CHAPTER: 5 LAND DEVELOPMENT AND ASSOCIATED CIVIL WORKS

Applicable Codes and Specifications

The following codes and standards are included in this section, as part of these specifications. However, respective IS codes (or latest) for the works not mentioned here shall also be applicable for those particular items of work.

IS:110	**Specification for Ready mixed paint, brushing, grey filler, for enamels for use over primers.**
IS:280	Specification for mild steel wire for general engineering purposes
IS:304	Specification for High Tensile Brass Ingots and Castings
IS:337	Specification for Varnish, finishing interior
IS:348	Specification for French polish
IS:383	Specification for coarse and fine aggregates from natural sources for concrete
IS:412	Specification for Expanded metal steel sheets for general purposes
IS:419	Specification for putty for use on window frames
IS:428	Washable Distemper-specification
IS:459	Indian standard unreinforced corrugated and semi-corrugated asbestos cement sheets- Specification
IS:702	Specification for industrial bitumen
IS:710	Specification for marine plywood
IS:712	Specification for building limes
IS:730	Specification for hook bolts for corrugated sheet roofing
IS:733	Specification for Wrought aluminium and aluminium alloys, bars, rods and sections (for general engineering purposes)
IS:15622	Specification for Pressed Ceramic Tiles
IS:1003	Specification for timber panelled and glazed shutters (Parts 1 & 2)
IS:1038	Specification for steel doors, windows and ventilators
IS:1077	Common burnt clay building bricks – Specification
IS:1081	Code of practice for fixing and glazing of metal (steel & aluminium) doors, windows and ventilators
IS:1124	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones.
IS:1237	Specification for cement concrete flooring tiles
IS:1322	Specification for Bitumen felts for water proofing and damp proofing
IS:1346	Code of practice for water proofing of roofs with bitumen felts
IS:1361	Specification for steel windows for industrial buildings
IS:1397	Specification for kraft paper
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles
IS:1477	Code of practice for painting of ferrous metals in buildings (Parts1 & 2)
IS:1542	Specification for sand for plaster
IS:1580	Specification for bituminous compounds for water-proofingand caulking purposes
IS:1597	Code of practice for construction of stone masonry : Part 1 Rubble stone masonry
IS:1659	Specification for block boards
IS:1661	Code of practice for application of cement and cement-lime plaster finishes
IS:1834	Specification for hot applied sealing compound for joints in concrete

IS:1838	**Specification for preformed fillers for expansion joint in pavements and structures (non- extruding and resilient type) : Part 1 Bitumen impregnated fibre**
IS:1948	Specification for aluminium doors, windows and ventilators
IS:1949	Specification for aluminium windows for industrial buildings

IS:1838	Specification for preformed fillers for expansion joint in pavements and structures (non- extruding and resilient type) : Part 1 Bitumen impregnated fibre
IS:2074	Ready mixed paint, air drying, red oxide- zinc chrome, priming – Specification
IS:2098	Specification for Asbestos cement building boards
IS:2114	Code of practice for laying in-situ terrazzo floor finish
IS:2116	Specification for sand for masonry mortars
IS:2185	Specification for concrete masonry units (Parts 1,2 & 3)
IS:2202	Specification for wooden flush door shutters (Solid core type) : Parts 1 & 2
IS:2212	Code of practice for brickwork
IS:2250	Code of practice for preparation and use of masonry mortars
IS:2338	Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
IS:2339	Specification for Aluminium paint for general purposes, in dual container
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)
IS:2402	Code of practice for external rendered finishes
IS:2571	Code of practice for laying in-situ cement concrete flooring
IS:2572	Code of practice for construction of hollow concrete block masonry
IS:2645	Integral cement waterproofing compounds for cement mortar and concrete – Specification
IS:2690	Specification for burnt clay flat terracing tiles : Part 1 Machine made
IS:2691	Specification for burnt clay facing bricks
IS:2750	Specification for steel scaffoldings
IS:2835	Flat transparent sheet glass
IS:2932	Enamel,synthetic,exterior(a)undercoating,(b)finishing– Specification
IS:3007	Code of practice for laying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets
IS:3036	Code of practice for laying lime concrete for a water-proofed roof finish
IS:3067	Code of practice of general design details and preparatory work for damp-proofing and water- proofing of buildings.
IS:3068	Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete
IS:3384	Specification for bitumen primer for use in water-proofing and damp-proofing
IS:3461	Specification for PVC-asbestos floor tiles
IS:3462	Specification for unbacked flexible PVC flooring
IS:3495	Method of test for burnt clay building bricks: Part 1 to 4
IS:3536	Ready mixed paint, brushing, wood primer, pink – Specification
IS:3564	Hydraulically regulated Door closers specification
IS: 3614 (Part – 1)	Specification for fire checks doors : Part –I Plate metal covered and rolling type
IS: 3614 (Part	Specification for metallic and non-metallic fire check doors : Resistance

– 2)	test and performance criteria
IS:3696	Safety code of scaffolds and ladders (Parts 1 & 2)
IS:4020	Door shutter - Methods of test
IS:4021	Specification for timber door, window and ventilator frames
IS:4351	Steel door frames – Specification
IS:4443	Code of practice for use of resin type chemical resistant mortars
IS:4457	Specification for ceramic unglazed vitreous acid resisting tile
IS:4631	Code of practice for laying epoxy resin floor toppings
IS:4832	Specification for chemical resistant mortars (Part II)

– 2)	test and performance criteria
IS:4860	Specification for acid resistant bricks
IS:4948	Specification for welded steel wire fabric for general use
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring
IS:5410	Cement paint- Specification
IS:5411	Specification for plastic emulsion paint (Parts 1 & 2)
IS:5437	Figured rolled and wired glass
IS:5491	Code of practice for laying of in-situ granolithic concrete floor topping
IS:6041	Code of practice for construction of autoclaved cellular concrete block masonry
IS:6042	Code of practice for construction of light weight concrete block masonry
IS:6248	Specification for metal rolling shutters and rolling grills
IS:7193	Specification for glass fibre base bitumen felts
IS:7452	Specification for hot rolled steel sections for doors, windows and ventilators
IS:8042	Specification for white Portland cement
IS:8543	Methods of testing plastics
IS:8869	Specification for washers for corrugated sheet roofing
IS:9197	Specification for epoxy resin, hardeners and epoxy resin composites for floor topping
IS:9862	Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting
IS:12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams – code of practice
BS : 476 (Part – 20)	Methods for determination of the fire resistance of elements of construction (General Principles)
BS : 476 (Part – 21)	Methods for determination of the fire resistance of load bearing elements of construction
BS : 476 (Part – 22)	Methods for determination of the fire resistance of Non-load bearing elements of construction
Part – IV Fire Protection	National Building code of India
IS : 383	Specification for coarse and fine aggregates from natural sources for concrete
IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
IS : 456	Code of Practice for plain and reinforced concrete – Specification
IS : 458	Precast concrete Pipes (with and without reinforcement).
IS : 516	Methods of tests for strength of concrete
IS : 554	Dimensions for pipe threads where pressure- Tight joints are made on the threads – Dimension, Tolerance and designation

IS : 774	Specification for Flushing Cisterns for water closets and urinals (other than Plastic cistern)
IS : 775	Specification for Cast iron brackets and supports for wash basins and sinks.
IS : 781	Sand-cast brass screw-down bib taps and stop taps for water services
IS : 783	Code of practice for laying of concrete pipes.
IS : 1068	Electroplated coatings of Nickel plus chromium and copper plus nickel plus chromium
IS : 1077	Common burnt clay building bricks- Specification
IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS : 1239	Mildsteeltubes,Tubularandotherwroughtsteel fittings– Specification
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage – Specification

IS : 774	Specification for Flushing Cisterns for water closets and urinals (other than Plastic cistern)
IS : 1703	Water fittings Copper Alloy float valves (horizontal plunger type) – Specification
IS : 1726	Specification for Cast iron manhole covers and frames
IS : 1729	Cast Iron/ Ductile iron drainage pipes and pipe fittings for over ground non-pressure pipeline socket and spigot series
IS : 1742	Code of practice for buildings drainage
IS : 2116	Specification for sand for masonry mortars
IS : 2212	Code of practice for brickwork
IS : 2250	Code of practice for preparation and use of masonry mortars
IS : 2326	Specification for Automatic flushing cisterns for urinals (other than plastic cisterns)
IS : 2470	Code of practice for installation of septic tanks (Parts I & II)
IS : 2556	Vitreous sanitary appliances (Part I to Part XV)
IS : 2963	Specification for copper alloy waste fittings for wash basins and sinks
IS : 3006	Specification for chemically resistant glazed stoneware pipes and fittings.
IS : 3311	Specification for Waste plug and its accessories for sinks and wash basins
IS : 5455	Specification for cast iron steps for manholes
IS : 4127	Code of Practice for laying of glazed stoneware pipes
IS : 3495	Methods of tests of burnt clay building bricks
IS : 4111	Code of practice for ancillary structures in sewerage system
IS : 5382	Specification for rubber sealing rings for gas mains, water mains and sewers
IS : 5329	Code of practice for sanitary pipe work above ground for buildings
IS : 5434	Specification for Non-ferrous alloy bottle traps for marine use

GENERAL

The intent of this technical specification covers the following:

All civil works shall be carried out as per drawings/design provided by the Employer/Contractor and as per these specifications provided by the Employer. In case any item is not covered under specification then the same shall be carried out as applicable Standards and Codes as per employers requirement. Any item for which specification is not provided herein and is not covered under standard specification shall be executed as per manufacturer guidelines. All materials shall be of best quality conforming to relevant Indian Standards and Codes.

The Contractor shall furnish all designs, (unless otherwise specified) drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of Employer.

All materials including cement, reinforcement steel and structural steel, etc shall be arranged by the Contractor. All testing required shall be arranged by the contractor at his own cost. The Contractor shall execute the work as per field quality plan (FQP) attached with this document.

The bidder shall fully apprise himself of the prevailing conditions at the proposed site. Climatic conditions including monsoon patterns local conditions and site-specific parameters, soil parameters, availability of construction material and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.

The scope shall generally cover switch yard structures, including gantries and equipment support structures and their foundations, cable trenches along with covers, cable trench crossings of road and rails, sump pits, marshalling box/control cubicle foundations, switch yard levelling, site clearance, soil investigation, roads, drains, fencing, gravel filling, transformer / reactor foundations, firewalls, control room building, other auxiliary buildings, potable water supply, street light etc. Any other items not specifically mentioned here but required for the commissioning of switch yard/substation shall be deemed to be included in the scope of this Specification. The scope shall further cover design, construction for all civil works at each substation. All civil works shall also satisfy the General Technical Clauses specified in other sections of this specification and as detailed below.

Excavation, de watering, carriage of excavated earth, plain cement concrete (PCC), casting of reinforced cement concrete (RCC) foundations, super-structures for switch yard structures, equipment supports, their control cubicles, bus post supports, lighting poles and panels, brick and stone masonry, cable trenches, pipe trenches with necessary pre cast RCC removable covers, with lifting facility and sump pits, cable supports and their embodiment in cable trenches and cable trench crossings road or rail track with backfilling complete as per drawings approved by the EMPLOYER, shall be carried out by the contractor. The cable trenches inside

the control room shall be provided with MS chequered plate with angle stiffeners at the bottom for mechanical strength and painting there of as per the standard practice.

SOIL INVESTIGATION

The Contractor shall use the recommendations made in the soil investigation report provided by the Employer with this bid document for reference purpose only.

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate general as well as specific information abou t the soil profile/strata and the necessary soil parameters of the site in order that the foundations of the various structures can be designed and constructed safely and rationally. Foundation systems adopted by the contractor shall ensure that relative settlement shall be as per provision in IS 1904 and any latest IS and other Indian Standards.

This Specification covers all the work required for detailed soil investigation and

preparation of a detailed report. The work shall include mobilisation of necessary equipment, provision of necessary engineering supervision and G e o t e c h n i c a l E x p e r t personnel , skilled and unskilled labour etc., as required to carry out field investigation and tests, laboratory tests, analysis and interpretation of data and results, preparation of detailed soil report including specific recommendations for the type of foundations and the safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Contractor shall make his own arrangements for locating the coordinates and various test positions in field and also for determining the reduced level of these locations with respect to the benchmark. All the test is to be carried out before the AEGCL officials or before any agency engaged by AEGCL. Prior intimation in this effect has to be given to AEGCL.

A report to the effect will be submitted by the Contractor for AEGCL specific approval giving details regarding his data for Civil structures design.

Any variation in soil data provided with bid document shall not constitute a valid reason for any additional cost and shall not affect the terms and condition of the Contract. Nothing extra whatsoever shall be paid to the Contractor on account of any variation in subsoil properties /or conditions. Tests must be conducted under all the critical locations i.e. GIS Building, Control room building, autotransformer, lightning mast, 400 kV/220 kV/132 kV column location, auxiliary buildings etc. However, some of the soil parameters given below for substations have to be determined and submitted to authorized representative of AEGCL.

Dry density

Bulk density

Angle of internal friction/cohesion

Specific gravity

Natural moisture content.

Bore holes

Drilling of a specified number of bore holes of 150 mm dia. in accordance with the provisions of IS 1892 at approved locations to specified depths or to refusal whichever occurs earlier. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). Nos of bore holes shall be executed as per employer approval.

Performing Standard Penetration Tests at 1.5 m intervals in the bore hole starting from

0.5 m below ground onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards. The depth of Water Table shall be recorded in each bore hole.

All samples, both disturbed and undisturbed, shall be identified properly with the bore hole number and depth from which they have been taken. The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor`s laboratory without any damage or loss but not limited to.

The logging of the bore holes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to AEGCL duly signed by representative of employer.

Dynamic cone penetration test

Two Dynamic cone penetration tests under the locations of auto transformers shall be carried out with the circulation of bentonic slurry at specified location and a continuous record of penetration resistance (NG) up to 15 metre from natural ground level or refusal, shall be maintained by the Contractor.

Dynamic cone penetration tests are conducted to correlate engineering properties such as stratification density, bearing capacity, settlement, etc., of soils which are primarily cohesive in nature. The tests shall be conducted by driving a standard size cone attached

loosely or screwed to a string of drill rods. The specification for the equipment and accessories required for performing this test, test procedure, field observations and reporting of results shall confirm to IS 4968-part 11 latest revision. The driving system shall comprise of 65 kg weight having a free fall of 75 cm. The cone size shall be 65 mm diameter, and provided with vents for continuous flow of bentonite slurry through the cone and rods in order to avoid friction between the rods and soil. The location for tests shall be as directed by AEGCL. On completion of the test, the results shall be presented as a continuous record as the number of blows required for every 300 mm penetration of the cone into the soil.

Trial pits

Trial pits shall be made at two locations as approved by AEGCL. The trial pits shall be 2 meters square in size extending to (four) meters depth or as specified by AEGCL. Undisturbed samples shall be taken from the trial pits as per the direction of AEGCL.

Field California Bearing Ratio test

This test shall be carried out to obtain the properties of soil required for the construction of roads. The equipment and accessories required for carrying out the test, test procedure, recording of observations and presentation of results shall confirm to IS 2770 part XXXI. The test locations of CBR test shall be on the road loc-ations as per GA drawing. These tests shall be performed on remoulded and undisturbed, soaked and un soaked samples.

Electrical resistivity test.

This test shall be conducted to determine the electrical resistivity of soil required for designing safety grounding system for the entire station area. The specifications for the equipment and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS 3043. The test shall be conducted using Wenner's four electrode method as specified in IS 1892, Appendix-B2. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis.

The following formula shall be used for measuring soil resisitivity : $P = 2 \pi a R$

Where a = Interelectrode spacing = 50M R = Earth resistance measured in Ohms P = Soil Resistivity in Ohm- m

The soil resistivity values shall be submitted duly marked on the route map and also in the form of statement. The quoted rates for detailed survey/ check survey work shall be inclusive of cost of measuring soil resistivity values along the proposed route and the contractor will not be paid separately for this work.

