PROJECT: **CONSTRUCTION OF THREE ARM FLYOVER AT HOSPITAL CHOWK IN RAJKOT CITY**

GENERAL & TECHNICAL SPECIFICATIONS FOR UTILITY SHIFTING WORKS

1. GENERAL INSTRUCTIONS

1.1. GENERAL INSTRUCTIONS

The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards. It may also be noted that the specifications are of generalized nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings. The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued there to or revisions thereof, if any, up to the date of receipt of tenders. In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, and requirements of the Engineer-in-Charge. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/ Municipal Corporation/ Development Authority/ Improvement Trust etc. under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each phase.

The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

The contractor shall clear the site thoroughly of all debris, surplus excavated materials and rubbish etc. left out of his work and dress the site

around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.

The Chief Engineer, DCSE, DAE, shall be the sole deciding authority as to the meaning; interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.

In case any difference or discrepancy between the specifications and the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specifications and drawing, the specifications shall take precedence. In case any difference or discrepancy between the specifications for civil works and specification for Public Health Engineering works, specifications for civil works shall take precedence.

1.1.1 APPROVAL

The materials for P.H. Engineering works which are to be supplied by the contractor shall conform to the relevant IS specifications and on the latest approved list of Mumbai Municipal Corporation/ Local bodies if any, and shall be approved by the Engineer-in-Charge prior to installation of fixture and the approved samples shall be maintained at site till the completion of work. The approved makes of main items are, however specified in the list of approved makes of materials here in before.

1.1.2 PRECAUTIONS

While carrying out pipe line work in case the contractor encounters any interference with other services such as cables, conduits etc, he shall take sufficient precautions in order to prevent any damage to them. If any damage occurs, it shall be rectified to its original condition at his own cost to the satisfaction of the officers concerned with such services.

The contractor shall ensure that all inserts, pipe lines embedded in structural members or sleeves are placed in position in co-ordination with civil work.

All public health engineering services shall be handed over to Engineer-in-charge complete in all respects on completion of the work. Incomplete work will not be taken over. Any loss or damage to these services due to any reasons by anybody whatsoever before handing over will be at contractor's risk and cost. Any damage to any structural/finishing work done during the testing or rectification shall be made good by the contractor at his own cost and risk.

1.1.3 COST TO BE COVERED

The rates quoted by the tendered under this contract shall cover the cost of all the following elements.

1.1.4 MISCELLANEOUS WORK

The contractor carrying out the construction work shall take effective measures to carefully open out all existing channels, culverts, bridges, pipelines, conduits, water courses, sewer, drains, electrical cables, transmission lines and their supports and all works buried or otherwise where such services have to be interfered with the purpose of the construction of the works. He shall provide and arrange all necessary temporary supports and diversions if necessary across/under/even through along sides of the trenches and all other parts of construction work for all such channels, culverts, bridges, pipe lines, conduits.

1.1.5 CLEARANCE FOR ROADS AND FOOT PATHS

The contractor shall arrange to carry out all works with least interference practicable with public footpath and vehicular traffic and with existing waste water or storm water drainage arrangements and provide all necessary road barriers, fences, notices, lights, gangways, access crossings, diversions for traffic, temporary drains, dewatering channels, chutes pumping or water lifting arrangements and all other facilities for the proper execution of the works to the approval and satisfaction in all respects of the Engineer-in-Charge. Any work carried out by the contractor in this connection shall be deemed as temporary works incidental to the construction work.

1.1.6 LOCATION

The rates quoted by the tendered under this contract shall be applicable for the work at all levels and locations.

1.1.7 DEWATERING

The rates quoted by the tendered under this contract shall include bailing or pumping out all the water which may accumulate during the progress of the work either through seepage, springs, rain or any other cause.

1.1.8 WATER SUPPLY MAIN

The cost includes for transport charges and testing charges prescribed by the municipal Corporation. Water mains thus laid shall be tested to a pressure as specified in the schedule and specifications. Contractor has to get the pipe line laid hydraulically tested by the Municipal Authorities. Contractor has to bear the Municipal hydraulic testing charges.

1.1.9 FORMALITIES WITH STATUTORY BODIES

The work shall be carried out in a manner complying in all respects with requirement of relevant bye-laws of the Municipal Committee/ Municipal Corporation/ Development Authority/ Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in- Charge and, unless otherwise mentioned, nothing extra shall be paid on this account. The contractor has to satisfy all the requirement of fire brigade, drainage and hydraulic engineering department of Municipal Corporation.

Note: In case a separate item is included in the schedule of quantities, contractor shall engage a licensed P.H. Engineer/ licensed plumber and obtain all the above certificates from Municipal Corporation. The Department shall authorize the contractor to deal with BMC on behalf of the Department.

1.2. LIST OF INDIAN STANDARDS

The following IS codes shall be referred in execution of PH Engineering works.

IS CODE	SUBJECT
IS: 456	Code of practice for Plain & Reinforced concrete.
IS: 458	Specifications for Concrete Pipes.
IS: 783	Code of practice for laying concrete pipes.
IS: 784	Pre-stressed concrete pipes.
IS: 1200 (Pt. 16)	Method of measurements for Laying of water and sewer lines including appurtenant items.
IS: 1239 (Pt I& II)	Specifications for Mild steel tubes
IS: 1726	Cast iron manhole covers and Frames.
IS: 2527	Code of practice for fixing rain water gutters and down pipes for roof drainage.
IS: 3597	Method of test for concrete pipes.
IS: 4038	Foot valves for water works purposes.
IS: 4111 (Pt. I to V)	Code of practice for ancillary structures in sewage system.
IS: 4111 (Pt. I)	Manholes
IS: 4736	Specification for hot –dip zinc coating on mild steel tubes.
IS: 4854 (Pt. I to III)	Glossary terms for valves and their parts
IS: 5312 (Pt. I)	Swing check type reflux (non-return) valves
IS: 5312 (Pt. II)	Reflux (non-return) valves – single door pattern
IS: 5455	Cast iron steps for manholes
IS: 5961	Specifications for Cast Iron grating for drainage purposes
IS: 7740	Code of Practice for road gullies
IS: 8835	Guide line for planning and design of surface drains.
IS: 9338	Specifications for Cast Iron screw downs top valves and stop & check valves for water works purposes
IS: 12592	Precast concrete frame & cover (SFRC frame & cover)

2. BASIS OF DESIGN

Storm Water System

- Road Runoff water to be collected through pits and troughs for disposal using pumps.
- Surface rain water collection & disposal in drainage network of pipes and chambers.
- Appropriate sized pipes will be provided for the disposal of rain water from the surfaces.
- All of storm water shall be disposed through NP3 Class R.C.C. Pipes with a slope such that the minimum self-scouring velocity of 0.6 m/sec is achieved.
- Run off values for Rain Water:
- The rain water design will be based on the following:
  - Run off Coefficient
  - Rain fall intensity
  - Location of city drain nearby, and
  - Slope of the site area
- As per rational equation of maximum rain fall = Area x Rain fall x Run off
- Design is based on 50 mm / hr. rainfall intensity, which is in line with the provisions mentioned in NBC-2016.

3. TECHNICAL SPECIFICATIONS

3.1. GENERAL SPECIFICATION FOR EARTH WORK AND BACKFILL

3.1.1. SCOPE OF WORK

The scope of work covered under this specifications pertains to excavation of foundations, trenches, pits and over areas, in all sorts of soils, soft and hard rock, correct to dimensions given in the drawing including shoring, protections of existing underground utilities if any, such as water lines, electric cables etc., dewatering and shoring if necessary, stacking the useful materials as directed within the lead specified, refilling around the foundation and into the plinth with selected useful excavated earth and disposing off the surplus earth/materials within specified lead and finishing the surface to proper levels, slopes and camber etc. all complete.

3.1.2. SITE CLEARANCE

Before the earth work is started the area coming under cutting and filling shall be cleared of all obstructions, loose stones, shrubs, rank vegetation, grass, brush-wood, trees and saplings of girth up to 30 cm. measured at a height of one meter above ground and rubbish removed up to a distance of 150 meters outside the periphery of the area under clearance. The roots of trees shall be removed to a minimum depth of 60 cm. below ground level, or a minimum of 30 cm. below formation level whichever is lower, and the hollows filled up with earth, leveled and rammed. This work is deemed to be included in the earth work items and no separate payment will be admissible for the work.

The trees of girth above 30 cm. measured at a height of one meter above ground, shall only be cut after permission of the Engineer-in-charge is obtained in writing. The roots shall also be removed as described in the preceding sub-Para. Payment for cutting and removing roots of such trees shall be made separately. Any material obtained from the site will be the property of the Department and the useful materials as decided by the Engineer- in-charge will be conveyed and properly stacked as directed within the lead specified.

3.1.3. SETTING OUT AND MAKING PROFILES

Masonry or concrete pillars will be erected at suitable points in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G. T. S. or any other permanent bench mark approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings or Burjis shall be made to show the correct formation levels before the work is started. The contractor shall supply labor and materials for setting out and making profiles and Burjis for the work at his own cost and the same shall be maintained during the excavation work. The Department will show grid Co-ordinate or other reference points. It shall be the responsibility of the contractor to set out centre lines correctly with reference to the drawings and install substantial reference marks. Checking of such alignment by the Department will not absolve the contractor from his

responsibility to execute the work strictly in accordance with the drawings.

3.1.4. EARTHWORK

The contractor shall notify the Engineer-in-charge before starting excavation and before the ground is disturbed, to enable him to take existing levels for the purpose of measurements. The ground levels shall be taken at 5 to 15 meters intervals in uniformly sloping ground and at closer distance where local mounts, pits or undulations are met with, as directed by the Engineer-in-charge. The ground levels shall be recorded in field books and plotted on plans, which shall be signed by the Contractor and the Engineer-in-charge, before the earth work is actually started. The labor required for taking levels, shall be supplied by the Contractor at his own cost. The Contractor shall perform excavation in all types of soils, murrum, soft and hard rock, boulders etc. in foundation, over areas and in trenches to widths, lines, levels, grades and curves as shown in the drawing or lesser widths, lines and levels as directed by the Engineer-in-charge and as per items in the schedule of quantities.

3.1.4.1. The item in the schedule of quantities shall specify the excavation in trenches for this purpose, the excavation in trenches for foundations and for pipes, cables etc. not exceeding 1.5 meter in width and for chambers, manhole, shafts, wells, cesspits and the like not exceeding 10 sqm. on plan and to any depth shall be described as Excavation in trenches for foundation, drains, pipes and cables and returning the excavated material to fill the trenches after pipes, cables etc, are laid and their joints tested and passed and disposal of surplus excavated material up to 50 m lead.

3.1.4.2. Excavation exceeding 1.5 meter in width as well as 10 sqm. On plan (excluding trenches for pipes, cables etc.) and exceeding 30 cm in depth shall be described as Excavation over areas.

3.1.5. CLASSIFICATION OF EARTH WORK

The earth work shall be classified under the following main categories and measured separately for each category.

1. All types of soils, murrum, boulders.
2. Soft rock.
3. Hard rock.

3.1.5.1. ALL TYPES OF SOILS, MURRUM, BOULD

This includes earth, murrum, top deposits of agricultural soil, reclaimed soil, clay, sand or any combination thereof and soft and hard murrum, shingle etc. which is loose enough to be removed with spades, shovel and pick axes. Boulders not more than 0.03 cum. in volume found during the course of excavation shall also fall under this classification.

3.1.5.2. EXCAVATION IN SOFT ROCK

This shall include all materials which are rock or hard conglomerate, all decomposed weathered rock, highly fissured rock, old masonry, boulders bigger than 0.03 cum. in volume but not bigger

than 0.5 cum. and other varieties of soft rock which can be removed only with pick axes, crow bars, wedges and hammers with some difficulty. The mere fact that the contractor resorts to blasting and/or wedging and chiseling for reasons of his own, shall not mean the rock is classifiable as hard rock.

3.1.5.3. EXCAVATION IN HARD ROCK

This includes all rock other than soft rock mentioned in Para 2.1.5.1 b viz. soft rock, occurring in masses, boulders having approximate volume more than 0.5 cum. Plain or reinforced cement concrete, which can best be removed by blasting or chiseling and wedging where blasting cannot be permitted owing to any restriction at site.

3.1.5.3.1. EXCAVATION IN HARD ROCK BY BLASTING

Where blasting is permitted the excavation in rock shall be done by means of blasting. No heavy blasting will be permitted and only controlled/muffled blasting will be permitted at the discretion of the Engineer-in-Charge. The Contractor shall be governed by the relevant statutory laws, rules and regulations on explosives, pertaining to the acquisition, transport, storage, handling and use of explosive which shall be rigidly followed and shall obtain him all necessary materials and equipment for blasting. Blasting shall be executed through a licensed blaster with prior permission from police authorities. Prior to blasting sufficient notice shall be given to concern parties to avoid danger to people, materials and nearby structures. All the damages caused by careless blasting if any shall be made good by the contractor at his own expenses.

3.1.5.3.2. EXCAVATION IN HARD ROCK BY CHISELLING AND WEDGING

Where blasting is not permitted and if the Engineer-in-Charge so desires, the excavation shall be done by chiseling and wedging or any other agreed method.

NOTE: All the excavated hard rock obtained shall be stacked properly and neatly within the specified lead by the contractor as directed by the Engineer-in-Charge.

3.1.6. EXCAVATION

The excavation under all classifications in areas in trenches or in pits shall be carried out systematically. Cutting shall be done from top to bottom and no under-pining or undercutting will be allowed. The bottom and sides of excavation shall be dressed to proper level, slopes, steps, camber etc. by removing high spots, and ramming thoroughly as directed by the Engineer-in-charge.

All the excavation shall be carried out strictly to the dimensions given in the drawing. The width shall generally be of the width of mud mat concrete and depth as shown in drawing or as directed by the Engineer-in- Charge, according to availability of the desired bearing capacity of soil below. Any excavation if taken below the specified depths and levels, the contractor shall at his own cost fill up such

overcut to the specified level with cement concrete 1:4:8 in case of excavation in all types of soils and with cement concrete 1:2:4 in case of excavation in soft and hard rock.

After the excavation is completed, the contractor shall notify the Engineer-in-Charge to that effect and no further work shall be taken up until the Engineer-in-Charge has approved the depth and dimensions and also the nature of foundation materials. Levels and measurements shall also be recorded prior to taking up any further work.

3.1.6.1. SIZES OF TRENCH FOR EXCAVATION FOR PIPE LINE :

Where the width of trench is not specified the following shall apply.

1. Up to 1.0 meter deep shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/collar) cable, conduit etc where a pipe is laid on concrete bed/cushioning layer, the authorized width shall be the external diameter of the pipe (not socket/collar) plus 25 cm or the width of concrete bed/cushioning layer whichever is more.
2. For depths exceeding one meter, an allowance of 5 cm per meter of depth for each side of the trench shall be added to the authorized width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils up to a depth of 2 meters from the bottom. For depths greater than 2 meters, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two meters from bottom.
3. Where more than one pipe, cable, conduit etc. are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.
4. Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored-up as directed by the Engineer-In-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-In-charge regarding increase in the width of trench, sloping or shoring to be done for excavation in soft, loose or slushy soils.

3.1.6.2. SIZES OF TRENCH FOR EXCAVATION FOR CHAMBERS, MANHOLES, SHAFTS, WELLS, CESSPITS:

Authorized working space shall be special in each case. Where authorized working space is not so specified the following shall apply:
600 mm measured from the external face of substructure/walls (including protective measures like water proof plaster, tile cladding etc. if any) at lowest level, where extra working space is required.

