

TRANSMISSION SYSTEM PACKAGES

TENDER DOCUMENT

VOLUME – III B

TECHNICAL SPECIFICATIONS FOR SUB-STATION (CIVIL PART)

**OFFICE OF ELECTRICAL TRANSMISSION & DISTRIBUTION
THE DURGAPUR PROJECTS LIMITED
DURGAPUR-713202 (W.B.)**

**BID DOCUMENT
FOR
TRANSMISSION SYSTEM PACKAGES**

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BID DOCUMENT
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VOLUME –IIIB

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TECHNICAL SPECIFICATION FOR
SUBSTATIONS
(CIVIL PART)

TECHNICAL SPECIFICATIONS
FOR 220 & 33KV SUBSTATION
NEW & EXTENSION (CIVIL)

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10.0 **TECHNICAL SPECIFICATION FOR SUB STATION CIVIL STRUCTURAL AND ARCITECHTURAL WORKS**

10.01 GENERAL;

This specification covers the general requirements for soil exploration, site grading, design fabrication, supply and construction of civil structural steel and architectural works for substation and staff quarters including setting out and survey work.

The Contractor shall perform the works to meet the requirements of this specification, the attached bid drawings and the relevant articles in this contract Document.

This specification is intended for general description of quality and workmanship of materials and finished works. This is not intended to cover minute details. It shall be specifically understood that the work shall be executed in accordance with the best modern practices and with best quality of materials and workmanship to the entire satisfaction of the employer. This specification shall generally have precedence in case any thing contrary to this is stated anywhere in the contract document but the decision of the Employer/Engineer shall be final and binding on the Contractor respect of any issue arising out of such discrepancies.

10.01.01 STANDARD AND REFERENCES

All equipment materials, fabrication galvanizing, erection and tests under these Specifications shall conform to the Indian Standard Specifications as amended till date of issue of invitation of Bid. In absence thereof, the work shall be executed according to the best prevailing State or Central Public Works Department Practice or as per relevant International Standards, codes manuals and specifications or to equivalent applicable international standards, manuals and Specifications established and approved in the country of manufacturer and approved as equal by the Employer/Engineer.

If the Contractor for any reasons/purposes equivalent to or deviates from the above standards, the Contractor shall state the exact nature of the change, the reason for making the change and shall submit complete specifications of the materials.

10.01.02 LIST OF CODES AND STANDARDS

The following codes and standards as amended till the date of issue invitation of bid are to be followed in the design of the architectural. Civil and structural works for substations.

Sl.No.	Indian Standards	Title
1	IS:209	Specification for Zinc
2	IS:209	33 grade ordinary Portland cement
3	IS:348	French polish
4	IS:383	Coarse and fine aggregates from natural sources for concrete.
5	IS:427	Distemper, dry colour as required.
6	IS:428	Distemper, oil emulsion colour as required.
7	IS:432(Part-1 & II)	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
8	IS:455	Portland slag cement
9	IS:456	Code of practice for plain and reinforced concrete. Code of practice for general steel construction.
10	IS:800	Code of practice for use of structural steel in overhead transmission line towers
11	IS:802(Part-1)1977	Code of practice for design loads (other than earthquake) for building structure./
12	IS:875(Part-1toV)	Steel doors, windows and ventilators
13	IS:1038	Common Burnt Clay Building Bricks
14	IS:1077	Steel tubes for structural purposes
15	IS:1161	Code of basic requirements for water supply, drainage and sanitation
16	IS:1172	Cement concrete flooring tiles
17	IS:1237	Code of practice for water proofing of roofs with bitumen felts.
18	IS:1346	Steel windows for industrial buildings
19	IS:1361	Code of practice for laying & finishing of cement concrete flooring files.
20	IS:1443	Code of practice for painting of ferrous metals in buildings
21	IS:1477(Part-I&II)	Portland Pozzolana cement
22	IS:1489(Part-I&II)	Code of practice for laying damp proofing treatment using bitumen felts
23	IS:1609	High strength deformed steel bars and wires for concrete reinforcement

24	IS:1786	Code of practice for sub surface investigation for foundations
25	IS:1892	Criteria for earthquake resistant design of structures. Code of practice for design and construction of foundations in soil general requirement
26	IS:1893	Schedule of unit weights of building materials.
27	IS:1904	Aluminum doors, windows and ventilators
28	IS:1911	Plain washers
29	IS:1948	
30	IS:2016	
31	IS:2065	Code of practice for water supply in buildings.
32	IS:2114	Code of practice for laying in situ terrazzo floor finish. Sand for masonry mortars.
33	IS:2116	Wooden flush door shutters (solid core type)
34	IS:2202(Part-I&II)	Code of practice for brick work.
35	IS:2212 IS:2338(Part-I&II)	Code of practice for finishing of wood and wood based materials.
36		Aluminium paint for general purposes, in dual container.
37	IS:2339	Code of practice for painting concrete, masonry and plaster surfaces.
38	IS:2395(Part-I&II)	Code of practice for installation of septic tanks.
39	IS:2470(Part-I&II)	
40	IS:2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
41	IS:2571	Code of practice for laying in situ cement concrete flooring.
42	IS:2629	Recommended Practice for Hot-Dip Galvanizing of iron and steel.
43	IS:2633	Method of testing uniformity of coating on zinc coated articles.
44	IS:2950	Code of practice for design and construction of raft foundations.
45	IS:2974	Code of practice for design and construction of machine foundations.
46	IS:3063	Fasteners-Single coil rectangular section spring washers. Code of practice for concrete structures for the storage of liquids.
47	IS:3370(Part-I to V)	Timber door, windows and ventilator I Frames.
48	IS:4021	Code of practice for earthquake resistant design and construction of buildings.
49	IS:4326	Hot-dip zinc coating on structural steel and other allied products.

50	IS:4759	Cement point.
51	IS:5410	Foundation Bolts.
52	IS:5624	Specification for metal rolling shutters and rolling grills.
53	IS:6248	Hexagonal bolts for steel structures.
54	IS:6639	Methods for determination of weight of zinc coating on zinc coated iron and steel articles.
55	IS:6745	Transmission Tower Bolts.
56	IS:12427	National Building Code of India 1983
57	NBC:1983	Plastic emulsion paint.
58	IS:5411(Part I&II)	Code of practice for design and construction of pile foundation:
59	IS:2911(Pt.1Sec.2)	Concrete piles-Board Cast-in-situ piles.
60	IS:7452	Specification for steel door.
61	IRC Codes	

10.02 SCOPE OF WORK

A. GENERAL:

- The scope of all civil and structural works shall include preparation of design, detailing, fabrication, galvanizing, supply of all materials, labour plant laid equipment, fixtures, fitting, erection and all temporary and permanent works necessary for the satisfactory completion of the job in respect of the major item of work listed below for each Sub-station as per requirement.
- Site survey and setting out, assessment of condition and requirements and collection of necessary site data.
- Electro logging and exploratory ring work for drinking water supply.
- Approach road, Precuts concrete pipe culvert, R.C.C. culvert.
- Gravel spreading in switchyard as required.
- Switchyard fencing and gates.
- Sub-station galvanized steel structure.

- Foundation of steel structures, equipment and erection of the same.
- Cable trench system (New/Extension Sub-station)
- Rail cum road/road portion connecting nearest bituminous road and transformer plinth.
- Oil soak pits, oil V water sump, sump pump house & pump etc.
- Water supply and plumbing system comprising of sinking of deep tube well, pump house with suitable pump R.C.C. overhead reservoir etc.
- Boundary wall, gates, Security post and animal obstruction grills.
- Residential Buildings.
- Guest House
- Administrative and Office Building, Community Centre
- Store Shed-cum-Garage etc.
- Site clearance.

N.B. However, item of work to be executed in respect of specific substation would be as per the individual bid schedule.

10.02 WORK SCHEDULE:

The Contractor shall submit to Engineer a graphical work schedule with and explanatory report before starting of the construction job. The work schedule and any amendments to it during the construction period will require Engineer's approval.

10.03 DESIGN AND DRAWINGS:

GENERAL:

The Contractor shall submit detailed design calculations of all civil works as required (other than steel structural work within switchyard). All drawing shall be submitted in proper sequence as would be approved by DPL.

10.04 DESIGN OF CIVIL WORK :

The Contractor shall perform detailed design for each structure described in article 10.2 on the basis of the design criteria and codes and regulations of Indian Standards. Prior to proceeding with the design work design condition or design values which shall include allowable stresses safety factors, safety factors, load conditions and applicable standards shall be approved by the Employer Contractor

The Contractor shall submit to Engineer corresponding detailed design calculation sheets, bill of materials, construction methods and construction schedules etc for approval of construction drawing of each structure. In case of any subsequent modifications of detailed design of civil structural/architectural work, the Contractor shall promptly inform Employer/Engineer of such modification and shall submit modified drawings to Engineer for approval. All design calculation along with drawings will be sent back to contractor on its approval keeping each of the copies duly with DPL.

DRAWING OF CIVIL WORK :

Separate drawings shall be prepared and submit for architectural, Civil, Structural & foundation works for building, structures and equipment pertaining to each Sub-station.

All drawings to be furnished by the Contractor shall be in standard size of sheets with maximum size being A.O. Drawings shall contain the following particulars in the title block at lower right hand corner in addition to the name of Sub-station contractors name, title drawing number and date, consultant's name and signature, revision no. etc.

