath at the intervals of not exceeding one meter throughout the length of the cable. The cables with poor and illegible embossing shall be liable for rejection.

- (a) Manufacturer's name.
- (b) Voltage grade.
- (c) Year of manufacture.
- (d) Successive Length.
- (e) Size of cable
- (f) ISI mark

Supplier should provide statistical data regarding cables of all sizes viz. -

- (a) Weight of one meter of finished product of cable of various sizes and ratings.
 - (b) Weight of one meter of bare conductor used for cables of various sizes and ratings.
-

3.1.17.6. LAYING OF POWER CABLE:

The 11KV & 415 V cable, SCADA/ communication cables shall be installed underground and normally laid through buried duct or cable trench as the case may be. Minimum clearance specified between different voltage levels of cable shall be maintained.

The sealing of power cable ends during the storage; execution & completion of jointing work shall be in the scope of successful Bidder. In no circumstances, the cable ends shall be kept open. The amount due to damages done because of water / moisture ingress or penetration in the cable / conductors during execution shall be recovered from successful Bidder. It shall be responsibility of successful Bidder to make them good or replace free of cost without affecting the completion schedules.

The power cable shall be laid generally at a depth of 1000-1500 mm and can vary, if obstacles like power cable of other rating / telephone cable / water pipe line etc, come in the way of installation. At least minimum Depth of 600 mm shall be maintained from nearest road level.

The cable drum must be handled correctly and with care during transport and laying of the power cables, in order to avoid damage to the cables. Any damages done because of poor handling of the cables to the properties of corporation, private or to anybody shall be responsibility of successful bidder & the client reserves the right to recover the amount due to such damages.

The Contractor shall make suitable security arrangements at his own cost to ensure the protection of all materials, equipment and works from theft, fire pilferage and any other damages and loss. It shall be the responsibility of the contractor to arrange for security till the works are finally taken over by the Client.

3.1.17.7. CROSSINGS:

Where road crossing comes in way of laying power cable, the power cable shall be laid through RCC Hume pipes/ HDPE pipes .

The RCC pipes to be laid shall have minimum depth in such a way that the back filling on top surface of the pipe shall be at least 600mm in depth. The pipe joints shall be smooth so that cables are not damaged during pulling & operation.

During the crossing of utilities like water line, drainage lines, telephone lines, gas lines etc., sufficient care shall be taken & protection shall be made available so that other utilities do not damage the cable mechanically and / or electrically or do not affect the performance of the cable.

3.1.17.8. IDENTIFICATION, MARKING AND WARNING:

The identification marker shall be of adequate size fabricated from 3 mm thick, 25 mm x 25 mm aluminium strip. The marker shall be embossed with.

The marker shall be tightened with nylon thread along with each cable at interval of 3 meters in such a way that it does not damage / penetrate the outer sheath of cable because of the dead weight of back filled materials or soil.

A pre-warning PVC yellow tape with size 152 mm (width) x 100 microns thick (HDPE) / LLDPE shall also be laid as per following clause of the specification.

The cable route marker is to be made from R.C.C. blocks duly embossed on all the side. The minimum size shall be 600 x 300 x 50 mm. It shall be at least embedded in ground up to 300 mm depth. The exposed portions shall be painted with non-washable paints. The interval should be minimum 30 meters between two markers. It should be put at bends, curves, road crossing, etc. of cable route.

3.1.18. SMART ENERGY METER

3.1.18.1. BASIC REQUIREMENT

There are more approximately consumers in which 50 numbers are 3 phase and balance are single phase consumers. Static whole current energy meters for single phase and three phase domestic and commercial applications with 0.5 accuracy. The energy meters shall conform to IS standard IS 13779-99/CBIP88 with IEC 62053-21, IEC 1107 for optical fibre port. The energy meter shall have the provision for external communication by using RS 232 port of IRDA for communication to a hand held unit or AMR. Energy meter capable of detecting and recording anti tamper features including neutral missing and abnormal voltage/ frequency protection.

3.1.18.2. ADVANTAGES

- (a) Timely availability of billing data for 100 % meters
 - (a) Reduce manual intervention
 - (b) Load reversal
 - (c) Billing history for 12 months
 - (d) Instantaneous voltage, current, load/ frequency
 - (e) Average power for 30 min interval
 - (f) Communication facility using optical port, infrared, RS 232
 - (g) Reduce operational and maintenance cost
 - (h) Detection of power outage
 - (i) Power failure log
 - (j) Detect pilferage and thefts
-

- (k) Collect accurate base line data for consumption patterns
- (l) Programming

3.1.18.3. RATING

Meter rating : As per customer requirement

Meter type :

Display : LCD

Meter class : 0.5

Power consumption : 1 W to 1.5 W

Application: Single phase / Three Phase

3.1.18.4. SYSTEM COMPONENTS

- (a) LPRF module
- (b) Hand held unit software (HHU)
- (c) Data concentrator unit (DCU)
- (d) Base computer software (BCS)
- (e) Meter data management system (MDMS)
- (f) SmartMesh – Optimized mesh networking algorithm
- (g) Diagnostic tools

3.1.18.5. DUCTS

All HV Power and communication cables at all sites shall be laid in HDPE) manufactured from rugged and virgin High Density Polyethylene. The HDPE duct banks have longer life as compared to RCC or PVC ducts. Once adequate numbers of duct pipes are installed for power and communication, there will not be any excavation of cable trenches for so many years. This helps in laying or upgrading the existing cables.

The advantage of duct bank for laying of cable is the following:

- (a) increased safety
- (b) faster installation
- (c) exact pipe spacing
- (d) smaller trench size
- (e) conduit arrives in rebar cage
- (f) labels make installation simple
- (g) sturdy enough to walk on (unlike snap-together spacers)
- (h) road and other closures impacting the general public are shortened

The following are the basic requirement of duct system:

- (a) Longer life and light weight
- (b) Easy to handle and install
- (c) Ability to take heavy loads
- (d) No sharp edges and flexible for taking bends
- (e) Chemically nonreactive
- (f) Rodent and terminate proof

The HDPE ducts are generally available at length of 6 meters. After, excavation of earth, The Duct pipe of required length is connected with couplers/ bends, joints as the case may be. The spacing between different duct pipes of same layer is maintained using spacers at standard intervals of say, 1.5 meters. The duct formation can be horizontal or vertical depending on the availability of ROW for each utility. 11 KV power cables shall be laid at a depth of minimum 1.0 from the finished road level. Similarly, 415 V cable shall be at distance of 750 mm below the road level. There shall be separate duct for communication cables. There shall be Concrete / masonry work manholes at regular intervals for pulling and jointing the cables. If the ducts are laid in layers, then the spacing between ducts of different voltage level shall be maintained with layers of soil. The ends of the ducts are closed with end caps to protect the entry of foreign materials. Suitable size of warning tape shall be laid along the duct to protect it from damage. Identification of ducts shall be done using duct tags. For power cables 120 mm duct and for communication cables 40 mm duct shall be used. The number of cable per duct shall be one and there shall be approximately 40 % vacant space in the duct after laying the cable.

Applicable standards:

- (a) The ducts shall be manufactured in compliance with the following standards:
BS EN 50086
- (b) IS 14930

3.1.18.6. EARTHING

Earthing of all electrical equipment shall be designed and provided as per the guidelines given in the latest IEEE-80 standard and IS-3043: Code of Practice for Earthing.

The earthing design shall be based on the soil resistivity measurement carried out at various locations of CSS and other substation sites. As the site is near the sea, it is proposed to use copper earthing, instead of conventional steel earthing. Wherever required the earth grid shall be placed 600mm below ground. All transformer neutrals shall be provided with double earths. Earth rods used shall be of copper clad steel. Where high resistivity values are encountered chemical earthing shall be employed.

3.1.19. LIGHTING

Basic requirement of road/area lighting shall be as follows:

- (a) Adequate level of illuminations for heavy vehicles/light vehicles/cyclist.
- (b) Uniform illumination level over the carriageway with minimum glare.
- (c) Safety of movement.
- (d) Minimum disturbance during fog condition /dust conditions.
- (e) Use of high efficiency lighting fixtures with high lumen output and low power consumption.
- (f) Aesthetic look.
- (g) Minimum lux level specified for parking area and road as per IS shall be ensured by the contractor.
- (h) To provide 6 meter high single arm / Double arm lighting poles on 240mm high foundation above FGL with LED lamp luminaires in the parking area and walkways as mentioned in the drawing.
- (i) Landscape lighting using LED lights

3.1.19.1. LIGHTING POLE DESIGN

- (a) Supply and erection of galvanized steel octagonal pole of suitable length conforming to IS 2629/IS 2633/ IS4759. The pole shall be in single piece (single hot dip galvanized) and shall tapered towards the top. The bottom section shall have open able slot with exterior surface door & shall have suitable locking arrangement for housing three phase 4wire cable connection, Bakelite sheet, MCB, loop in and out arrangement for incoming/ outgoing cables. There shall also be suitable arrangement for the purpose of earthing. Rigid Base plate of suitable size and thickness shall be welded inside and outside at the bottom of pole with provision for fixing 4 foundation bolts. The octagonal pole shall be bolted on a pre- cast foundation with a set of four foundation bolts for greater rigidity. The foundation shall be erected over cement concrete M20 of given size to fixed up to a required planting depth below ground level as required:-
- (b) Galvanized octagonal pole overall length 6 meter (sheet thickness 3mm), top dia.(A/F) 70mm and bottom dia. (A/F) 130mm, foundation size below ground level 550mm x 550mm x 1200mm, 4Nos. foundation bolts size 20mm dia., length \geq 600mm with base plate dimensions 220mm x 220mm x 12mm thick.
- (c) Supply and erection of single arm bracket 1.5 meter long for 4 to 6 meter long galvanized octagonal pole, the bracket should be fixed on the top of the pole having top outer dia. 70mm (A/F) complete in all respect as approved by the Engineer-in-charge.
- (d) Supply and erection of double arm bracket 1.5 meter long for 4 to 6 meter long galvanized octagonal pole, the bracket should be fixed on the top of the pole having top outer dia. 70mm (A/F) complete in all respect as approved by the Engineer-in-charge at site.

3.1.19.2. POLE SHAFT

The pole shaft shall have octagonal cross-section and shall be continuously tapered with single longitudinal welding. Circumferential welding of any kind is strictly prohibited and

pole with this type of welding shall be summarily rejected. The shaft will be welded longitudinally by submerged Arc Welding (SAW) process.

Pole shaft will be bent into octagonal shape from 4 / 3 mm thick sheet through a CNC controlled laser aligned single blade bending process and will conform to grade S 355 SJO as per BSEN 10025 and 10027 respectively. Dimension of each type of pole are as under: -

3.1.19.3. FOR 6 M HIGH POLES

Sheet thickness	=	3 mm (min)
Top Dia.	=	75 mm (min)
Bottom dia.	=	155 mm (min)

3.1.19.4. BASE PLATE

Base plate of size 220-x 220x 12mm (thick) minimum for 6 meter high pole shall be fabricated from steel plate free from laminations confirming to Gr. Jo as per BSEN 10025/27 with the provision of 4 Nos. holes of suitable diameter. The base plate will fillet welded to the pole shaft at two locations i.e. from inside and outside and Gusset Plate between the pole shaft and base plate shall be welded on all four sides for strengthening purposes.

3.1.19.5. FOUNDATION BOLTS

4 Nos. Foundation bolts of suitable length but not less than 600 mm in length and compatible with holes on the base plates i.e. 20 mm dia. for 6 meter high poles These Bolts shall be fabricated out of high tensile strength Iron bar conforming to EN8.

3.1.19.6. JUNCTION BOX

Dust / vermin proof Junction box of suitable width and length would be provided with in the pole shaft at a distance of 500mm from the bottom. The door shall flush with the exterior surface and shall have locking arrangement to avoid theft from vandal. 2 Nos. earthing studs arrangement is required in the Junction Box for duct earthing with two separate and distinct earth wires.

The GI junction box with polyurethane / powder coated finish from inside shall be provided with the following accessories.

(a) Single Pole MCB of 6 Amps. Rating (MDS or Hager make)	-	1 No.
(b) Neutral Link	-	1 No.
(c) Bus Bar type Connector of 63 Amp rating	-	4 Nos.

Shrouded with Nylon / Insulation

Mounted on D-Rail (Elmex or Connectwell make)

MCB and connectors should be completely shrouded so that live part is not exposed and 2 nos. 25mm flat (Ring type) lugs should be tightened properly for each phase with bus bar type terminal connectors and for proper and rigid interconnection for Loop in & Loop Out arrangement.

NOTE: - Phase to Phase clearance and Phase to ground clearance should be 25 mm (minimum) and two phases should be separated by thin insulated transparent barriers to avoid accident touching of two phases. Moreover, each connector should be suitable for two nos. 25 mm ring type lugs/ thimbles for rigid connections to facilitate LILO arrangement as illustrated below for clarity.

The pole shaft in the cut out portion needs to be properly / adequately strengthened to compensate for loss in section.

3.1.19.7. GALVANIZING

The poles shall be single dip, hot galvanized as per IS: 2629 / IS: 2633 / IS: 4759 standards with minimum coating thickness of 70 microns (Minimum). Galvanizing shall be done using single dipping process for achieving overall uniform thickness. Galvanizing plant with ISO certification shall be preferred.

3.1.19.8. ARM

Single arm of 40 to 60 mm dia. galvanized ERW pipe of 1.5 meter length and 2.0 meter length shall be provided on top of poles for holding luminaires as per site requirement.

3.1.20. LUMINAIRES

Luminaries complete with all accessories and Lamp should conform to IES – 60598 and meet the following standards: -

- (a) Luminaire housing should be made out of Die Cast Aluminium alloy (corrosion resistance) under high pressure.
 - (b) Should be of Aerodynamic shape with adequate strength to withstand maximum wind speed.
 - (c) Luminaire cover made out of same aluminum alloy should be suitable for top opening and fixed with 2 nos. clamps.
-

- (d) Provided with heat resistant curved toughened heat resistant glass properly sealed with gasket.
- (e) Luminaire should be suitable for IP 66 degree of protection for optical compartment.
- (f) Provided with precision optical system for lamp with lamp position adjustable from back and should be suitable for adjustment of through of length.
- (g) Reflector should be made from high purity aluminium sheet electrometrically brightened and anodized.
- (h) Luminaires should be achromatized and coated with pure polyester to 45-micron thickness. Color / shade of luminaire shall be as per IS-5 matching with ERW pipe on Galvanized pole.

3.1.21. 415 V OUT DOOR LIGHTING CONTROL PANEL

3.1.21.1. SCOPE

This section covers the detailed requirements for design, supply, installation, testing and commissioning of 415 Volts, 3 phase, 50 Hz 4 wire system, street/ road light feeder panel for road lights to switching ON/ OFF function.

3.1.21.2. TYPE OF BOARD

The medium voltage panel shall comprise of the following type of switchgears as specified. The panel shall be capable of fault withstand capacity of 31 MVA for duration of one second up to 200 Amp rating.

The Panel shall be metal enclosed, outdoor type having incoming, sectionalisation and outgoing switchgears as specified. The design shall be cubicle type. The degree of protection for enclosure shall be IP 55.

3.1.21.3. GENERAL CONSTRUCTION

The Panel shall be floor/ foundation mounted freestanding totally enclosed and non-extensible type. The switchboard shall be dust & vermin proof with lockable arrangement with degree of protection IP55 as per IS 2147 and shall be suitable for the climate conditions as specified. The design shall include all provisions for safety of operating and maintenance personnel. The general construction shall conform to IS: 8623 for factory assembled switchboard.

The panel shall be equipped with space heater with thermostat. Along with lamp for lighting of panel controlled by door switch & MCB and also 6/16 A socket & switch

3.1.21.4. CUBICLE TYPE PANEL

Outdoor type panel of approximate dimension 1200 mm (W) x 350 mm (D) x 1475 mm (H) shall be fabricated out of CRCA sheet steel 2.5 mm thick (Load bearing Main Frame) with double door arrangement out of 2.0 mm thick. Sheet and canopy on all four sides. Wherever necessary, such sheet steel member shall be stiffened by angle iron framework. The general arrangement shall be got approved before fabrication. Cable entries for various feeders shall be from the bottom. All cable entries shall be through gland plates of 3 mm thick. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuit when new feeders are added. Cable entry plates shall therefore be sectionalized. The panel will be provided with 75x40 mm base channel to be painted in black to facilitate mounting on concrete platform

3.1.21.5. INDICATOR LAMPS

On the incomer of L.T Panel, ON phase indicator neon type lamps shall be provided suitable for operation on AC 230 Volts supply. Necessary filter G/Y/R/A shall be provided depending upon the function. All lamps shall be protected by proper HRC fuses. Where phase indicator lamps are provided, these shall be associated with necessary ON/OFF toggle switch.