Plate load test

Plate load test shall be conducted to determine the bearing capacity and load/ settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to IS 1888. N o s o f P l a t e l o a d t e s t s h a l l b e c o n d u c t e d a s p e r e m p l o y e r r e q u i r e m e n t . The location and depth of the test shall be given by the Contractor and approved by AEGCL. Undisturbed tube samples shall be collected at 1.0 m and 2.5 m depths from the natural ground level for carrying out laboratory tests.

The size of the pit shall not be less than five times the plate size and shall be taken upto the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

If the ground water table is at a depth higher than the specified test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. Dewatering shall be at Contractor's cost.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate. The test plate shall be 600 x 600 mm size and at least 25mm thick. The bottom of the pit shall be levelled before placing the plate in position for conducting the test.

A seating load of 70 gm/sq.cm shall be applied and after the dial gauge readings are stabilized, the load shall be released, and the initial readings of the dial gauges recorded after they indicate constant reading. The load shall be increased in stages. These stages shall be 20, 40, 70, 100, 150, 200, 250, 300, 400. 500, 600 and 800 KN per sqm or as directed by AEGCL. Under each loading stage, record of time versus settlement shall be kept as specified in IS 1888.

The load shall be maintained for a minimum duration of one hour or till the settlement rate reduces to 0.02 mm/m. whichever is later. No extrapolation of settlement rate from periods less than one hour shall be permitted.

Loading shall be carried out in stages as specified above till one of the following conditions occurs:

Failure of the soil under the plate i.e. the settlement of the plate at constant load becomes progressive and reaches a value of 40 mm or more.

Total settlement of the plate is more than 4Omm.

Load intensity of 800 kN/sq.m is reached without failure of the soil.

Backfilling of the pit shall be carried out as per the directions of AEGCL. Unless otherwise specified the excavated soil shall be used for this purpose. The quoted rates shall include backfilling.

Dial gauge readings for settlement shall generally be taken at 1, 2, 4, 6, 9, 16, 25, 60, 90 and 120 minutes from the commencement of each stage of loading. Thereafter the readings shall be taken at hourly intervals upto a further four hours and at two hours intervals thereafter for another six hours.

Water sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in air- tight containers.

Laboratory Test

The laboratory tests shall be carried out progressively during the field work after a sufficient number of samples have reached the laboratory, in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the tests shall be carried out as per the procedures laid out in the latest edition of the relevant IS Codes and Standards.

The following laboratory tests shall be carried out:

Visual and engineering classification.

Liquid limit, plastic limit and and shrinkage limit.

Optimum moisture content, bulk density, dry density and specific gravity.

Grain size distribution.

Unconfined compression test.

Unconsolidated undrained test.

Swell pressure and free swell index determination.

California bearing ratio.

Consolidated undrained test.

Consolidated drained test.

Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic or inorganic matter and any other chemicals harmful to the concrete foundation.

Test results and reports

The Contractor shall submit the detailed report in four (4) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report in eight (8) copies shall be submitted.

The report shall include, but not be limited to the following:

A plan showing the locations of an exploration work i.e. bore holes, dynamic cone penetration tests, trial pits, plate load test, etc.

Bore logs: Bore logs of each bore holes clearly identifying the stratification and type of soil stratum with depth up to the refusal. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected shall be clearly shown against that particular stratum.

Test results of field and laboratory shall be summarized strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report.

Recommendation The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from AEGCL. The observations and recommendations shall include but not be limited to the following:

Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table, etc.

Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile shall be given.

Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations for the recommendations.

Recommendations regarding slope of excavations and dewatering schemes, if required.

Comments on the chemical nature of soil and ground water with due regard to protective measures.

If expansive soil is met with, recommendation on removal or retainment of the same under the structure/road etc. shall be given. In the latter case detailed specification of any special treatment required including specification for materials to be used, construction method and equipment to be deployed etc. shall be furnished.

Recommendations for additional investigation beyond the scope of the present work, if Contractor considers such investigation necessary.

STANDARDS, DESIGN AND DRAWINGS

All Civil works shall be carried out as per applicable Indian Laws, latest revision of

/International Standards and Codes. All materials shall be of best quality confirming to relevant Indian Standards and Codes. Civil works shall be designed to the required service conditions and /or loads as specified elsewhere in this Specification or implied as per National and International Standards. In case of any conflict between I.S. Code and the Procedures specified herein, the later shall prevail.

All foundations/RCC Design shall be of reinforced cement concrete and shall be as per requirementds of earthquake and wind for zone-V region of IS. The design and construction of RCC structures shall be carried out as per IS 456 and minimum grade of concrete shall be M20 corresponding to 1:1.5:3 (M20) nominal mix ratio with 12-20 mm coarse aggregate. Higher grades of concrete than specified above may be used at the discretion of the Bidder without any financial implication to the owner. Work covered under this clause of the specification comprises the construction of foundations and other RCC constructions for switchyard structures, equipment support, trenches, drains, jacking pad, pulling block, control cubicles, bus supports, Auto transformer/power transformer/reactors, marshalling kiosks, auxiliary equipment's and system buildings, tank or for any other equipment or service and any other foundation required to complete the work. Also applicable to other RCC constructions. If the site is sloping, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes. Minimum 75 mm thick lean concrete shall be provided below underground structures, foundations, trenches etc. to provide a base for construction. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The special footing or pile foundations as may be required based on soil/sub-soil conditions and superimposed loads shall be provided. The switchyard foundations plinths and

building plinths shall be minimum 900mm and 1200mm above finished ground level respectivelyAdmixtures in concrete shall confirm to IS: 9103. The water proofing cement additives shall confirm to IS: 2645. Concrete Admixtures/Additives shall be approved by the owner. Limit state method of design shall be adopted unless stated otherwise in the Specification. For design and construction of steel-concrete composite beams IS 11384 shall be followed. For detailing of reinforcement IS 2502 and SP: 34 shall be followed. Two layers of reinforcement (on inner and outer face) shall be provided for wall and slab sections having thickness of 125 mm and above. Clear cover to reinforcement towards the earth face shall be minimum 50 mm. RCC water retaining structures such as storage tanks, cooling water basin etc. shall be designed as uncracked sections in accordance with IS 3370 (Part 1 to IV) by working stress method and shall also be tested for water tightness at full water level. However, water channels shall be designed as cracked sections with limited steel stresses as per IS 3370 (Part 1 to IV) by working stress method. The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and /or equipment and /or superstructure, and other conditions which produce the maximum stresses in the foundation or the foundation component, and as per the relevant IS Codes of foundation design. The design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used. All foundations shall rest below virgin ground level and the minimum depth of foundation below the virgin ground level shall be maintained. Design shall consider any sub-soil water pressure that may be encountered. Necessary protection to the foundation work, if required, shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental or harmful to the concrete foundations. RCC columns shall be provided with rigid connection at the base. All building sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be as stated in relevant IS Codes or as stipulated elsewhere in the Specifications. Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered. In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, and substructures of any underground hollow enclosure etc., to allow for vehicular traffic in the vicinity of the structure.

The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

Pile Foundation shall be done for GIS buildings, Control room building, Transformer foundations and Reactor foundations, Fire protection wall and any other heavily loaded structure. The quotated rate for these structures shall be inclusive of pile foundation.

Any detail specification for carrying out pile foundation works which is not mentioned in this chapter shall be as per relevant IS codes and Chapter 35 of this bid document.

The foundation of the transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS:2974 and IS:456.

The tower and equipment foundations shall be checked for a factor of safety of

2.2 for normal condition and 1.65 for short circuit condition against sliding, overturning and pullout. The same factor shall be used as partial safety factor overloads in limit state design also.

All underground concrete structures such as basements, pump houses, water retaining structures etc. shall have water proofing cement additive conforming to IS 9103. In addition, the limit on permeability as given in IS 2645 shall also be met. The concrete surface of these structures in contact with earth shall also be provided with two coats of bituminous painting for water /damp proofing.

In case of water leakage in the above structures, leakage repair shall be achieved by the injection method.

The following conditions shall be considered for the design of water tanks, pump houses, channels, sumps, trenches and other underground concrete structures such as basements etc.

Full water pressure from inside and no earth pressure, ground water pressure and surcharge pressure from outside (applicable only to structures which are liable to be filled with water or any other liquid).

Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings. Base slabs of any underground enclosures shall be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT).

Base slab of underground enclosures such as water storage tank shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pump sump being empty for maintenance.

Machine Foundations

All machine foundations shall be designed in accordance to the provisions of the relevant parts of the latest revisions of IS 2974, IS 456 and IS 2911.The provisions of DIN 4O24 (latest) shall also be followed. All block foundations resting on soil or piles shall be designed using the elastic half space theory.

The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes, and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down by the relevant IS codes and/or machine manufacturers, shall be satisfied. Minimum reinforcement shall be governed by IS 2974 and IS 456.

For the foundations supporting minor equipment weighing less than one tonne, or if the mass of the rotating parts is less than one-hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structures, floors etc. suitable vibration isolation shall be provided by means of springs, neoprene pads etc. and such vibration isolation system shall be designed suitably.

Other Foundations

All foundations shall be designed in accordance with the provisions of the relevant parts of latest revisions of IS 2911 and IS 456. Type of foundation system i.e. isolated footing, raft or piling shall be decided based on the load intensity and soil strata. A minimum TWO piles shall be provided in any pile group. Gantry and tower foundations shall be designed for an additional factor of safety of 1.2 for normal/ broken wire conditions and for short circuit condition. Circuit breaker foundations shall be designed for impact loading and shall be strictly in accordance with the Manufacturer`s recommendations.

400 KV GIS Building - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

220 KV GIS Building - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

33kV Switchgear & Control Room building– Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Kiosk Building - Drawing to be prepared by contractor on the basis of specifications provided in the bid document.

Fire fighting pump house Building & Fire water Tank

R.E Residence - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Transit Camp - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Officers Hostel - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Staff hostel - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Security Barrack - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Security Booth - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Open Store Shed - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor.

Store Building - Architectural Drawings are enclosed with the tender documents. Structural Drawing shall be prepared by the Contractor

Septic Tank and Soak Pit - Drawing to be prepared by contractor on the basis of specifications provided in the bid document.

Roads and RCC box culverts – Drawing to be prepared by contractor on the basis of specifications provided in the bid document.

Drains - Drawing enclosed with the bid document. Any additional drawing necesary shall be prepared by the Contractor.

Security fencing – Drawing enclosed with the bid document.

Gate - Drawing enclosed with the bid document

Cable trenches - Drawing enclosed with the bid document.

The drawings provided with tender documents are initial drawings and are for reference purpose only, there may be some changes in final drawing as per the site condition/eqipments/panels and the same shall be prepared by contrsctor according to site/work requirements.

SITE CLEARANCE

Clearing and Grubbing

The work shall consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreign materials, obsolete structure and foundation etc., which in the opinion of EMPLOYER are unsuitable for incorporation in the works, from within the limits and such other areas as may be specified on the drawings or directed by EMPLOYER. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications and includes earthfilling required for levelling of land after demolishing existing structures. During clearing and grubbing, the contractor shall take all adequate precautions against soil erosion, water pollution etc., and where required undertake additional works to that effect.

Setting out and making profiles

After joint survey the Contractor with AEGCL's Engineer, have to prepare a Contour Map showing the existing levels of that area in respect of the B.M. The same shall have to be submitted to the Employer for scrutiny and approval with a comparison to the Contour Map provided by the Employer with the Bid Document and citing the variations (if any). Construction of general grid, B.M, HFL pillars etc is the responsibility of the Contractor. The Contractor shall give all help in instruments, materials and personal to the Employer for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels. A grid system of co-ordinates shall be established by the Contractor at the site. Reinforced concrete pillars of size 300mmX300mm shall be erected suitably at minimum of four places in the area to serve as benchmarks for the execution of the work. Each benchmark shall be protected from damage or disturbance. These benchmarks shall be connected with G.T.S. of any other permanent benchmark approved by EMPLOYER. Necessary profiles with pegs, bamboos and strings or 'Burjis' shall be made to show the correct formation levels before the work is started and the same shall be approved by EMPLOYER.

As per contour of the switchyard site, the Contractor shall have to prepare the site by earth cutting or filling as per site condition to arrive at the required F.G.L. Site levelling shall be in the scope of the Contractor. The finished ground level (FGL) of the switchyard area shall have to be fixed as approved by EMPLOYER above the highest flood level (HFL) of that area or site.

After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by EMPLOYER. The Contractor at his own cost shall make the layout and levels of all structure, etc., from the general grids of the plot and benchmarks set by the Contractor and approved by the Employer.

Programme

The Contractor shall execute the works as per the approved schedule in accordance with the requirements of this Specification.

Inclement weather

As per relevant Code, during hot weather, precautions shall be taken to avoid premature stiffening of the fresh mix and to reduce water absorption and evaporation losses. During hot weather (atmospheric temperature above 40 degree C) or cold weather (atmospheric temperature at or below 5deg.C) concreting shall be done as per the procedure set out in IS 7861.

MATERIALS AND WORKMANSHIP

General –

All materials used in the works shall be new and of the best quality of their respective kinds. They shall comply with the requirements of the latest edition of any relevant Indian Standard or Code of Practice where such exist, and current at the date of tendering. All workmanship shall be of the highest standard and shall be executed by competent men skilled in their respective trades.

Samples –

In addition to the special provisions made in this specification for sampling and testing of materials by particular methods, samples of any materials and workmanship proposed to be used in the Works may be called for at any time during the Contract by EMPLOYER and shall be furnished by the Contractor without delay and at the expense of the Contractor. Samples when approved, shall be regarded as the acceptable standard, and any material or workmanship subsequently not complying with that standard shall be rejected and replaced by those of acceptable standard at the expense of the Contractor. Sample storage boxes shall be provided by the Contractor free of cost if requested by EMPLOYER.

Tests –

Whenever considered desirable by EMPLOYER, inspectors may be sent to manufacturer’s premises to test materials or supervise their manufacture. Where specified or requested the Contractor shall obtain from the manufacturer and send to EMPLOYER, certificates of test, proof sheets, mill sheets, etc., showing that materials have been tested in accordance with this Specification or the relevant Indian Standard. Notwithstanding any tests which may be directed to be carried out at a manufacturer’s works, EMPLOYER may carry out any tests or further tests he considers necessary or desirable after delivery of materials to the Site. The Contractor shall provide all labour, equipment and facilities necessary for carrying out the tests both in works and on site. The cost of routine tests required by IS and this Specification shall be borne by the Contractor. The cost of other tests shall be borne in accordance with the Conditions of Contract.

Names of suppliers and copies of orders-

If so required, and before ordering material of any description, the Contractor shall submit for approval the names of makers or suppliers proposed. Copies of orders shall also be submitted if so required. EMPLOYER may at any time withdraw his previously given approval to obtaining materials from any maker or supplier should such maker or supplier fail to supply materials of the specified quality or quantity in the requisite time.

Rejection of materials and workmanship –

EMPLOYER shall at any time have power to reject materials and workmanship not complying with this Specification or with the approved Drawings. Materials so rejected shall be immediately removed from site and replaced by materials of an approved standard at the expense of the Contractor. Rejected workmanship shall be broken out and replaced by work of an acceptable standard including the supply of new

materials by the Contractor, at the expense of the Contractor, and without delay.

Explosives and Blasting –

All rules under the Explosive Act or other local rules in force shall be fully observed. All blasting works shall be done in accordance with the stipulation contained in IS 4081. Written approval shall be obtained from EMPLOYER before explosives are used for excavating foundations in rock and EMPLOYER may impose conditions for their use. The Contractor shall be responsible for complying with local regulations concerning the use of explosives and for the safe-keeping and handling of explosives. Proper warning shall be given of all blasting operations. During operations involving the handling or use of explosives, the Contractor shall be responsible for the safety of personnel, Site Works and people or properties in the vicinity of the site. The Contractor shall make good at his own expense any damage caused by the use or mishandling of explosives.

EXCAVATION AND BACKFILL

Excavation and backfill for foundations shall be in accordance with the relevant Code. The back fill around the foundations shall be compacted according to the specification mentioned for Compaction.

Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than one meter in height.

Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 15 cm in thickness, (of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by EMPLOYER. Rocks larger than ten centimeters shall not be placed in embankment adjacent to structures.

Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

Rock excavation - The rock to be excavated shall be classified under the following categories:

Ordinary rock - Rock which does not require blasting, wedging or similar means for excavation is considered as ordinary rock. This may be quarried or split with crowbars or pickaxes and includes limestone, sandstone, hard laterite, hard conglomerate and reinforced cement concrete below ground level. It will also include rock which is normally hard requiring blasting when dry but can be excavated without blasting, wedging or similar means when wet. It may require light blasting for loosening materials, but this will not any way entitle the material to be classified as hard rock.

Hard Rock - Any rock or boulder for the excavation of which blasting is required, for example quartzite stone, granite, basalt, reinforced concrete (reinforcement to cut through but not separated from concrete) below ground level.

Hard Rock (Blasting prohibited) - This shall cover any hard rock requiring blasting as described in above but where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging or any other approved method

Authority for classification

The classification of excavation shall be decided by EMPLOYER and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of EMPLOYER.

Excavations for foundations and other purposes

Excavations shall be of the minimum sizes necessary for the proper construction of the works, and excavations shall not be kept open for periods longer than that reasonably required to construct the works. The Contractor shall take all precautions necessary to ensure that the bottoms of excavations are protected from deterioration and that the excavations are carried out in such a manner that adjacent foundations, pipes or such like are not undermined, damaged or weakened in any way. Any excavation taken out below the proper level without approval shall be made good at the expense of the Contractor using concrete or other material as directed.

All excavated materials obtained from excavation shall remain EMPLOYER`s property. The useful portion shall be separated from the useless one and deposited in regular stacks at places indicated and as directed by EMPLOYER.

Support for excavations against collapsing

The Contractor shall be responsible for the stability of the sides of the excavations. Excavations shall be close timbered or sheeted, planked and strutted as and when necessary during the course of the work and shall ensure the safety of personnel working within them. If any slips occur, they shall, as soon as practicable, be made good in an approved manner at the expense of the Contractor. Shoring shall not be removed until the possibility of damaging the works by earth pressure has passed. No payment for shoring or timber left in shall be made.

Works shall be carried in dry condition

All excavations shall be kept free from water and the Contractor shall take whatever action is necessary to achieve this. Pumping, well pointing and other means necessary to maintain the excavations free from water shall be at the expense of the Contractor, and carried out in an approved manner.

Backfilling

As soon as possible after the permanent works are sufficiently hard and have been inspected and approved, backfill shall be placed where necessary and thoroughly consolidated in layers not exceeding two hundred (200) millimetres in depth.

On completion of structures, the earth surrounding them shall be accurately finished to the line and grade as shown on the drawings. Finished surfaces shall be free of irregularities and depressions.

The soil to be used for back filling purposes shall be from the excavated earth or from borrow pits, as directed by EMPLOYER.

Disposal of surplus

Surplus excavated material not required or not approved for fill or backfill shall be loaded and deposited either on or off site as directed. The Contractor shall not delay disposal of surplus material after receipt of instructions from EMPLOYER. The contractor shall arrange to transport the excavated earth by mechanical transport, not necessarily on Pucca roads. The soil so transported shall be stacked and levelled neatly and dressed. The location for disposal of shall be arranged by contractor at their own cost and responsibility within 5kM from the site observing necessary government law and regulation.

Compaction:

The method and equipment used to compact the fill material to a density that will give the allowable soil bearing pressure required for the foundations, roads, etc. in each layer of fill material. Each layer of earth embankment when compacted shall be as close to optimum moisture content (OMC) as practicable. Embankment material which does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains an excess of moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlaping half the width of the roller each time and progress to the center of the road or towards the building as applicable. Rolling will also be required on rockfills. No compaction shall be carried out in rainy weather.

At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

The density to which fill material shall be compacted shall be as per relevant IS and as per direction of Authorised representative of EMPLOYER. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The subgrade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Proctor test to be done at site in the presence of Employer.

Requirement for filling material under foundations

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil.

Where compacted fill is required it shall consist of suitable sand, or other selective inorganic material, subject to approval by EMPLOYER. The filling shall be done with locally available sand. The filled in sand shall be kept immersed in water for sufficient time to ensure compaction, if so desired by EMPLOYER.

SITE PREPARATION AND EARTH FILLING

Scope of Work - The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of EMPLOYER. The method and equipment used to compact the fill material to a density that will give the allowable soil bearing pressure required for the foundations, roads, etc. in each layer of fill material. Each layer of earth embankment when compacted shall be as close to optimum moisture content (OMC) as practicable. Embankment material which does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains an excess of moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlaping half the width of the roller each time and progress to the center

of the road or towards the building as applicable. Rolling will also be required on rockfills. No compaction shall be carried out in rainy weather. At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade. The density to which fill material shall be compacted shall be as per relevant IS and as per direction of Authorised representative of EMPLOYER. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The subgrade for the embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Proctor test to be done at site in the presence of Employer.

General Requirement - The material required for site surfacing, earthfilling, gravel filling shall be free from all types of organic materials and shall be of standard approved quality, and as directed by EMPLOYER.

The Contractor shall furnish and install the site surfacing to the lines and grades as shown in the drawing and in accordance with the requirements and direction of EMPLOYER. The soil of the entire switchyard area shall be levelled before placing the site surfacing/gravel fill material. The earthfilling where required should be done and compacted as per specifications, in layers of 200 mm. After all the structures and equipment have been erected and accepted the site shall be maintained to the lines and grades indicated in the drawing and rolled or compacted by using three ton roller with suitable water sprinkling to form a smooth and compact surface condition, which shall be matching with finished ground level of the switchyard area.

BOUNDARY WALL

The scope includes the design, engineering and construction of the boundary wall all along the property line of the EMPLOYER on each sub-station.

Construction of Boundary wall: The boundary wall shall be constructed to a height of 2.1 mtrs above finished ground level of the substation area with 5 inches wide brick masonry work with RCC (1:1.5:3) ground tie beam to be rested on the RCC pillars (pillar to pillar distance @ 2.5mtrs) as detailed below. Six (6) nos. Expansion Joint shall be provided at a maximum of 25 m. Reinforced barbed tape o n M S frame (50X50X5 mm) and concertina coil fencing 600mm Dia 10guage with Razer edges all as per standard drawing fencing shall be provided on top of the boundary wall as detailed below.

The boundary wall shall be designed based on the soil investigation data. Salient points to be considered at the time of design:

Random rubble masonry wall for retaining wall as per relevant IS code. –

Minimium top width of Random Rubble Masonary shall be 600 mm.

RCC (1:1.5:3) pillars to be considered : RCC pillar to pillar distance shall be maximum 5 mtrs along the boundary line. The height of the RCC pillars shall be 2.1 mtrs above finished ground level of the substation area and a minimum of 600 mm depth below the virgin (natural) soil.

Size of the RCC Pillar: Min. 250mmX250mm.

Provision of steel bar: (a) Vertical 12 mm Ø: 6 Nos. (b) Stirrup: 8 mm Ø,150 mm c/c minimum.

There shall be provision of RCC Raft at the bottom of the RCC pillar. Size of the Raft shall not be less than 900mmX900mmX200mm.

Provision of steel bar: (a) Both way top & Bottom 12 mm Ø in two layers @ 150mm c/c minimum.

RCC (1:1.5:3) beam:

Tie beam/Plinth beam - Continuous RCC tie beam/plinth beam of suiable size to be rested on the RCC pillars above the finished ground level all along the boundary line. Provision of steel bar: (a) Horizontal 12 mm Ø: 6 Nos. (b) Stirrup: 8 mm Ø, 150 mm

C to C.

Mid Beam - Continuous RCC mid beam of min. size 125 X 125 mm to be rested on the RCC pillars at a height of 1 m from FGL all along the boundary line.

Provision of steel bar: (a) Horizontal 10 mm Ø: 4 Nos. (b) Stirrup: 8 mm Ø, 150 mm C to C.

Top Beam - Continuous RCC top beam of min. size 250 X 125 mm to be rested on the RCC pillars all along the boundary line.

Provision of steel bar: (a) Horizontal 10 mm Ø: 4 Nos. (b) Stirrup: 8 mm Ø, 150 mm C to C.

Brick works: 1st Class Brick work all along the boundary wall to be provided above plinth beam. Cement sand mortar of ratio (1:4) to be provided for brick masonry works. A 50mm height of finished concrete (ratio 1:2:4) shall be provided on the top of the boundary wall.

BRICK: The bricks shall be Cement Bricks or Clay Bricks for all buildings. For GIS buildings they shall be Cement Bricks or Clay Bricks or AAC Block. The bricks shall be machine moulded and shall be free from cracks and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colour. The bricks shall be moulded with the frog of 100mm x 40 mm and 10mm to 20mm deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 1.2 mtrs

The size of the modular bricks shall be 190 x 90 x 90 mm.

The size of the conventional bricks shall be 250 x 125 x 75mm.

Only bricks of one standard size shall be used on one work. The following tolerance shall be permitted in the conventional size adopted in a particular work. Length

+3.0mm, Width + 1.50mm, Height +1.50mm.

The crushing strength of the brick shall not be less than 17 N/mm2. The average water absorption shall be within 13- 15% by weight. Necessary test for crushing strength and water absorption shall be carried out as per IS 3495: (Part I to Part IV) 1976.

Cement plastering works: Cement sand mortars of ratio (1:4) to be provided both the sides of the boundary wall.

Colouring: Primer and two coats of weather coats synthetic paint to be applied.

In case the boundary wall to be designed considering pile foundation, the minimum dia of the pile shall be 250mm of required length as per the design based on soil investigation. Rest of the boundary wall shall be in line with the above description.

BUILDINGS & GENERAL REQUIREMENTS

General

The scope includes the design, engineering and construction of 400 KV GIS Building, 220 KV GIS Building, 33kV Switchgear & Control Room building cum Administrative Building and colony quarters building as per approved drawing with the bid document. For control room and colony quarter building the tentative layout showing the facilities to be provided is indicated somewhere and also to be proposed by the bidders for better utility and aesthetic view..

Dimensions

An open space of one metre minimum shall be provided on the periphery of the rows of panels, and equipment generally, in order to allow easy operator movement and access as well as maintenance.

The building design shall also take into consideration the layout of the panels, switchboards, switchgear and other equipment in order to allow enough area for the future extension of switchyard depending upon the availability of substation area.

Design

The buildings shall be designed:

to the requirements of the National Building Code of India. and the standards quoted therein

for the specified climatic and loading conditions

to adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy

with a functional and economical space arrangement

for a life expectancy of structure, systems and components not less than that of the equipment which is contained in the buildings, provided regular maintenance is carried out

to be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design

to allow for easy access to equipment and maintenance of the equipment

with, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire

with material preventing dust accumulation

Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

Individual members of the building frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.

Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

All cable vaults shall be located above ground level i.e. cable vaults shall not be provided as basements in the buildings. The building lighting shall be designed in accordance with the requirements of relevant section.

The building auxiliary services such as air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant sections of this Specifications.

Design Loads

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, crane loads, wind loads, seismic loads, and temperature loads. In addition, loads and forces developed due to differential settlement shall also be considered. Dead load shall include the weight of structures, complete finishes, fixtures and partitions and should be taken as per IS:1911 (latest revision). Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers, and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame. For crane loads an impact factor of 30% and lateral crane surge of 10% of (lifted weight plus trolley weight) shall be considered in the analysis of frame according to provisions of IS:875 (latest revision). The horizontal surge shall be 5% of the static wheel load.

For temperature loading, the total temperature variation shall be considered as two thirds of the average maximum annual variation in temperature. The average maximum annual variation in temperature for the purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.

Wind loads shall be computed as per IS:875. Seismic coefficient method shall be used for the seismic analysis as per IS 1893 (latest revision), wind and seismic forces shall not be considered to act simultaneously.

Floors/slabs shall be designed to carry loads imposed by equipment, cables, piping travel of maintenance trucks and equipment and other loads associated with the building. In general, floors shall be designed for live loads as per relevant IS and cable and piping loads not less than 5 kN/ sq.m hanging from the underside. In addition, beams shall be designed for incidental point loads of 20 kN to be applied at any point along the beams. The floor loads shall be subject to the approval of EMPLOYER.

For consideration of loads on structures, IS 875 - Code of practice for structural safety of buildings shall be followed. The minimum superimposed live loads shown in Table shall be considered for the design.

Roof	**150 kg / sq m.**	**for accessible roofs.**
R C C Floors.	**75 kg / sq m. 500 kg / sq m.**	**for non - accessible roof.**
Stairs and balconies.	**500 kg / m.**	**for offices and minimum 1000kg/sq.m. for equipment floors or actual requirement, if higher than 1000kg/sq. m., based on equipment component weight and layout plans.**
Toilet Rooms.	**200 kg / m.**	
Chequered plate floor.	**400 kg /sq. m**	
Walkways.	**300 kg /sq. m.**	

Submission of data for approval

The following information shall be submitted for review and approval to EMPLOYER:

Design criteria for structural steel and reinforced concrete design. The criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors and maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.

Structural design calculations and drawings including those for construction and fabrication for all reinforced concrete and structural steel structures.

Fully dimensioned floor plans, cross sections, longitudinal sections and elevations of each building. These drawings shall be drawn at a scale not less than 1:50 and shall identify the major building components.

Fully dimensioned drawings showing details and sections, drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

Product information of building components and materials, including walls, partitions, flooring, ceilings, roofing, doors and windows and building finishes.

A detailed schedule of building finishes including colour schemes.

A door and window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

Electrostatic radio interference shielding

The building inside the energized area of the stations shall be electrostatically shielded to limit the exposure of the equipment and personnel to specified electric field strengths. The shielding system shall be grounded properly.

GIS hall/Control Room Building/Colony quarters

Design and construction, including anti termite treatment of GIS hall, control room building, administrative building and colony quarters for each sub- station or switchyard shall be in the scope of the contract. The GIS halls, control room buildings and colony quarters shall be of RCC framed structure of concrete M20 grade. The GIS halls, control room and some other rooms of the control room building shall be fully air conditioned.

Rolling shutters shall be of an approved manufacturer, conforming to the requirements specified in IS: 6248:1979. The type of rolling shutter shall be gear operated type (mechanical). Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column.

Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the Drawings prepared by the Contractor.

Shutters shall be built up of interlocking laths 75 mm width between rolling centres formed from cold rolled steel strips. The thickness of the steel strip shall not be less than

0.90 mm for shutters up to 3.50 m width and not less than 1.20 mm for shutters above

3.50 m width. Each lath section shall be continuous single piece without any welded joint.

The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built up construction. The channel shall be of size as stipulated in IS: 6248 for various clear widths of the shutters. Hood covers shall be of mild steel sheets not less than 0.90 mm thick and of approved shape. Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.

All component parts of the steel rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS: 2074 at the shop before supply. These surfaces shall be given an additional coat of primer after

erection at the site along with the number of coats and type of finish paint as specified in the respective items of works prepared by the Contractor. In case of galvanised rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanised with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be at least 610gms/sq.m.

Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation. The rolling shutter with handle gear operation shall be provided.

Colony quarter and auxiliary buildings.

All the buildings shall be designed as per drawings enclosed with the Bid document and specification will as per the clauses of the bid document.

Finish Schedule

The preliminary indicative finishing schedule is given in subsequent clauses. However, at the time of detailed engineering, EMPLOYER reserves the right to alter the finishing schedule and specifications and such changes shall have no additional financial implication whatsoever to the Employer.

Flooring (52 mm Thick)

75 mm flat brick soling on compacted soil, 75 mm thick cement concrete 1:2:4.

Double charged jointless vitrified tiles 600x600X12 mm for Control Room, conference room and MCCDB (AC & DC) room, Office, Toilet wall, etc.

Antiskid vitrified tiles 600X600X12 mm for Toilet floor.

18 mm thick Granite for Staircase, Steps and Kitchen slab.

Acid proof tiles 300X300X12 mm for battery room and wall.

Toilet wall ceramic tiles 300X450X12 mm.

Chequered terrazo tiles 22mm thick for Ramp and slope surface.

Walls

Control room buildings shall have framed superstructure. All walls shall be non-load bearing walls. Minimum thickness of outer walls shall be 230 mm and inner wall should be 125 mm with brick work (ACC Block) jointing Mortar or as specified by the Employer 1:4 cement sand mortar. A 50 mm thick DPC shall be provided at plinth level before starting masonary work.