- a) Client : The Durgapur Projects Limited
- b) Project Title : Transmission System Packages

A blank, space of size 100mm x 100 mm shall be provided for the Engineer's approval stamp and provision shall also be made by way of a block for details of revisions to be recorded. The drawing shall be marked with subsequent revision no. & date revision every time the drawing is revised.

On receipt of the approved electrical layout drawing of each Sub-station, the contractor shall submit to the Engineer Six copies of detailed structure and foundation designs, along with six copies of detailed drawings for review purpose if and where required, The contractor shall ensure that the contents of copies of drawings are legible and complete with detailing. Drawings that are not legible or incomplete will not be accepted Two sets drawings duly approved by the Engineer shall be furnished to the Contractor. Drawings returned with "not approved"/ "approved with comments" shall be resubmitted with revision number and date for approval till final approval is obtained. After obtaining approval, the Contractor shall immediately submit to the Engineer reproducible copy of each approved drawing along with eight copies of the said drawing.

Approval of such detailed drawings by the Engineer shall not relieve the contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor shall be fully responsible for the safety of the building and the structures from design, construction and erection points of view even after the approval of the drawings are communicated by the Engineer. The contractor shall take all necessary precaution for the safeguard of all existing structures during execution of the contract. The contractor shall also make good all damages, if cropped up, within contract period including the risk liability period at his risk and expense. In all cases, the new structures, must match with existing structures, for an coextension Submission.

10.04.02 CONTRACT DRAWING:

The drawing bearing the Engineer's approval or drawings corrected in accordance with the comments of the Engineer shall be deemed to be contract drawings and variation therefore may not be made without the Engineer's consent.

10.04.03 AS BUILT DRAWINGS:

There sets of "as built drawings" duly certified by site engineer(s) and Project Manager of contractor conveniently bounded along with one set of reproducible copy and CD of all such drawings shall be supplied by the contractor within a period of 30 days of completion of the work at site.

The design and drawings approved and used for the work under the scope of this contract shall be deemed to be the sole property of the "DPL" and the "DPL" reserves the right to use the same in its' other project(s) without any further reference to the contractor and without any additional charges for such reuse.

10.05 SURVEY AND SETTING OUT:

The contractor shall conduct topographical Survey and furnish Survey drawings of entire Sub-station land showing exact boundaries and spot levels dividing entire land area in 10Mx10M grids.

Master Grid pillars are to be constructed at four corner of substation land, for fixing the two right angled base lines. On the basis of them, other grid lines are to be marked out.

Before commissioning of the Sub-station, F.G.L. as indicated by the site Engineer of DPL shall have to be achieved by the contractor as final finishing.

The contractor shall prepare "land utilization in drawing" of cash Sub-station showing location of control building, switchyard, staff colony area, access roads and the permanent features including orientation of site with respect to magnetic north. Upon approval of the Employer of the final L.U.P drawing, the structural and building foundation, fencing and boundary wall, gates, approach roads etc. shall be set out accurately by the contractor on the ground.

10.06 GEOTECHNICAL PARAMETERS:

The contractor shall design foundations on the basis of the sub-soil parameters to be made available to him. They would refer to 'excerpts' of the report provided in 'Bid proposal' as guide line for bidding purpose. Complete set of report with relevant parameters shall, however, be handed over to the successful bidders in due course.

The contractor shall perform Electro logging and detailed exploratory boring work for drinking water supply required for entire sub station and colony are ascertain the depth of permanent and potable water bearing strata. The requirements of drinking water for various types of new sub-stations are as follows:

132 KV Sub-station – 20,000 lt/res/day

220 KV Sub-station – 30,000 lt/res/day

Necessary test certificates regarding portability of drinking water is to be furnished by the contractor from the test laboratory approved by the Engineer.

10.07 SUB STATION ROADS:

The contractor shall design and construct all roads within the sub station and switchyard area. The tentative requirement of the roads shall be as follows:

- a) The road (Bituminous) connecting the existing outside main road to the rail cum road within switchyard and extending beyond shall be of 5m width.
- b) The road serving the breaker location within switchyard at 220KV sub-stations 132 KV S/S Connecting the 5 m wide road shall be of 3.75 m width.
- c) The bituminous road connecting office, store-cum-gorge, security barrack etc. within sub-station area shall be of 3.75 m width.
- d) The bituminous road to the colony area an serving the colony area shall be of 3.75 m width.
- e) The road type and thickness etc. of all the above roads shall be as per Road Layout drawing and the design shall be as per load requirement.
- f) Connecting pavements: Pavements connecting bituminous road with staff quarters, pump houses and other structures, if and where required as per L.U.P. drawing shall be of 100 mm thick PCC (1:3:6) over single layers B.F.S. placed on 150mm thick sand filling.

However, the entire road shall be executed as per detailed Road Layout drawing of the Sub-station to be decided during detail engineering.

10.07.01 BOX CUTTING :

After the earth work in cutting and the earth work in embankments have been done properly up to final road level with gradient and camber as per drawings and proper consolidation of the filling is completed earth work in box cutting shall be taken in hand.

The box cutting shall be done in such a way that width of cutting is exactly the clear distance between the edging blocks. The depth of cutting shall be the total thickness of soling, metal lining etc. The formation shall have the same profile and the camber as per drawings and specifications.

If by mistake the box cutting is made more than required, the Contractor shall make up the extra depth by metal consolidation, at his own cost.

After the box cutting is completed, the formation shall be rolled with power roller, maintaining proper gradient and camber, care shall be taken to avoid excessive rolling of the formation.

If after rolling the formation is higher than required, the excess earth shall be removed by carefully cutting & dressing and the formation shall be rolled as specified above. In case after rolling the formation is depressed below the required level, the Contractor shall continue the process of filling and rolling as above till the correct levels are attained.

10.07.02 EDGING:

Edging blocks shall be as per approved drawing and design and specific code.

After rolling of the box cutting trenches, the finished depth of cutting shall be minimum and must be sufficient to insert the edging blocks. The clear width between the inside faces, of the edging blocks shall be exactly the same as shown on

drawing. The inside faces shall be in plumb and the gap between the blocks shall not be more than 10 mm. The edging blocks shall be thoroughly packed with a mixture of local earth and moorum at the outside face.

If, after consolidation of stone metal, any portion of the edging is found to be out of the lines & level, the Contractor shall take out the blocks and relay the same as required.

10.07.03 SOLING:

The soling shall be done with assorted rough stone boulders or quarried stone or brick as approved by the Engineer. The soling materials shall be tough and it shall not flake or crumble when being rolled with power roller. Soling thickness shall not be less than 75 mm or shall not be more than the depth of soling as specified in drawings.

The soling shall be laid on its narrowest side closely on the formation, so that minimum voids are left between the adjacent locks. The filling of bigger voids shall be done by wedging in smaller pieces of stone with hand hammer. The smaller void shall be filled up with blinding materials. The blinding materials shall be sufficient to fill up all voids and produce an even surface after rolling. Excess use of blinding materials shall be avoided.

The rolling should be done with power roller in such a way that the whole soling give a compact base without any voids. If voids are not filled up further blinding materials shall be added. The rolling shall be continued till there is no settlement or voids and surface is true and even. The finished soling shall have the correct thickness, gradient and camber as specified in drawing/direction.

If the Engineer finds that the soling done is not up to the specification, the whole soling over the defective portion shall be taken out, re-laid and compacted with a power roller as specified above by the contractor.

10.07.04 PRECAST CONCRETE PIPE CULVERTS:

N.P.3 class pre cast concrete pipes of required diameter as per I.S. 458 shall be supplied and laid in position in lines and levels under the approach road. Jointing of pipes and collars in cement concrete (1:2:4) etc. complete shall be done as per I.S. 783 and as approved by the Engineer. The pipes shall have adequate strength to resist the anticipated traffic load. Minimum depth of well compacted earth cushioning over pipe culvert shall be 1.00m.

10.07.05 WATERBOUND MACADAM

The metal shall be of 38 mm down graded approved quality crushed stone. The metal shall be of close, tough, durable and future and shall not flake or crush under pressure. The metal shall be granite, ballast or equivalent quality with high density, and shall not preferably absorb when immersed in water for 24 hours, more than 1% of own weight. In general, unless otherwise specified the metal shall conform to the standard laid down by the "Indian Road Congress" regarding toughness, abrasion co-efficient of hardness, alternation loss and cementation values. The gradation of metal shall be such that not more than 5% by weight shall be retained on 38mm sieve and not more than 50 to 65% retained on 25mm sieve and not more than 10 to 15% by weight retained on 20 mm sieve but 100% shall be retained on 12 mm sieve.

Metal shall be secured, if so desired by the Engineer of DPL in fines from 12 mm to dust screen out and may be used as blind age if found suitable by the Engineer.

The metal shall be laid to camber & profile in such a way that the total thickness of loose metal over soling is not less than 150mm if required to make the consolidated thickness to 100 mm after rolling. While spreading the metal proper profile and camber shall be maintained and checked with templates at every 10 M.

10.07.06 DRY ROLLING :

After metal have been laid and dressed as above, metals shall be rolled dry with a 10 Ton road Roller until well compacted and there is no appreciable movement of the stone or no appreciable wave in front of the advancing roller and no lines of roller are left on the surface Excessive dry rolling should also be avoided.