3.1.7. SHORING

Unless separately provided for in the schedule of quantities, the quoted rate for excavation shall include excavation of slopes to prevent falling in soil by providing and/or fixing, maintaining and removing of shoring, bracing etc. The contractor would be

responsible for the design of shoring for proper retaining of sides of trenches, pits etc. with due consideration to the traffic, superimposed loads etc. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. It shall be removed as directed after items for which it is required are completed. Should the slips occur, the slipped material shall be removed and slope dressed to a modified stable slope? Removal of the slipped earth will not be measured for payment.

3.1.8. DEWATERING

Unless specifically provided for as a separate item in the schedule of quantities, rate shall also include bailing or pumping out all water which may accumulate in the excavation during the progress of further works such as mud mat concrete, R.C. footings, shuttering etc. either due to seepage, springs, rain or any other cause and diverting surface flow by bunds or other means. Care shall be taken to ensure that the water discharged sufficiently away from the foundations to keep it free from nuisance to other works in the neighborhood.

3.1.9. DISPOSAL OF EXCAVATED MATERIALS

3.1.9.1. ANTIQUITES

Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.

3.1.9.2. USEFUL MATERIALS

Any material obtained from the excavation which in the opinion of the Engineer-in- Charge is useful, shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

No material excavated from foundation trenches of whatever kind they may be are to be placed even temporarily nearer than about 3 m. from the outer edge of excavation. Discretion of the Engineer-in-Charge in such cases is final. All materials excavated will remain the property of the Department. Rate for excavation includes sorting out of the useful materials and stacking them separately as directed within the specific lead.

Materials suitable and useful for refilling or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or other elevation shown on the plan or as directed by the Engineer-in-Charge. Materials not useful in anyway shall be disposed off, leveled and compacted as directed by the Engineer-in-charge within a specified lead. The site shall be left clean of all debris and leveled on completion.

3.1.10. REFILLING IN SIDES OF CHAMBERS, DRAINS ETC.

The back filling shall be done after the concrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for back filling, it shall be brought from the place where it was temporarily deposited and shall be used in refilling. The scope of work for back filling/ filling in sides of chambers and other areas shall include filling for all the excavation covered under the contract. Surplus earth available from the excavation, if required, shall be used for refilling/ filling for filling the trenches for pipes cables buildings also within the specified lead mentioned in the item.

All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface with approved materials in layers not exceeding 200 mm. in thickness, watered and well consolidated by means of rammers to at least 90% of the consolidation obtainable at optimum moisture content (Proctor density). Flooding with water for consolidation will not be allowed. Areas inaccessible to mechanical equipment such as areas adjacent to walls and columns etc. shall be tamped by hand rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones, shingle or boulder not larger than 80 mm. in any direction, salt and clods, organic or other foreign materials which might rot. The refilling in plinth and under floors shall be done in similar way in layers not exceeding 200 mm. thick and shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density.

Test to establish proper consolidation as required will be carried out by the Department at rates specified. Two tests per 50 sqm. Will be taken to ascertain the proper consolidation. The cost of tests carried out will be recovered from the contractor's bill.

3.1.11. REFILLING IN TRENCHES FOR PIPES, CABLES ETC.

Filling in trenches shall be commenced soon after the joints of pipes, cables; conduits etc. have been tested and passed. The space around the pipes, cables, conduits etc. shall be cleared of all debris, brick bats etc. Where the trenches are excavated in hard/soft soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the excavated earth is used for filling. In case of excavation of trenches in ordinary/hard rock, the filling up to a depth of 30 cm above the crown of pipe, cable, conduits etc. shall be done with fine material like earth, murrum or pulverized/decomposed rock according to the availability at site. The remaining filling shall be done with boulders of size not exceeding 15 cm mixed with fine material

like decomposed rock, murrum or earth as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30 cm. Excavated material containing deleterious material, salt peter earth etc. shall not be used for filling. Ramming shall be done with iron rammers where feasible and with blunt ends of crow bars where rammers cannot be used, Special care shall be taken to ensure that no damage is caused to the pipes, cables, conduits etc. laid in the trenches.

3.1.12. LEAD & LIFT

3.1.12.1. LEAD

The lead for disposal/deposition of excavated materials shall be as specified in the respective item of work. For the purpose of measurements of lead, the area to be excavated or filled or area on which excavated material is to be deposited/ disposed off shall be divided in suitable blocks and for each of the block, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route adopted.

3.1.12.2. LIFT

Lift shall be measured from ground level. Excavation up to 1.5 m depth below ground level and depositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5 m or part thereof. Obvious lift shall only be measured; that is lifts inherent in the lead due to ground slope shall not be measured except for lead up to 250 m. All excavation shall be measured in successive stages of 1.5 m stating the commencing level. This shall not apply to cases where no lift is involved as in hill side cutting.

3.1.13. MODE OF MEASUREMENTS

3.1.13.1. All excavation in areas having depth more than 30 cm. pits, trenches etc. Shall be measured net. The dimensions for the purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, rafts or other foundations, multiplied by the mean depth from the surface of ground determined by levels. Excavation for side slopes will not be paid for. Excavation in areas having depths less than 30 cms. Shall be measured as surface excavation on square meter basis, mentioning the average depth of excavation.

Reasonable working space beyond concrete dimension required for waterproofing and shuttering where considered necessary in the opinion of Engineer-in Charge will be allowed in execution and considered for payment for underground water tank, sump, septic tank etc.

3.1.13.2. Wherever direct measurements of rock excavation are not possible, volume of rock be calculated on the basis of length, breadth and

depth of stacks made at site. The net volume shall be worked out by reducing it by 50%, taking the voids into consideration as 50%. Similarly to arrive at net quantity to be paid in the case of soil, reduction @ 20% of corresponding stack/truck measurements shall be made.

3.1.13.3. The rate for excavation shall include carting and disposing and leveling the excavated materials within the specified lead. The rate shall also be inclusive of cost of all tools, plants, explosives, shoring, dewatering at various stages, labor, materials etc. to complete all the operations specified.

3.1.13.4. The backfilling and consolidation in sides of foundation and in plinth with excavated material will not be paid for separately. The rate quoted for excavation shall be deemed to have been included the cost of stacking of excavated materials, conveying within the specified lead, picking of selected stacked materials, conveying it to the place of final backfill, compaction to the required proctor density etc.

3.1.13.5. Payment for filling and consolidation inside the trenches, sides of foundations, plinth etc. with selected materials brought by the contractor other than the excavated material, shall be paid for separately as per the rates in schedule of quantities which includes cost of such materials/ excavation, royalty, its conveyance within the specified lead, watering, consolidating, dressing etc. Actual quantity of consolidated filling shall be measured and paid in cubic meters up to two places of decimal.

3.1.13.6. The rate quoted in cum. for items of excavation is deemed to include the necessary additional quantity of excavation involved beyond the plan dimensions of the work which may be necessary to be carried out for carrying out the work in an engineering manner, decided upon by the contractor. Therefore no extra payment will be made for any excavation done other than the required quantity as per the plan dimension indicated in the drawings.

3.1.13.7. Measurements for excavation over areas shall be determined by levels or by “Dead men” or both at the discretion of the Engineer-in-Charge. If however the Engineer-in-Charge decides on measurement by levels, levels of site shall be jointly taken and recorded by the Engineer-in-Charge or his representatives and the contractor, before commencement of the work and after completion of the work and the quantity of work done shall be computed based on these levels. The volume of earth work shall be computed based on “Simpson’s formula” or any other approved method at the discretion of the Engineer-in-Charge.

3.1.14. MODE OF PAYMENT

The contract rate shall be for unit cubic meter of earth work.

3.2. PLAIN CEMENT CONCRETE

3.2.1. GENERAL

The specification covers the requirement of ordinary Cement Concrete of the specified proportion to be used for various concrete items.

3.2.2. MATERIAL

The material requirement for particular item shall be as per IS 456

3.2.3. CEMENT

Cement shall be OPC/PPC cement conforming to IS 269 & IS 1489 respectively. Cement shall be stored in dry god owns or sheds use of PPC slag cement as approved by the Engineer In-charge, out of construction with damp ground on a 0.6M height platform. Cement shall not be stored in the open. All cement shall be kept well stacked and no cement other than intended to use in the work, shall be used. The cement shall be stored as received and shall be consumed in the order in which consignments are received and shall not be stored for long periods. No clogged cement caused by dampness shall be used. Blended cement for finishing work shall be used with the prior approval of the Engineer In-charge.

3.2.4. FINE AGGREGATE

The sand shall be clean, well graded, hard, strong, durable and gritty particles of size 0.15 mm to 5 mm fee from mica, dust, clay, kankar, soft or flaky particles and other deleterious materials. If the fine aggregate contain more than 4 percent of clay, dust or silt it shall be washed. Sea sand should not be used. The fineness modulus may range between 2.6 to 3.6.

3.2.5. COARSE AGGREGATE

All stone aggregate to be used for cement concrete shall be from approved sources. The aggregate shall be clean hard, strong and durable. It shall not contain soft, flaky thin or elongated pieces, alkali organic matter or other notorious matter. The specific gravity of the aggregate shall be between 2.5 to 2.7.

3.2.6. STORAGE, SCREENING AND WASHING

It shall be stored at the work site in such a manner as to prevent contamination. All aggregate shall be stored to convenient height on hard and dry platform. The contractor shall install screens, one for coarse aggregate and one for sand and shall thoroughly wash all aggregate if directed by Engineer-in-charge.

3.2.7. WATER

The water shall be confirming to IS 3025. The water shall be clean and free from deleterious matters such as acids, oils, alkalis, sugar and vegetable matter. Every attempt shall be made to use water that is fit for drinking and whenever possible, water shall be used direct from the supply mains. PH value of water shall not be less than 6.

3.2.8. PROPORTIONING OF MIX

In ordinary concrete although proportion of cement to fine and course aggregate is specified by volume, the quantity of cement shall be determined by weight assuming one bag of cement weighing 50 kg. Net to be equivalent to 35 Liters. Fine and course aggregate shall be measured by dry volume in suitable measuring boxes. The allowance shall be made for bulking in the fine aggregate due to moisture if any at the time of mixing. Water cement ratio will be such as will give concrete just sufficient workable to place and compact without difficulty.

3.2.9. MIXING

In all the cases concrete shall be mixed in a mechanical mixer at the site of work, mixer and other accessories should be in first class condition and well maintained throughout the construction. Mixing shall be continued till the homogeneous mixture is obtained but in no case mixing shall be done for less than 1.5 Minutes.

When hand mixing is permitted by Engineer-in-charge in any special condition, it shall be done on a smooth, hard and water tight, platform large enough to allow sufficient turning over of the ingredients of concrete after adding the water. The material shall be mixed in dry state and turned over until they are thoroughly and fully mixed homogeneously. In hand mixing, the quantity of cement shall be increased by 10 percent without any extra cost. Repapering or remixing of partially hardened concrete shall not be permitted.

3.2.10. PLACING

The concrete shall be transported in such a manner that there shall be no tendency for the segregation of the different ingredients and it shall not be dropped into position from the height greater than 1.00 meter and shall be placed within 30 minutes after mixing. It shall not be interfered when once it has become to set.

When new concrete is to be placed on the already set concrete, the surface of the old concrete shall be thoroughly roughened & wetted before the new concrete is laid.

Cement: Sand (1:2)slurry should be laid over the surface of the old concrete which is roughened, washed and wetted. The stripped surface of concrete shall be smooth & sharp. Any honey combing, air holes, board marks etc, shall be finished smooth prior to re-concreting.

3.2.11. COMPACTION

The concrete shall be thoroughly compacted during depositing to get dense concrete. The concrete shall not be disturbed once it is set. For important works, the use of mechanical vibrator is essential. The vibrator shall not be less than 4000 to 5000 impulse per minute and shall be worked at an interval about 600 mm. Over vibration shall be avoided.

3.2.12. DEWATERING

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

3.2.13. FORM WORK

The forms shall generally comply with IS 456 & IS 14687. The shuttering shall be of wood or metal. Before placing the concrete the inside of the forms which comes into contact with concrete shall be coated with mineral oil. The forms shall be erected in position firmly so that it should not be dislocated during concreting. The forms shall be removed without damaging the concrete structure after development of sufficient strength and taking consent of the Engineer- In-Charge.

3.2.14. DEFECTIVE CONCRETE

The defective concrete surface shall be made good as per the direction of Engineer- In-Charge at the contractor's own cost and charges.

3.2.15. WATERING AND CURING

All the concrete work shall be kept wet continuously for a period of least 14 days to prevent excessive evaporation. In hot and dry weather matting or gunny bags may be hung on outside of the concrete surface to keep moist.

3.2.16. THE RATE INCLUDES FOR

1. Installation and removal of scaffolding and shuttering.
2. Cost includes transporting, placing, compacting, curing and finishing cement concrete,
3. Necessary sampling and tests for materials and concrete.
4. Dewatering the pit or trench if found necessary till completion of work.
5. All labor, materials, use of equipment, tools and plants.

3.2.17. MODE OF MEASUREMENT

The measurement shall be for unit cubic meter of concrete or as specified in schedule of work. The concrete shall be measure for its length, breadth and depth. Deduction for pipe shall be made as per the actual outer dimension of the pipe.

3.2.18. MODE OF PAYMENT

The contract rate shall be for unit cubic meter of concrete or as specified in the schedule of work.

3.3. BRICK MASONARY

3.3.1. GENERAL

This specification covers requirement of the Brick Work in specified proportion of cement mortar.

3.3.2. BRICK

Brick shall generally confirm to IS 1077. All the bricks to be used in the work shall be well bunt clay brick of class 35, red color, homogeneous in texture, free from flaws, cracks and crevices. They shall have a frog of 10 mm. depth on one side of their flat faces. No brick after twenty four hours immersion in water shall absorb more than 25% of its own weight and strength should not be less than 3.5 MPa (35 kg/Sq.cm). The test report of the bricks shall be submitted to the Engineer-in-charge at the contractor's own cost, if required Brick shall be uniformly burnt throughout but not over burnt, shall give the clear metallic ringing sound when struck.

3.3.3. BRICK WORK

All bricks shall be thoroughly soaked in water before use till the bubbles ceases to come up. No half or quarter brick shall be used except as closures. The course shall be horizontal and the wall shall be raised to plumb. Joints in brick wall shall not exceed to 10mm thick. Brick work shall be uniformly raised around to heights as per drawings. All joints shall thoroughly flush with mortar at every course. Care shall be taken to see that the bricks are properly bedded and joint completely filled to full depth. No bat or cut bricks shall be used in the work unless absolutely required to give proper shape. Brick work shall be built in cement and sand mortar as specified in the schedule or as per drawing. The joints shall be raked for a depth of 10 mm to receive cement plaster.

3.3.4. DEWATERING

The item rate shall include bailing or pumping out all water which may accumulate during the progress of the work either from seepage, springs, rain or any other cause.

3.3.5. WATERING AND CURING

All the brick work shall be kept damp continuously for a period of 14 days to prevent excessive evaporation in hot and dry weather matting or gunny bags may hang on the outside of brick work & kept moist.

3.3.6. THE RATE INCLUDES FOR

1. Erecting, dismantling and removing the scaffolding and curing brick work for at least 14 days.
2. Dewatering the pit or trench if found necessary till completion of work.
3. Labor, materials, tools, paint etc. used in the work.

3.3.7. MODE OF MEASUREMENT

The measurement shall be for unit cubic meter of brick work or as specified in the schedule of work. The brick wall shall be measured for its length, breadth and depth.

3.3.8. MODE OF PAYMENT

The contract rate shall be for unit cubic meter or as specified in the schedule of work.

3.4. CEMENT PLASTER

3.4.1. GENERAL

This specification covers the requirement of the Cement plaster in the specified proportions.