Plastering

All internal walls shall have minimum 15 mm thick 1:4 cement sand plaster. The ceiling shall have 10 mm thick 1:4 cement sand plaster.

External Finish

All external surfaces shall have painted with weather proof synthetic paints over 20 mm thick cement sand plaster in two layers.

All ceilings shall be white based plastic emulsion paints and the internal walls are also to be provided with plastic emulsion synthetic paints. The outer of the building shall be provided with weather seal coats of synthetic paints.

One coat of Cement Primer has to applied after the Putty works.

Painting details:

Following colour paints of M/s Berger paints India Ltd., M/s Asian Paints India Ltd. & M/s Kansai Nerolac Paints Ltd. Or equivalent brand with specified standards are to be followed for all type of buildings.

Sl. No.	Decsription	Berger Paints	Asian Paints	Nerolac Paints
1	Interior wall	3P 0778- Soft Light (Easy Clean)	7907-Candle Wick (AP Royale)	2016P- Lemon balm (Lotus Touch)
2	Exterior wall (body)	2P 0229-Calming Touch (Weather Coat Smooth)	8564- Sweet Dreams (Apex)	4051- Lightest Peach (Excel)
3	Exterior wall (border)	2A 0232- Cookie Crisp (Weather Coat Smooth)	8645-Rich Chocolate (Apex)	2798C- Kitty Kat (Excel)

The following procedure need be adopted for maintaining optimum quality & durability in painting the walls (both internal & external walls).

Internal wall:

The walls are to be applied with 2 coats of water proof putty (JK/ Birla/ Bison make or equivalent) of minimum 2 mm of thickness. After the first coat is applied, minimum of 2 days may be spared for drying up the wall. Then the second coat may be applied over the first coat so that 2mm thickness is achieved & uniformity is maintained.

After applying the second coat, another 2 days may be spared & then sand paper is to be applied to remove the undulation of the wall.

White primer (water thin-able / solvent thin-able) of two coat (Berger/Nerolac/ Asian Paints or equivalent) is to be applied.

Then two coats of colour paints washable Acrlic emlusion paints are to be applied on the wall.

External wall:

The walls are to be applied with 2 coats of water proof putty (JK/ Birla/ Bison make or equivalent) of minimum 2 mm of thickness. After the first coat is applied, minimum of 2 days may be spared for drying up the wall. Then the second coat may be applied over the first coat so that 2mm thickness is achieved & uniformity is maintained.

Two coats of primer (Weather Coat) are to be applied.

Then two coats of Water proofing weather coat (Anti-fungal) need to be applied on the wall. The two coats should be applied with an minimum interval of 12 hours in between.

Roof wáter proofing and grading

Prepare the surface by thoroughly cleaning with wire brush followed by power washing making surface free from any foreign particles like dust, oil , Grease etc and allowing the surface to dry properly.

Apply water proofing system over the roof slab as specified below :

1mm thick single coat of Master Crete M-81 of Choksey Chemicals /Dr. Sealkit Sealcrete (Asian Chemicals)/ mixed with cement in the ratio 1:2 as a prime coat.

3mm thick Polymer modified mortar - Cement sand mortar (in prop 1:3) mixed with Master Crete M-81/Dr. Sealkit Sealcrete (Asian Chemicals) @ 15% by weight of cement.

1mm thick coat of Master Crete M-81 /Dr. Sealkit Sealcrete (Asian Chemicals) mixed with cement in the ratio 1:2 as final coat.

Over waterproofing layers provide concrete screed of average 30mm thick or as per drawings/ requirements in proportion 1:2:4 (1cement : 2fine aggregate : 4coarse aggregate) (by volume) with 10mm and down well graded aggregates and admixed with a normal plasticizer like Master Plast PL-1 of Choksey Chemicals /Dr. Sealkit Normal Plast (Asian Chemicals)/Rheomac 707 of BASF @ 0.3% by weight of cement and thereafter scoring the top surface of the concrete screed @ 200mm c/c as specified and directed by the Department.

The under bed shall be laid to provide an ultimate run off gradient of 1:120. The

extra heavy treatment shall be concrete based with water proof treatment as per the standard to protect the roof from damage due to water logging. Proper slope and adequate no of water drains outlets shall be provided for easy discharge of water from the roof. These drains shall be connected to the main drain. Roof treatment shall be done by authorized/certified personnel from the manufacturer. The warranty for the roof treatment should be submitted to EMPLOYER.

Glazing (glass)

Minimum thickness of glazing shall be 5 mm. The glazing for the control room area, which will be air-conditioned shall be provided with double toughened glass each of 5mm thickness. Frosted Glass for Toilets.

False Ceiling

False ceiling shall be provided for Control panel rooms in GIS buildings, control room building and administrative building, kiosk building, Lobby area for all residential buildings along with termal and sound insulation. The details for false ceiling to be provided shall be as below -

Provide Suspended Ceiling which includes Aluminium/G.I perimeter channels of size

0.55mm thick (having one flange of 20mm and another flange of 30mm and a web of 27mm) along with perimeter of ceiling, screw fixed to brick wall/ partition with the help of nylon sleeves and screws, at 610mm c/c. Then suspending G.I. intermediate channels of size 45mm (0.9mm thick with two equal flanges of 15mm each) from the soffit at 1220mm c/c with ceiling angle of width 25mmx10mmx0.55mm thick fixed to soffit with G.I.cleat and steel expansion fasteners. Ceiling section of 0.55mm thickness having knurled web of 51.5mm and two equal flanges of 26mm each with lips of 10.5mm are then fixed to the intermediate channel with the help of connecting clip and in direction perpendicular to the intermediate channel at 457mm c/c, 9.5mm/

12.5mm tapered edge Gypboard (conforming to IS:2095-1982) is then screw fixed to ceiling section with 25mm long drywall screws at 230mm c/c. Screw fixing is done mechanically either with screw driver or drilling machine with suitable attachment. Finally, the boards are to be jointed and finished so as to have a flush look which includes filling and finishing the tapered and square edges of the boards with jointing compound, joint paper tape and two coats of drywall topcoat suitable for Gypboard complete at all levels as specified and directed. (For light fittings, providing opening for doors, window, ventilators etc, cut out made with frame of perimeter channel supported suitably to be measured and paid separately where necessary). 12.5mm deep panels of approved colour with a recessed flange of 23.9mm roll formed out of

0.5mm thick aluminium alloy 5050/5052/3003 or equivalent, coated with

chromatised and stone enamelled on both sides, panels to be fixed on roll formed carriers 32 mm wide 39 mm deep out of minimum 0.9 mm thick aluminium alloy strip with cut outs to hold panels in a module of 100mm minimum at maximum 1.6 mc/c carrier suspended from roof by 4mm diameter galvanised steel wire rod hangers with special height adjustment springs/clips made out of spring steel at maximum spacing of 1.5 m c/c hangers fixed to roof, J'hooks and nylon insert including providing laying and fixing 25mm thick resin bonded mineral wool of approved quality, encased in 100 G black polythene and laid over top of places panels, all complete. The system is subject to approval by EMPLOYER before installation

Doors and Windows

Switchyard buildings and security booth

Providing, fitting and fixing Ivory powder coated aluminuim framed glazed doors with anodised aluminium frame made of 100mm x 45mm x 2.5mm section with door style of size

88mm x 45mm x 2.5mm, top rails 50mm x 45mm x 2mm lock rails 100mm x 45mm x 2mm and bottom rails 100mm x 45mm x 2.5mm fitted with glazing clip, special type rubber gasket complete including hydraulic floor spring, pivot, tower bolt in each leaf, aluminium door handle, lock, angles, cleat etc complete as specified and directed by the department at all levels. (i) 10 mm toughened glass

The doors and windows of the control room building, GIS building and security booth shall be of Ivory powder coated aluminium with M.S grill and all the frames of doors and windows shall also be the same as per the relevant IS Codes. Thickness of the aluminium section shall not be less then 2.0mm. Size and shapes shall be adequate for entering in to the room. The windows shall be of sliding type. The window sill shall be of 20mm granite.

Alumnium work for doors and windows, ventilators and partitions shall be provided and fixed in the building with extruded built up standard tubular and other sections approved make confirming to IS:733 and IS:1285,anodised transparent or dyed to required shade according to IS:1868 (minimum anodic coating of grade AC 15) fixed with rawl plugs and screws with fixing clips, or with expansion hold fastners including necessary filling up of gaps at junctions at top, bottom and sides with required PVC/neoprene felt etc and joined mechanically wherever required including cleat angle, Aluminium snap beading for glazing/panelling, C.P brass/stainless steel screws including glazing and fittings as specified.

Minimum section for aluminium doors & windows: Main outer size- 100mmX45mmX2.5mm; Horizontal & verical four track-100mmX45mmX2.5mm; Sliding shutter Horizontal & Vertical- 100mmX45mmX2.5mm;

Necessary hardware like locking arrangement with pin cylinder locks, dead locks, mortised locks, SS baby latch (occupied / vacant) SS push / pull or mortised handle, heavy quality hinges / pivot, concealed tower bolts, etc., of approved make & design. Floor springs and door closer shall be provided.

Residential buildings - All other quarter and hostel buildings shall have factory made wooden paneled doors with WPC chowkaths of size 150 x 75 mm and laminate. The thickness of the panel shall be 35mm. Flush door shutters of the solid core type with plywood face panels shall conform to IS: 2202 (Part 1) and with particle board/hard board face panels shall conform to IS: 2202 (Part 2).

Windows for all building shall be Ivory powder coated aluminum sliding windows and ventilators of standard sections as required complete as specified and directed for all levels. All window shall have sliding panel of mosquito proof net made of carbon fiber.

The window grill shall be made of: outer frame and two (2) intermediate vertical frame made of 50X25X1.5 mm MS tube, horizontal member 16mm round bar @ 100 mm centre to centre. Finishing with primer and enamel paint.

Proper locking arrangement with stoppers to be provided on the door and windows. Care should be taken while designing the grill frame that the entering of cat should be restricted.

Plumbing And Sanitation

Sanitation and plumbing shall be done as per requirement as complete. CPVC pipe shall be used for internal piping works for portable water supply. Any item required other than those mentioned below for completing the job shall be provided by EPC without an additional cost.

Each toilet shall have the following minimum fittings

All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufactures. All items brought to site must bear identification marks of the type of the Manufacturer. All sanitary and plumbing Works shall be done such that the pipelines are taken via outer wall and internal/concealed piping shall be avoided as far as possible.

	Items
1.	Providing and fixing white vitreous china pedestal type water closet (European type) with seat and lid, 10 litre low level white vitreous china flushing cistern & C.P. flush bend with fittings & C.I. brackets, 40 mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required : 1W.C . pan with ISI marked white solid plastic seat and lid
2.	Providing and fixing white vitreous china flat back or wall corner type lipped front urinal basin of 430x260x350mm and 430x410x265mm sizes respectively with automatic flushing cistern with standard flush pipe and CP brass spreaders with brass unios and GI clamps complete including painting of fitting and bracketscutting and making good the walls and floors wherever required One urinal basin with 5 ltr white PVC automatic flushing cistern. For ladies toilet Indian WC shall be provided.
3.	Providing and fixing wash basin with CI brackets 15mm CP brass pillar taps 32mm CP brass waste of standard pattern including painting of fittings and brackets cutting and making good the walls wherever require White vitreous china wash basin size 630x450mm with a pair of 15 mm CP brass pillar taps
4.	Providing and fixing 600x450mm beveled edge mirror of superior glass (of approved quality) complete with6mm thick hard board ground fixed to wooden cleats with CP brass screws and washers complete
5.	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink as per IS:13983 with C.I. brackets and stainless steel plug 40 mm, including painting of fittings and brackets, cutting and making good the walls whereverrequired: 610x510 mm bowl depth 200 mm
6.	Providing and fixing PTMT swivelling shower, 15 mm nominal bore, weighing not less than 40gms
7.	Providing and fixing PTMT soap Dish Holder having length of 138mm, breadth 102mm, height of 75mm withconcealed fitting arrangements, weighing not less than 106 gms.
8.	Providing and fixing PTMT towel rail and hanger complete with brackets fixed to wooden cleats with CP brass screws with concealed fittings arrangement of approved quality and colour. 600 mm long towel rail with total length of 645 mm, width 78 mm and effective height of 88 mm, weighing not less than 190 gms.
9.	Supplying fitting and fixing supreme brand / Prince brand or similar approved C.P.V.C. Pipes of following

Building storm water drainage

The building design shall provide for the collection of storm water from the roofs. This water shall be collected in junction boxes and these boxes shall drain to the main drainage system of the station.

110 mm nominal dia PVC pipe rain water of 6kg shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work of cement concrete or cladding material. The number and size of down comers shall be governed by IS:1742 and IS:2527.

All drains inside the buildings shall have minimum 40 mm thick grating covers and in areas subject to movement heavy equipment loads, precast RCC covers shall be provided in place of steel grating.

For all buildings, suitable arrangement for draining water collected from equipment blow downs, leakages, floor washings, firefighting etc. shall be provided for each floor.

Plinth Protection

Entire area around the control room building (outside) shall be provided with PCC paving starting from the building upto 1 mtrs clear distance for the full length of the building. The above specified PCC paving shall be with M20 mix grade concrete over suitable under bed arrangement as specified for other ground floor slab.Above the PCC paving suitable Cement pavers chequered plate of size as per the standard to be provided. The colour of the chequered plate shall be fixed over the PCC paving by using cement mortar and the colour of such plate shall be red.

The cable vault below the main control room shall have 50 mm thick smooth floor finish units of cement concrete.

Staircase - Staircase of all type of buildings shall have stainless steel pf 304 grade in hand railing using 50mm dia of 2mm thick circular pipe with balustrade of size 32mmx32mmx32mm @0.90mtr C/C and stainless square pipe bracing of size 32mmx32mmx32mm in three rows in staircase as per approved design and specification, buffing, polishing.

All stairs shall have maximum riser height of 150 mm and a minimum tread width of 250 mm. Minimum width of stairs shall be 1200 mm. There shall be provision of staircase to the roof of the building.

Illumination System

The Contractor shall design, supply and install illumination system for the entire substation. The average illumination level and limiting glare index for different parts of the substation shall be as follows.

Sl. No	Location/ Area	Average Illumination Level, 'Lux'	Limiting Glare Index
1.	GIS hall	300	19
2.	Control Room	300	19
3.	Battery Room	100	19
4.	Carrier Room	300	-
5.	Office/Conference Room	300	-
6.	Stairs and Corridors	100	-
7.	Outdoor Switchyard	20	-
8.	Road	20	-
9.	Store Room	100	-

The lighting system of a particular área whether indoor or outdoor shall be designed such a way that uniform illumination leve lis achieved. In outdoor swithcyard illumination shall be aimed as far as posible towards transformenrs, circuit breakers, isolators, etc. Typw of lamp used shall be LED. Provisions shall be made in switchyard Steel structures for mounting of lamps for switchyard.

Internal Electrification

It is in the scope of the contractor to design, instalkl and commisioning of the complete electrification scheme of buildings. Some of the general requirements of the internal electrification Works are as follows:

The internal electrification Works shall be carried out in concealed wiring system with rigid conduits and 1.1 kV grade PVC insulated, stranded copper conductors.

Illumination level and type of lighting in various locations shall be as specified.

Sufficient numbers of 3 pin 6 ampere and 16 amppere sockets shall be provided at various locations as directed by the Employer.

No re-wire able fuses shall be used in electrical distribution circuits, instead sufficient numbers of MCBs of short circuitrating of not less than 10 KA should be provided.

In conceal wiring the earth wire shall be 1.1 kV grade PVC insulated, stranded copper conductor.