When the desired degree of compaction has been obtained by dry rolling, screening of approved chipping 12mm down in size should be spread uniformly over the surface by

brooming and this should be pushed into the interstices by rolling successive layers of evenness observed shall be rectified by removing stone up to a depth 50 to 75 mm refilling the same hand packing and revolving. No watering should be done till this process is complete. The amount of screening used should not be less than 10 liters per one sq. m. of road surface.

Rolling operation has to be carefully carried out. Rolling should be done commencing from the edge for the road and working towards the centre. Roller should be passed equal and sufficient numbers of times on the metal spread at every stage so as to secure equal and thorough compaction. Speed of the roller has to be slow and uniform and reversing shall be quick and free from jerks. As far as possible, the reversing process should be at different section of length rolled during each successive trip.

10.07.07 WET ROLLING (WATER BOUND MACADAM):

When the dry rolling has been completed to the satisfaction of the Engineer, the surface is to be watered and kept saturated and rolled a few turns as specified above Approved quality blind age shall then be spread uniformly over the surface to a thickness of 25 to 12mm. The roller wheels as well as the road surface should be constantly watered during wet rolling process. The rolling should be continued until slurry is formed over the entire surface and the same moves in the form of a wave in front of the roller when the rolling operation may end and the surface allowed to dry. The finished metal ling shall be minimum 100 mm thick. The finished surface shall be smooth and uniform and free from waviness and corrugation and as per specified profile and camber.

After 24 hours of rolling the surface shall be sprinkled with a thin layer of sand not less than 56 ltr. Per 100 sq m. of surface.

The compaction and finish shall be as per specification and to the satisfaction of the Engineer in-charge at the site finds that the water bound macadam done is not as per approved drawing, the whole metal over the defective portion shall be taken out, re-laid and compacted as specified above.

10.07.08 BITUMINOUS CARPET & SEAL COAT :

The existing surface is to be examined with a template and straight edge and all deviations from the correct profile and grades are corrected by the recondition. The existing surface is also examined for the minimum depth of base and metal ling necessary to carry the traffic load. The surface then to be cleared entirely by means of wire brushes, bristle brooms and safe brooms so as to expose a clean metal surface with the sundry materials in the joints remove to a depth of 12 to 6 mm without loosening the stones.

The binding materials to be applied only after the road surface to be treated is thoroughly cleaned and dried. It is applied evenly at the correct temperature under pressured from a sprayer, taking care to see that the spraying is done longitudinally parallel to the axis of the road. The rate of application shall be minimum 260 kg. per 10 sq. m. depending on the grade of the binding material, its temperature when applied to the road and roughness of the surface. If bare or thin patches are caused, they should be covered by pouring very small quantities of the binding material at proper temp from a can and spreading it out evenly with the aid of squeegees.

After spraying, even when binder is not dry, chips 25 to 12mm size for rough surface and 10 to 3 mm for smooth surface free from dust, dirt, leaves etc. is spread at the rate of 1.50-1.75 cu. m per 100 sq. m. for rough surface & 0.85 to 1.25 cu. m per 100 sq. m. for smooth surface. This chip shall be best variety available with coefficient of wear not less than 17 in the dry test and not less than 8 in wet test.

After sufficient length and area covered with chips, the bituminous carpet is compressed by a power roller of not less than 10/8-ton weight. Rolling is done longitudinally at the sides and then proceed towards the centre of pavement, overlapping on successive trips by at least one half of the width of the rear wheel. Rolling to be done until all roller marks are eliminated. The rolling should always be done slowly so as to avoid displacement of hot mixture. Any displacement occurred is to be rectified by the use of rakes and of fresh mixture when required. The rate of rolling should in no case exceed 125 to 175 sq. m. per hour per roller and is to be continued until no further compression is possible. To prevent adhesion of the surface course mix, the roller wheels are to be kept properly moistened.

A seal coat with hot matrix and pre coated stone chips on newly laid black-top surface shall be applied after thorough cleaning 6 mm down stone chips, fully pre coating the same with matrix (tar or asphalt) @ 70 kg per cum. of stone chips, shall be applied @ 0.90 cum per 100 sq. m of area over the cleaned surface. The surface shall be thoroughly consolidated with power roller.

Traffic shall be allowed after four days from the day of application of seal coat or as approved by the site Engineer of DPL

The hand roller may be used by the contractor only for preparation of the sub grade and minor consolidation work wherever necessary.

10.07.09 R.C.C. CULVERT:

The contractor shall design and construct RCC box culvert with wing walls or RCC bridge at approach to Sub-station and other locations within Sub-station as required for conveying the heaviest equipment to and from the Sub-station. The culvert shall provide adequate waterway to cater entire monsoon flow of the existing natural drain/road side borrow pit. The culvert shall be designed suitably for Class A or 70R loading whichever causes worst effect.

10.08 EARTH WORK IN EXCAVATION BACK FILLING & GRAVEL PREADING :

10.09 EARTH WORK IN EXCAVATION:

Excavation shall include the removal of all kinds of soil, loose or compact morum, gravel etc. soft and hard rock including lateritic rock, schist/gneiss rock etc. required to properly execute the work and shall be made with sufficient clearance to permit the placing, inspection and setting of forms and completion of all work for which purpose the excavation was made and shall be inclusive of all loads and lifts.

All excavations shall be done to the minimum dimensions as required for the safety, stability and working facility. In firm soil, the sides of a trench shall be kept vertical up to a depth of 2 meters from bottom and for a greater depth, the trench shall be widened by

allowing steps of 50 cm. on other side after every 2 meters depth from the bottom. However the contractor shall be responsible for any consequent loss or damage and safety of the workmen.

Prior to starting excavation, the ground level at the location shall be checked by the Contractor in presence of the Engineer of DPL.

If the excavation shall not be carried out below the foundation level of the adjacent buildings until necessary protection works e.g. under pinning, shoring etc. are done as per instruction of Engineer. Cost of such protection work shall be borne by the contractor.

The contractor shall be solely responsible for assumptions and conclusions as to the nature of materials to be excavated and the difficulty in marking and maintaining the required excavation and performing the work in accordance with specifications. Cost of shoring, bracing, dewatering and availing out water from excavation manually or by using pumps well points dewatering during excavation of the work shall be included in the bid.

The contractor shall maintain dry working condition inside excavation pit for placement shuttering, reinforcement and concreting etc. below sub soil water level all excavations shall be kept free of water and slush. The contractor shall remove by pumping or by other means, approved by the Engineer, any water inclusive of rain water and subsoil water accumulated in excavation pit/trench until construction of foundation structure and back filling are complete in all respect. Sumps made for dewatering must be kept clear of the foundations.

Foundations at higher depths shall be completed before execution of the shallow depth foundations.

10.08.02 BACK FILLING

The material used for back filling shall be free from lumps & clods, roots and vegetation, organic materials, harmful salts and chemicals, stones, concrete etc.

Earth fill around the foundations structures, columns and below floors shall commence after the structures have been inspected and approved by the site Engineer of DPL. Prior to earth fill forms, temporary shoring, debris brick bats etc. shall be removed.

Earth fill shall be placed in horizontal layers not exceeding 1540mm in thickness. Each layer shall be watered, compacted and rammed with approved manual/mechanical means.

The final surface shall be trimmed and leveled to proper profile as required as per cl.no.10.07.

Excavated materials not suitable or not required for backfill, shall be deposited in areas as directed by the Engineer or shall be removed outside the area of Sub-station to a suitable place arranged by the contractor.

Structures like Cable Trench, Drain Switchyard Fencing etc. falling on back filled soil must be placed over a silver sand cushioning of minimum 500mm thickness.

10.08.03 GRAVEL SPREADING :

The work shall consist of a surfacing course 100 mm (min.) thick composed of gravel spread uniformly on the whole switchyard area as per design requirement.

MATERIALS :

The gravel shall be clean and hard approved by Engineer. The ratio of the length to the thickness of the particles, for the control of particles shape, shall not exceed 2. The size of gravel shall be 50 mm and down graded.

CONSTRUCTION METHOD:

- A) The preparation of the area for spreading of gravel surfacing shall be done in such a way as to clear of all grass, weeds, roots and all other objectionable materials. A suitable chemical treatment on the switchyard ground shall be applied to arrest future growth of tress, weeds etc. as per manufacturer's specification and approval of the Engineer.
- B) The first layer of lower size aggregate shall be spread uniformly and compacted to a thickness of s approximately 40 mm.
- C) The second layer shall consist of 50 mm and 25 mm size aggregates mixed in proportion of 2:1 by volume which shall be spread uniformly and compacted to a thickness of approximately 60 mm so as to furnish a total finished thickness of 100 mm (mm) of compacted gravel surfacing true to line and level.

10.09 : SWITCHYARD FENCING AND GATES: SCOPE:

This specification covers the furnishing of all materials, labour equipment, tools services for the complete and proper construction of chain link fencing as specified herein and shown on drawings.

10.09.01 : MATERIALS:

All materials shall conform to the relevant Indian Standards Specification (latest revision).

10.09.02 DESIGN:

Sub-station fencing shall be of galvanized steel chain links appropriate height conforming to IS: 2721 over 600 mm (max) height brick masonry wall thus making an overall height of 2.50 M from F.G.L.