3.4.2. CEMENT MORTAR

Cement and sand shall be mixed to the proportions as described in the schedule. Cement and sand shall be first mixed dry on the dry platform after which sufficient clean water shall be added to bring the whole mix into a plastic condition. No mortar which has started to set shall be used nor such mortar remixed with new one. It shall be removed from the work site at once.

3.4.3. PLASTERING

In all plaster work, mortar shall be firmly applied and well pressed into the joints on the surface and drubbed and leveled with a flat wooden rule to give required thickness. Long straight edge shall be freely used to ensure a perfectly plane and even surface. All corners must be finished to their true angle or rounded as directed. Cement plaster should be done in square or strips and shall be done from top to downward.

3.4.4. FLOATING COAT

The floating coat over the plaster shall be so done whenever specified in the item with neat cement to finish the surface so that cracks, crevices etc. are not developed in the plaster.

3.4.5. DEWATERING

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

3.4.6. WATERING AND CURING

All the plaster work shall be kept damp continuously for a period of 14 days to prevent excessive evaporation. In hot and dry weather matting or gunny bag may be hung on the outside of the plaster in the beginning and kept moist.

3.4.7. THE RATE INCLUDES FOR

1. Erecting, dismantling and removing the scaffolding.
2. Preparation of the surface to receive the plaster of specified thickness and number of coats, curing etc.
3. Labor, materials, tools and plants used to complete the work.

3.4.8. MODE OF MEASUREMENT

The measurement shall be for unit square meter of cement plaster. The plaster shall be measured for it length, breadth / depth.

3.4.9. MODE OF PAYMENT

The contract rate shall be for unit square meter of plaster.

3.5. CUTTING OF ASPHALT ROAD AND PAVED YARD

3.5.1. GENERAL

This specification covers the scope of cutting and breaking the asphalt, concrete roads, paths etc. and making good to its original condition.

3.5.2. MATERIAL

Wherever cutting is done across public paths, roads etc. the orders of materials excavated shall be preserved in well manner and reinstatement shall be done in the same order and road brought to the original condition. The contractor shall made up for any deficiency in/material at his own cost.

3.5.3. WORKMANSHIP

The cutting of road and paved yard shall be done as directed by the E-I-C, Ramming the sub-grade for piping work. The soling stones, spreading the metals to required thickness and making water bound with stone dust/ murrum as per requirement shall be reinstated to the original condition at his own cost.

3.5.4. THE RATE INCLUDES FOR

1. Cutting asphalt road, water bound macadam and soling and stacking usable material at site.
2. Ramming sub-grade for laying pipe line and making asphalt road in original condition after completion of work.
3. Labor, materials, tools and plants used to complete the work.

3.5.5. MODE OF MEASUREMENT

The measurement shall be for unit square meter. The cutting portion shall be measured for its length and breadth.

3.5.6. MODE OF PAYMENT

The contract rate shall be for unit square meter.

3.6. REMOVAL OF FOOT PATH TILES

3.6.1. GENERAL

This specification covers the scope of removing stone tiles from foot paths and re fixing the tiles as good to its original condition.

3.6.2. MATERIAL

Wherever cutting is done across pubic foot paths and roads, the orders of materials removed from foot paths shall be preserved in well manner and reinstatement shall be done in the same order and foot path brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

3.6.3. WORKMANSHIP

The foot path tiles shall be removed in required area required or as directed by the E-I-C. Ramming the sub-grade for laying and fixing the tiles after completion of work to the original condition with 1:3 cement mortars.

3.6.4. THE RATE INCLUDES FOR

1. Removing the stone tiles from foot paths and stacking at site.
2. Ramming sub-grade for re fixing the tiles including cement, sand, tiles etc.
3. Labor, materials, tools and plants used to complete the work.

3.6.5. MODE OF MEASUREMENT

The contract rate shall be for unit square meter and it shall be measured for it length and breadth.

3.6.6. MODE OF PAYMENT

The contract rate shall be for unit square meter.

3.7. <u>REMOVAL OF KERB STONE</u>

3.7.1. GENERAL

This specification covers the scope of removing road side kerbed stone and re fixing the kerbed stone as good to its original condition.

3.7.2. MATERIAL

Wherever cutting is done across public paths and roads, the order of materials shall be preserved in well manner and reinstatement shall be done in the same order and it shall be brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

3.7.3. WORKMANSHIP

The road side kerbed stone shall be removed to the required length or as directed by the E-I- C. Ramming the sub-grade for fixing the kerbed stone after completion of work in the original condition with 1:3 cement mortars.

3.7.4. THE RATE INCLUDES FOR

1. Removing the kerbed stone and stacking at site.
2. Ramming sub-grade for re fixing the kerbed stone including cement, sand, kerbed stone etc.
3. Labor, materials, tools and plants used to complete the work.

3.7.5. MODE OF MEASUREMENT

The measurement shall be for unit running meter and it shall be measured for its length.

3.7.6. MODE OF PAYMENT

The contract rate shall be for unit running meter,

4. TECHNICAL SPECIFICATION FOR DRAINAGE SYSTEM

4.1 UPVC- SWR PIPING WORK

4.1.1 SCOPE (Item Description)

4.1.1.1 The item includes supplying of UPVC soil, waste and rain water (SWR) andventilation pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting if required etc.

4.1.2 MATERIAL

4.1.2.1 The pipes shall conforming to IS 13592, UPVC - SWR (Type 'A' or 'B' as specified) and fittings conforming to IS 13591 shall be free from cracks, flaws and defects and shall be U.V. stabilized and able to withstand a pressure as mentioned in the schedule of work. Rubber sealing rings conforming to IS: 5382 with lubricant forsliding socket joints as mentioned in the schedule of work.

4.1.2.2 EXAMINING

Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

4.1.2.3 CLEANING

All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surfaces.

4.1.3 LAYING, FIXING & JOINTING

4.1.3.1 The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. The entire pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. The entire length of pipe shall be evenly supported on bed of the trench throughout. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

4.1.3.2 The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in- charge. The pipe shall be fixed with G.I. clamps not less than 2.0 mm thick of with suitable UPVC clamps/clips, The clamps/clips shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties keeping the pipe about 15 mm clear of the wall.

4.1.3.3 The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough or rubber sealing rings with lubricant for sliding socket joints . The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

4.1.4 DETACHABLE JOINT

4.1.4.1 Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

4.1.5 PAINTING

4.1.5.1 In case of underground piping, the pipe line shall be painted with two coats of approved oil paint of matching color over a coat of primer.

4.1.6 DEWATERING & CIVIL WORK

4.1.6.1 In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause. The rate shall also include for excavation, refilling, etc. civil work required if specified in schedule of quantities. Pipe shall be laid with suitable bedding, encasing as per actual site condition. For concealed piping, chasing, drilling holes in wall, etc. shall be covered under the rate.

4.1.7 TESTING

4.1.7.1 The joints shall be tested by either smoke test for vertical stacks or 2.5 m head of water at the highest point of the section under test for horizontal drainage pipes. Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a below and burner .The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell, if there is leak at any point of the drain. The water head test shall be carried out by suitably plugging the lower end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed to it so as to provide required test head , or the top may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation. The leaky joints shall be remade and section re-tested at no extra cost.

4.1.8 RATES

4.1.8.1 Supplying of UPVC-SWR pipes and fittings of specified diameter.

4.1.8.2 Laying and cutting the pipe wherever necessary and wastage.

4.1.8.3 Fixing the pipe line with G.I. clamps not less than 2mm thick and G.I./M.S. nails length not less than 40mm or with UPVC clamps, screws, wooden gutties etc.

4.1.8.4 Making the solution joint and painting if mentioned in schedule of work the pipe line.

4.1.8.5 All civil work required for concealed piping.

4.1.8.6 In case of underground pipes, dewatering if necessary till completion of work, excavation, refilling, etc civil work if specified in schedule of quantities.

4.1.8.7 Testing of pipes.

4.1.8.8 Making all damage good to original condition after completion of installation work.

4.1.8.9 All necessary materials, labor and use of tools.

4.1.9 MODE OF MEASUREMENT

4.1.9.1 The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting, civil work if mentioned in schedule of work and testing.

4.1.10 MODE OF PAYMENT

4.1.10.1 The contract rate shall be for unit running meter length of pipe line laid or fixed.

4.3 GI PIPES & FITTING

4.3.1 SCOPE (Item Description)

4.3.1.1 The item includes supplying of G.I. pipes with fittings including laying, fixing, cutting, joining, painting etc.

4.3.2 MATERIAL

4.3.2.1 Galvanized steel pipe shall conform to IS: 1239 of size & class as specified in bill of quantities. When Class is not specified they shall be Heavy Class.

4.3.2.2 Fittings shall be of malleable cast iron galvanized of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes etc. Fittings etc. shall conform to IS: 1879. (Part 1 to X) with latest edition.

4.3.3 JOINTING & FIXING

4.3.3.1 Pipes and fittings shall be jointed with screwed joints using Teflon tape suitable for water pipes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. Necessary vents and drains shall be provided at all high and low points respectively. G.I pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

4.3.3.2 Piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency.

4.3.3.3 All pipe clamps, supports, hangers, pipe support shall be factory made galvanized MS steel or alternatively galvanized/ anti rust coating after fabrication to suit site requirement pipe supports. Pipe supports shall be adjustable for height where pipe and clamps are of dissimilar materials a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following:

Sr. No.	Pipe Size	Spacing between Supports
1	Upto 12 mm	1500 mm (1.5m)
2	15 to 150 mm	2000 mm (2.0 m)
3	150 mm & over	2500 mm (2.5m)

4.3.3.4 G.I pipes in shafts and other locations shall be supported by clamps of design approved by the Architect/Consultants. Pipes in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from MS structural steel. Pipes in shafts shall be supported on slotted angles/ channels as specified/ as directed.

4.3.3.5 Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.

4.3.3.6 Anchor Fasteners:
All pipes supports, hangers and clamps to fixed on RCC walls, beams, columns, slabs and masonry walls 230 mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommended and approved by manufacturer of the anchor fasteners. Failureof any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

4.3.3.7 Unions:
Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock or check valve and on straight runs as necessary at appropriate locations as required for easy dismantling and/or as directed by Architect/Consultants.

4.3.3.8 Flanges :
Flanged connections shall be provided on pipes as required for maintenance/ease in dismantling or where shown on the drawings, all equipment connection sas necessary and required or as directed by the Architect/Consultants. Connections shall be made by the correct number and size of the GI nuts/ bolts as per relevant IS Standards and made with 3mm thick insertion rubber washer/gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Architect/Consultants. Hole diameter for bolt in flanges shall conform to match the specification for CI sluice valve as per relevant IS Gaskets shall conform to IS: 639.

4.3.3.9 Expansion joints shall be provided wherever necessary to take due care for expansion and contraction in the pipe

4.3.3.10 Trenches for Underground installation:

4.3.3.11 All G.I pipes below ground shall be laid in trenches with a minimum cover of600mm. The width and depth of the trenches shall be as follows:

Sr. No.	Dia of pipe	Width of trench	Depth of trench
1	15mm to 50mm	300mm	750mm
2	65mm to 100mm	450mm	1000mm
3	150mm and above	600mm	1200mm

4.3.3.12 S
and Filling:
GI pipes in trenches shall be protected with fine sand 150mm all around before filling in the trenches.

4.3.3.13 Thrust Blocks:
In case of bigger pipes (80 mm diameter and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Client's Representative.

4.3.4 INSULATION FOR GI PIPES (UNLESS OTHERWISE SPECIFIED)

4.3.4.1 All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.

4.3.4.2 Insulating material shall be rigid performed sections of mineral/rock wool with a "K" value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m or it shall be of Nitrile rubber.

4.3.4.3 No insulation shall be applied until the pipe is satisfactorily pressure tested.

4.3.4.4 Pipes shall be insulated with rigid performed pipe sections of the following thickness:

Pipe Diameter (mm)	Thickness (Mineral Wool)/Nitrile Rubber (mm)
80-150	50
40-65	9
15-32	6

4.3.4.5 Pipe insulation shall be applied as follows:
Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of antirust paint.

4.3.4.6 Pipes in Shaft:

4.3.4.6.1 Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).

4.3.4.6.2 The insulation shall be tied with GI chicken wire mesh.

4.3.4.6.3 The insulation shall be provided with 24 gauge aluminium cladding

screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.

4.3.4.7 Pipes exposed to weather:

4.3.4.7.1 Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).

4.3.4.7.2 The insulation shall be tied with GI chicken wire mesh.

4.3.4.7.3 Provide polythene based hessian (500 gauges) overlapping 100mm on all joints (transverse and circumferential) and stitched at the joints.

4.3.4.7.4 The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.

4.3.4.7.5 Over the wire mesh the surface shall be covered with two layers of tar felt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).

4.3.4.7.6 Over the second layer of tar felt final coat of hot bitumen not less than 6mm thick shall be applied.

4.3.4.7.7 Over the final layer of tar felt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tapings screws. Joints shall be overlapped minimum 25mm wide.

4.3.4.8 Pipes Buried Underground:

4.3.4.8.1 Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).

4.3.4.8.2 The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.

4.3.4.8.3 Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.

4.3.4.8.4 The polythene surface shall be covered with two layers of tar felt grade– II, type– II with bitumen between layers overlapped 100mm on all joints(transverse and circumferential).

4.3.4.8.5 Over the second layer of tar felt final coat of hot bitumen not less than 6mmthick shall be applied.

4.3.5 PAINTING

4.3.5.1 All pipes above ground shall be painted with one coat of red oxide and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by the Architect/Consultants.

4.3.6 PIPE PROTECTION

4.3.6.1 Where specified in the schedule of quantities all pipes in chase below ground shall be protected against corrosion by applying two coats of bitumen paint wrapping with polythene tape and finishing with one more coat of bitumen paint.

4.3.7 TESTING

4.3.7.1 The openings of the pipes shall be sealed for the section to be tested. All

control valves shall be positioned open for the duration of the test and open end closed with water tight fittings. The testing pressure on completion of the work shall not be less than 1.5 times the working pressure of the pipes or 7.5 Kg/Sq.cm whichever more is.

4.3.7.2 Pressure shall be applied either by hand pump or power driven pump. Pressure gauges shall be calibrated, correctly positioned and closely observed to ensure that at no time are the test pressure exceeded. The systems shall be slowly and carefully filled with water to avoid surge pressure or water hammer. Air vents hall be open at all high points so that air may be expelled from the system during filling.

4.3.7.3 When the system has been fully charged with water and air displaced from the line air vent shall be closed and the line initially inspected for seepage at joints and firmness of supports under load. Pressure is reached. Without any additional requirement of make-up-water the test pressure should not fall more than 0.02 Mpa (0.2 kg./sq.cm)at the end of one hour test duration.

4.3.7.4 The water pressure shall be maintained for minimum of two hour with accurate pressure gauge. The engineer shall examine carefully all the joints for leakage. Any joint found leaking shall be redone, and all leaking pipes removed and replaced without extra cost.

4.3.8 RATES

4.3.8.1 G.I. Pipes and fittings of specified diameter & pressure class.
4.3.8.2 Laying and cutting the pipe wherever necessary and wastage.
4.3.8.3 Underground installation with all necessary civil work if specified in bill of quantities like excavation, dewatering, backfilling, bedding, encasing, etc.
4.3.8.4 Or over round installation with supports/clamps, accessories required.
4.3.8.5 Pipe & Fitting with insulation for hot water application if specified in schedule of quantities
4.3.8.6 Jointing &fixing material.
4.3.8.7 Making all damage good to original condition after completion of installation work.
4.3.8.8 Testing the entire system and rectification of defects if any.
4.3.8.9 Painting the pipe line for over ground installation & pipe protection with coating & wrapping coating if mentioned in schedule of quantities.
4.3.8.10 All necessary materials, labor and use of tools.