Items	Unit	Quantity							
		RE's Residenc e	Officers Hostel	Staff Hostel	Security Barrack	Store Room	Guard Room	Transit Camp	
Light & fan Point (First Point)	No.	8	18	16	18	4	4	4	
Light & fan Point (second Point)	No.	22	50	64	50	16	14	10	
Call bell point including MS Box of Size 18 0mmx100mmx 60mm deep for Call bell	No.	2	2	2	2	2	2	4	
3 pin 6 amp plug point including earthing the 3rd pin (power Point)	No.	5	10	8	10	4	4	4	
3 pin 16 amp plug point including earthing the 3rd pin (power Point)	No.	4	7	8	7	1	1	2	

Items	Unit	Quantity							
Supply & erection of PVC Copper insulated & sheathed 2 Wire circular flexible wire size 4Sq.mm(power point)	Job		1	1	1	1	1	1	
Supply & erection of PVC Copper insulated & sheathed 2 Wire circular flexible wire size 2.50 Sq.mm(power point)	Job	1							
Supply & erection of PVC sheathed copper conductor cable single core 1100V grade in sizing 6 Sq mm (AC Point)	Job		1	1	1	1	1		

Items	Unit	Quantity							
		RE's Residenc e	Officers Hostel	Staff Hostel	Security Barrack	Store Room	Guard Room	Transit Camp	
Supply & erection of PVC sheathed copper conductor cable single core 1100V grade in sizing 4Sq mm (AC Point)	Job	1							
Supply & erection of 25 Amp DP MCCB (AC point)	No.	5	8	7	8	1	1		
supply & erection of 16 AmpDPMCCB (Exhaust fan point)	No.								
Supply & erection of sheet steel enclosure distri butionboard suitable for MCB,s etc on wall with rag bolts - 12 Way (Three Pole) Including SPMCB 10 No 6-32A & incomer DPMCB 63 A	No.	1	1	1	1	1	1	2	

Items	Unit	Quantity							
Supply & erection of MCCB on wall or on pedestal including bonding to earth & necessary connections-200Amp,415 V ,3phase	No.	1	1	1	1	1			
Supply & erection of MCB in existing distributionboard includingmaking connection complete with									
16 Amps SPMCB	No.	10	20	16	20	6	6	6	
25 Amps SPMCB	No.	9	17	12	17	6	5	4	
40 Amps DP MCB	No.	1	2	1	2	1	2	2	
63 Amps FPMCB	No.	1							
Call bell 220/230V with double coil	No.	2	2	2	2	2	2		
Bell Push	No.	2	2	2	2	2	2	4	
Supply & erection of 10.5cm dia MS Fan boxes	No.	6	10	10	10	2	2	4	
Supply & erection of 9W LED	No.	16	16	28	16	2	2	4	

Items	Unit	Quantity							
		RE's Residenc e	Officers Hostel	Staff Hostel	Security Barrack	Store Room	Guard Room	Transit Camp	
Supply&erection 2x24W led tube light	No.	2	4	4	4	5	5	4	
Supply & erection 5w led light	No.	2	15	24	15	4	4	2	
Supply & erection 12w led light	No.	2	10	5	10	5	10		
Ceiling Fans,1400mm Sweep (USHA/CGL)	No.	6	10	10	10	2	2	4	
Exhaust Fans	No.	5	6	8	6	2	4	2	
Industrial Power Socket 32 Amps	No.	1	4	2	4	1	1	2	
Industrial type Exhaust Fans, 1400 RPM,18 Inches	No.								

Items	Unit	Quantity							
Cable from ACDB to distribution board Al (4C x 35 sq mm)	Job	1	1	1	1	1	1	1	

Furniture

Supply and isntallation of all furniture and TV shall be as per the following table -

Sl. No	Items for	Item Description	Qty	Unit
1.	Bed (5'x7') for officer's hostel, staff hostel, transit camp & RE residence	Providing, assembling and placing of Metal double bed with min. dimensions of - H:66cm, L: 203cm, W: 157cm (26 inches x 79.9 inches x 61.8 inches)Headboard H: 45cm, Headboard W: 152cm (17.7 inches x 59.8 inches). The material shall be Teak wood or sheesham wood.	17	Each
2.	Bed (4'x6'5") for house keeping	Providing, assembling and placing of Metal double bed with min. dimensions of - H: 29cm, L: 188cm, W: 97cm (11.4 inches x 74.0 inches x 38.1 inches) Headboard H: 45cm, Headboard W: 91.5cm (17.7 inches x 36.0 inches). The material shall be Teak wood or sheesham wood.	3	Each
3.	Bed(4'x6'10")for security barrack	Providing, assembling and placing of Metal double bed with min. dimensions of - H: 29cm, L: 188cm, W: 97cm (11.4 inches x 74.0 inches x 38.1 inches) Headboard H: 45cm, Headboard W: 91.5cm (17.7 inches x 36.0 inches). The material shall be Teak wood or sheesham wood.	6	Each
4.	Almirah (4'x2'x6') for officer's hostel, staff hostel, transit camp & RE residence, security barrack, store room	Providing and placing of Double door powder coated CRCA steel almirah with 18 gauge steel and min. dimension in cm 91.6 x 198 x 48.6. The Almirah shall have minimum 5 nos. of shelves, an attached mirror and a secure locking mechanism.	34	Each
5.	Almirah (4'x2'x6') for DGM, AGM	Providing and placing of Double door powder coated CRCA steel almirah with min. 18 gauge steel and with min. Dimension in cm 91.6 x 198 x 48.6. The Almirah shall have minimum 5 nos. of shelves, an elevated base and a secure locking	3	Each

Sl. No	Items for	Item Description	Qty	Unit
		mechanism.		
6.	Bed Side Table for officer's hostel, staff hostel, transit camp & RE residence	Providing, assembling and placing of Bedside table made of sheesham wood with min. Dimension of (in cm) 45.7 L X 38.1 W X 40.6 H. The table shall be closed type with min. 2 Nos. of drawers.	34	Each

Sl. No	Items for	Item Description	Qty	Unit
7.	Table (3'x4') for officer's hostel, staff hostel, transit camp & RE residence, security barrack, store room, guard room	Providing, assembling and placing of study table made of sheesham wood and min. Dimension of Length = 120cm, Width = 60cm, Height = 79.5cm (47.2 inches x 23.6 inches x 31.3 inches). The hardware shall be of 18-inch telescopic Channels, stainless steel handles, hinges, screws, and dowels. The table shall have min. 1 No. of drawer. and a closed compartment.	25	Each
8.	Table (4'x6') for DGM, AGM	Providing, assembling and placing of executive office table made of Engineered Wood and min. Dimension of 220cm (L), 150 cm (W), Height = 75 cm. The table shall have min. 3 Nos. of drawer. and a closed compartment.	3	Each
9.	Executive Chair for DGM	Providing and placing of premium quality chair with High Back Chair, PU Arm, Chrome Plated Metal Frame & Base, Gas Lift with 360o revolving mechanism, Leatherette Tapestry	1	Each
10.	Executive Chair for AGM	Providing and placing of premium quality chair with TYPE/MECHANISM: Synchro Tilt Medium Back Chair , PP Adjustable Arm , Chrome Plated Metal Base, Gas lift Synchro Tilt Mechanism Seat .	2	Each
11.	Visitor Chair	Providing and placing of premium quality visitor's chair with Medium Back, PU Arm, Chrome Plated Frame, Leatherette Tapestry.	50	Each
12.	Sofa Set (3+1+1)	Providing and placing of premium quality 3 Seater Sofa for guest with min. dimension of Length - 204.9 cm, Width - 79.2 cm , Height - 77.9 cm (80.7 inches x31.2 inches x 30.7 inches) for 3 seater and Length - 92.9 cm, Width - 79.2 cm, Height - 77.9 cm (36.6 inches x 31.2 inches x 30.7 inches) for single seater. Sofa With Wooden Frame, seat fill material of foam and seat material shall be fabric.	5	Each
13.	Centre table	Providing and placing of premium quality Centre Table made of engineering wood, Tempered Glass top ,min. Size In MM 991(L) 600(D) 400(H),	5	Each

Sl. No	Items for	Item Description	Qty	Unit
14.	Dinning Table (6 Seater)	Providing and placing of premium quality 6 seater Dining Table including chairs with understructure of both table and chair made of solid rubberwood, Medium-Density Fibreboard (MDF) Tabletop with 19 cm thickness, Size of table In MM 1500(L) 900(W) 750(H), Size of chairs in mm 430(L) 563(W) 930(H). Chairs shall have Upholstery in cushion type.	4	Each
15.	Dinning Table (4 Seater)	Providing and placing of premium quality 4 seater Dining Table including chairs with Understructure of both table and chair made of solid rubberwood, Medium-Density Fibreboard (MDF) Tabletop with 19 cm thickness,	1	Each

Sl. No	Items for	Item Description	Qty	Unit
		Size of table In MM 1140(L) 700(W) 750(H), Size of chairs in mm 430(L) 563(W) 930(H). Chairs shall have Upholstery in cushion type.		
16.	Computer Table for DGM, AGM	Main table should be rectangular and of size 1500 mm (W) X 750 mm (D). Shall be made of 18 mm thick engineered wood. KBPT used should have a sliding mouse pad tray.	3	Each
17.	Meeting room table (3'x12') 10 seater with chair	Providing and placing of 10 seater conference table with min. dimension of 3000 (L) x 1200 (W) x 760 (H) mm and with a min. of 3 intermediate supports. Material shall be min. 18 mm thick MDF board with laminate. The table shall have min. 2 wire management grommet and min. 4 nos. 16 Amps power socket provision. Chairs shall be of premium quality with High Back, PU Arm, Chrome Plated Metal Frame & Base, Gas Lift with 360o revolving mechanism and Leatherette Tapestry	1	Each
18.	Workstation Table	Providing and placing of workstation table with min. dimension of 1500 (W) x 750 (D) x 750 (H) mm. Material shall be particle board. Storage in three drawer option on one side and the other of size 355.5 (W) x 559(D) x 433.5 (H) mm in one box and one drawer option on the other side.	9	Each
19.	Workstation Chair	Providing and placing of chair for workstation with TYPE/MECHANISM: Medium Back Chair, Chrome Plated pipe frame, material of Upholstery in leatherette type	9	Each

Sl. No	Items for	Item Description	Qty	Unit
20.	Workstation Almirah	Internal Size of Almirah: 1850 (H) X 900 (W) X 450 (D) mm Leg Size of Almirah: 150 (H) X 120 (W) X 450 (D) mm Rack with 5 Compartments of 4 no. of shelves. Standard lock and 2 sets of keys. The thickness of the Almirah sheet shall be 18 SWG. The body of the Almirah shall be manufactured from cold rolled MS sheet (C. R. Sheet) with Antirust treatment and shall be finished with powder coating. The quality of used M.S sheet for making Almirah shall be free from any pitting and corrosion etc. H/D Rubber bushes shall be provided to the bottom of legs of Almirah.	8	Each
21.	Steel book case for record room	914 (W) x 320 (D) x 1742 (H) mm min. dimension. Providing and placing of steel bookcase made of Sheet CR prime 0.80 mm thick Confirming to IS-513. Compartment- 4 no. Six leaver locks of high quality in each shutter operated by one key, supplied with key ring. Chrome plated, metallic handles two nos, on each shutter from outside. Plane glass, 4mm thick in each shutter fitted in suitable frame from inside. Shutter sliding on ball bearing, two nos. in each door with suitable system / double roller system.	3	Each

Sl. No	Items for	Item Description	Qty	Unit
22.	Meeting Room TV	Providing and placing of Sony Bravia 164 cm (65 inches) 4K Ultra HD Smart LED TV Specifications: (i) Supports Wifi, bluetooth, USB, HDMI Media Format: AVI, Blu-ray, DVD, MPEG, WAV, WMA Supported Audio Format: Mp3_audio, Wma	1	Each
23.	Smart TV for officer’s hostel, staff hostel, security barrack, RE residence, transit camp, visitor’s lounge	Providing and placing of Sony Bravia 108 cm (43 inches) Full HD Smart LED TV Specification: (i) Supports Wifi, bluetooth, USB, HDMI Resolution: 1080p Media Format: AVI, Blu-ray, DVD, MPEG, WAV, WMA Supported Audio Format: Mp3_audio, Wma	11	Each
24.	Modular TV unit for setup	Providing, fitting, fixing and placing of Tv unit made of engineered wood with min. Dimension in cm 152.4 L X 45.7 W X 50.8 H. The unit shall have min. 2 drawers on one side and closed type storage on other side.	12	Each

b) MISCELLANEOUS GENERAL REQUIREMENTS

Dense concrete with controlled water cement ratio, preferably 0.45, shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness. All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with general bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm. All steel sections and fabricated structures which are required to be transported by sea shall be provided with anti- corrosives paint. All mild steel parts used in the water retaining structure shall be hot-dip galvanised. The minimum coating of the zinc shall be 750 gm/sq.m. for galvanised structures and shall comply with IS:2629 and IS:2633. Galvanizing shall be checked and tested in accordance with IS:2629. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen. A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS:456- 1978, shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures. Bricks having minimum 75kg/sq.cm compressive strength can only be used for masonry work. Bidder shall ascertain himself at site regarding the availability of bricks of minimum 75kg/ sq.cm compressive strength before submitting his offer. Monorails, monorail girders and fixtures shall be provided, wherever required. Doors and windows on external walls of buildings other than areas provided with insulated metal claddings shall be provided with a RCC sun- shade over the openings with 300 mm projection on either side of the openings. Projection of sunshade/chajja from the wall shall be minimum 450 mm over window openings and 750 mm over door openings. All slabs shall be extended by 600 from the wall and parapet wall shall be on the Edge of the slab. All balconies shall be covered from rain by extending the roof slab on upper level.

Drainage hole shall be provided in the roof slabs such that the pipes for rain waiter drainage can be fitted to these holes and cladded to the building wall without bends. The columns in all buildings shall be extended by 750 mm above roof slab level to keep provision for future extension. Irrespective of drawing the mumty height shall be kept at the same level as the previous floor height .

Angles of 50x50x6 mm minimum with lugs shall be provided for edge protection all round cut out and openings in floor slab, edges of drains with grating covers, edges of RCC cable/pipe trenches with covers, edges of manholes with covers, edges of precast covers and any other place where breakage of corners of concrete is expected.

Anti-termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS:6313 and other relevant Indian Standards.

Hand railing of a minimum height of 900 mm shall be provided around all floor or roof openings, projections and balconies walkways, platforms, steel stairs etc. All handrails and ladder pipes shall be the railing of the staircase shall be made of proper aluminium sections.

AUTO TRANSFORMER / REACTOR & EQUIPMENT FOUNDATIONS

General - The Contractor shall provide a permanent transfer track system integrated with the auto transformer foundation to enable installation and the replacement of any failed unit with a spare unit. The transfer track system shall be suitable to permit the movement of any failed unit fully assembled (including OLTC, bushings) with integral radiators and oil, without the de-energization of any other equipment in the station. The system shall enable the removal of any failed unit from its foundation to a repair area and the installation of a spare unit. The system shall not interfere with the normal internal road and trench system. If trench or drain crossings are required, then suitable R.C.C culverts shall be provided in accordance with IRC Code and /or relevant IS.

Oil Recovery System

General

An oil recovery system shall be provided for all transformers (containing insulating oil or any flammable or polluting liquid) in order to avoid spread of fire by the oil, and for environmental protection.

Description

Each auto transformer/transformer including oil conservator tank and cooler banks etc. shall be placed in a transformer pit surrounded by retaining walls (pit walls). The clear distance of the retaining wall from the transformer shall be 20% of the transformer height or 0.8 m whichever is greater. The transformer pit thus formed shall have a capacity equal to volume of oil, usually 125%, in the transformers. The MS grating placed at the formation level shall be covered with 100mm thick gravel of 40 mm nominal size which acts as an extinguisher for flaming oil. The bottom of the pit shall have an uniform slope towards the sump pit.

Each transformer pit shall be drained towards a common sump pit whose role is to recover the infiltrating water and the drained oil from of the pit. The sump pit shall have sufficient capacity to receive, without overflowing, the oil content of large transformers plus the water content of any fixed firefighting system and a certain quantity of rainwater collected from the pit connected to it. The system shall be provided with air vents large enough to avoid over-pressure during operation. The whole internal surface of the sump pit

should be impermeable.

Materials

The retaining walls which make up the transformer pit shall be made of fire- resistant material such as reinforced cement concrete, fire brick etc., and shall be impervious to oil.