3.1.21.6. SMALL WIRING

All small wiring controls, indication etc. shall be with suitable stranded copper conductor cables PVC insulated conforming to IS: 1554 Part 1. Wiring shall be suitably protected within the switchboard. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of the wires. Where wires are drawn through PVC conduits, the works shall conform to IS 732. Identification ferrules shall be used at both ends of the wires. All control wiring meant for external connection is to be brought out on terminal block. All wiring shall be minimum 1.5 sq. mm and for CT. Circuits it shall be 4.00 sq. mm. Brass/ copper thimbles, insulation tape etc. shall be provided at joints and terminations as required.

3.1.21.7. BUS BAR & BUS BAR CHAMBERS

Bus Bar and Connections

The bus bar shall be high conductivity copper alloy of E 91 grade and of adequate section having current density not less than 1.0 Amp. / Sq. mm. Set of copper bus bar shall be completed shrouded with acrylic sheet to avoid accidental touch. All connections to individual circuits from the bus bar shall be with solid connections in case current exceeds 63

Amp. All bus bars and connections shall be suitably sleeved with PVC or suitably insulated in an approved manner. The bus bar temperature should not exceed 85 degree C i.e. 35 degree C temperature rise over 50 degree C ambient. The calculation for temperature rise and bus bar sizing should be furnished along with shop drawing for approval.

3.1.21.8. BUS BAR SUPPORT AND ARRANGEMENTS

Supports

Bus bar shall be firmly fixed on supports constructed from SMC (glass fiber reinforced thermosetting plastic). The supports shall be sufficiently robust to effectively withstand electro-mechanical stresses produced in the event of short circuit.

Connections to Bus Bars

The bolts and nuts used for connections to bus bars shall be of copper, alloy, and tinned forged brass or galvanized iron. Suitable precaution shall be taken against heating due to bi-metallic contact.

Further for tapping off connections from bus bars, VIR/PVC insulated wire may be used up to current capacities up to 63 amps and for higher current capacities solid conductors/ strips suitably be insulated with PVC sleeves / tape as per requirement.

Clearances

The minimum clearances to be maintained for open and closed indoor air insulated bus bars/ electrically non-exposed and working at system voltages up to 600 volts shall be as follows:

Between Minimum Clearances

Phase to Earth..... 22 mm

Phase to Phase 32 mm

Bus Bar Markings

The colors and letters (or symbols) for bus bars: -

Main bus bar connections and auxiliary wiring etc. shall conform to relevant Indian Standard. A brief from IS 375-1963 (revised) is given below: -

For AC bus bars and Main connections:

S.No.	Bus Bar & Main Connection	Colour	Letter/ Symbol
1	Three Phase	Red	R, Y, B



		Yellow	
		Blue	
2	Single Phase	Red	R
3	Neutral Connection	White	N
4	Connection to earth	Green	G

3.1.21.9. PHASE SEQUENCE AND POLARITY

Bus bars and main connections, when marked shall be marked in accordance with the following table to indicate the order in which the voltage in phases reach their maximum values.

System	As indicated by colour or letters	Phase sequence as indicated vector ally
Three Phase	Red, Yellow, Blue	R, Y, B
Two Phase	Red, Blue	R, B

3.1.21.10. ARRANGEMENT OF BUS BAR & MAIN CONNECTIONS:

Bus bars and main connections, which are substantially in one plane, shall be arranged in order given as follows: -

3.1.21.11. A.C SYSTEM

The order of phase connections shall be Red, Yellow and Blue.

When the run of the conductors is horizontal, the red shall be on the top or on the left or farthest away as viewed from the front.

When the run of the conductor is vertical, the red shall be on the left or farthest away as viewed from the front.

When the system has a neutral connection in the same plane as the phase connections, the neutral shall occupy an outer position.

Unless the neutral connections can be readily distinguished from the phase connections, the order shall be red, yellow, blue and black.

3.1.21.12. TERMINATIONS

Incomer terminals shall be suitable for receiving cables.

3.1.21.13. MOULDED CASE CIRCUIT BREAKERS

Moulded case circuit breakers shall comply with IEC 60947.2 & 13947 part 2. They shall have the voltage and current ratings of 440 Volt & 200 Amp respectively whereas short circuit breaking capacity and rated short – time withstand current should be as indicated below.

The breaking capacity performance certificates shall be available for category A to the above mentioned standards. The test shall be carried out under the breaking performance during the ultimate breaking capacity (Icu), Ics rating=100% Icu. Certificate for all the sequences (Sequence 1 mandatory) should be available.'

MCCB's shall be of the independent manual closing air-break type, rated for an uninterrupted duty.

Auxiliary facilities, including power closing and under voltage releases, shall be provided as indicated.

Each MCCB shall have a facility for padlocking in the "OFF" position.

Necessary set of CT's together with an ammeter and selector switch as specified.

Necessary inter-connections to bus bars.

Necessary isolating plugs and sockets for front operated switches to enable withdrawing the entire unit and replacing with another unit disconnecting the cable for maintenance operation.

Each MCCB shall provide with a rotary operating mechanism.

3.1.21.14. CONTACTOR

3 Pole contactor of 60 Amp rating type AC-1 should conform to IEC 60947-4-1, IS 13947

Various parameters shall be as under: -

Insulation voltage—690 V

Impulse withstand voltage (Uimp)—8 KV

Shock resistance 10/5 gn

Shock pick up @85—110% of control voltage

Should drop @30—60% of control voltage

Operating time—15 to 35 ms

3.1.21.15. CURRENT TRANSFORMERS

Cast Resin current transformer shall be provided for main distribution boards carrying current in excess of 60 amps wherever shown in drawing. All phases shall be provided with current transformers of accuracy 0.5 and suitable VA burden to operate associated metering.

Current transformers shall be in accordance with IS 2705.

3.1.21.16. EARTHING

All components, frame etc. shall be properly earthed.

GI earth bars of 25 x 5 mm shall be provided for the LT panel for the full length of the panel and connected to the framework. Provisions shall be made for connection from this earth bar to the main earthing bar on both sides of LT panel.

The Streetlight Control System will be auto controlled with a solar based real time clock /Timer with the following features.

The system should have a provision for remote and local operation with a three-way selector switch.

Street/Road Light Control Panel shall be equipped with the following: -

Sr. no.	Description	Quantity
1	200 Amp. TPN insulated copper Bus Bar	1 set
2	200 Amp TPN. MCCB with O/C & E/F protection releases make Merlin Gerlin or L&T	1 no.
3	63 Amp TPN. MCCB with O/C & E/F protection releases make Merlin Gerlin or L&T	1 no.
4	24 Hours& 7days (Real Time Clock) digital Timer make	1 no.
5	415 V, TPN 200 Amp, service cutout	1 nos.
6	RYB indicating LED lamps with fuses & 1 set of ON/ OFF LED lamp make	1 set each (5 nos.)
7	Ammeter with selector switch	1 no.
8	3-pole contactor of 60 Amp. Rating with prescribed heavy duty, type AC-1 with 240 V AC coil	4 nos.
9	220 V AC, 2 Amps. 2 Pole MCB of 9 KA short ckt. Breaking capacity	1 no.
10	3 positions AUTO/ OFF/ Manual selector switch of suitable rating.	1 no.
11	Elmex make bolted type Bus Bar Terminals type CBT—100	24 nos.

Sr. no.	Description	Quantity
12	Set of CTs (Cast Resin, Class 0.5, 200/5) – 3 Nos.	1 no.
13	100A TP strip fuse way with size - 00 'DIN' type 63A HRC Fuses make	4 nos.
14	Door switch (Snap action with push rod) make Kaycee / any reputed	1 no.
15	Push button make Telemecanique	2 no.
16	240V AC, power socket make Legrand/ any reputed	1 no.
17	240V AC, 60W bulkhead light make Reputed	1 no.
18	32A, 1P isolatable fuse carrier make – any reputed 4A, 10x38 Distribution fuse, Type gl-gg	4 nos.
19	4A, 10x38 Distribution fuse, Type gl-gg make any reputed	4 nos.
20	0-5 A Static/ Electronic KWH meter with set of CT's	1 set
21	63A, 10KA TP MCB make – any reputed make	6 nos.

3.1.21.17. PAINTING

All sheet steel shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating and then sprayed with a high corrosive resistant primer. The primer shall be baked in an oven. The finishing treatment shall be by application of two coats of epoxy paint of approved colour and stoved.

3.1.21.18. TESTS AT MANUFACTURERS WORK

All routine tests specified in IS: 8623:1977 shall be carried out and test certificates produced to the Engineer-in-charge. Typical type test certificate shall be furnished.

3.1.21.19. INSTALLATIONS AND COMMISSIONING OF STREET LIGHT CONTROL PANEL

The installation work shall cover assembly of various sections of the panels, lining up, grounding the units etc. In the case of multiple panel switchboards after connecting up the bus bars etc. all joints shall be protected with necessary insulated shrouding. A common earth bar as per IS specifications shall be run at the back of switch board connecting all the sections for connection to frame earth system. All protections and other small wirings for indication etc. shall be completed before calibration and commissioning checks are commended. All equipments, meters etc. shall be mounted and connected with appropriate wiring.

Testing and Commissioning

Commissioning checks and tests shall include all wiring checks and checking up of connections. Primary/ Secondary injection tests for the relay adjustment/ setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

Operation checks and lubrication of all moving parts.

Interlock function checks.

Continuity checks of wiring, fuses etc. as required.

Insulation test: when measured with 500 V megger the insulation resistance shall not be less than 100 mega ohms.

Trip test and protection gear test.

3.1.21.20. STREET LIGHTS

LIGHTING SYSTEM DESIGN

The street lighting system shall be designed considering the following:

- (a) The basic design criteria for street Lighting as per the latest Indian standard.
- (a) Lux Level Calculation.
- (b) Type of luminaries.
- (c) Control-scheme of luminaries.
- (d) Power sources for street lighting.
- (e) Power distribution for street lighting.
- (f) Mounting arrangement of luminaries.
- (g) Selection of street lighting poles.
- (h) Cable laying and termination scheme.
- (i) In Conformance with Base Exterior Architecture Plan (BEAP)

RECOMMENDED LEVELS OF ILLUMINATION

Taking into account consideration of principles of vision, criteria of quality and characteristics of sources and luminaries table below shows the desirable minimum levels of illumination which are recommended as per IUT-Institute of Urban Transport and SP : 30 - 2011)

TABLE 3-5: REQUIRED MINIMUM ILLUMINATION LEVEL

Sr. No	Particulars	Required Illumination Level
1.	Main Roads	30 lux
2.	Pedestrian crossing	50 lux
3.	Residential Street Lighting	1-10 lux
4.	Cycle Track	20 Lux

SELECTION OF STREET LIGHT FIXTURES

Light Emitting Diode (LED) type luminaires shall be used in the entire zone. LED street lighting is the energy-efficient alternative to traditional street lamps. LED lighting provides a multitude of advantages over conventional lighting: LED street lights are environmentally friendly, energy efficient and overall cost effective. This smart, "green" option for outdoor lighting has emerged on the green scene due to the recent technological advancements of LED illumination.

SELECTION OF STREET LIGHT POLES

Street Lighting Poles

Street Light poles structures are designed to support single or multiple luminaire configurations. A light pole is required to be strong to withstand the physical forces of the application, capable of providing a long, relatively maintenance-free service life and be pleasing in appearance.

Factors affecting Pole Selection:

Common materials used to construct poles include wood, steel, aluminium and fibreglass, with steel being the most common due to its strength and affordability. The following factors shall be considered in pole selection.

- (a) Mounting Height (MH)
- (b) Luminaire Selection and Configuration
- (c) Auxiliary Equipment and Special Loading
- (d) Wind Speed
- (e) Terrain and Special Wind Regions
- (f) Finish
- (g) Special Requirements and Mounting Configurations
- (h) Conformance with the BEE (Bureau of Energy Efficiency)
- (i) BEAP

POWER DISTRIBUTION FOR STREET LIGHTING

There will be installed a main distribution board which will be dedicated to supply power for street lighting feeder pillar. Each feeder pillar shall be capable to feed supply 500 meter in either side. Not more than 1000 W load of all LED bulbs or 10 No. of light fixtures, either of which is achievable shall be kept on a single circuit. All feeder pillars shall be IP-65 degree of protection and front operated. Feeder pillar construction shall be as per IEC-61439. Ref. Drawing no. STREET LIGHT POLE LIGHTING LAYOUT, DELD-LSCL-100-TP-RSN-3007.

LIGHTING MANAGEMENT SYSTEM

To have efficient use of light automatic light control system is recommended. The lights shall be with astronomical clock device to automatically set the timings for lights ON/OFF throughout the year in line with sun-set timings. A centralized solution shall be adopted for intelligent operation. In this system hardware modules would be installed in control cabinet of the lighting feeder pillars and would enable communication from the central server location to the control cabinet via fibre optics cable. This would ever provide switching off these lights in event of air-raid warnings.

MAJOR COMPONENTS

The major components of the system have been summarized below with some brief specification.

- (a) Feeder Pillar: Feeder pillar shall be installed for distribution of power to different light poles. Ref drawing no. GA& SLD of lighting control panel DELD-LSCL-100-TP-RSN-3026 & DELD-LSCL-100-TP-RSN-3027.
- (b) Power Factor correction: A poor power factor is a major (and avoidable) cost factor. As such light fitting with in-built capacitor has been considered to improve the system power factor to 0.90 lagging or better.
- (c) Surge Protector : Surge protector shall be installed for individual lights or for lighting circuit as per the design.
- (d) Earthing: All light poles, feeder pillar and junction boxes shall be earthed as per standards.

3.1.21.21. FANS

CEILING FANS

Adequate numbers of ceiling fans 1200 mm sweep in offices complete with down rods, canopy and speed regulator as approved by the Engineer shall be provided. All ceiling fans shall be of double ball-bearing type, class-I and conforming to IS 374.

EHAUST FANS

Adequate numbers of exhaust fan of max 450 mm sweep with louvers in the pump house, sub-station rooms, toilets as approved by the Engineer shall be provided.

- (a) Impeller shall be with blades of an aerofoil design. Blades shall be mounted on stream lined hub. Impeller shall be mounted directly on the motor shaft.
- (b) Casing shall be of heavy gauge construction properly reinforced for rigidity. It shall be provided with suitable supports.
- (c) In case of cane axial fans, guide vanes shall be provided on the discharge side.
- (d) Materials of construction

Casing	:	Mild Steel
Impeller	:	Mild Steel / Cast Aluminium
Inlet / Outlet	:	Mild Steel

- (e) Exhaust fan shall be provided with louver shutter made of MS sheet/Aluminium, which opens, by fan draft and close by gravity when the fan is switched off.

3.1.22. CONTRACTOR'S REQUIREMENT

- (a) Contractor should get Inspected all the works involved in the project, from the CEI Govt. of Punjab, duly paying the necessary requisite fees and submitting the Certificate-Unless and until such clearance are obtained, the commissioning activities will not be considered as completed.
- (b) It is obligatory on the part of contractor that the guaranteed technical particulars of all the equipments ordered on the vendors will be got approved from the owner / PSPCL before effecting their purchase.
- (c) The Contractor shall provide necessary drawings and documents required by statutory authorities and obtain approval before taking up erection.

3.1.23. INSPECTION

All the bought out items/ equipments/ panels will be got inspected at Vendor's premises from the owner before it is transported at the site failing which it will be treated as breach of contract.

3.1.24. DRAWINGS

The contractor will furnish three sets of all the drawings required for execution of work after detailed design and engineering on the basis of SLD for approval to the owner at the earliest but not later than one month after award of contract. The owner/ consultant will approve the drawings within 15 days after receipt and these approved drawings will be considered as GFC for execution at site. Similarly all the drawings in respect of equipments to be purchased from approved Vendors shall be submitted to owner/ consultant for approval and these drawings. It shall also be approved within 15 days after receipt. Any equipment purchased by the contractor without the approved drawing will be treated as a breach of contract.

3.1.25. STATUTORY APPROVAL

Obtaining Approvals & Consents from relevant authorities like Chief Electrical Inspectorate, State Electricity Board, PTCC, all statutory agencies etc like PWD , NHA etc. However, any statutory fees paid by the contractor shall be reimbursed against sub-mission of documentary proof.

3.1.26. SAFETY

Work is to be done on substations in operation; therefore, the following factors are of paramount importance:

- (a) Minimization of outage time
- (b) Adaptation to operational constraints. All the work shall be conducted in adhere to all instructions and safety rules approved by the PSPCL/Ludhiana Smart City Engineer –in- Charge.

3.1.27. SPARES

Recommended spares: The Tenderer shall furnish in his offer a list of recommended spares with unit rates for each set of equipment that may be necessary for satisfactory operation and maintenance of circuit breaker and Isolators for a period of 5 years.

The purchaser reserves right of selection of items and quantities of these spares to be ordered. The cost of such spares shall not be considered for tender evaluation.