All galvanized steel chain link fabric shall be of 6G with nominal mesh size of 75 x 75 mm and shall be fixed on M.S. angle frame with M.S. angle or flats of suitable size with bolts and nuts. The said fencing shall be placed on brick masonry wall 600mm high above ground level. The fencing shall be strutted by suitable M.S. angle struts on R.C.C. pillars at required intervals to correct line and level. Grouting of posts and struts shall be done with C.C. (M20) of approved block size.

Strained wire' fencing shall be constructed when necessary in accordance with specifications to be approved by the Engineer. Posts and struts shall be of R.C.C. of grade M-15 and line wires shall be plain wires of 14 mm dia.

10.09.03 M.S.GATE:

Gates for switchyard fencing shall be of M.S. construction of size 5.5 M x 2.5 M high with a well arranged frame work to ensure stiffness and rigidity combined with light weight it shall be two leaved operable type gate hung from R.C.C. pillars on both sides.

The gate leaf shall run on a track at ground level and shall be suitably supported against toppling when in the closed position. Suitable tracks/guides shall be provided to ensure smooth travel.

The gate shall be operated manually. The operating mechanism and fixtures shall be sturdy, capable of smooth and rattle free travel of gate with a minimum of effort and shall be easy to maintain. The gate shall be provided with suitable locking device. Name and voltage class of sub-station shall be boldly indicated on the gate.

10.10 CONCRETE AND ALLIED WORKS:

Concrete work shall mean and include all and every concrete work for the civil work. The contractor shall perform the concrete work in strict conformity to IS: 45612000 and as directed by Engineer and shall inform Engineer at least 24 hours in advance from the time of scheduled concreting.

10.10.01 COMPOSITION OF CONCRETE:

GENERAL MIX COMPOSITION:

The concrete shall be composed of cement, fine aggregate, coarse aggregate, water and admixtures as specified. All materials shall be well mixed and brought to the proper consistency.

NOMINAL MIX CONCRETE:

Nominal mix concrete may be used for concrete of grade M-10, M-15 and M-20. The proportions of materials of nominal mix concrete shall be in accordance with Table below : Cement shall be used by weight and not by volume

PROPORTIONS FOR NOMINAL MIX CONCRETE

Grade of Concrete	Total quantity of dry aggregates by Mass per 50 kg. to cement to be taken as the sum of the individual Masses of Fine and Coarse Aggregates (Max.)	Proportion of Fine Aggregate to Coarse Aggregate (By Mass)	Quantity of water per 50 Kg. of Cement (Max.)

1	2	3	4 Litres
MS	800	Generally 1:2 but	60
M7-5	625	Subject to an upper limit of 1:1.5 and a lower limit of 1:2.5	45
M-10	480		34
M-15	350		32
M-20	250		30

The detailed mix. proportion of concrete producing suitable workability, consistency, density, impermeability, durability and required strength supported with concrete compressive strength test results shall be submitted to Engineer for approval.

CONSISTENCY:

The detail mix. Proportions shall be submitted to Engineer for approval to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregate as they enter the mixer. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity in concrete consistency from batch to batch will be required.

LEAN CONCRETE:

Lean concrete shall be used under all foundations with the ratio of cement: coarse sand: stone aggregate equal to 1:3:6. The minimum thickness of the layer shall be 75mm.

10.10.02 CEMENT:

QUALITY:

Generally cement shall be ordinary Portland cement conforming for to IS:269, or Portland slag cement conforming to IS:455, or Portland Pozzolana Cement conforming to IS: 1489. In special cases, rapid hardening Portland cement, low heat cement etc. may be permitted by the Engineer.

10.10.03 COARSE AGGREGATE:

QUALITY:

Coarse aggregate shall conform to IS:383 and shall be either natural gravel or manufactured coarse aggregate. Coarse aggregate shall consist of well shaped clean, hard dense, durable rock fragments and shall not include elongated, flaky or laminated pieces and any other impurities or deleterious material.

GRADING:

Coarse aggregate shall be graded for each maximum size within the standard limits specified as follows:

GRADING LIMITS OF COARSE AGGREGATE

IS SIEVE DESIGNATION	PERCENTAGE PASSING FOR GRADED AGGREGATE
----------------------	---

	OF ONOMINAL SIZE	
	40MM	20MM
80.00 mm	100	
63.00 mm		
40.00 mm	95-100	100
20.00 mm	30-70	90-100
16.00 mm		
12.50 mm		
10.00 mm	10-35	25-55
4-75 mm	0-5	0-10

10.10.04 FINE AGGREGATE:

QUALITY:

Fine aggregate shall conform to IS:383 and shall be natural sand or manufactured sand. It shall consist of clean, hard, dense and durable rock particles, free from injurious amounts of dust, silt stone power, pieces of thin stone, alkali, organic matter and other impurities.

GRANDING:

The fine aggregate as batched shall be well graded and when tested shall conform to the following limits:

GRANDING LIMITS FOR FINE AGHGREGATES

IS SIEVE DESIGNATION	PERCENTAGE PASSING			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10mm	100	100	100	95-100
4.75 mm	900-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-39	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

According to IS: 383, the fine aggregate (i.e. sand) is graded into four zones. A fine aggregate whose grading falls outside the limits of any particular grading ozone or sieves other than 600 micron LS. Sieve is regarded as failing within the grading zone provided the total of he excess on the other four sieves is not greater than 5% Sand of zones 1 to 3 may be used for concrete work. Zone 4 sand should not be used except in special mixes.

10.10.05 ADMUXTURE:

The contractor shall use admixture, if required, in order to improve the quality of concrete or mortar such as workability and finish ability and water tightness as per manufacture's instructions only with the approval of Engineer. The admixture shall conform to IS:9103.

10.10.06 WATER:

Water used for both mixing and curing shall be clean and free from injurious materials such as oil, acids, alkalis, salts, organic materials or other substances that may be deleterious to concrete and steel, potable water is generally satisfactory.

10.10.07 STEEL REINFORCEMENT:

The contractor shall place all the reinforcement bars in the concrete structures as shown on the approved drawings and directed by the Employer/Engineer

QUALITY:

The reinforcement bars used for concrete structure shall be plain and deformed bars and shall conform to IS:432 and IS: 1786. All bars shall be of tested quality.

Reinforcement bars shall be accurately placed and special care shall be exercised to prevent the reinforcement bars from being displaced during the placement of concrete. Intersecting points and splices of the reinforcement bars shall be fixed by using black annealed wires, the diameter of which shall be more than 1.626 mm. The reinforcement bars in structures shall be placed and supported by use of cover blocks made up of cement sand mortar (1:2) duly cured, m.s. spacers or other satisfactory devices to ensure required coverage between the reinforcement bars and the surface of concrete. Bar bending schedule shall be submitted to the site in charge directly to execute the job accordingly with a copy to CP & ED

10.10.08 FORM WORK

GENERAL:

Forms shall be used, where necessary, to confine and shape the concrete to the required dimensions, levels, grade etc. lines and as directed by Employer/Engineer. Forms shall have sufficient strength to withstand the pressure resulting from placing and vibrating of the concrete, and shall be maintained rigidly in positions. Forms shall be sufficiently tight to prevent loss of cement slurry from the concrete. Each form shall be so prepared that each section may be removed individually without injuring the concrete. All supports and scaffolds should be manufactured from structural steel/tubular steel except when permitted otherwise by the Engineer.

Faces of formwork coming in contact with concrete shall be cleaned and two coats of mould oil or any other insoluble, non-staining approved material applied before fixing reinforcement. The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges and other blemishes.

Formwork, during any stage of construction, showing excessive distortion, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be removed entirely and formwork should be corrected prior to placement of fresh concrete.

REMOVAL OF FORMS:

The forms shall be removed at the following minimum times after concrete has been placed as per provision laid down in I.S.456-2000.

Side form of column, beam and wall	2 days
Supporting form slabs excluding beams	14 days
Supporting form of beams and arches	21 days.

Whenever required the form work shall be left for longer period than the period mentioned above.

Before reuse, all forms shall be thoroughly scraped, cleaned, nails/bolts removed, holes suitably plugged, joints repaired and warped lumber resized to the satisfaction of Engineer. Contractor shall equip himself with enough shuttering to complete the job in time.

The contractor shall be responsible for the safe removal of the of the formwork and any work showing signs of damage though premature removal of form work shall be rejected and entirely reconstructed.

10.10.09 BATCING AND MIXING:

All concrete shall be mixed in a mechanical mixer. The contractor shall provide equipment and shall maintain and operated the equipment to produce the require quality of concrete. The mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency.

The workability of concrete should be controlled by direct measurement of water content and shall be checked at regular intervals.

10.10.10 PLACING OF CONCRETE:

GENERAL:

Prior to placing concrete, the contractor shall submit to Engineer for approval the mix. Proportion, the characteristics of each of the materials of concrete, the concrete placing schedule, placing equipment and method of execution of work. No concrete shall be placed until all formwork, treatment of surface, placing of reinforcement and other parts to be embedded have been inspected and approved by the Engineer.

TRANSPORTING AND CONVEYING:

Concrete shall be transported from the mixer to the formwork as rapidly s possible to avoid segregation and loss of any ingredient. The concrete which has remained more than 30 minutes after being discharged from the mixer and/or in which slump loss exceeds 3.0cm. as it is delivered to the site for placing shall be disposed off at the place designated by Engineer. All such waste concrete shall be at the contractor's account. Concrete shall be placed with a vertical drop not greater than 1.0 m except where suitable equipment is provided to prevent segregation or where specifically authorized.