The minimum height of the retaining walls shall be 15 cm above the finished level of the ground to avoid ingress of water from outside.

The floor of the transformer pit shall be of plain cement concrete of concrete grade 1:2:4.

Drainage

A device showing level of sump pit shall be fitted along with an automatic pumping system which shall have sufficient capacity to evacuate the fire fighting and rainwater from the sump pit. The water/oil separation and drainage scheme shall be provided as described in the paper (23-07/1972 Cigre Session) presented by working group 23.04 regarding oil pollution. The Contractor may propose an alternative better scheme, which will be subject to the approval of EMPLOYER.

Particular Specification

If the height of the retaining walls which form the transformer pit exceed 60 cm, steps shall be provided to facilitate access to the transformer or auto transformer and reactor.

When designing the transformer pit, the movement of the auto transformer must be taken into account.

It must be assured that the coefficient of crushed stone (granular material) penetration which fills the transformer pit will be retained regardless of the climatic conditions

RAIL TRACK / ROAD CUM RAIL TRACK

Rail tracks shall be of RCC, M20 (1:1.5:3 mix) grade. The space between the tracks shall be suitably filled with local sand and 75 mm thick PCC of grade 1:3:6 placed over sand filling. The top of PCC shall be up to the formation level. In case of road cum rail track, 75mm thick PCC of grade 1:1.5:3 shall be placed up to the road level. Suitable drainage system between the tracks shall be provided.

The rails shall be first quality 52 kg/m medium manganese steel as per Indian Railway specification T-12-64 and its subsequent revision, joined together by fish plates as per Indian Railway specification T-1/57, and 27 mm diameter fish bolts.

A pylon support system shall be provided for supporting the firefighting system by the Contractor.

For design of foundation for transformer refer the weightage of the transformer indicated in the BPS (civil works)

FIRE PROTECTION WALLS

General

Fire protection walls shall be provided in accordance with as per IS 1646:2015 recommendations.

Application criteria

A fire wall shall be erected between the transformers and or the reactors if the free distance between the various pieces of equipment is less than 10 m, to protect each one from the effects of fire on another.

Fire walls shall also be erected between the transformers, reactors, and auxiliary services transformers if the free distance is less than ten meters.

Fire resistance

The fire wall shall have a minimum fire resistance of three hours. Partitions which are made to reduce the noise level of the transformers shall have the same fire resistance where they are also used as fire walls. The walls of buildings which are used as fire walls, shall also have a minimum fire resistance of three hours.

Fire walls shall be designed in order to protect against the effect of radiant heat and flying debris from an adjacent fire. The column of the fire walls shall be type be RCC, M20 (1:1.5:3 mix).

Mechanical resistance

Fire walls shall have the mechanical resistance to withstand local atmospheric conditions. If the wall is intended to serve as a support for equipment such as insulators etc., its mechanical rigidity must be increased accordingly.

Connecting the walls by steel or other structures, which may produce a reversing torque if overheated, shall be avoided.

Dimensions

Fire walls shall extend at least two metres on each side of the power transformers or reactors and at least one metre above the conservator tank or safety vent.

These dimensions might be reduced in special cases, and if TAC permits so, where there is lack of space. A minimum of two metres clearance shall be provided between the euqipments e.g. reactors, transformers and fire walls.

Building walls which act as fire walls shall extend at least one metre above the roof in order to protect it.

Materials

Fire walls shall be made of Reinforced Cement Concrete (RCC of M20 grade) only. Materials used must conform to the standards of the National Fire Prevention Association and TAC norms.

CABLE AND PIPE TRENCHES

General

Drawing for cable trench is attached with this bid document.

Cable trenches and pre-cast removable RCC covers (with lifting arrangement) shall be constructed using RCC of M20 grade.

The cable trenches shall be designed for the following loads.

Cable trench covers shall be designed for (i) self-weight of top slab plus concentrated load of 200 kg at centre of span on each panel and a surcharge load of 2 tonnes per sq. metre.

Cable trench crossings of road and rails shall be designed for class AA, class A and class 7OR loading of IRC or relevant IS Code and should be checked for transformer loading.

Trenches shall be drained. Necessary sumps be constructed, and sump pumps shall be supplied. Cable trenches shall not be used as storm water drains.

The top of trenches shall be kept at least 300 mm above the finished ground level. The top of cable trench shall be such that the surface rainwater does not enter the trench.

All metal parts inside the trench shall be connected to the earthing system.

Cables from trench to equipment shall run in hard conduit pipes (HDPE pipe, ends and sockets). A suitable clear gap shall be maintained between trench walls and foundations.

A clear (vertical) space of at least 300 mm shall be available for each tier in cable trench. From trench bed to lowest tier, a minimum clearance of 200 mm shall be available for one tier trench and 300 mm for trenches having more than one tier. The spacing between stands shall be 400mm.

The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.

All construction joints of cable trenches i.e. between base slab to base slab and the junction of vertical wall to base slab, as well as from vertical wall to wall, and all expansion joints shall be provided with approved quality PVC water stops of approximately 230 x 5 mm size for those sections where the ground water table is expected to rise above the junction of base slab and vertical wall of cable trenches.

Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12mm thick 1:6 cement sand mortar.

Cable tray supports (all galvanized structures) shall be designed and constructed to be a single complete fabrication or assembly such that every layer of the horizontal cable tray supports is fixed, either bolted or welded, to a vertical steel support that is embedded in the concrete wall of the cable trough. It shall not be permitted to embed a horizontal support beam directly into the wall of the trough in order to use the concrete wall as a means of load bearing.

Concrete troughs shall be provided with concrete covers of suitable load bearing strength. Where the cable troughs are run across or within 3 m of substation roads, the trough covers shall be capable of bearing an accidental wheel load of 20 kN.

The covers for the cable trench inside the control room shall be provided with MS chequered plate with MS angle stiffeners at the bottom for proper mechanical strength.

ExcavationExcavation for cable ducts shall generally be carried out in accordance with specification.

Back fill

Except where ducts are to be encased in concrete, sand is to be packed and well tamped round the duct until it is covered to a depth of 75 mm above the upper surface of the duct. Filling above this level is to be with suitable excavated material free from large stones. In multiple duct runs the interstices between the ducts are to be filled with sand and compacted. A cover of 75 mm above the uppermost ducts shall be maintained. The sand used shall be the same quality as approved for use in making concrete.

Laying of ducts

Telephone and electrical cable ducts shall be laid and jointed in accordance with the Manufacturer’s instructions.

Multiple runs to ducts

Electrical cable ducts in multiple runs whether encased in concrete or not, shall be laid at approved centres vertically and/or horizontally. The minimum concrete encasement where required is to be 150 mm. The final jointing of ducts in multiple runs shall be done in the trench, i.e. the duct shall be lowered and jointed singly not in groups, and duct joints shall be staggered by approximately half the duct length in alternate lines.

Cutting of ducts

The Contractor shall carry out any necessary cutting of pipe ducts according to the requirements of the work. Except where ducts enter the cable trench at an angle, they shall be cut at right angles to the length of the duct. The inside edges of cut ducts shall be thoroughly rounded off or so dressed before being placed in position so that there can be no possibility of damage to cables from the edges of the ducts. All electrical ducts entering draw pits shall be provided with suitable bell mouths.

Cleaning and testing of ducts

On completion of all electrical cable ducting, two mops of appropriate size connected one to each end of an iron mandrel shall be passed twice through each way to clean the conduit and to remove any foreign matter which may have entered. If any obstruction or other defect be discovered, it shall be removed or rectified forthwith.

Sealing of electrical ducts

As soon as every duct or set of ducts has been proved and its draw wire material installed, the ends of the cut or its bell mouth where provided, shall be sealed to a depth of 5 mm with an appropriate sealer, and a single coat of bitumastic paint shall then be applied over the end of the ducts and the seal. The length of draw wire installed shall be such that at least one metre of draw wire extends from each end of each duct. After the ends of ducts have been sealed the free ends of draw wires shall be neatly coiled.

Concrete cable and pipe trenches

In-situ concrete trenches are to be provided inside and outside the Substation. The trenches are to have falls in the floor and must be drained at regular intervals. All trenches must have trench covers suitable for their location and loading. Any beams or supporting covers must be as shallow as possible to avoid interfering with the pipes and cables in the trench. Once the trench covers have been made they are to be stored and not laid until all trench cabling, piping, etc. is finished. Any covers laid before this time which become damaged shall be replaced at the Contractor’s expense. Trench covers and bridging beams for covers, except where heavy duty, shall be light enough for two men to lift.

Buried cables

Cables are to be laid in neat lines and at suitable levels. Their depth below ground level will depend upon the voltage associated with the cables but in all cases the excavation must provide a clear trench. Sand filling below, around and above the cables will always be required and protection covers or tiles will be placed in position over the sand filling before final backfilling to the ground level. The line of the cable trenches shall be marked with suitable posts as required by relevant section of this Specification.

SEWAGE SYSTEM & STORM WATER DRAIN

Sewage System - A sewage system shall be provided for all utility buildings including the Control room building and other auxiliary buildings. The Contractor shall construct suitable septic tank (capacity 30 user minimum) and soak pit for the discharge of effluents. Sewers shall be designed for a minimum self-cleansing velocity of 0.6m/sec and the maximum velocity shall not exceed 2.4m/sec.

The sewage system shall consist of all necessary piping, pumps, if required, fittings, manholes, clean - outs, piping connections and all other materials required for safe and efficient sewage collection. Sewer pipes and fittings shall conform to the relevant Indian Standards.

UPVC pipes shall be used below ground level for sewage disposal.

Storm Water Drain

Storm Water drainage system shall be provided along both side of the road as well as surrounding the campus and switchyard. The Contractor shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains etc.) to accommodate the most intense rainfall that is likely to occur over the catchment area in one-hour period on an average of once per ten years. The surfaces of the site shall be sloped to prevent the ponding of water. The bottom of the drain should be minimum 600mm wide. The side wall should be minimum 2:1 slope. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and

1.8m/sec respectively. However, minimum non silting velocity of 0.6m/sec shall be ensured. Longitudinal bed slope not milder than 1:500 shall be provided. For design of RCC box culvert for drains and culverts, IS 456 and IS 783 shall be followed. The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc., to prevent erosion of material by water. The drainage system shall be adequate without the use of cable or pipe trenches. For road crossings RCC box culvert shall be provided. Manholes shall be provided at 30 m intervals, at connection points and at every change of alignment. All manholes deeper than 1.2 m shall be provided

with galvanized M.S. footrests. Footrests shall be of 20 mm M.S. square bars. Open surface drains shall be of RCC (1:1.5:3) type. Design and drawings shall have the approval of EMPLOYER. For expansive soils, the guidelines of IS 9451 shall be followed. Suitable expansion joints shall be provided as per standard. In general, all plant effluent drainage shall be through buried concrete pipes and all storm water drainage shall be through open drains/pipe drains. Open storm water drains shall be provided on both sides of the roads and shall be designed to drain the road surface as well as all the free and covered areas. Pipe drains shall be connected through manholes at an interval of maximum 30 m. Plant effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for their final disposal. Invert of the drainage system shall be decided in such a way that the water

can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location and approved by EMPLOYER. Pumping of drainage water, if required, shall be provided by Contractor. All internal site drainage systems, including the final connection and disposal to Authorized representative of EMPLOYER acceptance points shall be part of Contractor`s scope including all required civil work, mechanical and electrical systems. The Contractor shall connect his drain(s) at one or more points.

Precast manholes shall be preferred against cast-in-situ type. The drainage scheme may either employ open drain system or underground pipe system or a combination of both. A manhole shall be provided at every turn or corner in case of underground type in addition to the normal requirement.

Suitable pumping arrangement shall be provided by the Contractor to pump out the water from sump to the open channel; automatic float valve type pump shall be provided and installed by Contractor.

The Contractor shall locate the outfall point outside the substation vicinity and the substation storm drainage must be connected to this point.

The drainage scheme and associated drawings shall be subject to approval of EMPLOYER.

Excavation and backfill

Trench excavations for drains shall be carried out with the minimum disturbance to adjacent ground and in such a way that existing or new work shall not be undermined. No backfill shall be placed until pipes, etc. have been inspected, tested and approved. Backfill shall be carefully placed by hand tools round pipes, etc. and rammed in layers not exceeding one hundred (100) millimetres thick in a manner which will not cause damage. When a minimum thickness of three hundred (300) millimetres above the pipes has been so placed, normal methods of backfilling and ramming may be adopted.

Laying Of Pipes

Pipes and fittings shall be of the types, qualities and sizes specified and shown on the approved drawings. They shall be laid to the lines and levels shown, and the barrel of each pipe shall bear firmly and uniformly on the trench bottom or prepared foundation bed, any projections in the trench bottom which could cause damage to pipes being first removed. Pipes shall be kept clean during and after laying, and open ends shall be provided with the temporary plugs to prevent entry of foreign matter. Each pipe shall be accurately bonded to gradient between sight rails and drain. Laying shall commence at the lowest end and proceed uphill. Pipes shall be laid with the sockets leading uphill.

Testing of drains

All drains, other than open channels, stone filled drains and porous drains, shall be of watertight construction, and all soil drains shall be subjected to a water test before backfilling of trenches is commenced. Drains may be tested in sections, and manholes may be tested separately. The Contractor shall submit to EMPLOYER for approval his proposals for testing. The drains shall withstand, without leakage, a water pressure of not less than one and one half (1.5) metres at any point for a period of 20 minutes or such other time as EMPLOYER may direct. All necessary plugs, temporary connections and other equipment and all labour required for the tests shall be provided by the Contractor and at the expense of the Contractor. For testing of pipes in areas where an adequate supply of water is not readily available,

EMPLOYER will accept an air (smoke) pressure test, provided that the method of testing is approved by EMPLOYER. Further testing may be called for after backfilling of trenches to ensure that pipes have not been damaged during that operation.

Regulations

The regulations and recommendations of any relevant drainage or sanitary authority shall be fully observed, and the Contractor shall be responsible for acquainting himself with any such regulations.

ANTIWEED TREATMENT, SWITCHYARD PCC & GRAVELLING

General Requirement

The material required for site surfacing/gravel filling shall be free from all types of organic materials and shall be of standard approved quality, and as directed by EMPLOYER. The Contractor shall furnish and install the site surfacing to the lines and grades as shown in the drawing and in accordance with the requirements and direction of EMPLOYER. The soil of the periphery area of the switchyard area shall be subjected to sterilisation or anti-weed treatment before placing the site surfacing/gravel fill material or strictly

as per instruction or requirement of the manufacturer of the chemical required for soil sterilisation or anti-weed treatment. After all the structures and equipment have been erected and accepted, and soil sterilisation of the peripheral area (except the switch yard area) as specified is complete, the site shall be maintained to the lines and grades indicated in the drawing and rolled or compacted by using three ton roller with suitable water sprinkling to form a smooth and compact surface condition which shall be matching with finished ground level of the switchyard area.

After due compaction of the surface of the entire switchyard area shall be provided with plain cement concrete of 100 mm thickness after proper compaction, and antiweed treatment having cement concrete ratio 1:3:6. Care shall be taken for proper gradient for easy discharge of storm water.

As a final surface course minimum 100 mm uniform layers of uncrushed /crushed broken metals (gravel) of 20 mm. nominal size shall be spread over the base layer/course. This final surface course shall be applied in all areas of switchyard exclusive of roadways up to the fenced area. This surface course shall then be compacted by light roller using 1/2-ton steel roller (width 30”x dia 24”) and 4 to 5 passes or any other means with water sprinkling as directed by EMPLOYER. Water shall be sprinkled in such a manner that bulking does not take place. The 20 mm. nominal size (for both layers) shall pass 100% through IS sieve designation 37.5 mm and nothing through 16.0 mm. IS sieve.

In areas that are considered by EMPLOYER to be too congested with foundations and structures for proper rolling of the site base course material by normal rolling equipment’s, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structure or equipment during rolling or compaction. EMPLOYER by no means shall relieve the contractor of their contractual obligations as stipulated in General and Special Conditions of Contract.