3.1.28. TOOLS

The Tenderer shall submit a list and unit rates of all the special tools, equipment and instruments required for erection, testing, commissioning and maintenance of all electrical equipments. The purchaser shall decide the quantity of tools to be ordered. Prices of these tools shall not be considered for tender evaluation. However, the list of necessary tools/equipment which will be supplied free of cost with each equipment may be furnished separately.

3.1.29. TRAINING

Provide training on CSS/ SCADA, telecommunications equipment to the operation and maintenance staff of PSPCL/ Client.

3.1.30. LIST OF PREFERRED MANUFACTURERS

The list of "Preferred Equipment Manufacturers" is as given below:

S.No.	Description	Make
1.	11/0.4kV Distribution Transformer (As part of packaged RMU substation)	BHEL / Crompton / ABB / Schneider/Bharat Bijlee
2.	SF ₆ gas insulated 11kV RMU (As part of packaged substation) and Outdoor RMU +_FRTU	/ ABB / SIEMENS / SCHNEIDER
3.	Compact Substation (OEM Factory),	Schneider / Siemens / ABB
3a	Feeder Remote Terminal Unit (FRTU) & Fault Passage Indicator (FPI) Protection Relay & Meters and multifunction meters integral part of CSS	Schneider / Siemens / ABB
4.	LT Switch Board	Schneider / Siemens / ABB/
5.	CTs and PTs	AE / Kappa / Siemens / Crompton / ABB / Schneider
6.	Insulators	BHEL / Jai Shree / WSI
7.	Numerical Type Protection Relays (for 66kV & 11V Panels at substation level)	ALSTOM / Siemens / ABB / Schneider
8.	DC batteries / POWER PACK	Exide / Amar-Raja / HBL
9.	Battery Chargers	Amar-Raja / Exide / AE /HBL
10.	H.T., L.T. & Control Cables	CCI / Universal / RPG / KEI / Finolex
11.	Lighting Cables	Kalinga / Delton / Finolex /Havel
12.	Lighting Fixtures	Phillips / Bajaj / Crompton / Wipro

S.No.	Description	Make
13.	H.T. & L.T. termination kits	Raychem / CCI / M-SEAL
14.	Light Poles	Bajaj / Valmont / Sumip
15.	Smart Energy Meters	ABB / Schneider / L&T / Secure Meters
16.	Mild Steel and High Tensile Steel	SAIL / Tata Steel
17.	Bolts, nuts & spring washers	GKW
18.	HV and LV bushings	BHEL / Jayshree / WSI / CGL / SSB
19.	Cable Glands	HMI / Gripwel / Comet
21.	Cable lugs	Dowell's / AMP (Tyco Electronics)
22.	PVC terminals & terminal blocks	ELMEX / ESSEN / Phoenix
23.	Annunciators	Minilec
24.	Semaphore	ALSTOM / ABB / Siemens / Schneider
25.	Modular type switches	North West / MK / MDS / Schneider / Legrand
26.	Indicating meters	Siemens/ Schneider/ABB
27.	Pushing button & indicating light	L&T / BCH / Siemens / C&S
28.	Selector & Control Switches	ALSTOM / Siemens/Schneider
29.	ACB & MCCB	Siemens / ABB / Schneider
30.	Switch Sockets & Modular type receptacles	BCH / MDS / Crompton / Schneider
31.	MCB	Siemens / ABB / Schneider
32.	MCB distribution board	/ Siemens / ALSTOM / Schneider
33.	Lighting panels	MDS / Siemens / L&T / Schneider

S.No.	Description	Make
34.	Indicating Lamps	Siemens / BCH / / Schneider
35.	Contactors	L&T / Siemens / ALSTOM / Schneider
36.	Portable Fire Extinguishers	Minimax / Mather Platt / Ceasefire
37.	SCADA including Communication equipment & FRTU	ALSTOM / Schneider / ABB / Siemens
38.	DG Set with AMF Panel	Cater Pillar / Kirloskar / Sudhir / Jakson / Sterling & Wilson
39.	Underground HDPE Ducts	Duraline, Bajaj, Reliance
40.	Fibre Optic cables	Usha Martin/ RPG/Finolex
41.	Feeder Pillar	Schneider, Viduyat, Siemens, ABB, ETE, Adlec
42.	66kV/11kV Power Transformer	Siemens, ABB, Schneider, BHEL
43.	11kV Circuit Breaker and Panels	Siemens, ABB, Schneider
44.	66kV Circuit Breaker	Siemens, ABB , Alstom

3.2. ENGINEERING DELIVERABLES

The Bidder shall submit following minimum Engineering Deliverables from award of the Contract. Any other drawing / calculation which is not listed below and may be required for execution of the job shall also be submitted by the bidder.

Main Single Line Diagram indicating bus/breaker rating, cable/overhead conductor size, fault

A. Electrical Drawing

- (i) Levels of different voltage grade, Transformer details, metering and protection with CT / PT cores / ratio / burden / accuracy class.
 - (ii) Complete BOQ of the project with technical details.
 - (iii) Single Line Diagram of 415 V AC Distribution board
 - (iv) Single Line Diagram of 11KV panels
 - (v) Overall Site Layout Plan
 - (vi) Maximum & Minimum fault level calculation for the substations.
 - (vii) Insulation coordination.
-

- (viii) Switchgear/Control building layout – Plan.
- (ix) Cable duct routing, layout Plan & Section – outdoor.
- (x) Cable duct layout Plan & Section – Indoor.
- (xi) Sizing calculation of HV& LV Cables
- (xii) Power cable & Control cable schedules.
- (xiii) Cable tag marking concept.
- (xiv) Earth design calculation based on actual site soil investigation.
- (xv) Outdoor equipment grounding arrangement and details.
- (xvi) Input / Output list of SCADA system.
- (xvii) Outdoor Illumination system design Calculation.
- (xviii) Drawing of Outdoor Illumination with erection details.
- (xix) All major equipment sizing calculation
- (xx) Cabling, earthing & lightning concept
- (xxi) CSS, Lighting pole, Feeder Pillar Transformer foundation details
- (xxii) Firefighting arrangement of Transformers and indoor equipments
- (xxiii) Relay setting with calculations.
- (xxiv) Material inspection reportn
- (xxv) Pre commissioning / commissioning reports of all equipments
- (xxvi) As built documentation of the drawing / documents

LOAD LIST OF CONSUMERS

Sl.No	Consumer Load in KW	Sl.No	Consumer Load in KW	SL.No	Sl.No	SL.No	Consumer Load in KW	Sl.No	Consumer Load in KW
1	30	42	60	83	24.63	124	4	165	4
2	26.4	43	24	84	39.4	125	0.886	166	4.9
3	15	44	30	85	15	126	13.34	167	4
4	39	45	49.2	86	13.34	127	4	168	0.886
5	17	46	49	87	26.41	128	9.82	169	4
6	26.42	47	84.03	88	49.73	129	4.28	170	4.28
7	14.4	48	84.3	89	26.4	130	1.9	171	1.9
8	47.3	49	48.5	90	15	131	10.9	172	3.98
9	8	50	57.38	91	17	132	11	173	1
10	24.33	51	9.3	92	26.42	133	3.98	174	2
11	26.4	52	4	93	14.4	134	19.58	175	4
12	19.96	53	9.24	94	8	135	14.9	176	4.9
13	30	54	14	95	24.33	136	48	177	4
14	24.67	55	8	96	26.4	137	1	178	0.886
15	10.96	56	2.98	97	19.96	138	2	179	4
16	14.9	57	11.89	98	30	139	26.47	180	4.28
17	24.42	58	19	99	24.67	140	24.63	181	1.9
18	10.9	59	6.96	100	10.96	141	39.4	182	3.98
19	11	60	90	101	14.9	142	15	183	1
20	47.38	61	4.9	102	24.42	143	13.34	184	2
21	10.78	62	12	103	10.9	144	26.41		
22	90	63	4	104	11	145	4		

23	49	64	0.886	105	10.78	146	4.9
24	17	65	13.34	106	17	147	4
25	90	66	4	107	13.7	148	0.886
26	13.7	67	9.82	108	5.5	149	4
27	84.65	68	59	109	9.75	150	4.28
28	28	69	4.28	110	11	151	1.9
29	5.5	70	1.9	111	21.8	152	3.98
30	9.75	71	10.9	112	11	153	1
31	29.93	72	11	113	24	154	2
32	49.73	73	3.98	114	9.3	155	4
33	11	74	19.58	115	4	156	4.9
34	21.8	75	14.9	116	9.24	157	4
35	11	76	48	117	14	158	0.886
36	49.73	77	1	118	8	159	4
37	63	78	2	119	2.98	160	4.28
38	49	79	55.55	120	11.89	161	1.9
39	63.5	80	74.92	121	19	162	3.98
40	30	81	57.86	122	4.9	163	1
41	48	82	26.47	123	12	164	2

Chapter 6

Operation and Maintenance Services Schedule

Design, Construction and Maintenance of the RETROFITTING & IMPROVEMENT WORKS FOR SARABHA NAGAR MARKET, LUDHIANA (Smart City Mission) including 2 years of Defect Liability and 5 Years of Maintenance

1 For External Development works:

a) Softscape

- 1. Refer Item no. 1.5 (softscape maintenance) of Schedule 10-Technical Specifications**
2. Refer Table below:

Maintenance Work-Softscape works	Timing
Watering	As often as necessary to ensure that planting medium does not dry out
Weeding	Fortnightly
Fertilizing: - Tree - Shrubs/ground cover - Turf	Once every 3 months Monthly Once every 3 months
Soil aeration	Monthly
Firming up	Immediately after strong winds and/or every 4 months
Tying climbers to supports and climber wires	Check monthly ties as necessary
Pruning and shaping trees	As and when required
Trimming shrubs/ground covers	Monthly, or as and when required
Guying & staking	As and when required
Grass cutting	Fourteen (14) days interval or as specified
Control of pests	Check fortnightly, treat immediately as per manufacturer's instructions
Control of diseases	Check monthly, treat immediately as per manufacturer's instructions
Top dressing for turf/shrubs	Monthly, and until the soil is level
Removal of dead leaves in landscape areas	Daily
Storm damage: assessment & repair	After each incident

3. Damage to any Softscape item shall be repaired within timeframe and as per instructions mentioned below:

Defect/ Damage (Softscape)	Repair/Replacement (Softscape)
Rejection of any plant materials during the warranty period due to death, diseased or unacceptable/ defective growth pattern	The replacement made will be of <u>similar size as if normal growth had occurred since the original planting.</u> This should be done <u>within a period of 7 days.</u>

b) Hardscape

1. Removal of debris/rubbish within a nominated timeline as approved by the PMC/Client representative.
2. For removal of hard stains, conduct all necessary tests mandatory prior to applying any chemicals to the hard surfaces, to ensure that the surface will not be damaged.
3. Removal and replacement of damaged tiles/pavers and grouting to tiles within footfall and seating areas, within 24 hours.
4. Repairs to damaged walls within 24 hours after confirmation of cause of failure, assessment to be undertaken and approval from authority for restoration works within 5 working days. Barriers to be installed to prevent public access to areas considered unsafe.
5. Trip hazards to be rectified within 24 hours from notification.
6. All painted elements to be maintained to a standard associated with handover of project, all graffiti to be removed within 24 hours.
7. Drains to be maintained, including silt & debris removal on a monthly basis, a visual inspection to be undertaken weekly to ensure proper fitment of drainage lids to frames to prevent potential pedestrian injury.
8. All inspection openings to light poles, electrical cabinets to have a sturdy locking device installed by the manufacturer, keys to be provided to relevant authority.
9. An asset management protocol to be established and duly approved by the PMC/client representative to identify items such as seats, lighting elements (poles, uplights etc.) irrigation tapping points, control valves etc. which details maintenance schedule and works undertaken and future works programme.
10. Damage to any Hardscape item shall be repaired/replaced within timeframe mentioned below:

Hardscape works- Repair/Rectification	Timing
Paving & Kerbs- Any breakage/damage	Within 24 hours
Street Furniture-Benches, Bollards etc.- Any	Within 24 hours

breakage/damage	
Plaza Signage- Any breakage/damage	Within 48 hours
Play Equipment- Any breakage/damage	Within 48 hours
Art work- Any crack or peeling of plaster	Within 48 hours
Cladding- Any dent/damage	Within 24 hours
Steel gates- Any breakage/damage/malfunction	Within 24 hours

c) Public Toilet

1. All points mentioned above (Hardscape) apply.
2. Any damage to sanitary fixtures & CP fittings shall be replaced and rectified within 24 hours.
3. Piping/valve/traps/fittings/tap leakages – Shall be rectified/replaced within 2 hours.

d) Water Fountain

1. Check the water level frequently and add more water as needed, making sure to keep the water pump covered with water at all times.
2. Use distilled water to reduce the amount of mineral build-up in the fountain and on the water pump.
3. Check the water pump, nozzles and any fitting open to outside and remove any debris such as leaves, twigs and insects that might clog it, preventing it from circulating water properly.
4. Perform routine maintenance on the filter to ensure trouble-free nozzle operation. Be careful not to allow debris to enter the inlet plumbing when cleaning filters.
5. Perform regular maintenance to all pumps – unplug, remove cover to clear all debris, mineral build up, algae deposits etc. at least once monthly or when the water appears dirty.
6. Piping/valve/traps/fittings/tap leakages – Shall be rectified/replaced within 2 hours.
7. Damages or malfunction in filtration system/ pumps should be made good in 24 hours.

e) Bronze Statue

1. Bird droppings should be immediately washed off the sculpture. If dust, dirt, tree resin, etc. build up on the sculpture, it is time to wash. Wash the sculpture with warm water and soft cloths.
2. If the sculpture looks dull, it is time to wax. Waxing treatment should be done at least 4 times a year: early Spring, twice during the Summer months, and late Fall. Wash the sculpture with warm water and soft cloths. Allow the sculpture to dry before application of wax. (a good commercial wax such as Trewax or Butchers wax that do NOT have spirits or turpentine in it)
3. Never use any chemical, cleaning solutions, tarnish removers, or any other unknown or previously unused substance to clean the surface of the sculpture.
4. Avoid exposure of the sculpture to chemicals including but not limited to: grass and tree fertilizer spray, chlorine, pesticides, bug sprays and foggers, window washing products, ammonia or other commonly used household products.
5. Never use abrasive cleaning pads, steel wool, or sand paper on the sculpture. Use of such materials could mar the surface of the sculpture and require refinishing.
6. Do not mount a bronze sculpture directly onto a steel base. To avoid electrolysis, bronze sculptures may be mounted onto a steel base by placing a rubber, silicone or plastic buffer in between the two metals, ensuring that the metals do NOT meet.
7. Any dents/ damage to be fixed within 48 hrs.
8. Any structural failure will require immediate replacement.

2 Utilities

The Contractor shall ensure the Operation and Maintenance of the External Fire Fighting system, Storm water drainage network, Rain water harvesting facilities, Irrigation network and other allied works in compliance to the guidelines contained in the relevant BIS specifications and the prescription laid down hereunder.

Scope of Work

2.1. Operate the External Fire Fighting system, Storm water drainage network, Rain water harvesting facilities, Irrigation network, **for a period of 5 years as specified below:**

2.1.1. Scope

- a. The Contractor shall operate and maintain the External Fire Fighting system, Storm water drainage network, Rain water harvesting facilities, Irrigation network under the Contract complete including civil/structural, mechanical components, instrumentation system, Electrical System and all utility for the period of ten (10) years from the date of successful completion of "Tests after Completion of the Works".

- b. The Contractor shall make his own arrangements at his own cost for Works operation personnel, lubricants, diesel, spares, tools and tackles, routine maintenance, de-silted material collection, transportation and disposal, co-ordination with agency supplying power to the Firefighting Pump House and any other activity required for the operation and maintenance of the constructed Works in full compliance with all applicable rules, regulations, laws, codes and any other limitations.
- c. Take all necessary measures to minimize the power consumption in carrying out its operations.
- d. operate electrical equipment during power failures by making appropriate alternative arrangements,
- e. Dispose the de-silted material from storm water drains in a manner which is compliant to all applicable environmental laws and rules;
- f. The Contractor shall submit a weekly report to the Employer detailing the Operation and Maintenance indicating the labour hours expended, Electrical Power Consumed and other Consumables consumed and also problems faced and rectified.
- g. The Contractor shall submit detailed schedule/manual of all O& M activities with references of equipment manufacturers' maintenance schedules/manuals to the Employer for review and approval.
- h. The Contractor shall carry out all O&M activities as per the approved Operation and Maintenance Manuals.
- i. During the Operation and Maintenance period, the Contractor shall ensure that the storm water drains are always clean and shall not be blocked on account of silt deposition..
- j. The Contractor's responsibility shall also include the safety and security of the Works during the course of Operation and Maintenance.
- k. Acquire and maintain sufficient stock of consumables and procure necessary electrical and mechanical equipment required for operations and maintenance of facilities to ensure uninterrupted operations.
- l. The Contractor will be responsible to carry out day to day periodic maintenance, necessary to ensure to smooth and efficient performance / running of all equipment / instruments.
- m. Contractor will comply with all safety rules and regulations as followed by the Employer.
- n. The Employer will not be responsible for any accident /injury to the staff of the Contractor. Further the Employer will not provide any insurance or medical facility to the staff of Contractor. The responsibility lies with the Contractor.
- o. All Central/State Government / Semi-Government / Local Body's Rules and Regulations pertaining to this contract shall be followed and observed by the Contractor without any extra cost to the Employer.
- p. No equipment shall remain damaged for the period of 3 days.