Concrete which has segregated during transportation shall be remixed.

PLACING:

After the surface unformed construction joint has been cleaned and the placing of concrete has been approved by Engineer in accordance with the provisions of the preceding sub-articles, surface of unformed construction joint shall be covered with a layer of mortar approximately 1.5 cm. thick. The contractor shall place concrete upon the fresh mortar before it begins to set.

Concrete shall be deposited in all cases, as nearly as practicable, directly in its final position and shall not be caused to flow such that will permit lateral movement or cause segregation of the coarse aggregate, mortar or water from the concrete mass.

COMPACTION:

Immediately after placing, every layer of concrete shall be consolidated to the maximum practicable density so that it fits snugly against all surfaces of reinforcement bars and embedded fixtures and against all corners of the forms. Consolidation of concrete shall be done by electric or pneumatic power –driven, immersion, type vibrators or other approved means. Over vibration and under vibration shall be avoided.

10.10.11 CONCRETE CONSTRUCTION TOLERANCE:

Variation in alignment, grade and dimensions of the structures from the established alignment, grade and dimensions shall be remedied or removed and replaced by the contractor as per approved drawings and direction of Engineer.

10.10.12 CONSTRUCTION JOINTS:

Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be predetermined in the drawing.

When work has to be resumed on a surface which has hardened such surface shall be roughened. It shall be cleaned, thoroughly wetted and covered with a 12mm layer of mortar composed of cement and sand in the same proportion as that of cement and sand in concrete mix. This 12 mm layer of mortar shall be freshly mixed and placed immediately before pouring of fresh concrete.

When the concrete has not fully hardened, all latency shall be removed by scrubbing the surface with wire brush, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed.

The surface shall then be coated with neat cement. The first layer of fresh concrete on this surface shall not exceed 150 mm in thickness, and shall be well rammed against form work, particular attention being paid to corners and close stops.

10.10.13 : REPAIR CONCRETE:

The contractor shall repair at his own expense the imperfections of concrete surfaces and the regularizes which do not meet the specified dimensions, Repairing work shall be performed and completed within 24 hours after the removal of forms as per standard practice.

10.10.14 PROTECTION AND CURING OF CONCRETE:

Newly placed concrete shall be protected by approved means from rain, sun and wind, Concrete placed below ground level shall be protected against contamination from falling earth during and after placing.

As soon as concrete has hardened sufficiently, it shall be covered either with sand, session, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuously sprinkling of water may also be allowed with adequate arrangements made by the contractor.

10.10.15 TESTS:

The contractor shall make, all necessary tests for determining the mix proportions of each type of concrete, including tests of aggregates, so as to produce the concrete specifies in item 'Composition of Concrete'.

In order to control the quality of concrete to be placed, the contractor shall perform the following tests.

SLUMP TEST:

A slump test will be made from each of the first three batches mixed each day. An additional slump test will be made for each additional 40 cubic meters of concrete placed in any one day. Slump will be determined in accordance with IS: 1199.

COMPRESSION TEST:

Two sets of three concrete compression test cubes 150 mm x 150 mm x 150 mm each will be made every day when concrete is placed. One set of each group will be tested at an age of 7 days and the other set will be tested at an age of 28 days.

Samples from fresh concrete shall be taken as per IS: 1199 and cubes shall be made, cured and stored and tested in accordance with IS: 516. The test strength of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ± 15 percent of the average.

10.10.16 ACCEPTANCE CRITERIA:

Acceptance criteria of the concrete shall be guided by the provisions of IS:456

10.11 SUBSTATION STEEL STRUCTURES:

GENERAL:

The contractor shall assume full responsibility for supply, fabrication and detailing, if required of the steel structures and for their satisfactory performance. All detail drawings shall be supplied to the successful bidder by the Employer/Engineer. Employer/Engineer shall have the right to instruct the contractor to make any changes in details necessary to make the construction conform to the requirement of the Contract Document.

The contractor shall supply all materials, deliver the same to site, provide all labour, erection plant and equipment, fixtures, fitting and all temporary and permanent works necessary for satisfactory completion of the job in all respects.

No omissions or ambiguities on the drawings or in specification will relieve the contractor from furnishing best quality of materials and workmanship. Should any inaccuracies be found the contractor shall promptly notify the Employer/Engineer without carrying out the job and no further work shall be done before these discrepancies are corrected. Continuation of further work shall be done only after such discrepancies are rectified at contractor's risk and responsibility.

10.11.01 MATERIALS:

The materials shall conform to the following requirements.

All structural steel materials to be used in construction within the purview of the specification shall comply with.

IS: 2062- Structural Steel (Grade-A) (fusion welding quality) and manufacture red by Prime Rollers e.g. SAIL/TISCO/IISCO/RILNL. In case of MS sections not manufactured by prime rollers or such sections are not available with prime rollers the same is to be procured from approved conversion agents of prime manufacturer(s). In such case, prior approval of the Engineer is to be obtained is to be obtained by the contractor.

Successful bidder on receipt of structural drawing from department shall submit within 15 days a detailed raw material procurement plan indicating MS section wise producers name to the Engineer for approval. On according approval in this aspect, work for fabrication protons shall be taken up in hands.

Entire fabrication job of MS structural shall not be entrusted to more than two sub vendors Further, a list of bona fide fabricators, not exceeding 6 (six) shall be furnished to the Engineer for according approval within 15 (fifteen) days from the date of handing over of drawings.

All electrodes to be used under the contract shall comply with any of the following Indian Standard Specifications as may be applicable.

- i) IS: 814 : Covered electrodes for metal are welding structural steel.
- ii) IS: 815: Classification and coding of covered electrodes for metal are welding of mild steel and low alloy high tensile steel.
- iii) IS: 144: Covered electrodes for the metal are welding of high tensile structural steel.

All bolts and nuts shall be of grade 5.61(R1)and shall conform to the requirements of IS:6639 and IS:1367 and galvanizing quality shall be as per IS:1367. All bolts and nuts shall be of minimum diameter of 16 mm unless otherwise stated. All mild steel for bolts and nuts when tested I n accordance with the following Indian Standard specification shall have a tensile strength of riot less than 44Kg/sq.mm and a minimum elongation of 23 percent on a gauge length of 5.6 A, where 'A' is the cross sectional area of test specimen.

- i) IS: 1367: Technical supply conditions for threaded fasteners.
- ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip wire and tube.

Washers shall be made of steel conforming to IS:226, IS: 961 as may be applicable under the provisions of the contract and shall be electro gal vanished.

10.11.02 DESIGN CONSIDERATIONS:

- a) DEAD LOADS:

Soft weight of structure plus the weight of equipment including impact load and load from conductors, insulators etc. as applicable for the design of foundations for different sub-stns. structures.

b) LIVE LOADS:

- c) Generally, live loads shall be considered in accordance with IS: 875. The loads listed hereunder are minimum loads for the specific mentioned areas related to other civil work:

- | | |
|---|------------------------------|
| i) Roof (Control & other buildings) | : 150 Kg/sq.m. |
| ii) R.C.C. floors (Control buildings only) | : 750 Kg/sq.m. |
| iii) Stairs and balconies (Control buildings only) | : 500 kg/sq.m |
| iv) Culvert & R.C.C. Pipes | : IRC Class-A loading or 70R |
- whichever causes worst effect
- iv) Sump pit etc. Earth pressure/water pressure as applicable.

c) WIND LOAD:

Wind load on structures, trusses, equipment, conductor, insulators etc. shall be assessed as per IS: 802 (Part-1) with wind pressure of heavy zone (260 kg/sq. m.) for all types of structures.

d) SEISMIC LOADS:

The lateral forces shall be established in accordance with recommendations of IS:1893.

COMBINATION OF LOADS:

For the design of the steel structures and foundation simultaneous application of loads should be assumed such as to produce the maximum stress in any member for the worst combination of loads.

CONNECTIONS:

- a) bolts:
All connections shall be bolted.

b) SPLICES:

Splicing shall be avoided unless the length of a member exceeds 6.0 m or so. The number of splices shall be limited to a practical minimum. No credit shall be allowed for bearing on abutting areas. Lap joints in leg members shall be preferred to butt joints.

c) STEP BOLTS:

Step bolts shall be of 16 mm diameter and shall have round or hexagonal head. Each step bolt shall be provided with two hexagonal nuts. The minimum bolt length and length of unthreaded portion shall be 180 and 125 mm respectively. Step bolts shall not be used as connection bolts.

The step bolts shall be spaced alternately on the inner gauge line on each face of the angle about 40 cm centres. They shall be furnished for one leg of each steel structure column from its base elevation.

d) U-BOLTS:

U-Bolts shall be suitably furnished on steel structures to suspend or terminate insulator strings or ground wire assemblies. Size of U-bolt shall withstand all loads acting on it.

e) BILL OF MATERIAL :

The contractor shall prepare bill of materials (B.O.M) on the basis of the structural drawings supplied by the Employer. Bill of material shall indicate the size, length and weight of each member and the total weights of steel structures. It shall also include the number of bolts, nuts and washers per structure as per the detailed drawings of different structures supplied by the employer.

10.11.03 QUALITY CONTROL:

The contractor shall establish and maintain quality control procedures for different items of work and materials to ensure that all work is performed in accordance with the specifications and best modern practice.