Chemical to be used for soil sterilization /anti-weed treatment:

The details of quantities and method of application of chemicals used for soil sterilization /and anti-weed treatment shall be as per manufacturer`s recommendations. Bidders are required to submit the details of chemicals proposed to be used and recommendations of manufacturer with required guarantee along with their bids for necessary approval of EMPLOYER. Approval of EMPLOYER by no means shall relieve the contractor of their contractual obligations as stipulated in General and

Special Conditions of Contract.

FENCING AND GATE

Fencing

Fencing shall be designed for the most critical loading combination taking into account wind forces, stability, tension on wires, minimum requirements as per this clause and relevant IS recommendations.

Minimum specification of fencing:

Drawing as per attached with the BID document.

Fencing panel size: 2.5X3.0 mtr with 500 mm extension in V shape for 6 nos. of barbed wire.

Frame: 50X50X5 mm, 50X5 mm bracing.

6mm rod @ 100 mm C/C.

Priming and two coats of painting with enamel paint.

The unclimbable or security, or anti-intruder fencing shall consist of chain link mesh, all as soon on the drawings and as specified below, supported on approved sections of structural steel. The posts shall be erected truly vertical, and all posts and struts shall be set in concrete block foundations.

Concrete kerbing shall be provided between the fence posts as shown on the drawings. Areas requiring fencing - Fencing shall be provided for the following areas:

Site fencing for the complete station, complete with barbed wires on top. Separate gates shall be provided for men and equipment.

Internal fence surrounding the various equipments (if) mounted on ground or a height lower than 2.5 m, without barbed wires on top. Necessary gates shall be provided for each area so surrounded.

Wherever necessary anti-reptile fixture/arrangement shall be provided along with fencing.

Installations: Fence shall be installed along switch yard line as per the approved GA drawing. Post holes shall be excavated by approved method. All posts shall be 3 mtrs apart measured parallel to ground surface.

Fence posts shall be erected in vertical and kept for minimum 7 days curing before fence erection.

Paintings as per decision of the Engineer in charge have to be carried out.

Continuous running earth by using 50 X 6 mm GI flats to be provided for safety purpose.

A 125mm mm thick (one and a half brick size) toe wall of Brick with tie beam with notches shall be provided below all fencing and shall be minimum 200 mm above and 500 mm below finished ground level. All exposed surfaces for brick toe wall shall be provided with 15 mm 1:4 cement sand plaster and coated with two coats of extern al weather coat paint. In case if rubble masonry is provided suitable pointing shall be done.

Gates shall be installed in locations shown on drawings. Next to the main gate, a men gate (1.25 m wide, single leaf) shall also be provided.

Bottom of gates shall be set approximately 40 mm above ground surface and necessary guiding mechanism (with roller on the bottom of the gate and fixed guider in the road) shall be fitted to avoid hanging of the main gate.

Design of the gate shall be as per attached drawing in the BID document. Gates shall be fabricated with welded joints or other approved methods to achieve rigid connections.

ROADS AND CULVERTS

The Contractor shall be responsible for constructing approach roads, sub-station roads and service roads etc. within the substation area. Layout of the roads shall be based on general details and arrangement drawings for the substation. Adequate turning space for vehicles shall be provided and bend radius shall be set accordingly. Roads to the transformer bays shall be as short and straight as possible. Where the substation layout warrants headroom safety barriers shall be installed to prevent vehicles coming into contact with overlying conductors. Such barriers shall be included as part of the scope of the work.

Road construction shall be as per Indian Road Congress (IRC) standards. Adequate provision shall be made for road drainage.

All culverts and allied structures required for road/rail, drain, trench crossings etc. shall be designed for class AA loading as per IRC standard.

At the junction of the hard standing and roads due to different thickness of foundations, precautions shall be taken to ensure that sub-surface drainage from the hard standing does not have a detrimental effect upon the road foundations.

INTER LOCKING CONCRETE BLOCK PAVEMENT (ICBP) BLOCK ROAD:

The side shoulder of all the roads shall be with kerb stone at two sides. The kerb stones shall be painted yellow and black alternatively. In case of switch yard road (concrete road) the shoulder would be compacted earth 600 mm wide on the sides of the road. The inter locking concrete block pavement (ICBP) block road shall have minimum 80 mm thick. Below it 150 mm thick water bound macadam (WBM) in two equal layers of 75 mm each at the bottom and minimum 200mm granular sub-base.

Minimum two layers of 100 mm thick GSB (200 mm), two layes of 100 mm thick WBM (200 mm) along with 80 mm thick Inter-locking Concrete Block Pavement (ICBP) and M20 PCC kerb of size 300 mm width and 500 mm depth. The side shoulder of all the roads shall be with kerb stone at two sides. The kerb stones shall be painted yellow and black alternatively. the shoulder would be compacted earth 600 mm wide on the sides of the road.

FOUNDATION AND RCC CONSTRUCTION

General

Work covered under this Clause of this Specification comprises the design, supply and installation of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, rains, jacking pads, pulling blocks, fencing, control cubicles, bus supports, transformers, marshalling kiosks, auxiliary equipments and systems, buildings and tanks, or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

Concrete shall conform to the requirements of IS 456 and all the tests shall be conducted as per relevant Indian Standard Codes in Addition to total 9 nos of cube has to be prepare for 7 days , 14 days & 28days

If the site is sloping, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate for such slopes.

If the site is located in depressed areas or in low land areas and soil filling has to be required by 2 mtrs and above , such type of sites a pile foundation shall required to adopt for all type of swichyard structures , RCC buildings and supporting structures except boundary walls and minor civil works, a minimum two piles shall be provided in any pile group.

Minimum height of the pedestal shall not be less than 650 mm above FGL exclusively where the site is located in depressed areas or low lands and the foundation has to be located in filled up soil height by 2mtrs and above

A minimum of 75 mm thick lean mix concrete (1:3:6) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

Concrete made with portland cement (OPC-43 grade) shall be carefully cured and special consideration shall be given during the placing of concrete and removal of shuttering.

The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and combinations thereof. Spread footing foundations or pile foundations as may be required based on soil and subsoil conditions and superimposed loads shall be provided.

If pile foundations are adopted, the same shall be cast-in-situ, driven, bored, precast or underreamed type as per relevant IS. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the contractor showing complete details of piles and pile groups proposed to be used. Necessary initial load tests shall also be carried out by the contractor at their entire cost to establish the pile design capacity. Only after the design capacity of piles has been established, shall the Contractor commence of piling. All the design and testing work shall be planned in such a way that these shall not cause any delay in project completion.

Cement

The cement to be used shall be the best quality of its type.

All cement shall be sampled and tested in accordance with Indian Standards. Cement shall be Ordinary Portland Cement (OPC)

or Portland Pozzolona Cement (PPC) as per I.S.269-1976 or Portland Slag Cement as

per I.S. 455 1976 The Ordinary Portland cement (OPC-43 grade) used in concrete shall confirm to IS 269.

Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the contractor. High Alumina cement shall NOT be used.

Delivery and storage of cement- Cement shall be delivered to the site in bulk or in sound and properly sealed bags and while being loaded or unloaded whether conveyed in vehicles or by mechanical means, and during transit to the concrete mixers, must be protected from the weather by effective coverings. Efficient screens are to be supplied and erected to prevent wastage of cement during strong winds. If the cement is delivered in bulk, the Contractor shall provide at his own cost approved silos of adequate size and number to store sufficient cement to ensure continuity of work. The cement shall be placed in these silos immediately it has been delivered on the site. Suitable precautions shall be taken during unloading to ensure that the resulting dust does not constitute a nuisance.

If the cement is delivered in bags, the Contractor shall provide at his own cost perfectly waterproof and well-ventilated sheds having a floor of wood or concrete raised at least 150 mm above the ground. The sheds shall be large enough to store sufficient cement to ensure continuity of work. Each consignment of each type of cement shall be stacked separately therein. On delivery at site the cement shall at once placed in these sheds and shall be used in the order in which it has been delivered. Only fresh cement shall be used for all concrete.

Aggregate

Coarse and fine aggregate shall conform to the requirements of IS 383-1970.

Sampling and testing of aggregates shall be in accordance with the relevant Indian Standard.

Fine and coarse aggregates shall be obtained from the same source and the Contractor shall ensure that material from the source is known to have a good service record over a long period of time.

Aggregate shall be hard and dense and free from earth, clay, loam and soft, clayey, shaley or decomposed stone, organic matter and other impurities.

Storage of aggregates

Coarse and fine aggregates shall be stored on site in bins or on clean, dry, hard surfaces, and be kept free from all sources of contamination. Aggregates of different gradings shall be stored separately, and no new aggregate shall be mixed with existing stocks until tested and approved by EMPLOYER.

Approval of Supplies

As soon as possible after the Contract has been placed the Contractor shall submit a list giving details of the sources from which he proposes to obtain concrete and mortar materials. Only materials from approved sources shall be brought to site, but EMPLOYER will be prepared to extend his approval to other satisfactory sources of supply which may be proposed by the Contractor. Approval of a source of supply shall not imply acceptance of material found not to conform to this Specification

Water

Water used for mixing concrete and mortar shall be clean, fresh water obtained from an approved source and free from harmful chemicals, oils, organic matter and other impurities. Normally potable water may be considered satisfactorily for mixing and curing concrete and masonry work. Requisite tests to be done if directed by Employer.

Steel bar reinforcement (Fe500)

Reinforcement shall be of Fe-500 corrosion resistant steel bar complying to the appropriate Indian Standards from Primary Producer e.g TATA Steel, SAIL, Jindal, RINL, as per IS 13620:1993 or latest version. All bar reinforcement shall be hot rolled steel except where the use of cold worked steel is specified on the drawings or otherwise approved.The bars shall be round and free from corrosion, cracks, surface flaws, laminations, rough, jagged and imperfect edges and other defects.The bar reinforcement shall be new, clean and of the lengths and diameters described on the Drawings and Schedules. Bars shall be transported and stored so that they remain clean, straight, undamaged and free from corrosion, rust or scale. Bars of different diameters shall be separately bundled.

Bending of reinforcement

All steel bars are to be accurately bent cold to the shapes and sizes indicated on the Drawings and Schedules unless otherwise approved. Re-bending of bars and bending in position in the works shall not generally be allowed.

Welding of reinforcement

Spot or tack welding for positioning bars in heavily reinforced areas will only be allowed with the express permission of EMPLOYER. Extension of lengths of reinforcement by welding will not be permitted. Welding will be approved only in low stress members, and lap welding will not be approved in any circumstances.

Fixing of reinforcement

Before fixing in the works bars shall be seen to be free from pitting, mud, oil, paint, loose rust or scale or other adherents harmful to the bond or strength of the reinforcement. Bars shall be fixed rigidly and accurately in position in accordance with the working drawings, unless otherwise approved by EMPLOYER. Reinforcement at all intersections shall be securely tied together with 1.5 mm soft annealed tying wire the ends of which shall be cut and bent inwards. Cover to the reinforcement shall be in accordance with Clause 15.12 of this specification and sufficient spacers and chairs of precast concrete of approved design shall be provided to maintain the specified cover and position. No insertion of bars in previously placed concrete shall be permitted. Projecting bars shall be adequately protected from displacement. The fixing of reinforcement in the works shall be approved by EMPLOYER before concrete is placed. Measurement will be based on the calculated weights of steel actually used in tonnes corrected to second place of decimal.

Concrete cover to reinforcement

For durability the minimum concrete cover to any reinforcing bar shall be as follows:

Concrete above ground.

Internal faces of slabs 25 mm

Internal faces of beams and walls 30 mm

Exposed faces of slabs, beams and walls 50 mm

All faces of columns and sub-structures 50 mm

Only concrete or steel spacers shall be used to achieve the required minimum thickness of concrete cover to reinforcement. Concrete spacers shall have nonmetallic ties. Timber blocks for wedging the steel off the formwork will not be allowed.

Formwork

Form work shall be constructed from 12mm thick wáter proof Plywood Board (30kg) as necessary for special finishes and designed with the quality and strength required to ensure rigidity throughout placing, ramming, vibration and setting of the concrete, without detrimental effect. Form work shall be erected true to line, level and shapes required using a minimum of approved internal ties. Faces in contact with the concrete shall be true and free from defect, jointed to prevent loss of water or fines, in panels or units which permit easy handling, and designed to permit side forms to be struck independently of soffit shuttering. Ties or spaces remaining embedded shall have the minimum cover specified for reinforcement.

Forms for exposed concrete beams, girder casings and columns shall provide for a twenty-five millimetre chamfer on external corners. Wedges and clamps shall be kept tight during vibration operations. Before commencement or resumption of concreting, the interior of forms shall be cleaned and free of sawdust, shavings, dust, mud or other debris and openings shall be formed to facilitate this cleaning and inspection. The inside of the forms shall be treated with a coating of an approved substance to prevent adhesion. Care shall be taken to prevent this substance being in contact with the reinforcement.

Grades of concrete

Concrete shall be either ordinary or controlled and in grades designated M10, M15, M20 and M25 as specified in IS 456 (latest edition). In addition, nominal mixes of 1:3: 6 or as indicated on drawings, or any other mix without any strength requirements as per mix design shall be used where specified. RCC for pile works shall be Design Mix of minimum grade M-25 and also minimum cement content shall be 400 kg/cum as per IS:2911.

Ordinary concrete

Ordinary concrete shall be used for all plain cement concrete (PCC) work and where shown on drawings in proportioning concrete, the minimum quantity of cement shall be as specified in Table 15.15.1 of this clause and the amount to be used shall be determined by actual weight. The quantities of fine and coarse aggregate may be determined by volume, but preferably by weight.

The water cement ratio shall not be more than those specified in IS 456.

or allowed by EMPLOYER. Ordinary concrete shall not require preparation of trial mixes.

Grade of Concrete	Minimum
M10	236 kg
M15	323 kg
M20	410 kg
M25	530 kg

Controlled concrete

Mix proportions

The mix proportions for all grades of concrete shall be designed to obtain strength corresponding to the values specified in IS 456 for respective grade of concrete. Preliminary tests as specified in the IS Code with 9 nos of cube which is 3 sets of cubes for 7, 14 & 28 days compressive strength has to be verified or as required by EMPLOYER, shall be carried out, sufficiently ahead of the actual commencement of the work, with different grades of concrete made from representative samples of aggregate and cement expected to be used on the job. The purpose of this test is to ascertain the water cement ratio required to produce a concrete having specified strength, and to demonstrate sufficient workability to enable it to be well consolidated and to be worked into corners of shuttering and around the reinforcement.

Mix design

As a guide to perform the mix design properly, the relationship between water cement ratio, aggregate to cement ratio, workability and strength of concrete will be as per relevant IS.

The cement /total aggregate ratio is not to be increased beyond 1: 9.0 without specific permission of EMPLOYER. It should be noted that such high aggregate/cement ratios will be required for concretes of very low slump and high-water cement ratios which may be required to be used in mass concrete work only.

The actual cement aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used, and from trial mixes.

2. Strength Requirements

The mix proportions for all grades of concrete shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than the value given table.

Grade Designation	Characteristic Compressive Strength at 28 days
10	10N / sq. mm
15	15N / sq. mm
20	20N / sq. mm
25	25N / sq. mm

The strength of concrete given above is the 28 days characteristic compressive strength of 15 cm cube.

ii) Target mean strength of concrete

The target mean strength of concrete shall be as per IS 456:2000 or CPWD specifications and the formula governing thereto

Workability

The workability of concrete shall be checked at frequent intervals by slump test, where facilities exist and if required by EMPLOYER, alternatively the compaction factor test in accordance with IS 1199 shall be carried out.

Mixing of Concrete

Unless otherwise approved, concrete for foundations will be M 20 grade, corresponding to nominal mix of 1:1.5:3 as per IS 456. The proportions of fine and coarse aggregate, cement and water shall be as determined by the mix design or according to fixed proportions in case of nominal mix concrete and shall always be approved by EMPLOYER. The quantities of the cement, fine and coarse aggregates shall be determined by weight, the water shall be measured accurately after giving proper allowance for surface

water present in the aggregate. Water shall be added to make a workable mix and it is important to maintain the water-cement ratio at its maximum value of 0.55 in accordance with the requirements of IS 456.