- q. The payment of O & M charges will be made as per the tender conditions. The other terms and condition described in these complete tender documents, wherever applicable shall remain unchanged. In case of any discrepancy the decision of PMC/Client will remain final & binding on the Contractor.
- r. During Operation & Maintenance period, Contractor has to supply all the spares, at his cost during preventive, major-minor breakdown, replacement and maintenance work. No extra payment will be made for such maintenance on any ground. The payment for the same will be made strictly as per tender document irrespective of the number of break down / minor, major repairs replacements.
- s. Contractor will have to maintain required Power Factor as per STATE EB rules and regulations. In case penalty is levied by STATE EB for not maintaining the Power Factor the same will be recovered from the. Contractor
- t. Any other services required for smooth running of the scheme

Charter of Services

S.N.	Nature of complaints	Time for rectification
		(in hrs)
1	Leakage from Hydrant	24 hours
2	Replacement of damaged or stolen/missing drain cover	24 hours
3	Replacement of damaged / break down Electro-mechanical equipment	24 hours

2.2. Reporting and Record Keeping:

- a. The Contractor will prepare daily and monthly reports. The reports shall contain, inter-alia, the following:
 - A description of the maintenance work carried out in the reporting period.
 - A report on major failures, if any, their causes and remedial actions taken.
 - Power and consumables consumed in the reporting period.
 - An inventory of the consumables and spare parts available at the end of the reporting period.
 - O&M staff deployed by the Contractor during the reporting period.

3 ELECTRICAL

The Contractor shall ensure the Operation and Maintenance of the electrical equipment, and other allied works in compliance to the guidelines contained in operation and maintenance manual of electrical equipment and the relevant IS specifications and the prescription laid down hereunder.

3.1 Scope of Work

Operation and maintenance of Electrical equipment Sarabha Nagar Market Complex is in the scope of the contractor. The contractor has to ensure continuous power supply / minimum down time by timely rectification of electrical faults of the equipment if PSPCL supply failure has not occurred. The contractor has to coordinate with PSPCL and obtain permission from them for energising and de energising the system. The contractor has to obtain prior permission from PSPCL and / LSCL and duly intimated to consumers prior to shutting down the incoming supply to Sarabha Nagar Market Complex. The contractor has to keep a record of supply disruption on a daily basis.

All work in this area must conform to the Indian Standard or in its absence the International Standard Codes. Any condition observed by the Contractor that does not conform to this standard or code, which cannot be corrected in the normal maintenance activity, shall be reported to LSCL Operation & Maintenance Engineer - in- charge with recommended corrective action.

All approved safety practices must be observed. Permits to work and test must be raised where necessary and display caution plates. Also ensure that safety rubber mats are available for electrical panels (LT/HT) and safety gloves, eye goggles, mask, etc. for technicians.

Operate the Electrical equipment, for a period of 5 years as specified below:

3.2 Scope

- i. The Contractor shall operate and maintain all electrical equipment Compact Substations, Ring Main Units, Feeder pillars, Street lights and area lighting, energy meters, power, fibre optic and control cables, SCADA system and all related electrical and civil works for the successful upkeep of the power supply to both 11 KV and LT consumers of the project area. Electrical System and all utility for the period of ten (10) years from the date of successful completion of "Tests after Completion of the Works".
- ii. The Contractor shall make his own arrangements at his own cost for Works qualified operation and maintenance personnel, lubricants, spares, tools and tackles, routine maintenance and preventive maintenance, transportation and disposal, co-ordination with PSPCL and LSCL for supplying power supply to market area and any other activity required for the operation and maintenance of the constructed Works in full compliance with all applicable rules, regulations, laws, codes and any other limitations.
- iii. Take all necessary measures to minimize the down time of the power supply disruption to the Market complex.
- iv. The contractor has to arrange additional manpower/ tools and equipment like cable jointer, SCDA technician/ High voltage testing equipment/ transformer oil filters etc at their own costs as when required to rectify the fault at the earliest.

- v. The Contractor shall submit a weekly report to the Employer detailing the Operation and Maintenance indicating the labour hours expended, Electrical Power Consumed and other Consumables consumed and also problems faced and rectified.
- vi. The Contractor shall submit detailed schedule/manual of all O& M activities with references of equipment manufacturers' maintenance schedules/manuals to the Employer for review and approval.
- vii. The Contractor shall carry out all O&M activities as per the approved Operation and Maintenance Manuals.
- viii. During the Operation and Maintenance period, the Contractor shall ensure that the electrical equipment are always clean.
- ix. The Contractor's responsibility shall also include the safety and security of the Works during the course of Operation and Maintenance.
- x. Acquire and maintain sufficient stock of spares / consumables and procure necessary tools and equipment required for operations and maintenance of facilities to ensure uninterrupted operations.
- xi. The Contractor will be responsible to carry out day to day breakdown down and preventive maintenance suggested by manufactures' operation and maintenance manual to ensure to smooth running of all equipment / instruments.
- xii. Contractor will comply with all safety rules and regulations as followed by the Employer.
- xiii. The Employer will not be responsible for any accident /injury to the staff of the Contractor. Further the Employer will not provide any insurance or medical facility to the staff of Contractor. The responsibility lies with the Contractor.
- xiv. All Central/State Government / Semi-Government / Local Body's Rules and Regulations pertaining to this contract shall be followed and observed by the Contractor without any extra cost to the Employer.
- xv. The Contractor shall notify LSCL, Facilities Operation and Maintenance Engineer -in- charge, of any unplanned disruption to power supply and fault of HV switchgear, HV cable/LV cable, CSS / transformer, feeder pillar etc. which result in partial or total power outage to any facilities, by mail, as soon as possible and not more than 12 hours after the power outage. This shall be followed by written report within 48 hrs. Investigations have taken place. Notification is required whether the disruption is caused by a failure of PSCL power supply, or of the electrical distribution system. Financial penalty will be imposed if such power disruptions are not reported to LSCL within time.
- xvi. During Operation & Maintenance period, Contractor has to supply all the spares, at his cost during preventive, major-minor breakdown, replacement and maintenance work. No extra payment will be made for such maintenance on any ground. The payment for the same will be made strictly as per tender document irrespective of the number of break down / minor, major repairs replacements.

- xvii. Contractor will have to maintain required Power Factor as per STATE EB rules and regulations. In case penalty is levied by STATE EB for not maintaining the Power Factor the same will be recovered from the Contractor.
- xviii. Some repair or preventative maintenance activity may require disrupting normal services. Such action must be minimized by use of standby power, bypass switching, temporary bypass lines, etc. Such repairs shall be planned during off hours.
- xix. All electrical meters, e.g. Ammeter, voltmeter, KW meter, frequency meter, and power factor meter are required to be calibrated by a certified approved independent testing laboratory once during the Contract duration. The Contractor must receive LSCL approval before hiring a company for calibration. The Contractor must keep the calibration certificates available at respective sites and submit copies to LSCL for review and acceptance.
- xx. Secondary injection test require to be carried out annually for all protection relays . Primary injection test of HV/LV circuit breaker is required to be carried out once in the Contract duration. Hi-pot test of H.V. switchgear, bus-bar and transformers required to be carried out as per requirement.

3.3 Secondary injection test require to be carried out annually for all protection relays . Primary injection test of HV/LV circuit breaker is required to be carried out once in the Contract duration. Hi-pot test of H.V. switchgear, bus-bar and transformers required to be carried out as per requirement.

- a. Any other services required for smooth running of the scheme

Charter of Services

S.N.	Nature of complaints	Time for rectification
		(in hrs)
1	Major faults like breakdown of Compact substation / Transformer / Cable faults / SCADA	24 – 48 hours
2	Damaged cable termination/ MCB/, fuse failure, fused bulbs / tripping of equipment, power supply failure to consumers due to minor faults etc	1-2 hours

3.4 Tools & Equipment's:

- a. Standard measuring instruments e.g. Multi meter, Tong Tester, Megger Insulation tester, Megger earth tester etc. should be provided by the agency immediately after taking over the responsibility of the maintenance.

- b. Standard Tools i.e. Pliers, screw drivers, Files, Hammers, Hacksaw, Brushes, all types of wrenches, Crimping tool (up to 400 sq. mm), Test Lamps etc. should be provided by the agency in multiple sets so that, two independent team of workers can work simultaneously.
- c. Portable power blower, portable hammer drill m/c, cutting & drill m/c etc. are to be provided by the agency.
- d. Any other tools & tackles as may be required for breakdown or periodic maintenance work should be provided by the agency at the time of requirement on urgent basis (within 12 hrs.).
- e. All types of safety articles like safety gloves, safety shoes, safety apron, helmet etc. are to be provided for the use of the maintenance personnel by the contractor. Apart from this, the entrusted contractor has to provide uniform (2 sets per year) & Identity card for their employees to be deployed at LSCL within 30 days from the date of taking over of maintenance.

3.5 Reporting and Record Keeping

- a. Log book(s) should be maintained in which all daily electrical Preventive and Corrective Maintenance activities for each facility must be recorded. It is the electrical supervisor's responsibility to maintain this log and must be readily available for LSCL inspection.
- b. The schedule for conducting all periodic tests shall be submitted to LSCL O&M for approval within 90 days from the commencement of the Contract.
- c. All inspection observations, test results, equipment and system data, shall be documented and shall be made available for LSCL representative.
- d. The Contractor will prepare daily and monthly reports. The reports shall contain the details of breakdown, maintenance carried out, consumption of spares and man power deployed etc.
- e. Monthly Reports
The Contractor shall prepare and submit monthly reports to the LSCL's Representative for the works included in this tender, in four copies and within 10 days of the next month. The report shall describe the operation and maintenance of the treatment plant with copies of the records submitted to the LSCL's Representative including the summaries of the record in tabular and graphical form. The report shall include a section describing the performance in terms of compliance with the requirement of the contract. The Contractor shall make available all supporting documents, records etc., to the LSCL's Representative if required to do so.

The report shall be in a form approved by the LSCL's Representative to cover

- i) Operation – Records of operation of electrical equipment etc.,
- ii) Maintenance – A list of equipment break down, spares consumed, minor and major repairs carried out, schedule of maintenance carried out during the month etc.,

- iii) Staff, Skilled labour and unskilled labour – number of staff utilized, training programme conducted if any, performance evaluation made if any etc.,
- iv) Safety – Brief reports of all accidents and hazardous incidents including description of cause, extent of damage, action taken and precautions taken to prevent the repetition.
- v) Inspection reports of Routine / daily / weekly / monthly/ quarterly/ half yearly/ yearly
- vi) Confirmation on statutory compliance
- vii) Any other relevant information connected with works

3.6 Manpower

As a minimum, the following personnel shall be deployed at site for Operation and routine Maintenance activities, as described in Table 1, based on manufacturer’s recommendations and schedules. Table 4 “O&M Personnel Requirements”, below, shows only an estimated minimum manpower required. Based on the contractor’s final design, specific type, brand, model, make, quantity of equipment installed and the manufacturers maintenance requirements the contractor may need to modify or increase manpower requirements to properly operate and maintain all equipment, components and systems. Any required repairs or replacements of equipment or components, over and above routine O&M, will be covered .

S. No.	Item	Qualification	Nos.
1.	O&M supervising Engineer	10 years’ experience in O&M of similar works. For electrical works, B.Tech qualification is must.	2
2.	Electrician 1 each for 3 shifts for all Electrical room & substation	7 years minimum experience in O&M of similar systems. ITI certification required.	3

Liquidity Damages during Operations and Maintenance.

In case of failure by the Contractor, the following Liquidity damages would be levied as mentioned below:

SI No	Activites	Liquidity Damages per Week
1	For External Development works:	10% of the O&M fee
2	Utilities	10% of the O&M fee
3	Electrical Works	20% of the O&M fee

In addition to the above, the works would be carried out and the LSCL would back charge the bidder along with a markup of 20% on the actual cost incurred to carry out the said work

Bill of Quantities

Sl.no.	Description of items	Unit	Quantity	Unit Rate (Rs.)		Amount
				In Figures	In Words	
Softscape works						
Note-All softscape work rates included of maintainance for one year.						
1	EARTHWORK					
1.1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	cum	389			
2	FILLING					
2.1	Supplying and stacking of good earth at site including royalty and carriage upto 5 km complete (earth measured in stacks will be reduced by 20% for payment).	Cum	389			
2.2	Supplying and stacking at site dump manure from approved source, including carriage upto 5 km complete (manure measured in stacks will be reduced by 8% for payment): Sreed through sieve of IS designation 20mm.	Cum	109			
2.3	Mixing earth and sludge or manure in the required proportion specified asor directed by the Officer-in-charge	Cum	497			
2.4	Spreading of sludge, dump manure and/or good earth in required thickness as per direction of officer-in-charge (cost of sludge, dump manure and/ or good earth to be paid separately).	Cum	497			
3	PLANTING					
3.1	Supply and planting Trees , of height, caliper and multi-branching as per specification. Refer Drawing no 3004					
i.	Tabebuia Rosea/ Rosy Trumpet Tree (3m height overall, clear trunk height 1.5m, 2.5m canopy width, 50-80mm caliper, straight trunk & balanced canopy)	Nos	25			
ii.	Plumeria Alba/ Champa Tree (2.5m height overall, clear trunk height 1.0m, 3.0m canopy width, 60-80mm caliper, multi-branch)	Nos	15			
iii	Peltophoron-ferrugineum Tree(3m height overall, clear trunk height 1.5m, 2.5m canopy width, 50-80mm caliper, straight trunk & balanced canopy)	Nos	27			
3.2	Supply and planting Small Shrubs, Grasses, Climbers and Succulents of height, spread and growth as per specifications, for understorey planting (outer hedge min. 450mm high). Refer Drawing no 3004					
i.	Clerodendron Inerme	Sqm	470			
3.3	Supply and planting Ground Covers and seasonals (seedlings of hybrid varieties), planting inside hedgerow. Refer Drawing no 3004					
i.	Rhoeo	Sqm	468			
4	GRASSING					
4.1	Grassing by Dibbling Method with Axonopus Compressus, to be weed free, including watering and maintenance of the lawn till the grass forms a thick lawn free from weeds and fit for mowing and disposal of rubbish; including final levelling by spreading a mixture of sweet earth, sand and compost (5:2.5:2.5) upto a thickness of 50mm.	Sqm	1227			
				Total for Softscape works =		
Hardscape Works						
1	DISMANTLING & DEMOLITION					
1.1	Dismantling of existing Hard/paved areas to achieve grading as per drawings. Refer Drawing no 3002					
i	Dismantling of brick or flagged stone flooring without concrete flooring. Areas: Plaza, Parking	Sqm	5,316.69			
ii	Dismantling concrete or precast concrete Areas: Plaza, Parking					
	Cement concrete plain	Cum	1,219.34			
iii	Dismantling of brick work in cement sand mortar/lime mortar including T&P scaffolding wherever necessary, sorting the dismantled material, disposal of unservicable material and the stacking of servicable material with all lead and lift of 100m (By Mechanical means). Areas: Garbage room, compound wall	Cum	263.68			
iv	Dismantling of flexible pavements (Bituminous courses) (by Mechanical means) Areas: Parking area, External road					
	Dismantling of bituminous course of flexible pavements by mechanical means and disposal of dismantled material upto lead of 1000 m stacking servicable and unservicable material as per clause 202 of MORT & H specifications.	Cum	229.54			

v	Dismantling of granular course of flexible pavements by manual means and disposal of dismantled material upto lead of 1000 m stacking servicable and unservicable material as per clause 202 of MORT &H specifications. Areas: Plaza, Parking area, External road	Cum	2,573.59			
vi	Dismantling concrete or precast concrete					
	Reinforcement cement concrete	Cum	20.85			
vii	Loading and unloading by mechanical means of the debris for Item no. 1.1 (i to v)					
	Stone (building and pitching) sand, earth , fly ash,bajri, shingles.spalls,brick bats, brick ballast and stone metal.	Cum	4,132.78			
viii	Carriage of Material metalled road Excluding loading and unloading and stacking for Item no. 1.1 (i to v)					
	Debrish					
	to Barewal village pond 07 km from site.	Cum	4,132.78			
2.0	SUB-BASE PREPARATION					
2.1	Compacting original ground below road crust					
i	Loosening, levelling and compacting original ground upto a level of 500mm below road crust , mixed with water at OMC.levelled, graded and compacted in layers by rolling so as to achieve minimum dry density as given in table 300-2 for subgrade construction as per technical clause 202 of MORT &H. Areas: Plaza, Parking, Service areas	cum	5,180.63			
2.2	Construction of granular sub base by providing close graded material grading 1, spreading in uniform layers with motor grader on prepared surface , mixing by mix in place method with rotavator at OMC,and compacting with vibratory roller to achieve the desired density ,complex as per technical clause 401 of MORT &H specification.					
i.	Areas: Parking, Plazas, Pathways 230 mm thick	Cum	1,544.86			
ii.	Areas: Parking (Driveway only) 300 mm thick	Cum	1,171.50			
3.0	CONCRETE AND BRICK WORKS					
3.1	Cement Concrete 1:3:6 with stone ballast					
i.	Areas: Parking, Plaza, Pathways	Cum	1,042.38			
ii	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	43.56			
iii	Cement Concrete 1:3:6 with stone ballast	Cum	7.26			
iv	First class burnt brick work laid in cement mortar 1:5 in foundation and plinth.	Cum	42.40			
	Areas: Compound wall					
v	Reinforcement cement concrete M25 mechanically batch mixed using batch type concrete mixer as per IS:1791 and vibrated by needle vibrator excluding steel reinforced centering and shuttering in foundation and plinth.	Cum	1.43			
	Areas:Compound wall					
vi	20mm thick cement plaster 1:4 in two coat work external plaster	Sqm	137			
4	PAVING					
4.1	Providing and laying 60 mm thick factory made cement concrete paver block of M-40 grade made by block making machine with strong vibratory compaction and of approved size and design / shape and laid in pattern over and including 40 mm thick compacted bed of coarse sand, filling the joints with fine sand etc, all complete as per directions of Engineer-in-Charge. Refer Dwg No 3004 Section A; Areas: Plaza					
i.	Light grey,600mm (L) x 600mm (W) x 60mm(D) (40%),Shot blasted granite finish	Sqm	2085			
ii.	Mid grey,600mm (L) x 600mm (W) x 60mm(D) (40%),Shot blasted granite finish	Sqm	2085			
iii.	Red,200mm (L) x 200mm (W) x 60mm(D) (10%),Shot blasted ganite finish	Sqm	521			
iv.	Beige,200mm (L) x 200mm (W) x 60mm(D) (10%),Shot blasted granite finish	Sqm	521			