4.3.9 MODE OF MEASUREMENT

4.3.9.1 The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, supports, clamps & painting. It shall also include insulation for hot water application & civil work for underground installation if mentioned in schedule of quantities.

4.3.10 MODE OF PAYMENT

4.3.10.1 Mode of payment shall be Unit length of pipe line laid or fixed. No extra payment shall be made for fittings, making joint, supports, clamps &

painting. It shall also include insulation for hot water application & civil work for underground installation if mentioned in schedule of quantities.

4.4 RCC PIPES

4.4.1 GENERAL

The item includes supplying, laying and fixing the Non-Pressurized Reinforced Cement Concrete pipes of Class NP3 constructed as per IS: 458, with necessary fittings of specified diameter including laying, jointing etc for external drainage disposal.

4.4.2 MATERIAL

The pipe shall be new & of first class quality RCC & free from rough texture, inside & outside straight with uniform bore throughout.

All pipes shall be centrifugally spun NP3 class unless otherwise specified.

Pipe shall be tested at manufacturer's works prior to dispatch at site. A certificate shall be produce for the same.

Pipe shall be with or without reinforcement as required & of the class as specified.

The pipes shall conform to IS: 458.

4.4.3 LAYING

RCC spun pipes shall be laid on cement concrete bed or cradles as specified. Cradles shall be pre cast& sufficiently cured to prevent cracks & breakage in handling.

The invert of cradle shall be left 12 mm below the invert level of the pipe & properly placed on the soil to prevent any disturbance.

The pipe shall then be placed on cradles & set for the line & gradient by means of sight rails, bonding rods, etc. Cradles or concrete bed may be omitted if directed by engineer in charge.

4.4.4 JOINTING

After setting out the pipes, the collars shall be centered over the joint & filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive mortar.

The space then shall be filled with cement mortar 1:2 & caulked by means of proper tools.

All joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both sides of the collars neatly.

4.4.5 TESTING

All pipes shall be tested to a hydraulic test of 2.5 m head for at least 50 minutes at the highest point in the section under test.

Smoke test is to be carried out by the contractor, if directed by engineer in charge.

4.4.6 RATES

1. RCC pipes of specified diameter.
2. Laying the pipe wherever necessary and wastage.
3. Underground installation with trenching, bedding, encasing, dewatering, etc. civil work as specified in schedule of quantities.
4. Making joint, painting the pipe line if mentioned in schedule of quantities.
5. Making all damage good to original condition after completion of installation work.
6. Testing the entire system and rectification of defects if any.
7. All necessary materials, labor and use of tools.

4.4.7 MODE OF MEASUREMENT

The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting, It shall also include required civil work for underground installation if mentioned in schedule of quantities.

4.4.8 MODE OF PAYMENT

Mode of payment shall be Unit length of pipe line laid or fixed. No extra payment shall be made for fittings, making joint, painting. It shall also include required civil work for underground installation if mentioned in schedule of quantities.

4.5 ROAD GULLY CHAMBER / MANHOLES

4.5.1 GENERAL

The item includes provision of brick masonry manholes of internal size as specified in the schedule.

4.5.2 MATERIAL

Concreting, Brick work, plastering etc. shall be as per specifications as given in general specification under section II.

4.5.3 CONSTRUCTION

1. Internal dimensions and initial depth shall be as specified in the schedule of work or as shown in the drawing.
2. Foundation of 1:2:4 concrete shall be 200 mm thick and shall have 150 mm offset.
3. The concrete 1:2:4 shall be laid to necessary shapes to form the channel for the pipe being received in the channel. It shall be of appropriate diameter and shall be half round. The sides hall be kept sloping towards the channel.
4. Brick masonry shall be in cement mortar 1:2 or as specified in the schedule of work. These shall be constructed in 230 mm thick brick masonry up to 1.25M depth and remaining height shall be

345mm thick brick masonry.

5. Brick masonry shall be rendered with 15 mm thick plaster in cement mortar 1:1 or as specified in the schedule of work inside and outside surfaces in two courses and inside surface finished smooth with neat cement punning.

4.5.4 DEWATERING

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

4.5.5 THE RATE INCLUDES FOR:

1. Concreting in foundation, forming the channels, constructing brick masonry and plastering over the brick work and finishing smooth inside surfaces.
2. Cutting existing stoneware/RCC Hume pipe line to facilitate construction of new manhole.
3. Dewatering the pit if found necessary till completion of work.
4. All necessary labor, materials and use of tools.

4.5.6 MODE OF MEASUREMENT

The measurement shall be for one manhole of specified finished internal size and initial depth measured vertically from top of the frame and cover to the invert of manhole. Extra over for additional depth or rebate for lesser depth shall be measured in R.M.

4.5.7 MODE OF PAYMENT

The contract rate shall be for unit of manhole of specified internal size and initial depth, Extra/Rebate for additional/lesser depth respectively shall be paid in RM.

4.6 EXTRA DEPTH FOR INSPECTION CHAMBER AND MANHOLE

4.6.1 GENERAL

The item includes provision for extra depth of manholes of brick masonry for depths beyond the specified depth of the manhole.

4.6.2 MATERIAL

Brick work, plastering etc. shall be as per specifications. Only brick masonry and plastering shall be included for the material for extra depth.

4.6.3 CONSTRUCTION

Extra depth for manholes shall be constructed as per the details for Manhole.

4.6.4 DEWATERING

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

4.6.5 THE RATE INCLUDES FOR

1. Constructing brick masonry and plastering over the brick work.
2. Dewatering the pit if found necessary till completion of work.
3. All necessary labor, materials and use of tools.

4.6.6 MODE OF MEASUREMENT

The measurement shall be for unit 0.1 meter depth or part thereof for manhole constructed. Extra Depth of manhole or chamber shall be measured from top of the frame and cover to the invert level of manhole deducting the initial depth of at manhole/ chamber. Extra for additional depth or rebate for lesser depth shall be measured in R.M.

4.6.7 MODE OF PAYMENT

The contract rate shall be for each unit of 0.1 meter depth of manhole constructed.

4.7 C.I. FRAME AND COVER FOR MANHOLES

4.7.1 GENERAL

The item includes supply LD/MD/HD/EHD/C.I. Frame and cover as specified in schedule including fixing and painting.

4.7.2 MATERIAL

C.I. Frame and cover shall conform to IS 1720 and shall have IS certification mark with grade LD/MD/HD/EHD and the weight of frame and cover shall not be less than as specified in the schedule.

4.7.3 FIXING

Frame shall be fixed in the cement concrete 1:2:4 for bearing course and capping on the brick masonry wall of the chamber of manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

4.7.4 PAINTING

The frame and cover shall be painted with two coats of approved black bitumastic anticorrosive paint over a coat of primer.

4.7.5 THE RATE INCLUDES FOR

1. C.I. frame and cover cement concrete, cement plaster, painting etc.
2. All necessary labor, material and use of tools.

4.7.6 MODE OF MEASUREMENT

The measurement shall be for C.I. Frame & cover on actual unit weight basis.

4.7.7 MODE OF PAYMENT

The contract rate shall be for C.I. Frame and cover on actual unit weight basis.

4.8 CAST IRON STEPS / RUNGS

4.8.1 GENERAL

The item includes supplying of cast iron steps including fixing and painting

4.8.2 MATERIAL

The steps shall be of cast iron and minimum 150 mm wide. The minimum weight of each step shall not be less than 5 kg or as specified in the schedule.

4.8.3 FIXING

The steps shall be fixed in brick masonry wall with 1:2:4 cement concrete with 75 mm cement concrete cover at all around the step. The first step shall be 450 mm below from top surface of structure and next shall be fixed 300 mm centre to centre in two rows at 300 mm distance or as shown in the drawing.

4.8.4 PAINTING

The projected portion of the cast iron step shall be painted with two coats of approved black bit mastic anti corrosive paint over a coat of primer.

4.8.5 DEWATERING

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

4.8.6 THE RATE INCLUDES FOR

1. C.I. Steps cement concrete and painting etc.
2. Dewatering if found necessary till completion of work.
3. All necessary labor, material and use of tools.

4.8.7 MODE OF MEASUREMENT

The measurement for C.I. steps shall be on actual unit weight basis or unit C.I. step fixed as specified in the schedule.

4.8.8 MODE OF PAYMENT

The contract rate for C.I. steps shall be on actual unit weight basis or unit C.I. step fixed.

4.9 RAIN WATER GRATING

4.9.1 GENERAL

The item includes supplying of M.S. / Cast iron grating of specified size including fixing and painting.

4.9.2 MATERIAL

The rain water grating shall be M.S. / Cast Iron with closed grained without any casting defects. The thickness should be uniform throughout, one shaped C.I. grating.

4.9.3 FIXING

M.S. / C.I. rain water grating shall be fixed in position with 1:1 cement mortar.

4.9.4 THE RATE INCLUDES FOR

1. The cast iron rain water grating cement, sand etc.
2. Fixing the grating.
3. All necessary materials, labor and use of tools.

4.9.5 MODE OF MEASUREMENT

The measurement shall be for each unit of grating fixed.

4.9.6 MODE OF PAYMENT

The contracts rate shall be for each unit of grating fixed.

4.10 SUMP DRAIN PUMPS

4.10.1 SCOPE

This specification covers the supply, installation, testing & commissioning of Submersible sump pump. The scope also includes delivery piping upto 15 meter with necessary fittings & starter panel, etc. Each pump shall have PVC / PP isolation gate/ ball valve & NRV at pump delivery side.

4.10.2 DESIGN & CONSTRUCTION FEATURES

These shall be fully submersible with a fully submersible motor.

The pumps shall be provided with an automatic level controller and all interconnecting power and control cabling which shall cause the pumps to operate when the water level in the sump rises to a preset level and stop when the preset low level is reached.

Pumps for drainage shall be single stage, single entry.

Pump shall be C.I. casing and C.I. two vane open type with a dynamically balanced impeller connected to a common shaft of the motor.

The vane for Sewage sump pump will be open type, while for storm drainage pump, etc. it will be of semi open type. The MOC of the sump shall be in accordance to schedule of quantity.

Stuffing box shall be provided with mechanical seals.

Each pump shall be provided with a suitably rated induction motor suitable for230/415 volts, 1/3 phase, 50 Hz A.C. power supply.

Each pump shall be provided with in built liquid level controller for

operating the pump between predetermined levels.
The pumping set shall be for stationary application and shall be provided with pump connector unit. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation.

Pump shall be provided with all accessories and devices necessary and required for the pump to make it a complete working system.

Sump pump shall be complete with level controllers, power and control switchgear, Auto/off/Manual switches, pumps priority selections and control and power cabling up to motor and controller/probes etc. (Including earthing).

Level control shall be such that one pump starts on required level, 2nd pump cuts in at high level and alarms is given at extra high level. All level controllers shall be provided with remote level indications.

4.10.3 MOTOR DESIGN

The pump motor shall be a squirrel cage induction, housed in air filled water tighten closure. Oil filled motors are not acceptable. The stator windings shall be Class "F" insulation (155 C° or 311 F°) for general usage and class `H' insulation(180 C° or 317-8 grade 2) for submersible type.

The stator shall be heat shrunk fitted into the enclosure and shall not use bolts, pins or other fasteners that penetrate through the stator enclosure. The starter shall be equipped with a thermal switch embedded in series in the coils of the stator windings to protect the stator from wheel.

The motors shall be designed for continuous running duty type at 230/ 415 volts,1/3phase, 50 Hz power supply and capable of sustaining a minimum of 20starts/stops per hour.

4.10.4 RATES

Pump-Motor sets.
Pump suction – delivery pipe & suction & delivery manifolds.
Pump delivery & delivery manifold isolation valve & NRV.
Level indicator to be interlocked with pump operation.
Starter panel with all electrical components, protections, interlocks, cable from starter to pump.
All material like flanges, hardware, gaskets, etc. required for installation.
Installation, testing & commissioning.
Making all damage good to original condition after completion ofwork.
All necessary labor, material and use of tools.

4.10.5 MODE OF MEASUREMENT

The measurement shall be for one set including working & stand by units.

4.10.6 MODE OF PAYMENT

The contract rate shall be for one set including working & stand by units.

LIST OF APPROVED MAKES:

Sr.No.	Item	Approved Make
1	R.C.C. Pipes (NP3)	ALCOCK / INDIAN HUME PIPE / EQUIVALENT
2	PUMP	LUBI / WILO / XYLEM / EQUIVALENT
3	M.S. RUNGS	KK India / KGM / Accurate Buildcon
4	C.I. GRATING & COVERS	NECO / Thermodrain / Crescent Foundries

ELECTRICAL WORK

Part A: General

Particulars

1. General Instructions
2. Special Conditions of Contract

GENERAL INSTRUCTIONS

1.0 Scope of work:

1.1 The Contractor's scope of work covers supply, installation, commissioning and testing of the complete Electrical installation as specified in material specification and bills of quantities.

2.0 Location:

2.1 The works are to be carried out for **Rajkot Municipal Corporation**, a **Project CONSTRUCTION OF THREE ARM FLYOVER AT HOSPITAL CHOWK IN RAJKOT CITY.** All electrical equipment and gear shall be designed for an average ambient of 45°C. With a peak of 50°C.

3.0 Drawings, Specifications & Deviations:

3.1 The drawings and specifications lay down minimum standards of equipment and workmanship. Should the tenderer wish to depart from the provisions of the specifications and drawings either on account of manufacturing practice or for any other reasons, he should clearly draw attention in his tender to the proposed points of departures and submit such complete information, drawings and specifications as will enable the relative merits of the deviations to be fully appreciated. In the absence of any deviations, it will be deemed that the tenderer is fully satisfied with the intents of the specifications and drawings and their compliance with the statutory provisions and local codes.

3.2 In case of any discrepancy between the drawings and specifications or any other tender documents, the tenderer shall assume the more stringent of the two and furnish his rates accordingly.

3.3 The Contractor shall prepare fabrication and working drawings and all work shall be as per the approved working drawings. Approval of drawings does not relieve the Contractor of his responsibility to meet with the intents of the specifications. All such drawings for approval shall be in duplicate.

4.0 Tools and Spare Parts:

4.1 All the tools, tackle, scaffolding and staging require for erection and assembly of the equipment and installation covered by the contract shall be obtained and maintained by the contractor himself. All other materials such as foundation bolts, nuts etc. required for the installation of the plant shall also be supplied and included in the contract.

4.2 Tenderer should submit the spares recommended by him for two years operation of each type of equipment covered by these specifications on completion of work.

5.0 Testing & Handing over:

5.1 The contractor shall carry out tests on different equipment as specified in various sections in the presence of representatives of clients, Architects and Consulting Engineers in order to enable them to determine whether the plant, equipment and installation in general comply with the specifications.

5.2 All equipment shall be tested after carrying out necessary adjustments and

balancing to establish equipment ratings and all other design conditions. At least six sets of readings shall be taken for each item tested and submitted.

5.3 The project shall be handed over after satisfactory testing along with six sets of documentation along with two sets of soft copy each consisting of :

i) Detailed equipment data as approved by the Consulting Engineers/Employer.

ii) Manufacturer's maintenance and operating instructions.

iii) Set of drawings, showing plant layouts, piping, ducting, cabling etc.

iv) Approved Test reading & certificate of local authorities.

v) List of recommended spares.

5.4 Submission of the above documentation shall form a precondition for the final acceptance of the plant and installation and final payment.

6.0 Performance guarantee:

6.1 All equipment and the entire installation shall be guaranteed to yield the specified ratings and design conditions plus/minus 3% tolerance. Any equipment found short of the specified ratings by more than the allowable tolerance as determined by the test readings shall be rejected.