In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer. As far as possible all inspection by the Engineer or Engineer's representatives shall be made at the Contractor's fabrication shop whether located at site or elsewhere. The contractor shall cooperate with the Engineer in permitting access for inspection to all places where work is being done and in providing free of cost of all necessary help in respect of tools and plants, instrument, labour and material required to carry out the inspection. Materials or workmanship not in reasonable conformance with the provisions of these specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work:

- | | |
|---------------------------|--|
| i) Steel | Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used. |
| ii) Bolts, nuts & Washers | Manufacturer's certificate, dimension check, material testing. |
| iii) Electrodes | Manufacturer's certificate, thickness and quality of flux coating. |
| iv) Welds | Inspection, X-ray, ultrasonic test, magnetic particle tests as required. |
| v) Paints | Manufacturer's certificate physical inspection reports. |

vi) Galvanizing

Tests in accordance with IS: 2633 – Method of testing uniformity of coating on zinc coated articles and steel. Raw zinc & samples collected from bath shall be tested at third party laboratory as per direction of the Engineer.

The contractor shall submit detailed material inspection plan on the basis of various IS codes & standard practices in respect of structural fabrication, galvanization, bolts, nuts, anchor bolts et much prior to commencement of the job.

10.12 FABRICATION:
10.12.01 WORKMANSHIP:

All workmanship shall be equal to the best practice in modern structural shop and shall conform to the provisions of IS-800/IS:802.

Rolled materials before being laid off or worked, must be clean free from sharp kinks, bends, or twists and straight within the tolerances allowed by IS:1852. If straightening is necessary it may be done by mechanical means or by the application of a limited amount of localized heat not exceeding 600oC.

Cutting shall be effected by shearing, cropping or sawing, Use of mechanically controlled Gas Cutting Torch may be permitted for mild steel provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge.

The erection clearance for cleared ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without cleats shall not be more than 3 mm at each end, but where for practical reasons greater clearance is necessary suitably designed clearance shall be provided.

All members shall consist of rolled steel sections.

Holes for bolts shall not be more than 1.5 mm larger than the diameter of the bolt passing through them unless otherwise stated.

All members shall be cut to jig and all holes shall be punched and drilled to jig. All parts shall be carefully cut and holes accurately located after the members are assembled and tightly clamped or bolted together.

Drifting or rimming of holes shall not be allowed. Holes for bolts shall not be formed by gas cutting process.

Punching of holes will not be permitted for M.S. members up to 8 mm thick and in no case shall hole be punched where the thickness of the material is less than the diameter of the punched hole.

Minimum bolt spacing and distances from edges of members shall in accordance with the provisions in the relevant Indian Standard Specification.

Built members shall when finished, be true and free from all kinds of twists and open joints and the material shall not be defective or strained in any way.

All bolts shall be galvanized including the threaded portion except the foundation bolts for which galvanizing work shall be done for a length of 100 mm (mm) to 175 mm (max) measured from the tip of the treated portion. The treads of all bolts shall be cleared of smelter by spinning or brushing. A die shall not be used for cleaning the threads unless specially approved by the Engineer. All nuts shall be galvanized with the exception of the threads which shall be oiled. In case of foundation bolts the same shall be galvanized excepting the length of embedment.

When in position all bolts shall project through the corresponding nuts but not exceeding 10mm . The nuts of all bolts attaching insulator sets and earth conductor clamps to the structure shall be carefully positioned as directed by the Engineer.

Bolts and nuts shall be placed in such a way so that they are accessible by means of an ordinary spanner.

Foundation bolts shall be fitted with washer plates or anchor angles and flats, nuts etc. and shall be manufactured from mild or special steel.

Washers shall be tapered or otherwise, suitably shaped, where necessary to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least by 3 mm. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut, In addition to the normal washer, one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified in drawings.

The thickness of spring washer shall be 3.5 mm for bolt diameter 16 mm and 4 mm for bolt diameter 20 mm.

10.12.02 CLEANING & GALVANIZING :

CLEANING:

After fabrication has been completed and accepted, all materials shall be cleared off rust, loose scale, dirt, oil grease and other foreign substances.

GALVANIZING:

All materials shall be hot dip galvanized after fabrication and cleaning. Retapping of nuts after galvanizing is not permitted.

Galvanizing for structural mild steel products shall meet the requirements of IS: 4759. All holes in materials shall be free of excess speller after galvanizing.

Galvanizing for fasteners shall meet the requirement of IS: 1367. The spring washers shall be electro galvanized as per IS: 1573.

Finished materials shall be dipped into the solution of dichromate after galvanizing for white rust protection during transportation.

All galvanizing shall be uniform and of standard quality. Quantity of zinc shall meet the requirement of IS-209.

Mass of Zinc Coating:

The mass of zinc coating for different class of materials, as given in Table below, shall be followed.

MASS OF ZINC COATING:

Sl. No.	Product	Minimum value of Average Mass of Coating
i)	Casting gray iron, malleable iron	610 (g/sq.m)
ii)	Fabricated steel articles	610
a)	5 mm thick and over	460
b)	Under 5 mm. but not less than 2 mm	340
c)	Under 2 mm. but not less than 1.2 mm	
iii)	Threaded work other than tubes and tube fittings	
a)	10mm dia and over	300
b)	Under 10 mm dia	270

STRAIGHTENING AFTER GALVANIZING:

All plates and shapes which have been warped by the galvanizing process shall be straightened by being re-rolled or pressed. The materials shall not be hammered or otherwise straightened in a manner that will injure the protective coating. If, in the opinion of Employer/Engineer the material has been forcibly bent or warped in the process of galvanizing or fabrication, such defects shall be cause for rejection.

REPAIR OF GALVANIZING:

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized, unless, in the opinion of Engineer, the damage is local and can be repaired by zinc spraying or by applying a coating of galvanizing repair compound. Where re-galvanizing is required, any member which becomes damaged after having been dipped twice shall be rejected.

10.12.03 SHOP ASSEMBLY:

One of each type of steel structures shall be assembled in the shop to such an extent as to ensure proper field erection in order to facilitate inspection by the Engineer.

10.12.04 SHOP TEST:

10.12.05 The following shop tests shall be performed with relevant provisions of I.S. Codes:

- General Inspection
- Material test
- Assembly test
- Galvanizing test.

The contractor shall furnish four certified copies of reports of all tests to the Engineer.

10.13 FOUNDATION WORKS:

GENERAL REQUIREMENT:

The design of RCC foundation for all the Sub-station steel structures, electro-mechanical equipments, control and residential buildings etc. to be constructed shall be the responsibility of the contractor. All design of RCC foundation works shall conform to IS: 456 (2000) unless otherwise mentioned herein. All designs and details shall be subject to approval of the Engineer. Effect of additional surcharge due to earth filling shall duly be taken into account during design.

However, detailed foundation design shall be based on the actual soil parameters which may be consulted by the intending bidder at the design office. Any variation in design of foundations due to change in soil parameters during execution of work shall not affect the terms of the Contract. No extra payment on account of any change whatsoever in soil parameters.

10.13.01 DESIGN OF FOUNDATIONS:

A) STEEL STRUCTURE FOUNDATIONS:

The foundations shall be designed such that the upper structure shall be securely supported. Any unequal displacement that may cause harmful effect to the upper structures shall not be allowed. The safety factors for strength and stability of the foundations shall be as per relevant code.

The overload factor shall be taken as 1.1 for designing foundations of all gantry and equipment. The loads and moment values shall be multiplied with this overload factor so as to obtain the design values.

B) ELECTRO-MECHANICAL EQUIPMENT FOUNDATIONS:

The foundation shall be so designed that the upper equipment shall be securely supported. The effect of vibration of the equipment impact load when in operation and overturning force due to abnormal condition of equipment shall be considered in foundation design. The safety factor for stability of the foundations shall be as per relevant code with an overload factor of 1.1.

R.C.C. foundations of 13/33 KV, 31.5 MVA transformers & below shall be designed and constructed in such a way, so that same can be utilized for installation of 50 MVA transformers in future. The oil soak pit and oil/water sump shall also be designed and constructed with such future provisions. For various design parameters and other details refer clause 10-21 of this specification.

Following minimum values shall be used while designing foundations.

- i) Minimum base slab thickness of fittings : 20mm
- ii) Minimum bar dia for foundation : 10mm TOR
- iii) Minimum bar dia for columns : 12 mm TOR with binder spacing limited to 190 mm c/c.
- iv) Clear cover to:
 - Main bars in base slab : 50 mm
 - Main bars in columns : 40 mm TOR
 - Main bars of beams : 40 mm TOR

- v) Minimum reinforcement for base slab shall be 0.2 percent of cross sectional area, depth to be considered as effective depth and where beam slab mechanism will be deployed 0.12 percent of gross cross sectional area shall be considered.
- vi) Minimum reinforcement both at top and bottom in either direction shall not be less than 10 Tor @ 200c/c.