4.2	Providing and laying 80 mm thick factory made cement concrete paver block of M-40 grade made by block making machine with strong vibratory compaction and of approved size and design / shape and laid in pattern over and including 40 mm thick compacted bed of coarse sand, filling the joints with fine sand etc, all complete as per directions of Engineer-in-Charge. Refer Dwg No 3004 Section B; Areas: Parking, Driveway					
i.	Light grey,600mm (L) x 600mm (W) x 80mm(D) (40%),Shot blasted granite finish	Sqm	1562			
ii.	Mid grey,600mm (L) x 600mm (W) x 80mm(D) (40%),Shotblasted granite finish	Sqm	1562			
iii.	Red,200mm (L) x 200mm (W) x 80mm(D) (10%),Shot blasted granite finish	Sqm	390			
iv.	Beige,200mm (L) x 200mm (W) x 80mm(D) (10%),Shot blasted granite finish	Sqm	390			
4.3	Providing and laying granite stone of required size and shape of approved shade, colour and texture in footpath, flooring in road side plazas and similar locations, laid over 20mm thick base of cement mortar 1:4 (1 cement : 4 coarse sand) including grouting the joints with white cement mixed with matching pigment, epoxy touch ups etc. complete as per direction of Engineer-in-Charge. Refer Dwg No 3004 Section B; Areas: Plaza, Parking, Driveway, Waterbody					
	Type: Lakha Red, Size: 500mm (L) x 500mm (W) x 50mm(D), Finish: Shotblasted (Basic Rate of Granite : Rs 425 /Sft)	Sqm	397.13			
	Dark Grey colour, 50mm thick, shot blasted (basic rate of Granite Rs 410 per sqft.)	Sqm	7.69			
	Light Grey colour, 50mm thick shot blasted (Basic Rate of Granite : Rs 385 /Sft)	Sqm	38.47			
4.4	Kota stone rough dressed 40 mm to 50mm thick slab, set to pattern in pavements over 20mm thick base of cement mortar (1 cement : 3 sand) laid and jointed with neat cement slurry, mixed with pagment to match the shade of stone.					
	Kota Stone, 400mm(L)X400 mm(W)X40 to 50mm thick slab. Honed 80%.	Sqm	678			
	Kota Stone, 400mm(L)X400 mm(W)X40 to 50mm thick slab. Honed 20%.	Sqm	170			
4.5	Providing and laying of Rubberized Flooring in the Kids Play Area of minimum thickness 36mm (30mm SBR + 6mm EPDM) and specified as per drawing (REFER DWG No. 3004 Detail G); shall be wet poured in place and trowelled to provide for a resilient, seamless rubber surface installed over the specified base. The surface shall be stable and slip resistant to comply with all requirements. Areas: Play areas in Park	Sqm	95			
4.6	Providing and laying tactile tile for (vision impaired person as per standards) of the size 300 X300 X9.8 mm having with water abosption less then 0.5%and confirm to IS 15622 of approved make in all colors and shade in for out door floors such as footpath laid on 20mm thick base of cement mortar 1:4 in all shapes and patterns including grouting the joints with white cement mixed with matching pigments etc. (REFER DWG No. 3003); Areas: Pavement and Plaza	Sqm	162			
5	STEEL WORKS FOR GATE					
5.1	Fabrication, supply and installation of 2 nos Sliding MS gates of size A. 5m wide X 1.5 height and B. 2.5m wide X 1.5 height , with outer frame of M.S. hollow box section of size150 mm X 50mm and vertical members of M.S. square box section of size 18 mm X 18 mm (@c/c 90mm-180mm) and horizontal members of MS flat plates 50mm wide, 6mm thk (4 rows as per drawing). Gate to include sliding rails at the bottom, return spring and lockable hatch and to be supported by vertical post of 150mmx 75mm hollow box section at both ends, embedded in concrete. All Gate, posts and fixings to be powder coated in black colour with matte finish. Cost to include all mechanical fixings / adhesives as required. Cleaning upon completion. All works to be to the satisfaction of the Engineer in Charge. (REFER DWG No. 3005); Areas: Park boundary					
	Size of gate 5X1.5 heigh.	Nos	1.00			
	Size of gate 2 X1.5 heigh.	Nos	1.00			

5.2	Providing and fixing handrail of approved size by welding etc. to steel railings and similar work , including applying priming coat of approved steel primer.MS tube	Kg	2,472.23			
5.3	Providing and fixing SS (Grade 304) railing made of Hollow tubes,channel ,plates etc.including welding , grinding and buffing ,polishing and making curvature and the same with necessary accessories and SS dash fastners ,stainless steel dash fastners ,bolts etc.,of required size on the top of floor .	Kg	773			
6	KERBS					
	Providing and fixing or near ground level precast cement concrete in kerbs,edging etc. as per approved pattern and setting in position with cement mortar 1:3 including the cost of required centering and shuttering. Grade M30 1:2:4 (1 Cement: 2 Coarse sand: 4 graded course aggregate 20 mm nominal size).					
6.1	Grey colour, 300mm (L) x 300mm (W) x 150mm (D), Smooth finish M-30 grade concrete	Rm	8593			
6.2	Supply of Car wheel stopper/ Kerb Stone of size 1800 mm Length X 150 mm Height X 150 mm Top Width / 200 mm Bottom Width, manufactured with M - 30 grade of concrete.(NOTE: COST OF NAILS NOT INCLUDED)	Nos	133			
7	WATER FEATURE					
7.1	Supply and installation of Plaza CIRCULAR water feature as per drawing (REFER DWG No. 3005), with laminar jets with size, shape and depth as shown in drawings. Specification to include at minimum the following: a) Filtration system which consist of cartridge filter + re-circulation pumps (02 nos.) + Chemical dosing (02 nos.) + UV system. b) Flush deck fountain with clear jet nozzles with Integrated underwater Light (RGB) c) Power + data supply + DMX control for above mention RGBW fountains. d) Basin fitting like inlet/drain/skimmer + Maininace kit with recirculation pumps for above said fountain (05 nos.) + VFDs , uPVC pipe+ fitting + valves all in 10 bar pressure for filtration + Fountain + submersible pump in plant room. Electrical cables + Driver for Lights + Electrical Panel for above said equipment with PLC + programming Design & drawing for complete MEP details along with Supervision of E & C for above water feature. Rates included of 5 year maininace and operation of water	LS	1			
7.2	Providing and fixing Glass mosaic tiles at finished plain wall surface of size 20 mm x 20 mm x 4 mm in white colour, design , fixing in design as per direction of Engineer-in- Charge. The glass mosaic tiles to be fixed on the wall surface & tank bottom with the help of approved adhesive applied at the rate of 2.5 kg per sqm and grouting of the same. The rate is inclusive of all operation, material and required pattern approved by Engineer-in-Charge	Sqm	48			
7.3	Cement Concrete 1:3:6 with stone ballast					
i.	Areas:water body,Pump room	Cum	7.25			
7.4	Reinforcement cement concrete M25 mechanically batch mixed using batch type concrete mixer as per IS:1791 and vibrated by needle vibrator excluding steel reinforced centering and shuttering in foundation and plinth. Areas:water body and pump room.	Cum	50.32			
i.	Shuttering of faces of concrete foundation and foundation beam and plinth beam (Vertical and battering)	sqm	188.41			
ii.	Cold twisted deformed (Ribbed /Tor steel bars) Bars Fe500grade as per IS 1786-1985, for RCC work, where not including in the complete rate Of RCC including bending and placing in position complete.	Kg	4,025.60			
iii	Plastering on under side of ceiling 6mm thick cement plaster 1:3	sqm	23.75			
iv	12.5 mm thick cement plaster 1:4 external wall	Sqm	98.30			
v	40mm thick grey polished flooring cement concrete 1:2:4 toping finished with 3 mm thick neat coat of cement rubbed and polished. Pump Room	Sqm	24			
8	FURNITURE & FIXTURES					
8.1	Fabrication, supply and installation of Furniture in the landscape as specified in the Schedule, drawing (REFER DWG No. 3005) and revelant technical specifications					

	Benches (Fabrication, supply & installation) of high quality finished concrete base & exterior grade wooden slats (teak) back rest, including fixing using necessary SS bolts with at level to surface, and leaving clean slots for any recessed lighting fixture as per approved drawings.				
i.	Size 1.8m L x 0.55m W	Nos	26		
ii.	Size 2.4m L x 0.55m W	Nos	12		
iii.	Size 2.7m L x 0.55m W	Nos	5		
iv.	Dust Bins (Fabrication, supply & installation), Stainless Steel (Conforming to J-4 Grade, Satin finish) with overall dia of 350 mm & height of 900mm , consisting of 1 mm thk sheets as per approved drawing /details.	Nos	25		
v.	Stainless steel Bollards (Supply & installation) of size 900mm high, 150mm dia with plate/sheet thickness 6mm, including base plate 12mm thk. and 210mm dia, buff finish	Nos	20		
vi.	Erection, installation of Integrated parking management system to include Parking ticketing terminal (2 nos.), Automatic boom barrier (2 nos.), RFID reader (2 nos.), Central management station (2 nos.) including all necessary cable & conduit works	Lot	1		
vii	Water ATM - 250 Ltr capacity with chiller	Nos.	1		
9	Public Toilet: Public Toilet: 30' X 10' steel toilet with 2 Indian W.C., 2 European W.C., including WC for physically challenged, 4 wash basins, storage/janitor's closet, mobile charging point, space for water ATM, sitting bench, space for advertisement. RCC construction (bioidgestor or foundation), Top structure of Mild steel framework , Stainless steel and aluminium sheet cladding , polycarbonate roofing and ACP interior cladding , Epoxy flooring, all necessary fixtures and fittings inclusive.	Nos.	1		
i	Cement Concrete 1:3:6 with stone ballast				
	Areas: Toilet platform	Cum	2.98		
ii	Reinforcement cement concrete M25 mechanically batch mixed using batch type concrete mixer as per IS:1791 and vibrated by needle vibrator excluding steel reinforced centering and shuttering in foundation and plinth. Areas: Toilet platform,	Cum	8.19		
iii	Shuttering of faces of concrete foundation and foundation beam and plinth beam (Vertical and battering)	sqm	9.76		
iv	Cold twisted deformed (Ribbed /Tor steel bars) Bars Fe500grade as per IS 1786-1985, for RCC work, where not including in the complete rate Of RCC including bending and placing in position complete.	Kg	491.40		
9.1	Solar Panels as per MNRE guidelines	sqm	34.5		
10	PLAY EQUIPMENT				
10.1	Supply and installation of proprietary manufactured, play equipment in the landscape as per approved Play Equipment Schedule; including fixing, maintenance, cleaning etc. All works to be to completed to the satisfaction of the Engineer in Charge. Note: Client approval required prior to procurement.				
i.	Play Tower with slides	Nos	1		
ii.	Four seater Sea Saw	Nos	1		
iii.	Merry-go ground	Nos	1		
11	ART WORK				
11.1	Manufacture, supply and installation of artworks in the landscape as specified in the Artwork Schedule by specialist. All works to be to completed to the satisfaction of the Engineer in Charge.				
i.	Statue by Ram Suthar as per client requirement (REFER DWG No. 3005)	Nos	1		
				Total for Hardscape Works =	-
	External Plaza Signage and Column Improvement				
1.0	Corridor Improvement work				
1.1	Providing and fixing ACP sheet 4mm thick of approved colour & make (all sides wrapped) for Vertical Facing of 4.0m (height) x 1.0m (width) fixed to RCC column with Aluminium section 50mm X 75mm as primary framework & Aluminium section 50mm x 50mm as secondary framework. Rate to include all fastener, SS bolts (hilti make) and fixing with columns. (Two vertical facing per column with panel size of 1.0m x 0.5m)	Sqm	156.80		
1.2	Art work/graffiti work on walls	Sqm	607.00		
2.0	SIGNAGE				

2.1	Providing, fixing & commissioning of all Signage items as elaborated below. The vendor shall deliver, hoist (in case of Totem) and fix the sign in position at the specified locations. 1) All SS in the design shall be mirror finish, 304 grade of appropriate thickness; 2) All acrylic & polycarbonate sheet will be of approved make and specified thickness; 3) All glass used will be toughened and of minimum thickness of 6mm; 4) All Vinyl applications will be of outdoor/external grade with a minimum performance guarantee of 3 years; 5) All LED based lighting will be of approved make or equivalent, control gear to be remotely installed; 6) All electrical fittings and fixtures shall be made waterproof & all control gear to be IP64 rated or housed within an IP64 rated shell; 7) All Aluminium or aluminium composite sheets to be of approved make and specified thickness; 8) All Internal MS structure to be appropriately primed and painted to approved colour, red oxide primer not to be used; 9) All SS anchors & fasteners to be of approved make; 10) All exposed concrete base to be of consistent smooth finish (polished) and colour (light grey or as per approval), with etching pattern in sandblasted finish as per approved drawings. All works to be completed to the satisfaction of the Engineer in Charge as per drawing (REFER DWG No. 3005).					
i.a	Providing, fixing & commissioning of TOTEM pole of size 4.5m high x 1.0m wide x 1.0m depth or as per approved shop drawings.	Nos.	2			
i.b	Providing, fixing & commissioning of TOTEM pole of size 2.5m high x 1.0m wide x 0.5m depth or as per approved shop drawings.	Nos.	2			
ii.	Parking scheme for overall neighbourhood level - Vehicular Direction signage + Pedestrian Route marker signage of size 1.85m high x 0.6m wide x 0.20m depth on panel/panels (with both sides text) as per approved shop drawings.	Nos.	8			
iii.	Digital Display board- Retail Information signage + Plaza wayfinding signage of size 1.85m high x 0.6m wide x 0.20m min. depth (with both sides text) on panel/panels (with both sides text) as per approved shop drawings.	Nos.	5			
iv.	Digital Display board of size	Nos	5			
v	Digital- software bundle for minimum 10 items	LS	1			
vi	Parking area- Vehicular direction signage of size 1.85m high x 0.45m wide x 0.20m depth (with single side text)	Nos.	6			
vii	External signage for Safety & Information signage : Protected area marking, Utilities area marking (Public Toilets)	LS	1			
			Total for Signage and Column Improvement =			-

Electrical Works						
Meter Room						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	48.00			
2	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications. PCC Grade M15	Cum	1.63			
3	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications. RCC Grade M25, Using Concrete Mixer	Cum	12.84			
4	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Kg	1027.20			
5	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttresses etc when curved.	Sqm	78.00			
6	Earth filling under floors with surplus ordinary soil or soil containing gravel or kankar upto 40% excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres	Cum	48.00			
7	First class burnt brick work laid in cement sand mortar 1:6 in first storey upto 4 metres above plinth level.	Cum	27.00			
8	12.5 mm thick cement plaster 1:4	Sqm	234.00			