7.0 Defects Liability:

7.1 All equipment and the entire installation shall be guaranteed against defective materials and workmanship for a period of 12 months reckoned after the plant is commissioned and handed over to the clients along with the 6 sets of completion documents and In case the testing of the plant is delayed for any reason, the defects liability shall extend for a minimum period of 6(six) months from the date the test readings are accepted. During the defects liability period, the contractor shall rectify, repair or replace defective parts and components free of cost except in the case of those, which are due to normal wear & tear.

8.0 Statutory Inspections:

8.1 The contractor shall be fully responsible for meeting all the statutory obligations & local inspectorate pertaining to the works carried out by them. The contractor should prepare all working drawings and obtain approval of competent authorities and also have the equipment and installation inspected and got approved. All official fees will be paid by the clients directly against demand in writing from the appropriate authority and all other expenses for submission and approval of the various and relevant statutory/bodies shall be embodied in the tender prices.

9.0 General Conditions:

9.1 The tender shall be governed by General Conditions of Contract forming Part I of this tender. Wherever conflicting, the general conditions shall prevail.

9.2 Tenderers may indicate their comments, only as deviations from the conditions stipulated herein. Wholesale submission of their own conditions and/or printed conditions in disregard of the conditions stipulated herein shall not be binding on this contract.

10.0 Safety Precautions:

10.1 A competent and authorized Supervisor shall be on the site whenever the contractor's men are at work. The supervisor should ensure that all plant and machinery used on the site are rendered safe for working and meets with the Indian or International safety standards applicable for the use and operation of such machinery. The supervisor should also ensure that the workmen are supplied with and made to use safety appliances such as safety belts, lifelines, helmets etc. The supervisor shall not leave the work site without permission from Employer's Project Manager or his nominee.

10.2 Smoking shall not be encouraged on the site but altogether strictly prohibited in areas where combustible and inflammable goods/materials are stored or lying about.

10.3 Any hot job such as welding, soldering, gas cutting shall not be carried out without the permission of the Engineer-in-charge. Such jobs shall not be carried out where inflammable materials are stored or lying about. All electric connections shall be through adequately sized mechanically protected cables without any joints and with proper and adequate terminals. All power supplies shall be through properly rated fuses with isolating devices. No such hot jobs shall be carried out on holidays and without the presence of the Contractor's Supervisor.

10.4 It is entirely the responsibility of the Contractor to practice the principles of `Safety First' during the entire tenure of work with adequate insurance covering injury or death to workmen, loss by theft or damage to materials and property in position or not and third party.

10.5 The contractor should clear the site of all debris every day to avoid accidents. In case this is not done, the owners may engage necessary labour to maintain the cleanliness of the premises and removal of debris, and debit all or part of the expenditure so incurred from the contractor/s.

11.0 Payment to civil contractor.

The electrical contractor will have to pay to the civil contractor for any work done on behalf of the electrical contractor like laying of pipes, filling of zarries etc.

12.0 Temporary wiring

Whenever any temporary wiring is done, it has to be done so that all precaution for safety is taken and temporary wiring shall be also done so that, it is not hazardous to anybody. Any accidents happen because of temporary or permanent installation, it will be entire responsibility of contractor for all compensation to concern parties.

Clients, architects will not be responsible for such accidents, mistake etc.

13.0 Compilation Drawing:

The contractor shall to submit 6 sets of as built drawings showing substation layout, single line diagrams, circuit distribution layout, conduit layout, quantity of Junction box of wires, Distribution boards, Switch boards, Circuit mains, Mains, low voltage systems layout, security systems layout etc. complete in all respect.

SPECIAL CONDITIONS OF CONTRACT

1. General:

   The following special conditions of contract shall supplement the General Conditions of Contract, whenever there is a conflict, the provision herein shall prevail over those in the general conditions of contract.

2. Amount of Bid Security EM : As specified in GCC

3. Performance Bank Guarantee : As specified in GCC

4. Period for Completion of the Works : As specified in GCC

5. Equipment & Machinery on Work Site

   The contractor will be required to provide and maintain in working order power driven machines like welding, drilling machine, zarri cutters, meggar, multimeter, continuity tester etc. till the completion of work.

6. The quantity for measurement will be actual quantity used in electrification:

   I) The contractor shall bear all incidental charges for the storage and safe custody of the materials at site at his own responsibility.
   II) The contractor shall make arrangement at the site of works for safe custody of materials to protect from damage by rain, dampness, fire, theft etc.
   III) In case any materials get damaged the contractor shall replace the same at his own cost.
   IV) The contractor shall furnish to Engineer-in-Charge sufficiently in advance a statement showing his requirements of quantities of materials to be supplied by Owner if any and the time when he will require the same.
   V) A day to day account of the material supplied by Owner/Contractor shall be maintained by the contractor in the agreed proforma.

7. Application codes for Specification of Electrical works shall be as per that in Material Specification and as specified in Applicable Standards.

8. Clearance of site on completion.

On completion of the works, the contractor shall clear away and remove from the site, surplus materials, rubbish and temporary works of every kind and leave the whole site and works clean and in workman like condition to the satisfaction of Owner at his own cost. If the contractor fails to clear the site within 15 days after virtual completion/ submission of final bill whichever is earlier, it shall forfeit all his claims and the owner may get the site cleared at contractor's cost.

9. Scope of work

Supply, Installing, Testing and commissioning of all kind of electrical work during the contract period as instructed by Client/Architect/Consultant with same quoted rate.

Preparing necessary drawing submitting to authorities, getting their approval /

senction and final certificate to energize the sub-station equipment's. Filling the necessary application to supply co. following up and getting the supply filling the necessary test report to the supply co. inclusive. All official / statutory fees shall be paid by clients on submission of documentary proof.

Contractor is responsible for maintaining the power factor as per rules of supply co. Cost will be debited to the contactor in case of any penalty due to low power factor by Supply Company. No credit shall be passed on to contractor if any given by Supply Company for better power factor.
Engineer In charge will provide operative instructions on regular basis related to project during contract execution period, which are not covered in this tender document. Contractor and his staff at site shall comply all these instructions.

10 Client's approval will be final in all concerned matters.

11 All correspondences between contractor and architect will be through client.

12 No extra payment shall be made for all above requirements. .

13 Minimum Criteria for selecting Electrical contractor.

1. The Electrical contractor must be licensed Electrical contractor.

2. The Electrical contractor must have available all kind of necessary equipments at site.

3. The Electrical contractor must have completed following kind of jobs under one project head in last 3 years.

   - SITC M.V.Cabling.
   - SITC of all M.V. Switch gear panels made by CPRI approved panel vendor.
   - SITC of external lighting like poles, cables, cable trenches etc,.

4. The Electrical contractor should get approval prior to appoint any sub agencies for specialized jobs. Client /Consultant/Architect have right to reject any contractor at any stage of project.

5. It is presumed that all insurance formalities & workman's compensation policy will be carry of.
6. The contractor will have to provide:
   - Minimum one senior Electrical site engineer B.E. with more then 10 years experience.
   - Minimum one junior Electrical site engineer D.E.E. with more then 5 years experience.
   - All wiring person must be a supervisor level grade.

7. Emphasis will be given to the contractor venders who had already completed similar kind & Magnitude projects of similar type of renowned client / Architect.

ITEM SPECIFICATION

SUMMARY PAGE

I. Electrical Works

A. Item Specification

ELECTRICAL ITEM SPECIFICATION

1.0 Panels Section Feeder Pillar

1.1 Supplying, unloading at site, shifting to site, assembling, leveling, grouting, erecting, Testing, & Commissioning double compartmentalized Double door type section feeder piller with IP 55 protection & should be powder coated fabricated from 14 Gauge CRCA sheet & folded channel totally enclosed cubical type with pad lock arrangement. The successful tenderer will have to prepare general arrangement with dimensions (referring the typical elevation drawing provided) & get it approve through Architect/ Consultant. All civil work including RCC platform for section pillar should be in scope of Electrical contractor complete in all respect as per detail drawing and directed by engineer in charge.
(As per attached Single line diagram)
Space Provision for Supply Co' Energy meter in section feeder piller.

1) Material:

MV switch gear & power panel shall confirm E-1.

2) Workmanship:

1) Main bus bar should be electrolytic tinned copper type.
2) All internal wiring and all connection shall be with copper wires and strips as required. Use copper flexible wire for below 100 Amps and copper strips for 100 Amps and above ratings.
3) All component, frame etc shall be earthed. A common internal earth bar with two separate earthing leads to be provided.
4) Painting or powder coating to be done on all sheet metal works as required.
5) Panel should have MS base frame for floor mounting unless otherwise specified.
6) The board should be front operated and extensible type.
7) Compression type brass glands and crimping lugs for incomer and outgoing ends.
8) All ammeters to be provided with C.T.s and selector switch and voltmeter with selector switch and control fuses.
9) Panel components shall be as specified.
10) The design and location of all panels to be approved by the architect / consultant before fabrication and Instalment.
11) All panels should be dust and vermin proof.
12) All panels should be fabricated out of 14 gauge sheet, the door should be made from 14 gauges (2 mm) and the other parts should be made from 14 gauge sheet metal **(Applicable for Metallic Panels)**.
13) All meters should be digital type with communication port only unless and otherwise specified.

14) The metering on main panels shall be LOAD MANAGER with communication port unless and otherwise specified.

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15) All the Switches used should be capable of withstanding the AC23 duty for motor operation. The Switches should have quick make quick break. The contacts should be silver plated double break type.
16) Main Panel fabricated in the approximate length of 1 meter and depth of 1 meter compartment.
17) The board should withstand the system prospective fault current.
18) Engraved plastic labels shall be provided indicating the feeder details, capacity, cable size and load in KW and danger signs.
19) The entire panel board should be with adequate height width & depth as per relevant prevailing I.S. code and Installation include foundation bolts of suitable size as per requirement.
20) All compartment doors should be concealed hinged type & handles of feeders to be interlocked mechanically with the doors such that door cannot be opened when the switch is in 'ON' position & switch cannot be 'ON' when the door is in open position.

3) Mode of measurement:

The rate shall be for one unit of panel complete in all manners.

2.0 CABLE TRENCH

2.1 Making trench in soft soil of suitable width of 90 cms deep for laying cable or locating the fault all over the run and backfilling the same and making the surface as normal ground.

1 **Material:**
All the tools and tackels required for the excavation shall be provided by the contractor. Cable markers shall be provided.

2 **Workmanship:**
Excavation shall be done as per the route specified in the plan of the consultant. Also the depth as specified in the item shall be strictly maintained. Cable markers shall be installed at length specified in the item.

3 **Mode of measurement:**
The item shall be paid in running Mtr. And the measurement shall be certified by the engineer in charge from the Clients side. Depth of the excavation shall be measured from average ground level given in drawing

2.2 Covering of cable with second class bricks or cement tiles laid cover the cable crosswise & also on both sides with covering of 7. 5 Cms. layer of sand above &

below cable (16 bricks per meter)

1 **Material:**
All the tools and tackels required for the spreading fine sand and back filling shall be provided by the contractor. Bricks of 2nd class or higher quality shall be used.

2 **Workmanship**
Bricks shall be laid on all the three sides of the cable as per the drawing of the consultant. Proper thickness for the fine sand as specified in the item shall be strictly maintained. After back filling proper levelling shall be done and lumps of soil should not be visible. The trench should give a levelled look.

3 **Mode of measurement:**
The item shall be paid in running Mtr. and the measurement shall be certified by the engineer in charge from the Clients side.

LT CABLING

Providing and erecting XLPE (IS:7098)(I)-88 ISI armoured cable multistrand Copper conductor for 1.1 KV. to be laid on wall with necessary clamps or in existing trench / pipe of following size of cables.

1) Material
Shall be confirm to E- 9,

2) Workmanship
Installation

A) Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the contractor shall mark it out on the drawings and also on the site and obtain the approval of the Architect/Consultant before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.

B) Cables, running indoors shall be laid on walls, ceiling, inside shafts or trenches. Single cables laid shall be laid in GI/PVC pipe and not to fix on wall slab directly or drawn through GI / PVC pipes fixed on wall or ceiling and supported at not more than 500 mm. Where number of cables is run, necessary perforated cable trays shall be provided wherever shown. Perforated trays shall be mild steel or Aluminum as specified in the schedule of work and supported on mild steel frame work as shown on drawings or as approved. Cables laid in built-up trenches shall be on steel supports. Plastic / Aluminum identification tags shall be provided at every 30 m. All cables laid shall be properly dressed and at least 50 mm space shall be kept between the cables.

C) Cables shall be bent to a radius not less than 12 (twelve) times the overall diameter of the cable or in accordance with the manufacturer's recommendations whichever is higher.

D) In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to Lower Promenade ways, walls etc. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion. Cables shall be protected with brick or cement tiles on all the three sides as shown on drawings. Width of excavated trenches shall be as per drawings. Back fill over buried cables shall be with a minimum earth cover of 750 mm to 1000 mm. The cables shall be provided with cables markers at every 20 meters and at all loop points.

E) The general arrangement of cable laying is shown on drawings. All cables shall be full runs from panel to panel without any joints or splices. Cables shall be identified at end termination indicating the feeder number and the Panel/Distribution board from where it is being laid. cable termination for conductors up to 4 sq.mm. may be insertion type and all higher sizes shall have tinned copper compression lugs. Cable termination shall have necessary brass glands. The end termination shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armouring shall be earthed at both ends.

F) In case of cables entering the buildings. It would be done duly only through pipes. The pipes shall be laid in slant position, so that no rain water may enter the building after the cables are tested. The pipes shall be sealed with M. seal & then tarpaulin shall be wrapped around the cable for making the entry of water light.

G) Cables shall be provided with stainless steel/Aluminum cable/Copper identification tags at a maximum distance of 10m.

H) All cables to be laid should be properly dress and at least 50 mm space should be kept between the cables.

Testing:

A) MV cables shall be tested upon installation with a 500 V Meggar and the following readings established:

1) Continuity on all phases.
2) Insulation Resistance.
   (a) Between conductors.
   (b) All conductors and ground.

All test readings shall be recorded and shall form part of the completion documentation.

3) Mode of measurement

The cable shall be measured in per mt. Basis and the rates shall include,
Cables and clamps

1) Installation, Commissioning and testing.

Cable length shall be certified by engineer in charge from Client's / PMC side.

CABLE TERMINATION

Providing and, fixing heavy duty flange type brass cable gland with rubber ring for PVC insulated armoured cable complete with out going tails, insulating tape etc for following size of cables.

1) Material

Should conform to E – 10.

2) Workmanship

Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool.

3) Mode of measurement

Rate shall be considered for 1 nos of joint complete.

Solderless crimping type Aluminium lugs conforming to IS suitable for cable of following size evenly crimped with high pressure tool & connected to switchgear terminals with brass/cadmium plated nut bolts in an approved manner.

1) Material

Should conform to E – 10.

2) Workmanship

Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool.

3) Mode of measurement

Rate shall be considered for 1 nos of joint complete but without Gland.

Fabrication

Supplying, fabricating and installation of various sizes junction boxes/clamps/hangers for light fixtures etc. made out of 14 gauge sheet/Angle/Flat/rod/ channel/box section etc with all necessary accessories like bend, junction boxes, coupler, supporting clamps, elbows, hardware, anchor fasteners etc All the necessary fabrication required will be included in the scope of contractor. Scope also includes two coats of primer and two coat of painting of each items on all the sides complete in all respect.

1) Material

Should be 'got it approved' from client engineer / Site incharge / PMC before executing.

2) Workmanship

As per the drawings provide by architect / consultants / as per the instruction of site in-charge. Finish should be given up to satisfying level of client / architect / consultants to each fabricated item.

3) Mode of measurement

Rate shall be considered per Kilogram of fabrication item complete.