Water shall not be added to the mix until all the cement and aggregates constituting the batch are already in the drum and dry mix for at least one minute. Mixing of each batch shall be continued until there is uniform distribution of materials and the mass done for less than 2 minutes and at least 40 revolutions after all the materials and water are in the drum.

When hand mixing is permitted by EMPLOYER for concrete to be used in unimportant locations it shall be carried out on a watertight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand mixing, an extra 10% of cement shall be added to each batch and additional cost due to extra cement will be borne by the Contractor.

Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of final laying as rapidly as practicable by approved means before the initial setting cement starts. Concrete should be conveyed in such a way which will prevent segregation or loss of any of the ingredients. If segregation does occur during the transport of concrete same shall be re- mixed. The requirements to be fulfilled during transportation are:

No segregation or separation of materials in the concrete, and concrete delivered at the point of placing should be uniform and of proper consistency.

Placing Concrete

Form work and reinforcement shall be approved in writing by EMPLOYER before concrete is placed. The forms shall be well wetted and all shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. Concrete shall be deposited in its final position without segregation, re-handling or flowing. As far as possible concrete shall be placed in the formwork by means approved by EMPLOYER and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over

180 cm. shall have to be approved by EMPLOYER. Once the concrete is deposited in its final position, it shall not be disturbed. Care should be taken to avoid displacement of reinforcement or movement of formwork.

The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete. When fresh concrete is required to be placed on previously placed and hardened concrete, special care should be taken to clean the surface of all foreign matter. For securing a good bond and water tight joint, the receiving surface should be made rough and a rich mortar placed on it unless it has been poured just before. The mortar layer should be about 15 mm thick with cement and sand proportion as that of the mix in use, and have the same water-cement ratio as the concrete to be placed.

After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men and over vibration shall not be permitted. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there is any sign of washing of cement and sand, the concrete shall be entirely removed immediately. Slabs, beams and similar structure shall be poured in one operation normally. In special circumstances with the approval of Authorized representative of EMPLOYER these can be poured in horizontal layers not exceeding 50 cm. in depth. When poured in layers, it must be ensured that the under layer is not hardened. Bleeding of under layer if any shall be effectively removed.

Compaction of Concrete

Compaction is necessary for production of good concrete. After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibrator to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during the vibration of the concrete. The Contractors shall provide standby vibrators. Vibration is commonly used method of compaction of concrete, the use of mechanical vibrators complying with IS 2505, IS 2506, IS 2514 and IS 4656 for compacting concrete is recommended

For all practical purposes, the vibration can be considered to be sufficient when the air bubbles cease to appear and sufficient mortar appears to close the surface and facilitate easy finishing operations. The period of vibration required for a mix depends upon the workability of the mix.

Curing of Concrete

In order to achieve proper and complete strength of the concrete, the loss of water from evaporation should be prevented. percent of the strength is attained in the first 28 days and hence this 28-day strength is considered to be the criterion for the design and is called characteristic strength. The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 10 days after laying.

The curing increases compressive strength, improves durability, impermeability and abrasion resistance. Failure to carry out satisfactory curing can lead to cracking in the concrete. This in turn can lead to salt attack of the reinforcement and consequential failure of the structure. If cracks occur in a structure which are severe enough to affect the structure, the Contractor shall cut out and replace the defective concrete at his own cost. The Contractor's attention is, therefore, drawn to this particular aspect of proper and adequate curing.

Construction joints

Construction joints are a potential source of weakness and should be located and formed with care and their number is kept to a minimum. When the work is to be interrupted, the concrete shall be rebated at the joint to such shape and size as may be required by EMPLOYER or as shown on the drawings. All vertical construction joints shall be made with water bars which are rigidly fixed and shall provide a positive barrier against movement of water through the joint. Great care

shall be taken when placing concrete around water bars because the space is often congested. Concreting shall be carried out continuously up to construction joints. Construction joints, if not described on the drawings, shall be in accordance with the following:

In a column, the joint shall be formed about 75 mm below the lowest sofit of the beams framing into it, at the meeting points of the columns and the raft, and at the point of contraflexure in the columns.

Concrete in a beam shall be placed throughout without a joint. However, if the provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.

A joint in a suspended floor slab shall be vertical at one of the quarter points of the span and at right angle to the principal reinforcement.

Additional reinforcements and shear keys shall be provided at the construction joints.

In forming a joint, concrete shall not be allowed to slope away to thin edge. The locations of construction joints shall be planned by the contractor well in advance of pouring and be approved by EMPLOYER. Construction joints in foundation of equipment shall not be provided without the approval of Authorized representative of EMPLOYER.

Expansion and separation joints

Expansion joints shall be as shown on the drawings or as specified in the schedules. Expansion joint filler boards conforming to IS 1838 and sealing strips shall have minimum transverse joints. Joints shall be vertical and straight except where otherwise approved and concrete surfaces and faces shall be flush on both sides of the joint.

Separation joints shall be with standard waterproof paper or with as alkathene sheets about 1 mm in thickness. Lap length and sealing of laps shall be to the satisfaction of EMPLOYER.

Removal of form work

Form work shall be kept in position fully supported, until the concrete has hardened and gained sufficient strength to carry itself and any loads likely to be imposed upon it. Stripping must be affected in such a manner and at such a time that no shock or other injury is caused to the concrete. The responsibility for safe removal rests with the Contractor but EMPLOYER may delay the time of striking if he deems it necessary.

Pre cast concrete members

Precast concrete members shall be used in the works only where specified on the Drawings or approved by EMPLOYER. The technical specifications for cement concrete, formwork and reinforcement covered under earlier clauses shall form a part of these specifications and shall be followed for carrying out precast concrete work.

Precast members shall not be disturbed or lifted until the minimum periods specified for formwork removal have elapsed.

Load Test on Parts of Structures

The load test on concrete, if desired by EMPLOYER shall be carried as soon as possible after the expiry of 28 days from the time of placing of concrete as per the clause 16.5 to 16.6 of IS: 456.The structure shall be subjected to a load

equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24 hours and then the imposed load shall be removed. The entire cost of load testing shall be borne by the contractor and if any portion of the structure found unacceptable under the relevant clause of IS: 456, the same shall be dismantled and replaced by a new structure as per specification at no extra cost to the Employer. If during dismantling any of the adjacent structure is damaged, the same shall be made good free of charge by the contractor to the satisfaction of EMPLOYER.

Finish of concrete surface

Concrete cast against formwork.

The following finishes to concrete surfaces, unless otherwise specified or shown on the drawings, shall be as follows—

Class A1: All permanently exposed surfaces, including exposed sides of foundations.

Class A2: Surfaces to be covered by backfill, plasters or the like.

Class A1 surfaces shall be dense, fair, smooth, even, free from honeycombing, water and air holes and other blemishes, true to line and surface and free from board or panel marking. They shall be of uniform colour. Rendering of defective surfaces shall not be permitted, and, if ordered by EMPLOYER, the Contractor shall at his own expense cut out to expose reinforcement and make good any unsatisfactory work. All areas so treated shall be rubbed down and kept moist for several days.

Class A2 surfaces shall be dense, even, free from honeycombing and true to line and surface.

Any special finishes will be to details or instructions given by EMPLOYER.

Concrete not cast against form work.

The following finishes shall be provided unless otherwise specified or shown on the drawings—

Class B1: All permanently exposed surfaces, including tops of equipment foundations, wall copings, window sills, precast items (except paving flags).

Class B2: Paving flags and paths. Floors and slabs to be surfaced with blocks, tiles or waterproofing materials.

Class B3: Roads, buried concrete and floors or slabs to be covered by screed.

Class B1 surfaces shall first be levelled and screened to produce a true surface. After the moisture film has disappeared, and the concrete has hardened sufficiently, the surface shall be finished with a steel trowel under firm pressure to give a smooth, dense, even and hard surface free from all marks and defects.

Class B2 surfaces shall be levelled and screened to produce a true surface and be finished with wooden or steel float to give a level surface free from screed marks. Excessive floating shall be avoided.

Class B3 surfaces shall be levelled and screened to produce a true and uniform surface.

Holes, pockets, threaded inserts, etc.

The threaded inserts for casting into concrete shall be electro-galvanized and of malleable iron or mild steel. Holes, cavities and fixings shall be provided in the works only at the positions indicated on the drawings or as directed and they shall

be incorporated as necessary during the work of concreting. Unless otherwise agreed a tolerance in position of plus or minus five millimetres shall be allowed. Inserts and bolts shall be fixed square in the works by means of temporary bolts or nuts, and then concrete cast around them. The projecting portions of such fixings, and concrete within fifty millimetres of them, shall be bitumastic painted and all threads well greased on completion of the work. Holes and pockets shall be stripped down clean on completion.

Admixtures and Additives

Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labelled containers to enable identification.

Admixtures in concrete shall conform to IS:9103. The water proofing cement additives shall conform to IS:2645. Concrete admixtures and additives shall be approved by EMPLOYER.

The Contractor shall use an approved neutralized vinsol resin air-entraining agent in all concrete. The Air entraining agent shall be supplied and batched as a solution with a solids content not exceeding 15 percent by weight with suitable, stable and consistent pH.

The Contractor may propose, and EMPLOYER m a y approve the use of a water-reducing set- retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid overcoming unusual circumstances and placing conditions.

Water-reducing set-retarding admixture shall be an approved brand of lgno- sulphonate type admixture.

Water proofing cement additives shall be used as required or advised by EMPLOYER.

INTERFACING

Proper coordination and execution of all interfacing civil works activities such as fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embodiments, provision of cut-outs etc. shall be the sole responsibility of the contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and such that dismantling, breakage etc. is reduced to minimum.

WATER SUPPLY

The Contractor shall be overall responsible for supply of water within switch yard for firefighting, drinking purposes, construction purpose and other miscellaneous purposes. The scope is also inclusive of installation of deep tube well, construction of slow sand filter and ground storage tank, supply and installation of distribution network pipe lines, supply and erection of all overhead tanks, staging for OH tank wherever necessary, pipes, fittings, motors, etc. required for the water supply to be taken from the terminal point to the respective buildings. A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall subject to the approval of EMPLOYER before actual start of work. Any extra bore holes required shall be within the scope of the contractor.

There shall be separate bore wells for the control room building and colony quarters if required. There shall be pump houses for the bore wells and approach road to the pump houses shall be provided. Boring and installation of 250mm dia deep tube with 200mm min dia. PVC casing and 5nos. of filter (3m each) and the gap between boring and casing shall be filled with pea size gravels. Provide 2 HP submersible pump with 40mm dia CPVC column pipe. Pump shall be tied with laminated twin steel wire rope (10sqmm). For service connection provide 6sqmm UG cable and 3 core 6sqmm copper cable shall be provided for control panel etc. including all accessories such as nipple, clamp elbow, well cover, valve etc. to complete the work in all respect.

Provide two storied RCC (M-25) slow sand filter having sand filter at upper level with aeration arrangement and openable steel roof and reserviour at bottom. Bottom reserviour shall be 600mm above FGL with stopper at construction joint, water proofing, 2 HP horizontal submersible pump for delivery to OH tank, outlet and drainage valve, control panel (starter), cable, approved sand for filter media (charcoal, stone chips, etc. as per requirement).

CPVC distribution pipe network from storage tank to all the OH tank of building i.e RE residence, officer’s hoatel, staff’s hostel, transit camp, security booth, security barrack, store building, control room building as well as landscaping work for gardening.

The capacity of each submersible pump shall be 2 HP and all control as per standard has to be provided. The no of bore holes shall be two nos, one for colony township and the other one for the switch yard building. Two nos pump house as per standard are also within the scope of this contract. The height of the pump house (LXW=3mtrsX3mtrs) shall be 3 mtrs and shall have RCC roof and brick walls having MS doors.

Overhead water tank shall be as per BOQ.

There shall be interconnection between two pump sections in order to meet any exigencies.

SECURITY BOOTH

There shall be one RCC type security booth near the main gate, switchyard gate and as per master plan to be provided as per design and drawing. The booth shall have also provision of sitting arrangement for the guests and toilet. The shed shall be provided with telephone internal, electrical lighting and ceiling fan facilities. There shall be provision of gate lights. A portion of the shed shall be used for the guest who comes for visit the sub-station. Adequate no. of aluminium doors and windows are also to be provided. Necessary paintings as per standard are also to be done.

CAR PARKING SHED

Shed for Car parking shall be constructed adjacent to all building depending upon the space available and the requirement. Each unit for single car parking shall be of minimum size 5.5m x 3 m with a plinth height of minimum 300 mm. The floor should be completed with pavers block with appropriate base, which has to be joined with the approach or internal road. Shed structure shall be constructed using Steel section by TATA of YST 310 Grade or equivalent with RCC block as base. Shed roofing to be completed with PPGI sheet roofing with minimum 0.6 mm thickness.

(Design and Drawing to be prepared by Contractor and shall be approved by EMPLOYER)

STATUTORY RULES

The Contractor shall comply with all the applicable statutory rules pertaining to Factories Act (as applicable for ASSAM State), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc.

Provisions for fire-proof doors, numbers of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.

Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

LANDSCAPING, GARDEN & PLANTATION

Within the campus gardening should be done on roadside as well as available spaces. Proper water supply piping should be provided for aeriation. A garden in front of the control room building is to be developed. It includes treatment of the land of size (30mtrsX10mtrs), manuring, and plantations of sufficient flower based, show based, crotons and entire portion shall be provided with garden grass. Proper land slope also to be maintained for better and aesthetic looking. Provision of water taps and garden lights at different locations are to be provided for watering the plants and lighting of the garden. 100 nos. fruit bearing plants and 100 nos. other show plants along the roadside, near colony quarters and near control room building are required to be planted. Treatment of the soil and manuring are to be done before plantation of these plants. Water taps at different locations are to be provided for

watering the plants. Plantation of trees shall comprise of Bakul tree and flowering plant Mosanda, multiple colours of Bougainvillea and Hydrangea.

RAINWATER HARVESTING

In addition to drainage of rainwater, the contractor shall make arrangement for rainwater harvesting also.

Rainwater harvesting shall be done by providing two numbers recharge structures with bore wells. The recharge structures shall be suitably located within the S/S. Branch drains from the main drain carrying rainwater from entire switchyard shall be connected to the recharge structures.

The internal diameter of recharge shafts shall be 4.5 meter with 230mm thick lining of brick work up to a depth of 2.0 meter from ground level and 345mm thick brickwork below 2.0- m e t e r depth. The brickwork shall be constructed with cement mortar 1:6 (1 cement: 6 coarse sand) . The overall depth of shaft shall be 5.0 meter below invert level of drain. The shaft shall be covered with RCC slab for a live load of 300Kg. per Sq. m. two openings of sizes 0.7X0.7 meter shall be provided in the RCC cover slab as shown in the drawing. An iron cover made of 5mm thick chequered plate with hinges shall be provided in the openings. Galvanized M.S. rungs of 20mm diameter at spacing of 300mm shall be provided in the wall of the shaft below the opening of the RCC slab to facilitate cleaning of shaft.

A 300mm diameter bore well shall be drilled in the center of the shaft. The depth of bore well shall be 5.0 meter more than the depth of the sub soil water.

A 100mm diameter medium duty MS pipe confirming to IS 1161 shall be lowered in the bore well keeping bail plug towards bottom of bore well. The pipe shall have

1.58mm holes for 4.0- m e t e r length starting from 1.0 meter from bottom of bore well. Holes of 3.0mm dia. Shall be provided for a length of 2.0 meter starting from the bottom level of coarse sand and downwards. The overall length of the pipe shall be equal to the total depth of the bore well plus depth of shaft.

Gravel of size 3mm to 6mm shall be filled around 100 dia MS pipe in the bore well. The shaft shall be filled with 500mm thick layers each from the bottom of shaft with boulders of size 50mm to 150mm, gravel of size 5mm to 10mm, coarse sand having particle size 1.5mm to 2.0mm and boulders of size not less than 200mm respectively.

Fire water Tank: This is a lump-sum item. The contractor shall be required to complete the work in all respect as per requirement. All the items including excavation, compaction, brick work, roof truss, corrugated A.C. Sheet roofing, all types of miscellaneous steel internal and external plastering, painting, etc. shall be deemed to be included in this lump-sum water tank.