9	Painting two coats with synthetic enamel paints in all shades on old wood work or metallic or plastered or concrete surface to give an even shade including rubbing down old paint. (a) With special quality paint	Sqm	234.00			
10	Deodar wood doors shutter with 12mm thick phenol Bonded BWP ply (Anchor Kit ply, Nova teak, or National or any other ISI approved quality) I/C hinges, screws, hocks & cords etc. Complete fixed in position (Single leaf). (a) Phenol Bonded Ply Panel. 40mm thick.	Sqm	5.04			
11	Exhaust fan	Nos	2.00			
12	Kota stone tile flooring 20mm to 30 mm thick over 12.5mm thick base of cement mortar 1:3 (1 cement, 3 Sand) laid and jointed with neat cement slurry, mixed with pigment to match the shade of stone including rubbing and polishing.	Sqm	18.00			
13	Roofing consisting of 5cm thick precast cement concrete 1:2:4 tiles laid in position with cement sand mortar 1:3 over RCC battens 0.6 metre apart excluding cost of RCC battens but including 4 cm thick screed of cement concrete 1:4:8 over tiles 2 coats of bitumen @ 2.34 kg per sqm 25 mm mud plaster. 7.5cm mud, another layer of 25mm mud plaster filling space between battens over beams with cement concrete (1:3:6) blocks in cement mortar 1:3 and cement pointing 1:2 on the underside of tiles.	Sqm	18.00			
14	GI Sheet gutters 0.80mm thick semicircular 15cm diameter including fixing with clamps and making connections with rain water pipes.	RM	6.00			
LIGHTING FIXTURES						
1	LED Light Double Arm Pole - 70W+ 35W- 6m high	Nos	11.00			
2	LED Light Double Arm Pole - 70W+ 70W- 6m high	Nos	12.00			
3	LED Light Single Arm Pole - 70W- 6m high	Nos	12.00			
4	LED Light Single Arm Pole - 70W- 8m high	Nos	3.00			
5	LED Light Double Arm Pole - 70W+ 35W- 8m high	Nos	3.00			
6	LED Light Double Arm Pole - 35W+ 35W- 6m high	Nos	15.00			
7	LED Light Single Arm Pole - 35W- 6m high	Nos	2.00			
8	Two way floorwasher 5W, LED light	Nos	30.00			
9	Wall uplighters light 20 W, LED light	Nos	10.00			
10	Light bollards, 9W LED, 1m HIGH POLE	Nos	10.00			
Lighting pole civil work						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	84.70			
2	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications. RCC Grade M25, Using Concrete Mixer	Cum	17.50			
3	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Kg	1750.00			
4	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttresses etc when curved.	Sqm	140.00			
5	Earth filling under floors with surplus ordinary soil or soil containing gravel or kankar upto 40% excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres	Cum	334.14			
6	Foundation bolt M30x900	Kg	2332.26			
7	Plate	Kg	791.28			
Each Transformer						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	64.72			

2	Providing and laying plain/reinforced cement concrete works cement with coarse sand & 20mm down graded stone aggregate including dewatering if necessary, and curing complete but excluding cost of form work and reinforcement for reinforced cement concrete work (form work and reinforcement will be measured and paid separately) - Using mixture machine - RMC M-25 in foundation and plinth Reinforced cement concrete M-25 with cement @375/kg per cum hand mixed but excluding steel reinforcement centring and shuttering in foundation and plinth	Cum	18.49			
Trench						
Size 1 x 1 mtr						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	460.00			
2	Cement Concrete 1:3:6 with stone ballast or shingle.	Cum	30.00			
3	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications. RCC Grade M25. Using Concrete Mixer	Cum	123.00			
4	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Kg	14760.00			
5	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttersses etc when curved.	Sqm	1140.00			
6	Earth filling under floors with surplus ordinary soil or soil containing gravel or kankar upto 40% excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres	Cum	168.00			
7	12.5 mm thick cement plaster 1:4 for internal	Sqm	300.00			
Size 1 x 1.2 mtr						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	805.00			
2	Cement Concrete 1:3:6 with stone ballast or shingle.	Cum	42.50			
3	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications. RCC Grade M25. Using Concrete Mixer	Cum	187.50			
4	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Kg	18750.00			
5	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttersses etc when curved.	Sqm	1700.00			
6	Earth filling under floors with surplus ordinary soil or soil containing gravel or kankar upto 40% excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres	Cum	210.00			
7	12.5 mm thick cement plaster 1:4 for internal	Sqm	500.00			
Cable laying through pipe						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	1522.50			
2	Earth filling under floors with surplus ordinary soil or soil containing gravel or kankar upto 40% excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres	Cum	609.00			
Feeder Piller						

1	Earth work in excavation of foundations of bridges culverts, building including handling of materials with combined lead of 15 metres dressing of bed and sides stacking the excavated soil clear from the edge of excavation and subsequent filling around:- For ordinary gravel soil involving pick work.	Cum	31.25			
2	Cement Concrete 1:3:6 with stone ballast or shingle.	Cum	1.14			
3	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttersses etc when curved.	Sqm	62.88			
4	Reinforced cement concrete M-25 with cement @425/kg per cum hand mixed but excluding steel reinforcement centring and shuttering in superstructure.	Cum	9.45			
5	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Qtl	5.67			
6	12.5 mm thick cement plaster 1:4	Sqm	24.75			
7	Preparation of concrete or plastered surfaces for painting or oil-bound distemper including sand papering the surface applying one coat of linseed oil and filling with approved quality filler, consisting of white lead, linseed-oil varnish and chalk mitti including finishing the surface to the required finish complete.	Sqm	24.75			
Junction Box						
1	Earth work in excavation of foundations of bridges culverts, building including handling of materials with combined lead of 15 metres dressing of bed and sides stacking the excavated soil clear from the edge of excavation and subsequent filling around:- For ordinary gravel soil involving pick work.	Cum	1.93			
2	Cement Concrete 1:3:6 with stone ballast or shingle.	Cum	0.05			
3	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttersses etc when curved.	Sqm	2.590			
4	Reinforced cement concrete M-25 with cement @425/kg per cum hand mixed but excluding steel reinforcement centring and shuttering in superstructure.	Cum	0.32			
5	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Qtl	0.19			
6	12.5 mm thick cement plaster 1:4	Sqm	1.98			
Manhole (Size- Length 0.9 m , Width 0.9 m & Depth 1.5 m)						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation	cum	83.53			
2	Flat brick paving laid dry over 25mm thick mud mortar grouted with sand.	Sqm	35.64			
3	Cement Concrete 1:2:4 with stone ballast or shingle.	cum	35.64			
4	Reinforced cement concrete M-20 with cement @375/kg per cum hand mixed but excluding steel reinforcement centring and shuttering in superstructure.	cum	12.07			
5	Mild steel reinforcement for RCC work where not included in the complete rate of RCC including bending, binding and placing in position complete:-	qtl	9.48			
6	First class burnt brick work laid in cement sand mortar 1:4 in foundation and plinth.	cum	33.83			
7	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or bartering including attached pillasters buttersses etc	Sqm	75.38			
8	20mm thick cement plaster 1:4 in two coat work	Sqm	108.90			
9	Floating coat of 1.5mm thick neat cement laid in one operation to the topping.	Sqm	108.90			
10	Earth filling under floors with surplus soil containing more than 40% gravel or kankar excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres.	cum	16.71			

11	Providing & fixing 560mm, 500mm and 450mm internal Diameter circular or 455 mm x 610mm clear inside opening rectangular cast iron manhole cover and frame ISI marked as per IS12592-2002 including carriage from the stores of the Engineer-in-charge to site of work, loading, unloading including stacking and setting the same to correct lines and levels in 1:2 cement sand mortar over manholes including cement concrete copping (1:2:4) around the frame etc. Dia of steel for lifting hook is 16mm.- R.C.C. Manhole cover 560mm i/d Extra heavy duty	each	11.00			
12	Foot Rest for Manhole.	each	55.00			
TRENCH (Size- Length 70 m , Width 0.8 m & Depth 1 m)						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation	cum	56			
2	Earth filling under floors with surplus soil containing more than 40% gravel or kankar excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres.	cum	49.55			
TRENCH (Size- Length 185 m , Width 0.6 m & Depth 1 m)						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation	cum	111			
2	Earth filling under floors with surplus soil containing more than 40% gravel or kankar excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres.	cum	97.668345			
TRENCH (Size- Length 270 m , Width 0.5 m & Depth 1 m)						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation	cum	135			
2	Earth filling under floors with surplus soil containing more than 40% gravel or kankar excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres.	cum	120.97			
3	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation.	Cum	1522.5			
4	Earth filling under floors with surplus ordinary soil or soil containing gravel or kankar upto 40% excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres	Cum	609			
TRENCH (Size- Length 270 m , Width 0.5 m & Depth 1.5 m)						
1	Earth work in excavation in foundations, trenches etc. in all kinds of soil where pick jumper work is not involved and not exceeding 2.0 metres depth including dressing of bottom and sides of trenches, stacking the excavated soil clear from the edge of excavation	cum	255			
2	Earth filling under floors with surplus soil containing more than 40% gravel or kankar excavated from foundation and taken only from outside the building plinth in 15 cm layers including ramming, watering and consolidating lead upto 30 metres.	cum	241.86852			
DISMANTLING OF ELECTRICAL EQUIPMENTS						
1	415 V LT 4 wire line	KM	1			
2	415 V LT 5 wire line	KM	1			
3	11 KV line 3 wire line	KM	0.8			
4	11 KV /415 V Transformer	No	10			
Supply, Installation, testing and Commissioning of the following.						
1	11KV HT XLPE CABLE					

	Circular Aluminium conductor, conductor screened with extruded semi conducting compound, XLPE insulated, insulation screened with extruded semiconducting combination in combination with copper tape(0.3KA for 1 sec) core laid up FRLS PVC inner sheathed cable conforming to IS:7098/II/85 working voltage 11KV(E) grade 300 Sq.mm (three Core).				
a.	3c x 300 Sq.MM- 11KV	Mtr	3500		
2	JOINTING KIT FOR 11KV HT CABLE				
	Supply & making outdoor type cable end jointing with cast resin compound, including lugs and other jointing materials for following size of 3 Core XLPE aluminium conductor of 11 KV grade as required				
a.	300 Sq.mm	Each	4		
3	END TERMINATION KIT FOR 11KV HT CABLE				
	Supply & making outdoor type cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for 3 core, XLPE Aluminium conductor of 11 KV o grade as required.				
a	300 Sq.mm	Each	20		
4	1.1KV, XLPE INSULATED LT, CABLE				
	Supplying & laying of aluminium conductor , XLPE insulated pvc sheathed aluminium conductor served sheathed cables 1100V conductor armoured (earthed) cable .				
a	4C x 300 SQ. MM. XLPE AL. AR. CABLE	Mtr.	2500		
b	4CX240 SQ.MM XLPE AL. AR. CABLE	Mtr	100		
c	4C x 185 SQ. MM. XLPE AL. AR. CABLE	Mtr.	300		
d	4C x 95 SQ. MM. XLPE AL. AR. CABLE	Mtr.	3200		
e	4C x 25 SQ. MM. XLPE AL. AR. CABLE	Mtr.	3500		
f	4C x 50 SQ. MM. XLPE AL. AR. CABLE	Mtr.	1500		
e	4C x 6 SQ. MM. XLPE CU AR CABLE	Mtr.	3000		
	Cable for Lighting				
i	3.5C x 2.5 SQ Cu Flexible Cable	Mtr.	4000		
j	4C x 25 SQ. MM. XLPE AL. AR. CABLE	Mtr.	2000		
k	2Cx 6 sq.mm PVC AL. AR CABL	Mtr.	1000		
5	END TERMINATION KIT FOR 1.1KV LT CABLE				
	Supply and making end termination with brass compression gland and aluminium lugs for the following size of PVC insulated and PVC sheathed/ XLPE Aluminium Conductor cable of 1.1 KV grade as Required.				
a	3.5 x 300 sq.mm	Each	50		
b	3.5 x 240 sq.mm	Each	20		
c	3.5 x 185 sq.mm	Each	30		
d	3.5 x 95 sq.mm	Each	20		
e	3.5 x 25 sq.mm	Each	100		
f	3.5 x 50 sq.mm	Each	16		
h	4 x 4 sq.mm	Each	90		
i	4Cx6 SQ.MM XLPE AL AR. CABLE	Each	140		
j	4Cx10 SQ.MM XLPE AL AR. CABLE	Each	40		
k	4Cx16 SQ.MM XLPE AL AR. CABLE	Each	40		
	For Lighting				
l	3 x 2.5 sq.mm flexible copper	Each	240		
m	4 x 25 sq.mm XLPE AL AR CABLE	Each	150		
n	2CX6 Sq.mm XLPE/PVC AL AR CABLE	Each	150		
6	Supply and making straight through joint with cast resin compound including ferrules and other jointing materials for the following size of PVC insulated and PVC sheathed XLPE Aluminium conductor of cable of 1.1 grade as required.				
a	3.5 x 300 sq.mm	Each	6		
b	3.5 x 185 sq.mm	Each	10		
7	Supply , Installing following size of perforated Hot Dipped galvanised Iron cable tray (galvanisation thickness shall not be less than 50 microns) with perforations not more than 17.5%, in convenient sectioned joined with connectors, suspended from ceiling with GI suspenders including GI bolts & nut bolts etc. as required				
a	450X50x2 mm thickness	Mtr.	500		
	150x50X1.6 mm thickness	Mtr	100		
	Supply and Erection of ISMB 100X50 with cutting, bending and necessary holes as directed by engineer in charge at site	kg	7560		
d	Supply and Erection of MS angle Iron size 50mmx50mmx6mm with cutting, bending and necessary holes as directed by engineer in charge at site	Kg	7599		

	Supply and erection of MS angle size ISA 25x25x5 with cutting, bending and necessary holes as directed by engineer in charge at site	Kg	2520			
8	Providing, laying and fixing dia RCC pipe NP2 class in complete with RCC collars, jointing with Cement Mortar 1:2 (1 Cement: 2 sand) including trenching 750 mm deep and filling as required					
a	250mm dia	Mtrs	200			
9	Wiring of Panel Room					
	Wiring in PVC insulated copper conductor single core FRLS cable (ISI marked), 1100volts grade to be laid in heavy gauge welded conduit pipe 20 mm/25 mm dia (1.6mm thick) ISI Marked, recessed in wall etc., complete with powder coated/anodized concealed metal boxes required for suitable number of modules, for having electronic fan regulators (two module), bell push, electronic buzzer, 3pin 6Amp., 3pin 16/20 Amp. Sockets and 6 Amp./16/20Amp. Switches etc., and covered with Frame Plate etc., & including the cost of required number of modular switches/sockets, step type electronic fan regulator 100 watts, PVC connector (For Fan Box and Electronic Buzzer), PVC Bush, Steel Hooks, Circular Inspection Box (Recessed Type and Deep Type) conduit pipe & copper wire and other petty material etc. including the cost of cutting and filling up of chases:-					
9	Wiring					
a	Wiring fan point with sheet metal fan box (shape hexagonal & sheet thickness not less than 1.60 mm) in PVC insulated copper conductor single core FRLS cable (ISI marked) overall 1.5 sq. mm, 1100volts grade with step type electronic fan regulator 100watts.	Nos	4			
b	Wiring light point in PVC insulated copper conductor single core FRLS cable (ISI marked) overall 1.5 sq. mm, 1100volts grade.	Nos	10			
c	Wiring 3 pin 6 Amp. wall socket (Shuttered) point in PVC insulated copper conductor single core FRLS cable (ISI marked) overall 1.5 sq. mm, 1100volts grade complete with bonding to existing earth with PVC insulated copper conductor single core FRLS cable (ISI marked) overall 1 sq. mm, 1100volts grade.	Nos	10			
d	wiring 3 pin 16/20 A power plug control and switch	Nos	6			
e	Supplying and fixing 3 pin 5 a ceiling rose on the existing junction box including connection etc.	Nos	20			
10	Sheet metal double door S.P. & N. distribution board (dust protected) provided with bus bar, neutral link and din bar, suitable for incorporating MCB's/ RCBO/ RCCB's, 4 way each inclusive of all.	Each	4			
11	EARTHING SYSTEM					
A	EARTHING STATION					
a)	Earthing of sheet metal iron clad switches and metal cases with 20x3 mm thick electrolytic copper tap riveted with 10 nos. of copper rivets to 30cmX120x3 mm thick tinned copper plate buried 10 meter of excavation of having bore dia 125 mm and surrounded by salt & charcoal dust including fixing copper tape on the wall and in floor etc. up to 13 meters of length GI pipe 20 mm dia (A class) should be laid in in the hole of excavation from bore surface level to 1 feet below the ground level of the pipe.300x300x300 mm deep haudi bricks of finished with 1:4 cement plaster and haudi covered with 300x300 m around the hole of excavation.	set	30			
b)	Supplying and laying 25mmX5mm Copper strip at 0.5 meter below ground as strip earth electrode , including connection/ termination with nut bolt, spring, washer, etc. as required . Jointing shall be done with overlapping 2 sets of brass nut bolts & spring washer spaced at 50 mm.	Meter	100			
c)	Earthing with G.I. Earth pipe 4.5 metre long, 40 mm dia including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal/ coke and salt as required.	set	50			
b)	G.I. Earthing Strip / Wire					
	Supply and laying of following size of GI strip from earth electrode directly in ground as required complete in all respects.					
1	25 x 5mm GI strip	Meter	450			
2	Bonding to earth with GI wire No. 8 SWG in 20 mm dia heavy quage welded conduit including painting etc	Meter	4000			