EARTHING

Providing earthing stations for equipment earthing as shown and specified in drawing for equipment complete with:

A) Electrode Type , 3 Mtr long electrode rod earthing.

1) Material

Shall be as per E - 14

2) Workmanship

A) 50 mm. dia. G.I. pipe for watering shall run from top edge of the plate \ pipe electrode to the mid level of block masonry chamber. (Not required for Electrode type earthing)

B) Top of the pipe shall be provided with G.I. funnel and screen for watering the earth \ ground through the pipe. (Not required for Electrode type earthing)

C) The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing. (Not required for Electrode type earthing)

D) The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.

E) Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

F) The earth conductors (Strips / Wires copper/ Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws \ bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

G) The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

H) Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

I) The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.
J) The connection between strip and plate shall be through stainless steel bolts and washers.

Following tests shall be carried out:

A) The following earth resistance values shall be measured with an approved earth meggar and recorded.

1) Each earthing station
2) Earthing system as a whole
3) Earth continuity conductor

B) Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 3 Ohm in each case.

C) Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

D) All tests shall be carried out in presence of the Site Engineer / PMC.

3) Mode of measurement

Rate shall be considered for one unit of pit complete in all manners.

Earth wire/strips:

Providing and erecting HOT deep Galvanised iron strip wire 8 SWG.

1) Material

GI Wire of sizes specified in the BOQ..

2) Workmanship

GI Wire shall be laid along with the cables and mains as instructed by the consultant and along the path of the cable. The strips/ Wire shall be terminated at both the ends properly via brazing SS nut and bolts with double washer screws and nuts as instructed by the consultant. Strips shall not be bend to and extent that they go brittle.

3) Mode of measurement

The rate shall be considered on meter basis and the quantity shall be certified by the engineer in charge from Clients side.

MISCELLANEOUS

Providing & laying ISI marked Rigid PVC pipe having 10Kg / cm2 (Class-3) to be erected at road crossing on or floor as directed for laying of cable. The pipes as following size of dia & weight per 6 mtr.

1) Material:

Rigid and Flexible conduits:

A) All conduits shall be rigid PVC having minimum wall thickness of medium gauge 1.6 to 1.8 approved by F.I.A. & I.S.I. All rigid pipe and its accessories shall be of suitable material complying with IS: 3419-1989 and IS: 9537 (Part 5) 2000 for flexible conduits.

The conduits shall be circular in cross-section and designated by their nominal outside diameter. Minimum thickness of walls shall be as follows:

a) Up to 38 mm. diameter - minimum 1.8 mm. wall thickness.
b) Above 40 mm. diameter - minimum 2.2 mm. wall thickness.

The maximum number of PVC insulated copper conductor cables of 650/1100V grade confirming to IS: 694-1990 that can be drawn in one conduit of various sizes shall be as specified.

B) Flexible conduits shall be formed from a continuous length of spirally wound interlocked steel strip with a fused zinc coating on both sides. The conduit shall be terminated in brass adapters.

Accessories:

A) PVC conduit fittings such as bends, elbows, reducers, chase nipples, split couplings, plugs etc. shall be specifically designed and manufactured for their particular application. All conduit fittings shall conform to IS: 2667-1964 and IS: 3857-1966. All fitting associated with galvanized conduit shall also be galvanized.

2) Workmanship

As per item no 16.1

2) Mode of measurement

3) The rate shall be for 1 mtr of PVC pipe complete with all required accessories.

Providing and laying non-pressure RCC hume pipes of approved make.

1 **Material**

RCC hume pipe should be of NP2 class

2 **Workmanship**

Including excavation of trenches, laying the pipe as per layout and drawing, filling the joints with stiff mixture of cement mortar (1:1) and jute, curing, testing the pipe and re-filling the trenches etc. complete as directed

.

3 **Mode of measurement**

The rate shall be for 1 mtr of RCC pipe

Follow Up with supply co. for getting supply to various Section Pillar. The scope also covers laying of L.T. cable from Section Pillar to company's cut-out. This also covers to obtain any permission required for road crossing from any authority (if required), Filling the necessary application to supply co., following up and getting the supply filling the necessary test report to the supply co. All official fees shall be paid by client on presentation of documentary proof and all other out of pocket expenses shall be of contractor.

1) Material

Not Applicable

2) Workmanship

As directed by engineer in-charge /Consultant.

3) Mode of measurement:

Shall be measured on lump sum basis.

EXTERNAL LIGHTING

General Note: The Sampling should be required for each type of light fixtures as per requirement.. **No extra cost** shall be paid for the process to the contractor; it is the responsibility of contractor to co-ordinate with all the required concerns & vendors for sampling & takes the approval of the same from the authorities of client & architects.

Poles

Supply and Installation of Octagonal Street Light Pole as shown in the drawing complete with all required accessories & clamps etc.:

1) Material

Shall conform E - 17.

2) Workmanship

The pole shall be installed as shown in the drawing and shall be checked for proper earthing (Not required for Non-metallic poles). Wiring sequence shall as per the design given by the consultant.

3) Mode of measurement

The rate shall be for one pole complete in all manners.

Supplying, erecting, connecting, testing and commissioning of Various External Lighting Fixture with all necessary Hardware, Internal Wiring with Lamp, Ballast etc. all required accessories Complete in all respect.

1) Material

As per item no 13.1

2) Workmanship

As per item no 13.1

3) Mode of measurement

The rate shall be for one no of light fixture with Lamp & control gear complete.

TECHNICAL
MATERIAL SPECIFICATION

SUMMARY PAGE

I. Electrical Works

A. Material Specification

Section - 1	E-6	Panels_Section Feeder Pillar
Section – 2	E-9, 10	LT Cabling and Termination
Section – 3	E-14	Earthing
Section – 4	E-17	External Lighting

B Special Condition for Testing

C Applicable Standards - IS codes

D List of Approved make

ELECTRICAL MATERIAL SPECIFICATION

E – 6 Panels_Section Feeder Pillar

1.1 Scope:

The scope covers supply, installation, testing and commissioning of power panels, incorporating circuit breakers, fuse units, busbars, interconnections, earthing etc., meeting the requirements shown in equipment schedule and the drawings.

1.2 Standards:

AS PER SCHEDULE OF INDIAN STANDARD ATTACHED WITH THE DOCUMENT
The PCCs & MCCs shall comply with the latest edition of relevant Indian standards and Indian Electricity rules and regulations. The following Indian Standards shall be complied with:

IS: 4237 : General requirements for switch gear and control gear for voltage not exceeding 1000 v.
IS: 375 : Switchgear bus-bars, main connection and auxiliary wiring, marking and arrangement.
IS: 2147 : Degree of protection provided by enclosures for low voltage switch gear and control gear.
IS: 8197 : Terminal marking for electrical measuring instrument and their accessories.
IS: 2557 : Danger notice plates.
IS: 2516 : Specification for AC circuit breaker.
IS: 1818 : Specification for AC isolator and earthing switch.
IS: 3072 : Code of practice for installation and maintenance of switchgear.
IS: 8623 : Specification for factory built as symbolize of switch gear and control gear for voltage up to and including 1000v. A.C.& 1200 v. D.C.
IS: 8828 : Miniature Circuit Breaker.
IS: 2516 : Air circuit breaker.
IS: 4064 : Fuse switch and switch fuse unit.
IS: 9224 : HRC fuse unit.
IS: 2705 : Current transformer.
IS: 3155 : Voltage transformer.
IS: 3231 : Electrical relay for protection.
IS: 1248 : indicating instrument.
IS: 722 : Integrating instrument.
IS: 6875 : Control switches & push buttons.
IS: 2959 : Auxiliary contactor.
IS: 1822 : AC motor starters of voltage not exceeding 1000V.

1.3 TYPE OF M.V. SWITCH GEAR:

1.3.1 All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor / wall mounted, air - insulation, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz. neutral effectively / Non effectively grounded at transformer and short circuit level not less than 30 MVA at 415 volts.

1.3.2 The PCC's / MCC's shall be designed to withstand and heaviest condition at site, with minimum expected ambient temperature of 45 degree celsius, 80 percent humidity and dusty weather.

1.3.3 Should confirm to Indian Electricity Act and rules. (as amended up to ate) & approval of FIA. of India.

1.4 STRUCTURE:

1.4.1 The PCCs, MCCs & PDBs shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.

1.4.2 All CRCA sheet steel used in the construction of PCCs / MCCs / PDBs shall be 2 mm thick and shall be folded and braced as necessary to be provided a rigid support for all components. Joints of any kind in sheet shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.

1.4.3 The PCCs / MCCs / PDBs shall be totally enclosed, completely dust and vermin proof and degree of protection being no less than IP-51 to IS 2147. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and / or rubber strips and shall be lockable.

1.4.4 All panels and covers shall be properly fitted and secured with the frame, and holes in the panel correctly positioned. Fixing screw shall enter into holes taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of PCCs / MCCs / PDBs.

1.4.5 A base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom.

1.4.6 PCCs / MCCs /PDBs shall arranged in multi-tier formation. The PCCs / MCCs / PDBs shall be of adequate size with a provision of 20 percent spare space to accommodate possible future additional switch gear. The size of the PCCs / MCCs / PDBs shall be designed in such a way that the internal space is sufficient for hot air movement, and the electrical component does not attain temperature more than 40 degree celsius. If necessary openings shall provided for natural ventilation, but the said openings shall be screened with fine weld mesh.

1.4.7 Knockout holes of appropriate size and number shall be provided in the PCCs / MCCs/ PDBs in conformity with number, and size of incoming and outgoing conduits / cables.

1.4.8 Alternatively the PCCs / MCCs / PDBs shall provided with removable sheet plates at top and bottom to drill holes for cable / conduit entry at site.

1.4.9 The PCCs / MCCs / PDBs shall be designed to facilitate easy inspection, maintenance and repair.

1.4.10 The PCCs / MCCs / PDBs shall be sufficiently rugged in design and shall support the equipment without distortion under normal and short circuit

condition, they shall be suitable braced for short circuit duty.

1.5 PROTECTION CLASS:

All the indoor PCCs / MCCs / PDBs shall have protection class as IS.

1.6 PAINTING:

All sheet steel work shall undergo a process of decreasing pickling in acid, cold rinsing, phosphating, pesivating and then sprayed with a high corrosion resistant primer. The primer shall be backed in an oven. The finishing treatment shall be by application. Three coats of synthetic enamel paint of approved colour shall be applied by spray and stoves in dust free atmosphere or the panel shall be powder coated.

1.7 **CIRCUIT COMPARTMENT :**

1.7.1 Each circuit breaker and switch fuse units shall be housed in separate compartments and shall be enclosed an all sides. Sheet steel hinged lockable door shall be duly inter locked with the breaker / switch fuse units in ON and OFF position. Safety interlocks shall be from being drawn out when the breaker is in ON position.

1.7.2 The door shall not form as integral part of the drawout position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tires in a vertical section.

1.8 INSTRUMENT COMPARTMENT

Separate and adequate compartment shall provided for accommodating instruments, indicating lamp, control contactors, relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, switch fuse units, busbars and connections.

1.9 BUSBARS

1.9.1 The busbar shall be air insulated and made high quality, high conductivity, high strength copper and as per relevant IS code. The busbar shall of three phases and neutral system with separate neutral and earth bar. the busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper. the busbar shall be of rectangular cross section designed to withstand full load current for phase busbar and full rated current for neutral busbar and shall be extensible type on either side. The busbar shall be rated for the frame size of the main incoming breaker but in any case not less than 200 amp capacity. The busbar shall have uniform cross section throughout the length.

1.9.2 The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, Yellow, Blue and Black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non hygroscopic DMC insulated supports at sufficientevely close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand of 105 KA minimum.

1.9.3 The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick bakalite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as per below.

Between phases	:	27 mm min.
Between phases and neutral	:	25 mm min.
Between phases and earth	:	25 mm min.
Between neutral and earth	:	23 mm min.

1.9.4 All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated brass bolt and nuts. Additional cross section of busbar shall be provided in all PCCs / MCCs / PDBs to cover-up the holes drilled in the busbars. Spring and flat washers shall be used for tightening the bolts.

1.9.5 All connection between busbar and circuit breaker / switches and between circuit breaker/ switches and cable terminals shall be through solid copper strips of proper size to carry full rated current. These strips shall be insulated with insulating strips.

1.10 ELECTRICAL POWER & CONTROL WIRING CONNECTION

a) Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawing for the PCCs, MCCs, PDBs.

b) Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.

c) Both control and power terminals shall properly be shrouded.

d) 10% spare terminal shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.

e) Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures.

f) Wiring inside the module for power, control protection and instrument etc. shall be done with use of 660/1100 confirming to IS 694 and IS 8130. Power wiring inside the starter module shall be rated for full current rating of contactor, but not less than 4 sq mm cross section area. For current transformer circuits, 2.5 sq mm copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq mm copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.

i) Control power for the motor starter module shall be taken from the respective module switchgear outgoing from R phase and Neutral. Control wiring shall have control fuse (HRC type).

j) Particular care shall be taken to ensure that the layout of wiring neat and orderly. Identification ferrules shall be filled to all the wire termination for ease of identification and to facilate and testing.

k) "CUPAL" washers shall be used for all copper and aluminum connections.

k) Final wiring diagram of the PCC, MCC, PDB power and control circuit with ferrules number shall be submitted along with the PCC/MCC/PDB as one of the documents.

1.11 TERMINALS

The outgoing terminals and neural link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformer for instrument metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming and outgoing cables to internal components connection of the distribution board is permitted, only one conductor may be connected in one terminal.

1.12 WIREWAYS

A horizontal PVC wire way with screwed covers shall provided at the top to take interconnecting control wiring between different vertical sections.

1.13 CABLE COMPARTMENT

Cable compartment of adequate size shall be provided in the PCCs, MCCs, PDBS for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate support shall be provided in the cable compartment shall be brought out to terminal blocks in the cable compartment.

1.14 EARTHING

a) Copper earth busbar of 25 mm x 3 mm shall be provided in the PCCs, MCCs, PDBS for the entire length of panel. The frame work of the PCCs, MCCs, PDBs shall be connected to this earth busbar. Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both sides of the PCCs, MCCs, PDBs.

b) The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

1.15 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

1.16 NAME PLATE

a) A name plate with panel designation in bold letter shall be fixed at top of the central in panel. A separate name plate giving feeder giving feeder details shall be provided for each feeder module door.

b) Inside the feeder compartment, the electrical component, equipments, accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers.

c) Engraved name plates shall preferably be of 3 ply, (red-white-red or black-white-black) lamicold sheet. However black engraved perplex sheet name plates shall also be applicable. Engraving shall be done with square groove cutters.

d) Name plate shall be fastened by counter sunk screws and not by adhesives.

1.17 DANGER NOTICE PLATE

a) The danger plate shall be affixed in a permanent manner on operating side of the panel.

b) The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.

c) The danger notice plate in general shall meet to requirements of local inspecting authorities.

d) Overall dimension of the danger notice plate shall be 200 mm wide and 150 mm high. The danger notice plate shall be made from minimum 1.6 mm thick mild steel sheet and after due pretreatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

e) The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS : 2551-1982.

f) The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS : 5-1978.

g) The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit design of the panel.

h) The danger notice plate, if possible, be of ISI certification mark.

1.18 INTERNAL COMPONENTS

a) The PCC / MCC / PDB shall be equipped complete with all type of required number of air circuit breakers, switch fuse unit, contactor, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, busbar, cable boxes, cable glands etc. and all the necessary internal connections /wiring as required and as indicated on relevant drawings. Components necessary for proper complete functioning of the PCC / MCC / PDB but not indicated on the drawings shall be supplied and installed on the PCC / MCC / PDB.

b) All part of the PCC / MCC/ PDB carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at any part of the PCC / MCC / PDB.

c) All units of the same rating and specifications shall be fully interchangeable.