12	Supply and erection of earth rod 20 mm dia for providing earth connection up to line earth with GI wire no 8 SWG . The rod shall be tapered at one end and flattened on the other end . The hole size shall be drilled on the flat end side for facilitating connection with GI wire thimble etc. The rod shall be grouted up to complete length vertically . GI Electrode 20 dia with 3 meter long	Meter	50			
a	Compact RMU (VCB SF6 Type with Aluminium busbar) 4 way RMU 20D+2 VL Incomer + three breaker + one outgoing 350 MVA, 630 A)	No	2			
b	LT feeder pillar Box 12 Way with Cutout	No	3			
13	Cable for Lighting					
a	4 x 4 SQ. MM. XLPE CU AR CABLE	Mtr.	3000			
b	4 x 2.5 SQ CU Flexible Cable	Mtr.	1500			
14	Supplying and laying of following size HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, part II complete with fitting and cutting and joints etc. in direct ground (75 cm below ground level including excavation and refilling the trench but excluding sand cushioning and protective covering etc. complete as required.					
a	HDPE DUCT 110mm dia	Mtrs	700			
b	HDPE 50/40mm dia	Mtrs	6000			
c	16/20 mm plain HDPE pipe for laying optical fibre cable	Mtrs	2000			
d	HDPE duct OD 160 mm dia (3C x 300 sqmm XLPE 11KV cable)	Mtrs	1500			
e	HDD duct OD 50/42 mm dia for street lighting cable	Mtrs	1750			
f	HDD duct OD 110 mm dia	Mtrs	3000			
g	HDD duct OD 40mm dia /ID 33 mm	Mtr	3000			
	Supply and laying of					
15	6 Core single mode optical fibre cable for integration of SCADA & RMU	KM	3.5			
16	Smart Metering System					
a	Supply of single phase meter	No	70			
b	Three phase meter	No	120			
c	Data concentrator unit	No	1			
d	meter data acquisition software	LS	1			
e	Installation charges for 200 meters	LS	1			
17.i	Main Feeder pillars					
a	Supply, installation, testing and commissioning of OUTDOOR type double door panel factory fabricated and wired metal clad and dust and vermin proof floor mounted panel complete with MCCB and instrument chamber etc. complete in all respects. The instrument chamber shall be separate and shall comprise of ammeter, voltmeter, selector switches for ammeter and voltmeter. The board shall have suitable capacity electrolytic aluminium busbars as per IS: 8623 isolate with heat shrink sleeving and mounted on non hygroscopic supports such as CMC/DMC support. The panel shall be fabricated using 14 gauge CRCA MS Sheet steels for cubicles & 16 gauge CRCA for partition and vertical separations. The door shall be lockable. All MCB shall be thermal magnetic type. MCCBs beyond 250 should have thermal memory.	No	2			
ii	Supply, installation, testing and commissioning of OUTDOOR type double door panel factory fabricated and wired metal clad and dust and vermin proof floor mounted panel complete with MCCB and instrument chamber etc. complete in all respects. The instrument chamber shall be separate and shall comprise of arrangement for smart metering. The board shall have suitable capacity electrolytic aluminium busbars as per IS: 8623 isolate with heat shrink sleeving and mounted on non hygroscopic supports such as CMC/DMC support. The panel shall be fabricated using 14 gauge CRCA MS Sheet steels for cubicles & 16 gauge CRCA for partition and vertical separations. The door shall be lockable. All MCCB's shall be thermal magnetic type with positive isolation and class 2 front facia. MCCB beyond 250A, should have thermal memory. MCCB should have cross bolted termination to withstand thermodynamic stress. As per attached drawing. Provision shall be given for installing 40A, 63A MCB, 100 A MCBs. The exact number of MCB shall be installed as per the load requirement.	No	29			
18	Lighting Control Panel	No	1			
19	Junction Box	No	2			
20	Three Phase Submersible pump controller with single phase preventer model MU-G30 FASD . 20 HP 20-33A, L&T make	No	1			

21	11/0.433 KV 500 KVA Compact Substation with 150 KVAR capacitor Bank	No	2			
22	11/0433 KV 1000 KVA Compact Substation with 225 KVAR capacitor Bank	No	3			
23a	Star Delta starter for Fire water pump 40 HP	No	1			
23.b	DOL starter for Jokey Pump of Fire water pump 5 HP	No	1			
24	Dismantling of Existing HT /LT overhead power system lines complete with all associated items like poles, conductors, insulators, overhead conductors / lines, wires, stay , studs, MS structures, AB switches, Do fuse, LA, LT boxes, street lights, switch boxes and depositing the same to PSPCL store.					
a	415 V LT 4 wire line	KM	1			
b	415 V LT 5 wire line	KM	1			
c	11 KV line 3 wire line	KM	0.8			
d	11 KV /415 V Transformer	Km	10			
						Total for Electrical works =
	Utilities Work (Water Supply, Sewerage and Storm Water Drainage)					
	Under Ground Service Reservoir with Pump House					
	EXCAVATION					
1	Earth work in excavation of foundation of structures as per drawing and technical specification , including setting out , construction of shoring and bracing , removal of stumps and other deleterious matter ,dressing of sides and bottom and backfilling with approved material . In soil					
	Mechanical Means- Pump Room	Cum	310.18			
	Underground Room	Cum	320.84			
2	Extra for disposal of surplus soil beyond one kilometer Taking lead upto 2.0 km	Cum	376.00			
	P.C.C					
3	Cement Concrete 1:2:4 with stone ballast or shingle. Pump Room	Cum	8.29			
	Underground Room	Cum	8.63			
4	Shuttering for faces of concrete foundations and foundation beam & plinth beam (vertical or battering) PCC Pump Room	Sqm	13.41			
	PCC Underground Room	Sqm	13.77			
	RCC WORK (pump room)	Sqm	6.55			
	RCC WORK (Water tank)	Sqm	18.00			
5	Centering and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttersses etc Pump Room	Sqm	235.22			
	Underground Room	Sqm	130.73			
6	Centering and shuttering for sides and soffits of beam, beams launching girders bressumers , lintels	Sqm	25.76			
7	Centering and shuttering for columns (Square or rectangular or polygonal in plain)	Sqm	179.80			
8	Centering and shuttering for flat surfaces such as suspended floors , roofs , landings ,chajjas shelves etc.	Sqm	96.73			
9	Centering and shuttering for staircase with sloping with soffits including risers and stringers	Sqm	11.07			
	STEELWORK					
10	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Qtl	114.43			
	RCC WORK					
11	Reinforced cement concrete M-30 with cement @450/kg per cum hand mixed but excluding steel reinforcement centring and shuttering in superstructure.	Cum	97.91			
12	Earth,Surkhi,Sand ,Earth,Fly Ash ,Bajri ,Ballast ,Stone Boulders, Kankar and Builing Rubbish , Earth. (Lead 160 km)	Cum	117.47			
	BRICKWORK					
13	First class burnt brick work laid in cement sand mortar 1:6 in first storey upto 4 metres above plinth level.	Cum	34.45			
	PLASTERING WORK					
14	12.5 mm thick cement plaster 1:4 for internal	Sqm	365.59			
15	16 mm thick cement plaster 1:4 in two coat work for external	Sqm	335.96			
16	Plastering on underside of ceiling 10 mm thick cement plaster 1:3	Sqm	76.12			
17	40mm thick grey polished flooring cement concrete 1:2:4 topping finished with 3 mm thick neat coat of cement rubbed and polished. Pump Room	Sqm	46.61			
	Water Room	Sqm	29.25			
	FLOORING					

18	Kota stone tile flooring 20mm to 30 mm thick over 12.5mm thick base of cement mortar 1:3 (1 cement, 3 Sand) laid and jointed with neat cement slurry, mixed with pigment to match the shade of stone including rubbing and polishing.					
	Entrance, Staircase (landing), Staircase	Sqm	14.93			
19	Kota stone tiles 20mm thick in skirting risers of steps, dado walls and pillars laid in 12.5mm thick cement mortar 1:3 (1 cement 3 coarse sand) and jointed with neat cement slurry mixed with pigment to match the shade of stone, including rubbing and polishing.					
	Riser for staircase & Skirting	Sqm	5.40			
	Doors and Windows					
20	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded builtup standard tubular sections/appropriate z section and other sections conforming to Is:733 and IS :1285 of jindal , Hindalco , Mahavir or equivalent make approved by engineer in charge ,fixed with rawl plugs and screws or with fixing clips , or with expansion hold fasteners including necessary filling up of gaps at junctions ,at top , bottom and sides with required PVC Plug/neoprene felt etc.Aluminium sections shall be smooth,rust free,straight,mitered and jointed mechanically wherever required includingcleat angle, Aluminium snap beading glazin/ paneling, brass/ stainless screws, all complete as per for steel architectural drawings and the directions of Engineer-in charge. (Glazing and panelling to be paid separately) : 14 guage section (1.75"X4") weight 1.77 kg in per mtr.	KG	31.86			
21	For shutters of doors, windows & ventilators including providing and fixing hinges/pivots and labour for fixing of fittings wherever requiredincluding the cost of PVC Plug / neoprene gVa1sket required 14 guage section weight 1.22 kg in per mtr .	KG	21.96			
22	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with PVC Plug/ neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item) Float glass panes of 4mm thickness	Sqm	4.75			
23	Cost of Aluminium fittings ISI marked complete for doors, windows, such as tower bolts, handles and screws etc. for these fittings (excluding sliding bolts). for doors & window shutter	Sqm	4.75			
	Painting Work					
24	Preparation of plastered or concrete surface for painting (including sand papering the surface) using ready mixed cement based wall putty by applying two coats to get required finish	Sqm	777.66			
25	Distempering with Acrylic washable oil bound distemper (of approved manufacture) two coats over one priming coat to give an even shade.					
	As per putty work	Sqm	584.31			
26	Top khurra 0.6m x 0.6m for rain water pipe in 25mm thick cement concrete 1:2:4 over 50mm thick cement concrete 1:8:16.	Nos	2			
27	Bottom Khurra on ground 1.2m x 0.6m consisting of brick on-edge laid in cement mortar 1:3 over 75mm cement concrete 1:8:16 including 12.5mm thick cement plaster 1:3.	Nos	2			
28	Providingand fixing 110 mm dia SWR U.P.V.C rain water pipe(ring fitted type-A) as per I.S13592 including jointing during masonry complete as per specifications and to the entire satisfaction of Engineer -in - charge .(if fixed on wall face clamp to be paid separatly as per respective item)	Mtr	12			
29	Providing and fixing 110 mm dia SWR U.P.V.C bend for rain water pipe as per IS:14735 including jointing complete as per specifications and ti the entire satisfaction of engineer -in -charge .	Each	4			
30	Terracing consisting of tiles 22.86 cm x 11.43 cm x 3.81 cm laid over 25mm mud plaster, 75 mm mud filling on another layer of 25 mm mud plaster including two coats of bitumen laid hot @ 1.65 Kg. per Sqm. on top of R.C.C slab including grouting with cement sand mortar 1:4 and top surface to be left clean after wire brushing etc.	Cum	46.605			
31	Cement concrete 1:2:4 gola 10 cm. x 10 cm. quadrant along junction of roof with parapet wall finished smooth, where specially specified.	Nos	93.21			
	RAILING WORK					
32	Providing & fixing 16 gauge stainless steel pipe railing of grade 304 duly fixed on steps with the help of bolts grouted on steps with hand rail and newel post of 50mm dia Stainless steel pipe, Balusters of 40mm dia Stainless steel pipe and guard 3 Nos of 15mm dia Stainless Steel pipe complete in all respect	m	13			

33	Providing & fixing 560mm, 500mm and 450mm internal Diameter circular or 455 mm x 610mm clear inside opening rectangular cast iron manhole cover and frame ISI marked as per IS12592-2002 including carriage from the stores of the Engineer-in-charge to site of work, loading, unloading including stacking and setting the same to correct lines and levels in 1:2 cement sand mortar over manholes including cement concrete copping (1:2:4) around the frame etc. Dia of steel for lifting hook is 16mm. 560mm i/d having weight 208 Kg. as per ISI .	each	1			
34	Providing and Placing in position suitable PVC water stops conforming to IS : 12200 for construction / expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete: Serrated with central bulb (225 mm wide, 8-11 mm thick)	Mtr	37.84			
35	Mixing and Laying of the Grouting materials as per the direction of Engineer In charge including cleaning of surface, curing for 24 hrs before grouting and required curing after grouting upto 100mm thick.	Sqm	91.30			
36	Bending and fixing iron rungs on lined slopes. @ 300 mm c/c	Cum	13			
MECHANICAL WORKS						
40	Providing, Stringing out, cutting, Jointing and testing of ISI marked D.I. Pipe as per IS 8329 and laying the same in trenches to correct alignment and gradients, jointed with rubber tyton joints fitted complete including all cartage. 100mm i/d pipe line laid complete. Inlate	M	10			
41	Providing, Stringing out, cutting, Jointing and testing of ISI marked D.I. Pipe as per IS 8329 and laying the same in trenches to correct alignment and gradients, jointed with rubber tyton joints fitted complete including all cartage. 100mm i/d pipe line laid complete. Over flow	M	10			
42	Supplying and laying D.I. specials/fittings as per IS:9527-2000, class K-12 suitable for tyten joint with external bitumen coating and inside cement mortar lining, scaffolding, derricks, Jim poles, tools and plants, ropes, guys, etc. Complete.	Kg	1.8			
43	Providing & fixing sluice valves ISI marked 14846-2000, socketted or flanged, jointing with tyton joints including all carriage complete. 100mm i/d Sluice Valves Socketted or Flanged	Each	3			
44	Supplying, fixing and testing at site Automatic electronic type water level indication system with gun metal float sensor and electrical cable suitable for three phase pupm submersible/monoblock to be fixed on existing panel for UGSR complete in all respects.	each	1			
45	EOT Crane 1 MT (Including Insertplate ,Grider, and Rails)	LS				
46	Puddle flange and Piping	LS				
FIRE PROTECTION SYSTEM						
A	FIRE PROTECTION & ALARM SYSTEM					
A.1	FIRE PUMPS AND ACCESSORIES					
1	FIRE PUMP : Electrical operated Main Fire Hydrant Pump (2280 lpm) head 70 mtr.					
	Supply, erection, testing & commissioning of Electrical motor driven main pump of horizontal centrifugal end suction backpull out type with gland packing and capable to deliver 2280LPM at 70 MWC. The pump shall be coupled to TEFC motor of suitable HP with speed of 2900RPM and complete set shall mounted on common base frame.	Nos.	1			
2	FIRE PUMP : Diesel Driven Pump (2280 lpm) head 70 mtr.					
	Supply, erection, testing & commissioning of diesel Engine pump of horizontal centrifugal end suction backpull out type with gland packing and capable to deliver 2280 LPM at 70 MWC. The pump shall coupled to suitable HP of Diesel engine radiator water cooled type with speed of 2900RPM and complete set shall be mounted on common base frame. Batteries & battery leads with stand, Fuel tank (for 6 Hrs. operation) with stand & gauge glass, Fuel piping with valves. The quoted rate shall includes radiator water cooling piping (if required) coupling guard and other standard accessories, RCC foundation as recommended by manufacturer and foundation bolts etc., complete.	Nos.	1			
3	JOCKEY PUMP : Electrical operated Pump (180 lpm) head 70 mtr.					
	Supply, erection, testing & commissioning of electrical motor driven Jockey pump of horizontal centrifugal end suction backpull out type with gland packing and capable to deliver 180LPM at 70M WC. The pump shall be coupled to TEFC motor of suitable HP with speed of 2900RPM and complete set shall mounted on common base frame.	Nos.	1			

4	Supplying, fixing, testing and commissioning of condenser water pipes of following sizes of MS 'C' class along with necessary clamps, vibration isolators and fittings such as bends, tees etc..but excluding valves, strainers, gauges etc. adequately supported on rigid supports duly painted/buried in ground excavation and refilling etc. as per specification and as required complete in all respect.					
	200NB	Mtr	12			
	150NB	Mtr	12			
	100NB	Mtr	6			
	80NB	Mtr	6			
	65NB	Mtr	6			
	25NB	Mtr	6			
5	Supplying , installing, testing and commissioning of Bronze Ball valve with (suitable for test pressure of not less than 15 Kg / sqcm of the following size including providing necessary union / flange.					
	Providing and fixing in position automatic brass ball valves in tanks.					
	25mm i/d Brass ball valve with copper ball	Nos	2			
	15mm i/d Brass ball valve with copper ball	Nos	8			
7	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications. BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/hot eater circulation as specified					
	200NB	Nos.	2			
	150NB	Nos.	2			
	100NB	Nos.	1			
	80NB	Nos.	1			
	65NB	Nos.	1			
8	NON - RETURN VALVE with duel plate of C I body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating for chilled / hot water circulation including insulation as specified.					
	150NB	Nos.	2			
	65NB	Nos.	1			
9	Providing & fixing Single air valve as per IS-14845 jointing with tyten joint including all carriages complete. 25 mm	Nos.	1			
10	Supplying & Fixing of Pressure Switches of suitable range complete for isolation and fittings such as unions / elbows / reducers etc.	Nos.	3			
11	Supplying & Fixing of Pressure gauge of suitable range(0-16Kg/cm ²) complete for isolation and fittings such as unions / elbows / reducers etc.	Nos.	4			
12	Providing & Fixing of M ³ Class β diesel engine exhaust pipe (including all fittings, clamps, steel support) of suitable dia for the engine. The pipe shall be provided with 12 mm thick supercera ceramic fiber rope . Non insulated pipe shall be painted .	Mtr	12			
13	Supply and installation of 100 NB Draw out connection with Foot Valve in Fire water Tank	Nos.	1			
14	SITC of MS fabricated Air Vessel at pump room about 250mm dia and 1200mm high on MS stand with necessary cut off drain and air release arrangements and leading the drain pipe to the sump at pump room.	Nos.	1			
15	Supply and installation of 4 Way Fire Brigade Inlet with built in NRV & Butterfly valve-150NB with all other accessories located in Fire Water Tank.	Nos.	1			
16	Pump Control Panel with all necessary wiring work including control and instrumentation, etc complete.	Lot	1			
18	Rubber Expendion Below					
	200NB	Nos	2			
	150NB	Nos	2			
	80NB	Nos	1			
	65NB	Nos	1			
	1100 V GRADE POWER / CONTROL CABLES					
19	Supplying, laying, testing & commissioning of PVC insulated PVC sheathed, steel armoured, aluminium conductor, 1100v grade power cables.The cables shall be laid in tray / Hume pipe / in trenches/on walls/ floor etc. as required.					
a	4C x 70sq.mm Aluminium for Main Pump	Mtr	60			
b	4 C x 50 Sqmm. Aluminium for Jockey	Mtr	30			
c	2 C x 1.5 Sqmm. Copper Armoured for Instrumentation	Mtr	100			
d	8C x 2.5 sq.mm Copper Armoured for Start/Push Button	Mtr	20			
20	Supplying and fixing of perforated G.I.sheet CABLE TRAY with necessary angle iron suspension supports, anchor fasteners etc. complete. Maximum height of suspension shall not exceed 500 mm.Size of the tray is					
	300mm x 50mm and 1.6mm thick.	Mtr	25			
	100mm x 50mm and 1.6 mm thick.	Mtr	30			

21	G.I. EARTHING STRIPS of . strip shall be run on floor / ceiling / walls, from the equipment to the nearest Earth pit with necessary accessories as required. (Earth pit shall be executed by other agencies).				
	25mm x 5mm thick	Mtr	12		
	25mm x 5mm thick COPPER	Mtr	15		
23	Supplying, fabricating, STRUCTURAL STEEL SUPPORTS such as MS channels, angles, flats, rods as required at site with anchor fasteners, clamps, threaded rods, nuts, bolts, washers etc. complete with painting.	Kgs	1,000		
C.2	EXTERNAL FIRE HYDRANT SYSTEM				
1.1	Supplying, installing, testing and commissioning of M.S. Pipes conforming to IS:1239 Pt - I Heavy grade Class-C for 15NB to 150NB and IS:3589 Gr 410 ERW Pipe(min 6mm thick) for 200NB & Above with suitable type of supports (Shall be fabricated by M.S. Channel / Angle / Flat for above 50mm dia), anchor fasteners, bolt, nuts, clamps, "U" bolts, Pipe fittings such as Reducers, Tees, elbows, flanges. including cutting, grooving, Welding, fixing in / on walls, ceiling by using suitable supports etc, as per drawings with painting as PO Red as per shade 536 of IS:5 for Above ground piping				
	A/G Pipe				
	150NB	Mtr	0		
	100NB	Mtr	0		
	80NB	Mtr	36		
1.2	U/G Pipe				
	150NB	Mtr	800		
2	Providing & fixing SS Fire hydrant Single headed landing valve as per IS:5290 Type-A with 80 N.B. flanged inlet, brass spindle controlled 63 mm dia female instantaneous outlet type. SSCoupling, blank cap, chain, twist release type lug & all accessories Complete.	No.	18		
3	Providing and fixing 63 mm dia instantaneous pattern branch short SS pipe, 20 mm dia nozzle conforming to IS 903, suitable for inter connection to hose pipe coupling complete as required.	No.	18		
4	Supplying and fixing 63mm dia Hose pipe Reinforced Rubber lined as per IS 636 Type-A - 15 M X 1 No. standard length including SS male and female Coupling duely bound with aluminium wire,etc	No.	36		
5	Supplying, fixing, testing and commissioning of following valves, strainers, gauges in the chilled water plumbing duly insulated to the same specifications as the connected piping and adequately supported as per specifications. BUTTERFLY VALVE (MANUAL) with C I body SS Disc, Nitrile Rubber Seal & O- Ring PN 16 pressure rating for chilled water/ hot eater circulation as specified				
a	150NB	No.	4		
6	Providing and fixing weather proof lockable cabinet of size not less than 0.75 x 0.6 x 0.25 mtr made out of MS sheet of 16 gauge thickness having central opening and 4 mm thick glazed glass doors (Two nos.) suitably marked F'I'E_ on the outside.	No.	18		
7	Excavation	Cum	360		
8	Back Filling	Cum	144		
	Rain water Harvesting Pit				
1	Excavation in soft/sandy soils including backfill				
	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom and backfilling with approved material.				
	Mechanical Means	Cum	64.17		
	P.C.C WORK				
2	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications. PCC Grade M15	Cum	2.31		
	R.C.C WORK				
3	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications.				
	RCC Grade M25				
	(i) Using concrete Mixer				
	(Top slab)	Cum	1.25		
	STEELWORK				
4	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Kg	150.43		
	BRICKWORK				
5	Brick masonry workin cement mortar 1:3 in foundation complete excluding pointing and plastering as per Drawing and Technical specification	Cum	11.21		
	PLASTERING WORK				

6	12.5 mm thick cement plaster 1:4 for internal	Sqm	24.83		
7	Plastering on underside of ceiling 10 mm thick cement plaster 1:3	Sqm	6.29		
8	Cement rendering on plaster 1 mm thick	Sqm	24.83		
9	Sand Filling in Wells complete as per Drawing and Technical Specifications	Cum	1.41		
10	Gravel				
	11.0 km to 20 km	Cum	11.41		
11	Flexible Apron : Construction of flexible apron 1 m thick comprising of loose stone boulders weighing not less than 18 kg beyond curtain wall.	Cum	1.41		
12	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or bartering including attached pillasters buttersses etc when curved	Sqm	3.94		
13	Providing & fixing 560mm, 500mm and 450mm internal Diametre circular or 455 mm x 610mm clear inside opening rectangular cast iron manhole cover and frame ISI marked as per IS12592-2002 including carriage from the stores of the Engineer-in-charge to site of work, loading, unloading including stacking and setting the same to correct lines and levels in 1:2 cement sand mortar over manholes including cement concrete copping (1:2:4)around the frame etc.Dia of steel for lifting hook is 16mm.				
	Heavy Duty				
	a) 560mm i/d having weight 208 Kg. as per ISI	nos	2.00		
14	Boring/Drilling bore well of required dia for casing/strainer pipe,by suitable method prescribed in IS:2800 (part1), including collecting samples from different strata , preparing and submitting strata chart/bore log ,including hire & running charges of all equipments , tools plants & machinerise required for the job,all complete as per direction of engineer -in charge ,upto 90 meter depth below ground level.				
	All types of soil.				
	300 mm dia.	Mtr	30.00		
15	Supplying, assembling, lowering and fixing in vertical position in bore well unplasticized PVC medium well screen (RMS) pipesand ribs, conforming to IS:12818, Including hire & labour charges, fittings & accessories etc. all complete, for all depths, as per direction of Engineer-in- charge.(150mm nominal size dia).				
	150 mm nominal size dia	Mtr	30.00		
16	Foot rest for manhole				
	b) Providing orange colour safety footrest of minimum 6mm thick plastic encapsulated as per IS:10910 on 12mm dia steel bar confirming to IS: 1786 having minimum cross section as 23mm x 25mm and over all minimum length 263mm and width as 165mm with minimum 112mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specification and having manufacturer's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x15x11.5cm cement concrete block 1:2:4 (1 cement: 2 sand: 4 stone aggregate) complete as per design.	No	17.00		
	Irrigation Network				
	EXCAVATION				
1	Excavation for pipe lines in trenches and pits including trimming and dressing sides leveling of beds of trenches to correct grade, cutting joint holes, refilling consolidation and watering of refill in 15cm layers and restoration of unmettaled or unpaved surface to its original condition including the cost of necessary shoring, timbering, dewatering of rain water, diversion for traffic, night signals, providing & fixing caution boards, crossing over trenches for access to the houses, watching, fencing, etc. and removal of surplus spoil outside/inside the town involving lead upto one kilometer.				
	Earth work upto 1.5m Depth for				
	(i) All classes of soil except rocky	Cum	374.51		
	LAYING				
2	Providing,stringing out P.V.C pipes as per ISI -4985 casting along the trenches and laying the same in trenches to correct alignment and gradients, cutting, jointing and testing including cost of specials complete as per specifications .				
	xi) 110 mm o/d pipe of 8 Kgf/sqcm	meter	582.81		
3	Providing & fixing sluice valves ISI marked 14846-2000, socketted or flanged, jointing with tyton joints including all carriage complete.				
	Class PN-1 as per ISI				
	(b) 100mm i/d Sluice Valves Socketted or Flanged	Nos	4.00		

4	Providing water connection with grooved coupler and service coupler in Quick coupling pipe line complete in all respect.					
	(d)In 101.60mm outside diameter pipe line	Nos	13.00			
5	Providing and fixing Double air valve as per IS-14845 jointing with tylen joint including all carriages complete	Nos	1.00			
6	Gravel packing in tube well construction in accordance with IS:4097,including providing gravel fine/medium/coarse,in required grading and sizes as per actual requirement,all complete as per direction of Engineer-in-charge Gravel 75mm to 25mm	cum	10.00			
	11.0 km to 20 km	cum	10.00			
7	Construction of masonry Sluice Valve Chamber complete in all respects as per standard drawing.					
	b. Size 0.9 Mx0.9M	nos.	4.00			
8	Boring for hand-pump in clay fitting strainer and pipe. Bores,					
	(b) Above 75mm dia. but not exceeding 100mm dia.					
	(iii)Exceeding 30 m.	meter	50.00			
9	Supplying, assembling, lowering and fixing in vertical position in bore well unplasticized PVC medium well screen (RMS) pipes and ribs, confirming to IS:12818, Including hire & labour charges, fittings & accessories etc. all complete, for all depths, as per direction of Engineer-in-charge.(150mm nominal size dia).					
	100mm nominal size dia	meter	50.00			
10	Supplying at quarry site of gravel of 1/16" to 1/18" size including pouring and packing in the annular space between the pipes assembly and the bore . The gravel should be free from dust , dirt or the vegetable matter as per IS 4097/1967 with latest amendents (to be paid as per actual length of pipe)	cum	5.30			
11	Development of tubewell in accordance with IS:2800(PART-I) and IS: 11189, to establish maximum rate of usable water yield without sand content (beyond permissible limit), ith required capacity air compressor, running the compressor for required time till well is fully developed, measuring yield of well by "V" notch method or any other approved method, collecting water samples & getting tested in approved laboratory, i/c disinfection of tubewell, all complete, including hire & labour charges of air compressor, tools & accessories etc. all as per requirement and direction of Engineer- in-charge.	hr.	10.00			
12	Providing and Fixing suitable size threaded mild steel cap or spot welded plate to the top of bore well housing/ casing pipe, removable as per requirement and direction of Engineer-in-charge.	each	1.00			
13	Providing and Fixing M.S Clamp of required dia to the top of casing/ housing pipe of tubewell as per IS:2800 (PART I), including necessary bolts and nuts of required size complete	each	1.00			
14	Providing and Fixing Bail plug/ Bottom plug of required dia to the bottom of pipe assembly of tubewell as per IS:2800 (PART I)	each	1.00			
15	GALVANIZED IRON PIPES AND G.I .					
	Supply & erection of G.I pipe for wiring purposes including bends , inspection boxes etc , where necessary including painting as per PWD general inspection 2010 ;					
	v) Galvanized iron pipe 40mm dia. (A class)furnished	meter	125.00			
16	Submersible pump- 5 H.P.	no.	1.00			
17	L&T make model MUG6 3 phase submersible pump controller (with single phase preventer)	no.	1.00			
18	Flat cable 3c x 4 sqmm cu	meter	150.00			
	Storm Water Drain					
	EXCAVATION					
1	Excavation of trenches , Lanes or in open area for storm waters and manholes to full depths as shown in drawings , including shoring , timbering of polling board frame system type ,dressing to correct section and dimensions according to template and dewatering , provision for diversion of traffic , protection of existing services i.e telephone cables , electric lines, water supply lines and gas lines etc , providing and fixing night signals , profiles pegs sight rails ,boning rods ,crossing over trenches for access to the houses , watching , fencing etc ., providing and fixing and maintenance of caution boars ,refilling trenches , watering of refill in 15cm layers ,ramming and restoration of surface to original condition and removal of surplus spoil from site of works , for all works other than connections to Ventilating shaft upto a lead of one kilometer .					
	For depths not exceeding 2.0 meters below G.L					
	(a) for all classes of soil except rocky .	Cum	521.07			
	P.C.C					
3	Cement Concrete 1:3:6 with stone ballast or shingle.	Cum	39.92			

	SHUTTERING					
4	shuttering for faces of concrete foundations and foundation beam & plinth beam (vertical or battering)					
	PCC	Sqm	84.04			
	RCC base	Sqm	126.07			
5	Centring and shuttering for faces of walls, partitions, retaining walls and the like (vertical or battering) including attached pilasters, buttersses etc					
	Wall	Sqm	924.48			
6	centering and shuttering for flat surfaces such as suspended floors , roofs, landing , chajjas ,shelves etc					
	Slab	Sqm	189.10			
7	Reinforced cement concrete M-25 with cement @425/kg per cum hand mixed but excluding steel reinforcement centring and shuttering in superstructure.					
	Rcc base	Cum	47.27			
	Wall	Cum	69.34			
	Slab	Cum	18.91			
	CARRIAGE					
8	Earth,Surkhi,Sand ,Earth,Fly Ash ,Bajri ,Ballast ,Stone Boulders , Kankar and Builing Rubbish , Earth. (Lead 120 km)					
	C.A	Cum	115.19			
	F.A	Cum	58.27			
	STEELWORK					
9	Cold twisted deformed (Ribbed/ Tor Steel Bar) Bars Fe 500 grade as per IS 1786-1985, for R.C.C works, where not including in the complete rate of RCC including bending and placing in position complete	Qtl	108.42			
10	Providing & fixing of road gully grating and frame fixing and erecting the same in position to correct line and levels in 1:2 cement sand mortar complete as per drawings/specifications and to the entire satisfaction of Engineer -in- Charge .					
	b) C.I Road Gully grating and frame having weight 77 Kg. 610mmX457mm	Each	28			
	PLASTERING WORK					
11	12.5 mm thick cement plaster 1:4 for internal	Sqm	462.24			
12	Floating coat of 1.5mm thick neat cement laid in one operation to the topping.	Sqm	378.20			
13	25mm thick polished flooring cement concrete 1:2:4 topping finished with 3 mm thick neat coat of cement rubbed and polished.	Sqm	189.10			
14	Shifting of existing Water supply mains and connections and making them good	LS	1.00			
15	Refurbishment of damaged Sewer connections and manholes including temporary diversion works	LS	1.00			
						Total for Utilities Work =
	Operation and Maintainence Charges (Quarterly Charges)					
	External Development Works	LS	15.00			
	Utilities	LS	15.00			
	Electrical Works	LS	15.00			
						Total for Operation and Maintainence