1.19 INSPECTIONS

Each equipment should inspect and witness by client & consultant.

a) The PCC / MCC / PDB shall be inspected and checked as per inspection manual of the PCC / MCC / PDB manufacturer.

b) Various electrical components and accessories of the PCC / MCC / PDB shall be checked as per drawing for the respective PCC / MCC / PDB.

c) The PCC / MCC / PDB shall be checked for rigid mounting, earthing connections, proper rating and size of components, internal wiring, etc.

d) All mechanical fasteners and electrical connections shall be checked and tightened before installation.

e) Type test certificates for all ACB for similar rating shall be submitted.

f) Test:

a) Prior to dispatch of the PCC / MCC / PDB following tests shall be carried out.

b) Mechanical endurance test shall carried out by closing and opening of all the ACB's, MCB's switches etc.

c) Over voltage and Insulation resistance test shall be carried out between phases and between phase to earth bus, keeping the isolating switch in ON position. Similar test shall be carried out keeping the isolating switch in closed position.

D) All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

1.20 COMPONENTS:

A) GENERAL

a) The type, size, and rating of the components shall be as indicated on the relevant drawings.

b) While selection of the capacity of the components resulting from the prevailing conditions like room temperature shall be allowed for the Thermal and magnetic trip rating shall be compensated for the ambient temperature.

c) The rating indicated on the drawings are rating anticipated at prevailing site condition.

B) FUSE SWITCH UNITS:

The fuse switches unit shall be 3 pole double break type suitable for load break duty (AC 23), quick make and break action. Separate neutral link shall be provided with hinged doors duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in "ON" position and also prevent closing of the switch when the door is not properly secured. All contacts shall be silver plated and all live parts shall be shrouded. The incoming and outgoing terminals of switches shall be adequately sized to receive proper size of the cables. High Rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS : 2208-1962 and having rupturing capacity of not less than 35 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to show that they have operated. The switch fuse unit shall be manufactured in accordance with IS : 4047 - 1967 as amended to date.

C) MINIATURE CIRCUIT BREAKER

Miniature circuit breakers shall be quick make and break and break type conform with British standard BS : 3871 (Part-I) 1965 and IS :8825 (1996). The housing of MCBs shall be heat resistant and having the high impact strength. The fault current of MCBs shall not be less than 10000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker dollies shall be of trip free pattern to prevent closing the breaker on a faculty current.

The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger relay 3 as for over current and short circuit protection. The over load or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian Standard, prior to Installation.

D) FUSE

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having rupturing capacity of not less than 35 MVA at 415 Volts. Backup fuse rating for each motor / equipment. HRC fuses shall be of English Electric make or approved equal.

F) MOULDED CASE CIRCUIT BREAKER

The MCCB shall be air break type and having quick make quick break with trip free operating mechanism.

Housing of the MCCB shall be of heat resistant and flame retardant insulating material.

Operating handle of the MCCB shall be in front and clearly indicate ON / OFF / TRIP positions.

The electrical contact of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts.

The MCCB shall be provided with thermal / magnetic type bi-metal over load release and electro-magnetic short circuit protection device. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided.

The MCCB whenever called for in the appendix drawings shall provide an earth fault relay.

The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date.

The electrical parameters of the MCCB shall be as per the descriptions given in the appended drawings.

G) CONTACTORS:

The contactor shall meet with the requirements of IS : 2959 and BS : 775.

The contactors shall have minimum making and breaking capacity in accordance with utilization category AC 3 and shall be suitable for

minimum class II intermittent duty.
If the contactor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.

H) LOAD MANAGER:

The load manager should meet the following requirement unless and otherwise specified in the bill of material or drawings.

KWH METER: Digital KWH meter 96 x 96 x 80 mm size Acc Class 1.0 suitable for true RMS reading having reverse LED. Optically isolated pulse output having pulse with 500 ms and pulse amplitude 12 volts.

Load Manager (For Main Incoming) : The load manager should be 192 x 144 mm size having facility to read voltage current harmonics power parameters. It should contain real time clock. The meter should be field programmable and to generate high / low profile for all power parameters with date & time, also able to store previous period integrated data. The meter should have RS 485 port for networking purpose. All the programming should be pass word protected.

Load Manager (For Outgoing) : Load manager facility to measure A, V, Hz, PF, kW, kWH with RS 485 port for networking. The meter should be totally field programmable and having a password protection. Size should be 96 x 96 mm.

I) CURRENT TRANSFORMER

Where ammeters are called for, CT's shall provided for current measuring. Each phase shall be provided with separate CT of class I accuracy and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS : 2705 - 1964 as amended up to date.

J) PUSH BUTTON:

The push button unit shall comprise of the contact element, a fixing holder, and push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps continuous current rating. The actuator shall be of stranded type and colour as per its usage for ON, OFF and Trip.

K) INDICATING LAMP:

Indicating Lamp shall be transformer operated low voltage rated and shall supplied complete with translucent covers to diffuse the lamp light.

Colour shade for the indicating lamps shall be as below :

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow, Blue.

LT CABLING AND TERMINATION

1.1 Scope:

The scope consists of Supply, laying, testing and commissioning of L.T. XLPE Cable and its termination.

1.2 Standards:

AS PER SCHEDULE OF INDIAN STANDARDS; ATTACHED IN THE DOCUMENT

1.3 Cables:

A) LV POWER CABLES will be 1100 Volts grade single / multicore standard aluminum conductor extruded XPLE insulated with extruded PVC inner sheath outer sheath made of FRLS PVC compound conforming to IS-7098 part-1. Single core will be used for DC application. Cables in buried insulation shall be armoured type. Armoured cable should be provided with galvanized steel wire or strip or Cooper Wire armouring.

B) Control cables will be 1100 Volts grade multicore minimum 2.5 sqmm cross section standard copper conductor minimum 7 strands PVC insulated inner extruded sheathed and other sheath made of extruded FRLS PVC compound conforming to IS-1554 part-1.

Cables in buried insulation shall be armoured type.

C) All cables shall be new without any kind or visible damage. The manufacturers name, insulating material, conductor size and voltage class shall be marked on the surface of the cable at every 600 mm centres.

Cable joints and termination:

A) Connectors :

Cable terminations shall be made with copper/Aluminium Heavy duty long neck copper crimping lugs only crimped type solder-less lugs for all Copper/aluminium cables and stud type terminals. For copper cables copper crimped solder-less lugs shall be used.
Crimping shall be done with the help of hydraulically operated crimping tool. All cable lugs should be long neck type only.

B) Cable Glands :

Cable glands shall be of heavy duty brass compression / whether proof type as specified. Generally single compression type cable glands shall be used for indoor protected locations and double compression type shall be used for outdoor locations. Glands for classified hazardous areas shall be CMRI approved.

C) Ferrules :

Ferrules shall be of self sticking type and shall be employed to designate the various cores of the control cable by the terminal numbers to which the cores are connected, for ease in identification and maintenance.

D) Cable joints :

Kit type joint shall be done and filled with insulating compound. The joint should be of 1.1 KV grade insulation.

EARTHING

1.0 Scope of Work:

The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of:

1.1.1 copper/galvanized/aluminium/chemical or Electrode type Earthing station.

1.1.2 Earthing G.I./Aluminum/copper strips from earthing station to equi-potential bar.

1.1.3 Earthing G.I./ Aluminum/ copper strips/ wires from equi-potential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.

1.1.4 Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

1.1.5 Provide inter connection between all earth pits of same type.

2.0 STANDARDS

1.2.1 The following standards and rules shall be applicable:

1) IS: 3043 - 1966 Code of practice for Earthing.

2) Indian Electricity Act and Rules

1.2.2 All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Codes of Practice in absence of Indian standard.

3.0 GENERAL

All the non-current carrying metal parts of the electrical installation and mechanical equipments shall be earthed properly. The metal conduits, trucking, cables armoured and sheath, electric panels boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specified earthing system.

An earth continuity conductor shall be installed with all the feeders and circuits and shall be connected from the earth bar of the panel boards, to the conduit system, earth stud of the switch box, lighting fixture, earth pin of the socket outlets and to any metallic wall plates used. All the enclosures of motors shall be also connected to the earthing system.

4.0 TYPE OF EARTHING STATION

PIPE EARTHING STATIONS

The substation earthing shall be with GI Pipe earthing station and equipment earthing grid shall be with hot dip galvanized iron earthing

station.

The Pipe electrode shall 38mm dia GI pipe for earthing

The earthing station shall be as shown on the drawing.

The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

The resistance of each earth station should not exceed 4 ohms.

The earth lead shall be connected to the earth plate through copper/brass bolts in case of copper earth plate and shall be hot dip galvanized iron for G.I. Pipe earth as shown on the drawing.

The earthing grid and the earthing conductors shall be of hot dip galvanized iron strip of size as mentioned on the drawing.

The block masonry chamber with Cast Iron hinged cover of 300 x 300 mm shall be provided for housing the funnel and the pipe for watering the earthing electrodes \ stations.

The hardware and other consumable for earthing installation shall be of copper/brass in case of copper earth plate and shall be hot dip galvanized iron material in case of G.I. Pipe , as per details shown in the drawing .

5.0 INSTALLATION AND CONNECTION :

5.1 The plate \ pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.

5.2 The plate \pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall \ column.

5.3 The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.

5.4 G.I. pipe for watering, shall run from top edge of the plate \ pipe electrode to the mid level of block masonry chamber.

5.5 Top of the pipe shall be provided with G.I. funnel and screen for watering the earth \ ground through the pipe.

5.6 The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.

5.7 The masonry chamber shall be provided with a Cast Iron hinged cover

resting over the Cast Iron frame which shall be embedded in the block masonry.

5.8 Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

5.9 The earth conductors (Strips / Wires copper/ Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws \ bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

5.10 The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

5.11 Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

5.12 The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

6.0 EARTH LEADS AND CONNECTIONS :

6.1 Earth lead shall be bare copper or galvanized steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. Galvanized steel buried in the ground shall be protected with bitumen and Hessian wrap or polytene faced Hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is at least 8 mm away from the wall surface.

6.2 The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

7.0 EQUIPMENT EARTHING :

All apparatus and equipment transmitting or utilizing power shall be earthed in the following manner. Copper/G.I. earth strips/wires shall be used unless other wise indicated in the Schedule B.

8.0 POWER TRANSMISSION APPARATUS

8.1 Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated / bare earth continuity conductor of size 50 % of the phase conductor subject to the minimum and maximum shall be provided.

	Copper	Aluminum	G.I.
Minimum(sqmm)	2.5	4.0	6
Maximum(sqmm)	75	100	200

The earth continuity conductor be drawn inside the conduit shall be insulated.

8.2 Non metallic conduit shall have an insulated earth continuity conductor of the same size as for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conduct or shall be distinctly coloured (Green or Green/Yellow) for easy identification.

8.3 Armoured cable shall be earthed by two distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit.

8.4 In the case of Unarmoured cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable.

8.5 Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate.

9.0 UTILIZING EQUIPMENT :

9.1 Three phase motors and other three phase apparatus shall have two distinct earth connections of the size equal to 50% of the connecting cable subject to the following:

	Copper	Aluminum	G.I.
Minimum(sqmm)	6.5	10	20
Maximum(sqmm)	75	10	200

9.2 For single phase motors and apparatus, the single earth connection shall be provided of the above size. For all light fittings and fans a single earth connection with 1.5 sqmm copper or equivalent size shall be provided.

9.3 All street light poles shall have an earth stud and shall be connected to the cable armouring using 6.5 sqmm copper or equivalent unless shown otherwise. For street lighting poles planted in ground, 2.4 M long 10 SWG bare copper wire shall be coiled and buried with every fourth pole in addition to connection to cable armouring.

9.4 An equipment earthing grid shall be established as shown in the drawing. All earth connections to all panels, DB's and equipment shall be connected to the nearest point of the earthing grid.

10.0 TEST :

10.1 The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.

10.2 The following earth resistance values shall be measured with an approved earth meggar and recorded.

1) Each earthing station
2) Earthing system as a whole
3) Earth continuity conductors

10.3 Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 Ohm in each case. This is responsibility of contractor to get the final value for resistance.

10.4 Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

10.5 All tests shall be carried out in presence of the consultant..

11.0 METHOD OF MEASUREMENT :

11.1 Provision of earthing station complete with excavation, plate, earth lead upto chamber, earth link in the chamber, electrode, GI watering pipe, Salt, Charcoal, soil treatment to achieve the earth resistance less than 4 ohm, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.

11.2 The following items of work shall be measured and paid per unit length covering the cost of the earth wires/strips, clamps, labour etc.

a) main equipment earthing grid and connection to the earthing stations.

b) Connection to the power panels, DB etc.

11.3 The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made.

a) Light fittings - form part of installation of the light fitting.
b) Conduit wiring, cabling - should form part of the wiring or cabling.
c) Street lighting - should form part of the street light poles.

E-17 External Lighting

1.0 Scope:

1.1 The scope of work covers the supply, installation and testing of lighting poles, Light Fixtures with required foundation as per Boq / drawing complete in all respect, weather proof light fixtures if any, wiring up to the fixtures, cable laying, earthing as specified and shown on drawings.

2.0 Standards:

As per Applicable standard.

3.0 Light Fixtures: -

3.1 The LED light fixture construction shall be minimum **IP 66 & 5500k Pluse or Mines 10% as per Instruction of Engineer-in-Charge** as stated in BOQ only. Die cast aluminium / Extruded Aluminium with a separate compartment for integral ballast equipment, with driver. The reflector shall be anodized polished aluminium. The glass refractor shall be heat resistant.

3.2 Lamp holder shall be of porcelain and shall comprise of a terminal block of non- hygroscopic material. The luminaries shall have integral Driver housed in water tight and dust tight metal cases. Driver shall be pre-wired to the Lamp socket and terminal block, requiring only power supply leads to the ballast primary terminals.

3.3 Lighting fixtures shall be designed for minimum glare and for continuous operation under specified atmospheric condition.

3.4 The Lamp & Luminary shall generally follow the specification under section `LIGHT FIXTURES'.

3.5 **The LED streetlight system will have to meet the following Specifications**:

Tilting angle	- 0 to 5 degree
Maintenance Factor	- 0.8-0.9
Protection level	- IP 66 & IK-055

Power factor	- > 0.95
Construction body	- Die cast Aluminum / Extruded Aluminum with finish to be of colour and with the confirming to the safety of IS 10322 (part - 2) -1982
Heat Sink	- Integrated with in luminaries & The dimensions of luminaries shall be adequate to permit sufficient heat dissipation through the body it self, so as to prevent abnormal temperature rise inside the lantern & consequential damage to cover & gasket materials, LEDs, lenses & Electronic Driver.
Application	- Outdoor Use
System efficacy-Lm/W25c amb	- > =110
Warranty	- 5 years on the LEDs, Fixture & Driver
Protection	- Overheat, Overload, Short Circuit, HV Surge up to 6 KV
Certification	- LM 79, LM80, RoHS, EMC, EMI, CE
Marking	- Company LOGO Engraving/Embossing on Body, AMC marking
LED life-time (L70)	- > 50000 hrs
Driver Life Rating	- > 50000 hrs
Beam angle	- 135/80 degree
LED	- CREE, Osram, Philips, Nichia
LED junct temp in □@	- < 75
Lens material	- Polycarbonate
Working humidity	- 10% - 90% RH
Working temp in □	- 05 to 50 deg C
LED driver type	- Constant Current
Drive Current	- ≤750mA
Driver Efficiency	- >80%
T H D Amp	- < 15%
T H D Volt	- < 5%
Input Voltage range (Vac)	- 150-270 +/- 5%
Input Voltage frequency (Fac)	- 50 Hz +/-3%
CRI Color Rendering Index	- > 70

Lumen Maintenance Factor - 70% up to 35000 burning hrs

Uniformity ratio U0 - > = 0.4 (Min /Avg.)

Uniformity ratio UT - > = 0.33(min / max)

Required Avg. Lux level on road - > = 30(CIE method)

Color Temperature = 5500K

Vendor to submit dialux design report stationg avg. lux level, Uo, UT, before finalizing the light fixtures as per site measurements.

3.6 Particulars and Details to be submitted by the bidder:

In order to properly assess and due diligence on submissions, the Proponent should provide following information on the quality and photometric of proposed luminaries.

3.6.1 General description

Following details of the proposed luminaries shall be submitted as per Annexure I

ANNEXURE I

Sr. No.	Description
1	Luminaries manufacturer
2	Luminaries model name
3	Wattage
4	Stated lumen output
5	IP rating
6	Lumen output (as per LM79 report, mentioning current in mA)
6	Luminous efficacy (as per LM79 report)
7.	Lumen deprecation (L70 mentioning temperature in 0C and current in mA)
8	Correlated colour temperature (CCT)
9	Colour rendering index (CRI)
10	LM 80 report to prove the authentications of LED module

3.6.2 Electrical specifications

Electrical ratings of the proposed luminaries product for the following criteria shall be submitted in Annexure II

ANNEXURE II

Sr No.	Description
1	Voltage range or rating single phase AC
2	Amperage range or rating
3	Frequency range
4	Power factor
5	Total harmonic distortion
6	Working humidity
7	Working temperature
8	Ingress protection
9	Electrical connector
10	Ability to operate under conditions of unpredictable voltage variations ; Submit the information whether and how the proposed luminaries product might accommodate adaptive controls that allow remote dimming or switching on/off, and indicate what types of controls may be integrated into the proposed luminaries product;

3.6.3 LED chip and driver information - details to be filled up by bidder

LED chip and driver information of the proposed luminaries product for the following criteria in Annexure III.

ANNEXURE III

Sr No.	Description
1	Name of the LED chip manufacturer
2	LED chip model name and number
3	LM 80 report from the LED chip manufacturer on the lumen depreciation characteristics of the specific LED chip employed in the proposed luminaries product
4	Junction temperature (0C)
5	Information on drivers employed in the Proposed luminaries
6	Name of the manufacturer
7	Model name and number
8	Expected lifetime of the LED driver used in the proposed luminaries
9	Estimated cost of driver replacement by your company, including component and installation cost
10	Name of the LED chip manufacturer

3.7 Bidder shall have to offer the following minimum warranty:

a. Provide a five year on-site replacement warranty covering material fixture finish and workmanship, to include transportation, removal, and installation of new products.

b. Provide five year replacement warranty for defective or non-starting LED source assemblies and all drivers.

c. Provide a five year warranty for luminaries exhibiting inadequate lumen maintenance
at the end of the warranty period in compliance with the following table:

L70 lifetime claim	Min. lumen maint @ 5 years
35,000 hours	92.50%
50,000 hours	85.50%
1,00,000 hours	80.00%

d. A luminaries dirt depreciation (LDD) factor may be included in the above calculation, such a value be determined by mutual agreement between AMC and the manufacturer, consistent with local ambient environmental conditions and practice.

f. A monitoring programme to implement will be determined by mutual agreement between AMC and the Bidder. The costs of the monitoring programme over the five year warranty period will be borne by the Bidder, unless agreed otherwise by AMC and the Bidder.

g. The warranty shall cover all LED light sources (packages or modules/arrays) including but not limited to the LED die, enclosure, and phosphor. If the expected life of the luminaire system is not maintained net of LDD, then the Bidder shall replace the light source(s) and/or luminaries as needed.

3.8 Photometric information

The proponent needs to submit the following photometric information:

1) Photometric modeling results, preferably within a LM79 report, from an independent accredited laboratory showing generic candlepower traces and iso foot candle plots for the proposed luminaries product.
2) Photometric information, data and diagrams that model the luminance flux distribution of the proposed luminaries referencing the site characteristics. The proponent should consider the following during the modeling exercise.
3) Such modeling should verify that the proponent's proposed luminaries will meet Indian Roadway Lighting standard IS 1944, which specifies average luminance (E avg.) and uniformity (Emin / Eavg) for roads at the above sites.
4) Use industry accepted, standardized software like Dialux for the above

modeling while modeling, a maintenance factor of minimum 0.8 should be used.

Note: the proponent needs to submit a soft copy of the IES file of the proposed luminaries along with the bid.

3.9 Lumen maintenance statement

1) 1) The proponent must submit a lumen maintenance statement that estimates how many operating hours can be expected from the proposed luminaire product until its light output declines to 70% of its initial output (L70), given the specific climactic character, including extremes of temperature and high humidity, associated with the Thane local condition.
2) The lumen maintenance statement should also clearly explain that how or what method was used to determine the rated lifetime.
3) Describe in details the thermal management: how the physical and thermal design of the luminaire will prevent the LED chips from overheating on extremely hot days.
4) Other trials or pilot projects: submit information and contacts for other relevant trials in which the proponent's proposed luminaire product, or similar products sold by the agency, have been tested in the field.
5) Such information should include: LM 80 report for the LED chip package employed in the proposed luminaire product Illuminance or luminance measurements, if available, taken over a minimum of two years of operation from pilot projects that have tested the proposed luminaire product, or a similar luminaire product, in the field.

3.10 Luminaire specifications -

The proponent shall provide information and certifications

1) Luminaries: General Requirements, Tests, and Certifications specified in IS 10322
2) Electrical safety certifications such as ISI and CII
3) Ingress Protection - Certification IP66

3.11 DRAWINGS AND DATA OF LIGHTING FIXTURES:

As per proposal, the bidder shall furnish relevant descriptive and illustrative literature of the lighting fixtures and accessories along with drawings/ data for the respective lighting fixtures :-

i) Dimensional Drawings.

ii) Mounting details cable entry facilities and weights.

iii) Lamp output V/S temp. curves.

iv) Colour of light fixture should match with pole colour as per Architect's Client's Requirement.

4.0 Lighting Poles: Lighting Poles for street lights

4.1 **Design The Octagonal Pole**
shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40-3:2000, pr EN-40-3-3.

Pole Shaft The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process.

All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.

opening for cable entry: Pole should have appropriate size holes for cable entry.

5.0 Cable laying:

5.1 Cabling shall be generally as specified in the section `CABLING'.

5.2 Cables shall be terminated in a 6-way terminal block inside the pole or attached therewith as shown on drawings.

5.3 Cable route shall be as shown on the drawings or the contractor shall mark out the route and lay the cables only upon approval of the route.

6.0 Earthing:

6.1 All street lights fixtures and poles shall be earthed as specified under section `EARTHING'.

7.0 Mode of Measurement:

7.1 Each lighting pole, concrete foundation, base plate with stiffener plate, MCB, connector, Clamp, connecting chain to door, wiring up to light fixture to junction box with both end cable termination , earthing, necessary hardware etc. shall be considered as one unit for measurement and payment.

7.2 All cabling work shall be measured on the basis of unit length and the cost shall include, cost of cable, cable termination in junction boxes or pole terminal box etc.

7.3 Each light fitting with lamp, Driver, internal wiring, earthing etc. shall be considered as one unit for measurement and payment.

SPECIAL CONDITION FOR TESTING
(CONTRACTOR TO READ THIS CAREFULLY)

1.0 SCOPE :

If required contractor should have to take all necessary testing/ random testing of equipments and component prior to supply as per the guidelines / rules / sampling method etc. of IS at manufacturing works or other standard lab in presence of Client's representative & consultant as witness testing. Any deviation in parameters which is not as per IS is not accepted and client reserve the rights to reject the same at any stage of the project.

APPLICABLE STANDARDS

Sr. No.	IS No.		Description
1)	IS: 2026-1977 &1981-1994	:	Power transformers fittings.
2)	IS 3639-1966	:	Fittings and acc. For P.T.
3)	IS10028-Part III 1981	:	Installation of Transformer.
4)	IS: 13118-1991	:	Specification for High voltage AC circuit breakers.
5)	IS: 335-1993	:	Insulating oil for Transformers & switch gear.
6)	IS: 2705-1992	:	CT for measuring and protection.
7)	IS: 3156-1992	:	Voltage (Potential) Transformers.
8)	IS: 3156-1992	:	Voltage Transformer.
9)	IS: 8623-Part II	:	Bus-bar arrangement and marking
10)	IS: 2099-1986	:	Bushing
11)	IS: 5621-1980	:	Large Hollow Porcelains Insulator
12)	IS: 2544-1973	:	Insulators greater than 1000V
13)	IS: 2629-1985	:	Hot Dip Galvanizing
14)	IS: 2633-1986		
15)	IS: 3842-1967	:	Relays for AC system
16)	IS: 1248-2003	:	Meters (measuring).
17)	IS: 10118-1982	:	Installation of Switch gears.
18)	IS: 692-1994	:	HV Cable Paper Insulated Lead Sheathed Cables for Rated Voltage up to and Including 33 kV Specification.
19)	IS: 1255 -1983	:	Installation of HV cables and jointing.
20)	IS: 3043-198	:	Code of practice for earthing.
21)	IS: 13947-Part III -1993	:	HD Air breaker, Switch gears and fuses for voltage not exceeding 1000 Volts.
22)	IS: 13703-Part IV	:	Selection, installation and

maintenance -1993 of fuses up to 650 Volts.

23) IS: 13947-Part I-1993 : General requirements for switch gear and control gear for voltage not exceeding 1000 Volts.

24) IS: 13947-Part III -1993 : Air-break isolators for Voltage not exceeding 1000 Volts.

25) IS:8623-1993 : Factory built assemblies of switch gears and control gears for voltage up to and including 1000 Volts A.C. and 1200 Volts D.C.

26) IS: 11353-1985 : Marking and arrangement of switch gear bus bars main connectors and auxiliary wiring.

27) IS: 13947 PART-1 : Cubical Boards

28) IS: 8084-1976 : Insulated Bus bar rating.

29) IS: 2675-1983 : Enclosed distribution fuse boards and cut-outs for Voltage not exceeding 1000 Volts.

30) IS: 8828-1995 : Miniature Circuit Breaker.

31) IS: 9926-1981 : Fuse wire used in rewirable type electric fuses up to 650 Volts.

32) IS: 1554-Part I -1988 : PVC insulated electric cables Heavy duty.

33) IS: 3961-Part II & IV-1967: Recommended current rating for cables.

34) IS: 8130-1984 : Copper conductor in insulated cables and cores.

35) IS: 8130-1984 : Conductor for insulated electric cables and flexible cords.

36) IS: 3975-1999 : Low Carbon Galvanized Steel Wires, Formed Wires and Tapes for Armouring of Cables - Specification

37) IS: 5831-1984 : PVC insulation and sheath of electric cables.

38) IS: 8130-1984 : Aluminum conductor for insulated cables.

39) IS: 11955-1987 : Recommended current rating for Cable.

40) IS: 732-1989 : Code of practice for electrical

wiring installation system Voltage not exceeding 650 Volts.

41) IS: 1646-1997 : Code of practice for fire safety of Buildings (general) electrical installation.

42) IS: 9537-1981 : Rigid steel conduits for electrical wiring.

43) IS: 2667-1988 : Fittings for rigid steel conduits for electrical wiring.

44) IS: 3480-1966 : Flexible steel conduit for electrical wiring.

45) IS: 3837-1976 : Accessories for rigid steel conduits for electrical wiring.

46) IS: 694-1990 : PVC insulated cables (wires).

47) IS: 9537-Part III -1983 : Installation of Rigid non-metallic conduits for electrical wiring.

48) IS: 6946-1973 : Flexible (playable) non-metallic conduits for electrical installation.

49) IS: 1293-2005 : Plugs and sockets up to 250V.

50) IS: 8130-1984 : Conductors for insulated electrical cables and flexible codes.

51) IS: 9537-1980 : Specification for conduit for electrical installation.

52) IS: 3419-1988 : Accessories for non-metallic conduits for electrical wiring.

53) IS: 3854-1997 : Switches.

54) IS: 6538-1971 : Plugs.

55) IS: 13585-Part I : Shunt Capacitors for power-1998 systems up to 650V.

56) IS: 1370 : Low voltage fuse and links up to 1000 volts.

57) IS: 1913-1978 : General and safety requirement for lighting fittings.

58) IS: 1944-1981 : Code of practice for lighting public thorough fares.

59) IS: 3528-1966 : Waterproof electric lighting

fittings.

60) IS: 3553-1966 : Water tight electric lighting fitting.

61) IS: 1239-Part I-2004 : Mild Steel tubular and other wrought steel pipe fitting.

62) IS: 10322-Part V-1987 : Luminaries for street light.

63) IS: 13703-Part III-1993 : HRC fuses having rupturing capacity voltage up to 1000V.

64) IS: 2312-1967 : Exhaust Fan.

65) IS: 374-1979 : Class I Ceiling Fan.

66) IS: 7098 (Part I, II, III) - 1988 : XLPE armoured Cables up to 1000V.

NOTE: All codes and standards means the latest where not specified otherwise the installation shall generally follow the Indian Standard codes of practice or relevant British Standard Codes of Practice in the absence of corresponding Indian Standards.

PLEASE FOLLOW:

a. Indian Electricity Act of 1910 and rules issued there under revised up to date.

b. Regulations for electrical equipment in building issued by The Bombay Regional Council of insurance Association of India.

LIST OF APPROVED MAKE / MANUFACTURER

1) Rigid PVC Conduit	:	ISI & FIA approved & manufactured from virgin material. Precision, Nihir.
2) Accessories for conduit	:	Same make as of pipe
3) MCCB/MCB/ELMCB	:	Legrand ,Schneider MG, L&T, Hager.
4) PVC tape	:	Steel grip, Anchor
5) LT Cables	:	Finolex, Havells, Polycab, KEI.
6) Glands	:	Compression type, Heavy duty and deep threading with rubber ring and double washers. (Sample to be approved) HMI, Comet
7) Cable Lugs	:	Dowels, 3-D
8) Meter (DIGITAL ENERGY METERS)	:	Secure, L&T, ElMeasure, HPL
9) Light Fixture	:	As mentioned in BOQ only. (Sample to be approved)
10) Panel Fabricators (Metallic)	:	CPRI approved vendors only
11) Load Manager Power meter/MFM	:	Conzerv, L&T, ElMeasure, HPL
12)Meters (V, A, PF etc)	:	IMP, AE, RISHABH, ElMeasure, HPL
13) Timer	:	Theban (Indoasian), Legrand,
14) LT CT	:	KAPPA/ AE / Pragati
15) DWC Pipes	:	Rex, Dutron, equi
16) Water Tight JB	:	Hensel, Spealsberg
17) Flexible Copper Wires	:	FRLS type: Finolex, Polycab,KEI.

Special Notes:

- The successful tenderer will have to supply the makes from above in consultation with the Client / Architect / Consultant without any extra cost.
- The tenderer should have to submit considered makes from the above list along with the tender with covering letter of separate letter enclosure. However, the final decision for accepting make specified by tenderer would be of client / Architect / Consultants.
- As far as possible, the successful tenderer will have to place order directly to the manufacturer OR it's authorized dealer.
- The Client/Architect/Consultants have right to check the challans of supplier.
- Make of components required to be used by contractor to complete the installation, if not mentioned anywhere, shall be required to GOT IT APPROVED by Client/Architect/Consultant before installation in writing manner.
- Within a week of work order, the contractor shall submit the sample of each item / component of above mentioned approved make for the approval of the Client/Architect/Consultant.
- Light fixture mounting on same pole should be of same family and of similar shape irrespective of dimension of light fixtures.