THE LOADS MOMENTS AND SHEAR FOR FOUNDATION SUMMARY OOF LOADS MOMENTS AND SHEAR AT CONCRETE LFVEL OF VARIOUS TRUCTURES & EQUIPOMENT STRUCTURES

Sl. No.	1. Structure	Vertical loads(Kg)	Moment Along bay Across bay		Horizontal Shear Along bay Across bay	
1	2	3	4	5	6	7
132 KV						
1	LINE TOWER	3000	115360	39350	8990	3800
2	'A' Frame (Main Bus with Twin (Moose)	2900	83525	19930	10425	2040
3	'A' Frame Transfer Bus with Single Moose)	2415	46820	11615	6150	1880
4	H.L. Isolator	3715	87245	18636	11010	2803
5	L.L. Isolator	1700	5400		2330	
6	B.P.L.	288	2860		531	
7	P.T.	748	3025		886	
8	High level CT	875	3806		1036	
9	Low Level CT	797	2359		825	
10	L.A.	506	823		387	
11	CVT	811	1256		582	
12	Isolator (1-Ph)	500	3080		1170	
13	Lighting Mast	4900	62000	62000	4100	4100
14	Breaker	As per manufactures load + wind load				
15	Transformer	As per manufacturer's load + seismic load				
33 KV						
1	LINE TOWER	1966	36013	5925	5100	1183
2	A-Frame Main Bus with (win Moose)	2163	49475	3233	9352	915
3	A-Frame Transfer Bus with single Moose	1920	25795	2810	5040	800
4	H.T. Isolator	3458	60694	4373	9666	1203
5	Isolator (3-Ph)	701	2488		1237	
6	Isolator (1-Ph)	355	1071		640	
7	BPI (2-Ph)	690	2056		1091	
8	BPI (1-Ph)	175	622		283	
9	PT-(1-Ph)	906	2584		1278	
10	Pt-(1-Ph)	512	829		458	
11	H.C.T. (3-Ph)	470	2628		1257	
12	L.C.T.(3-Ph)	440	1869		1065	
13	L.A.(3-Ph)	615	2196		1062	
14	NCT	237	852		354	
15	REACTOR	331	1356		503	
16	CAPACITOR BANK	2920	5008	3313	1448	1105
17	BREAKER	As per manufacturers load+ wind load				
18	TRANSFORMER	As per manufacturer's load +seismic load				

1	2	3	4	5	6	7
20 KV						
	Wave Trap	700	1513		518	
	L.L. Isolator	900	3600		1040	
	Bus sup[port	430	3720		884	
	Circuit Breaker	As per	Manufacturers		884	
	C.T.	2000	5352		Load + Wind Load	
	P.T.	1060	2691		1319	
	L.A.	700	4500		877	
					1300	

8	C.C/C.V.I.	900	1785	650
9	220/132 KV Transformer	As per Manufacturer Load + Seismic Load		Seismic Load

220 KV

Sl. No.	Type of Tower	Vertical	Horizontal Shear				Moment			
			Longitudinal directions		Transverse Direction		Longitudinal directions		Transverse Direction	
			Longitudinal wind	Transverse wind	Long wind	Transv. wind	Longwind	Transv wind	Long. wind	Transv. wind
1	2T2TA	8973	11268	6132	4200	9092	166230	108032	44940	96452
2	212	7134	9334	5166	259	1886	137000	88036	5362	43524
3	2C1	6000	11636	8400	0	2818	117756	89880	0	20486
4	2C2	3350	6450	4200	0	2000	62746	43900	0	13404
5	2C3	2620	4053	2100	0	1618	37800	23262	0	10642
6	2T4/2T4	9472	10602	5166	4459	9425	151094	88036	50301	102670

Note:

1. Uplift /down thrust due to moment shall be computed with the base dimensions shown in bid drawing.
2. Columns in foundation shall be checked in compression with bending and up lift with bending also.
3. Above loads & moment etc. shall be multiplied by an overload Factor of 1.1 while computing design values.
4. Foundations for single phase structures shall be designed in both direction i.e. along bay and across bay with loads shown in the aforesaid table.

Any doubt in regards to design loads, moments etc. and about its applicability to any particular structure shall be limited to tendering authority prior to submission of bid. No claim whatsoever on this amount will be entertained during execution of work.

10.13.02 DETAILS:

A) DETAIL DESIGN CALCULATION:

Detail design calculations for each type of foundation shall be submitted for approval of Engineer. Such details shall show the following requirements.

- i) Detailed calculation of loads acting on foundation under different loading conditions
 - ii) Calculated safety factor for each type of stability and other conditions.
 - iii) Maximum stresses in concrete and in steel reinforcement at any critical section.
- B) LINE AND GRADE:

The contractor shall set all lines and grades or elevation of the ground at all footings and set the necessary stakes that are required for the work and will be responsible for their accuracy.

Employment/Engineer may check lines and levels set by the Contractor from time to time, and inadequacies if any, shall be rectified by the contractor as per the direction of the Engineer. but the responsibility for their accuracy shall rest entirely with Contractor.

C) DETAIL DRAWINGS

Details of each type of foundation submitted for Employer's/Engineer's approval shall be as shown on the approved design drawings and shall conform to the requirements described hereafter. No change shall be made without the written approval of Employer/Engineer. The detail drawings shall include but not limited to the following:

- i) Detail dimensions of foundation.
- ii) Details of setting dimensions of foundation.
- iii) Details of placing of all reinforcing steel which shall conform to the Building, Code Requirements for Reinforced Concrete (IS:456) and the Manual of Standard Practice for Detailing Reinforced Concrete Structure unless otherwise specified herein.
- iv) Details of type size and length of each reinforcing steel including schedule of bar bending to be submitted to the Engineer at site.

10.14 CONTROL BUILDING:

GENERAL:

The contractor shall provide control building and furnish the indoor facilities in accordance with the requirements specified herein and in the accompanied bid drawings.

Where the control building is to be constructed as an extension of the existing control building, the same shall be placed by the side of the existing control room and shall be connected by dismantling the common existing brick wall of the existing Control room, without endangering the safety of the structures. The Contractor shall ensure smooth functioning of day to day work during execution of the extension job.

The control room will be having adequate area and will accommodate all control panels along with specified nos. of future control and relay panel as per approved layout, D.C. & A.C. Distribution boards and battery charger panel etc. Apart from control room battery.

from P.L.C.C. room, stair and toiler block etc. shall be provided as per approved layout drawing. Control panels and equipments shall be laid in control room keeping adequate clearance and sufficient space for movement and maintenance. Minimum clearance from wall at the back of panel will be 1200 mm. clearance between two adjacent boards of panels will be decided during detailed engineering.

The planning of control building shall be made in such a way that the entire switchyard is made clearly visible from the control room for better supervision and control.

The contractor shall furnish detailed conceptual drawings showing floor plans, front, rear and side elevations accommodating all panels, equipments and other required spaces.

The indicative drawing as attached in these documents is outline plan for bidding only. The contractor shall, on the basis of drawing and specification made part of the document prepare design drawings including all facilities in accordance with relevant IS codes and National Building codes and submit to Employer/Engineer for approval.

Generally, live loads shall be considered in accordance with IS:8/5. The design live load for floor, stairs and balconies of control building shall be as per cl. No. 10.12.02 (Live load). The live load for roof of 132 KV Control Room shall be 500 Kg/Sq. m.

The foundation of control building excluding the control room shall be designed with future provision of an additional storey in case of extension sub-stations.

The control room & PLCC room and conference room shall be air conditioned by installing suitable air conditioners for all sub-stations. Exhaust fans of approved capacity shall be installed in battery room and toilets of control building and kitchens of residential quarters.

The work will also include sanitary, plumbing, cable trench, cable hangers, partition walls, false ceiling, flooring, wall/ceiling finishing work, painting job plinth protection, surface drain, septic tank, soak pit, illumination, internal electrification, A.C. & ventilation work and all other architectural and civil item of works required for completion and successful commissioning of the control building on turn key basis.

10.14.01 DOORS, WINDOWS AND COLLAPSIBLE GATE:

The Contractor shall supply and install doors and windows, according to the approved drawings, prior to the execution of the work; the contractor shall prepare and submit drawings to Engineer for approval.

Steel Sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS:1361 or as specified in approved drawing. All welds shall be dressed flush on all exposed and contact surfaces.

Aluminum sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS: 1948 and 1949 and of approved standard make and shall be of approved thickness. Doors, frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 20 micron thickness. The anodized material shall then be sealed by

immersion in boiling water for 15 minutes. A protective transparent coating shall be applied to the sections at shop.

Hardware and fixtures shall be of adequate strength and of best quality and from approved manufacturers.

Portions, of aluminium frame which come in contact with masonry construction shall be protected with a heavy coat of alkali; paint at shop, portions coming in contact with other incompatible metals shall be coated with zinc chromate primer.

All steel doors, windows etc. shall be hot dip galvanized to give coating weight as specified in cl. 10.13.02. One coat zinc chromate primer coat shall then be applied as shop paint.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel other members shall be bedded in mastic cement and caulking done properly as per drawing and instruction of the Engineer.

All windows shall be outside glazed, fixed with putty or metal glazing beads as shown on the drawings. Aluminium glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 45.0 mm to Hick glazing. Glazing beads shall be cut with mitered corners. Glazing clips, fixing devices etc. shall be supplied in adequate number.

Locks, fasteners, etc. shall engage positively, key shall be non interchangeable.

Before bulk supply, the contractor shall submit to the Engineer samples of each type of fabricated/manufactured items for approval. The samples shall be retained by the Engineer for

comparison of bulk supply and returned to the contractor towards the end for final incorporation in the job.

Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

Glass and glazing for door, windows, sashes, ventilators, fixed louvers, partitions etc. shall be plain glass except as otherwise specified and shall be of uniform refractive index and free from flows, unevenness, stain or bubbles etc.

Glazing shall be carefully done in accordance with IS:3348 and IS: 1083.

Clear glass shall be flat, drawn sheet glass and shall be at least 4 mm thick in steel windows. Sheet glass for doors shall be minimum 5.5 mm thick. Putty used for fixing glass shall be well mixed and spread out neatly to make an even surface.

After completion of glazing work, the contractor shall remove all dirt, stains, excess putty etc. clean the glass panes and leave the work in perfectly acceptable condition. All broken, cracked or damaged glass shall be replaced by new one, by the Contractor within the stipulated period or till formal handing over of the installation.

10.14.02 ROLLING STEEL SHUTTERS/GRILLS:

Rolling shutters shall be made in accordance with IS:6248 from tested bright cold rolled, annotated M.S. stripes, not less than 0.9 mm thick for shutters up to 4.5 M wide and Not less than 2.25 mm thick for shutters 5.5 M wide and above, machine rolled at 7.5 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.

Rolling grills shall be constructed out of 6 mm rods at 35mm Centers running horizontally flexible connected with vertical likes spaced not more than 200 mm centers. Alternatively, rolling grills shall be made from perforated spots of approval design reinforced with 6mm dia rods. Guides shall be of such depth as to retain the shutter under specified wind pressure.

Shafts shall be of steel pipe of sufficient size to carry the torsion load with a maximum deflection of 1/360th of span. Greaser packed ball bearings or bushing shall be provided for smooth trouble free operation.

Hoods shall be formed of not less than 20 gauge steel suitably reinforced to prevent sag.

Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides.

Operating chains shall be of tested quality,

Perforated spots of approved design reinforced with 6mm dia rods.

Guides shall be of such depth as to retain the shutter under specified wind pressure.

Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushing shall be provided for smooth trouble free operation.

Hoods shall be formed of not less than 20 gauge steel suitably reinforced to prevent sag.

Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides.

Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operations and hand protection.

Rolling shutters/grills shall be easily operable by of person with speed of operation of about 1-3 meters per second. In general, manually operated shutters shall be push pull type for operating up to 9 sq. meter in area.

Shutters shall be painted with one coat of zinc chromate primer at shop.

After installation of the shutters, the contractor shall test the performance of the shutter in presence of the Engineer. All control and locking devices shall give fault free performance.

10.14.03 MASONRY & ALLIED WORKS:

Bricks for generally masonry work shall be of first class (compressive strength= ≥ 100 kg/cm² minimum) well burnt, of uniform size, shape and colour free from crackles, flaws or nodules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grills, lumps, holes etc. Water absorption after 24 hours immersion shall not exceed 20% by weight. The bricks shall show no efflorescence after soaking in water and drying in shade and shall in general conform to the requirements IS:1077.

The mortar shall be prepared by mixing cement and coarse sand in the specified proportion as stated in the drawings or as instructed by the Engineer. Water shall be clear, free from organic matters, acids, or soluble salts and other deleterious substances in accordance with IS specifications,

generally, mortars in the proportion 1:4 (1 cement and

4 sand) shall be used in brick masonry works in superstructure and mortars in the proportion 1:6 (1 cement and 6 sand) shall be used in masonry works in substructure upto plinth level unless otherwise specified in the drawings or instructed by the Engineer. Internal partition walls of 125 mm and 75 mm thick brick walls shall be laid with cement sand mortar in the proportion 1:4 and 1:3 respectively with chicken wire mesh in every third layer.

All joints between bricks shall be kept uniformly 10 mm thick and shall be fully filled with mortar.

All brick shall be laid in English bond with frog on top except for the layer just below D.P.C. and in accordance with IS:2212.

The brick walls shall be truly vertical and all course shall be truly horizontal.

Masonry shall be cured by keeping it wet for seven days from the date laying. In dry weather at the end of days work top surface of masonry shall be kept by ponding.

10.14.04 PLASTERING:

Generally, brick walls shall be cement plastered with mortar in the proportion 1:6 (1 cement and 6 sand) The thickness of cement plaster on the inside and outside surfaces of brick wall shall be 19 mm and 12 mm respectively. Ceiling of the roof shall be plastered with 6 mm thick cement sand mortar in the proportion (1:4) unless otherwise specified in the drawings or instructed by the Engineer.

For sand and cement plaster, sand and cement in the specified proportion shall be mixed dry on water tight platform and minimum water added to achieve working consistency.

Plaster, when more 12mm thick, shall be applied in two coats a base coat followed by the finishing coat. The base coat shall be allowed to dry and shrink before applying the second coat of plaster.

The finished wall surface shall be true to plumb and the contractor shall make up any irregularity in the brick work with plaster.

Before plastering all the mortar joints shall be tacked out to a depth of at least 12 mm. The exposed brick surface and the joints shall be thoroughly cleaned and washed with clean water and should be kept wet for at least 12 hours before commencement of plastering.

The plastering shall be started from top and worked downwards and ensure even thickness and true surface. All corners, edges and junctions shall be neatly finished.

All drips, grooves, moldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles.

After plastering work is completed, all debris shall be removed and the area left clear.

All plastered surfaces after laying, shall be watered, for a minimum period of seven days and shall be protected from excessive heat and sunlight by suitable approved means.

Moisturing shall commence as soon as the plaster has hardened sufficiently and not susceptible to damage.

10.14.05 FINISH :

Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish.

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise, the interior plaster shall generally be finished to a smooth surface. The interior surface shall generally be finished with a wooden float.

Plastered surfaces, where an even smooth surface is specified, plaster of Paris punning shall be done.

Materials for plaster of Paris punning shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 3 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

10.14.06 FLOOR FINISH:

All types of flooring, skirting, dado and similar locations, the base surface to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush.

Artificial stone flooring shall be laid in panels of shape and size as directed. The casting of panels will be so programmed as to prevent bonding on the freshly laid panel with adjacent panels. Suitable grading where required shall be provided in the flooring for drainage of water, as directed by the Engineer. The artificial stone flooring shall be 25 mm thick concrete in (1:2:4) cement: sand: stones chips (6-10mm) including a skinning of 6.0 mm with cement neatly troweled and finished.

Cast -in-situ Terrazzo flooring shall consist of an underbed and a topping laid over an already laid and matured concrete base. Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which topping shall not be less than 12mm. While the topping shall be of uniform thickness, the underbed may vary in thickness to provide necessary slopes. The underbed shall be made with a mix of 1 part cement, 1 and 1/2 parts coarse sand and 3 parts stone chips (10 mm down) by volume'. For vertical surface, the mix shall consist of 1 part cement to 3 parts sand by volume. The mix for topping shall be composed of cement colour pigment, marble chips proportions of the ingredients shall be such as to produce the terrazzo of colour, texture and pattern approved by the Engineer.

The cement shall be white or grey or a mixture of the two to which the pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1 and 1/2 parts of marble chips by volume shall be added and thoroughly mix dry again. Water shall be added to the mixture to make it workable but not too wet.

Dividing strips made of aluminum or glass covering the total depot roof underbed plus topping shall be used for forming the panels. The panels shall not be more than 1.5 sq.m. in area of which no side shall be more than 1.2 m long. For exposed locations the maximum area of a panel shall be 2 sq.m. The panel shall be laid in alternate bays or chequered board pattern. After 12 to 18 hrs. of laying the surface shall be cured by allowing water to sand on the surface by covering with wet sack for four days.

Grinding and polishing shall be done when the surface has sufficiently hardened as per standard practice.

Glazed tiles shall be of total thickness between 20 mm and 25 mm including the underbed. The tiles shall be of approved earthenware, covered with glazed white or colored, of 150 mm x 150 mm nominal sizes and 4.5/5 mm thickness unless otherwise specified and shall conform to IS: 277. The mix for underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water. The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be thoroughly cleaned with soap.

Acid and alkali proof tiles up to the height of 1500 mm over floor level to be provided in the battery room of control building shall be of best indigenous thickness of 20 mm for skirting and 2.5 mm for floor manufacturer and having minimum thickness of 25 mm and shall have the adequate chemical resistant properties. The tiles shall have straight edges, uniform thickness, plain surface, uniform onion fading colour and textures and shall be approved by the engineer, Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have minimum compression strength of 700 kg/sq.cm. The surface shall be abrasion resistant and durable, Acid and Alkali proof paint as per approved specification is to be applied over a cast of primer on bare plastered wall.

The mortar used for setting or for underbed the tiles shall be durable and strong. The setting and fixing shall be done according to the manufacturer's specification.

All timber shall be best quality seasoned Sal, Gamari wood free from large or loose knots, cracks or other defects. Timber shall be treated with approved wood preservative before use. Before starting the carpenter's work, the Contractor shall have the rough timber approved by the site Engineer of DPL.

Plywood shall be commercial quality or with veneered decorative surface. Unless specifically permitted otherwise the adhesive used in plywood shall be phenol-formaldehyde resin of BWR grade conforming to IS:848.

Flush doors of approved thickness shall be solid core doors with decorative faces and hardwood edges. The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. Adhesive used shall be phenol formaldehyde of BWR grade, conforming to IS:848.

Panel door shall be of sal wood and frame gamari wood rail and styles & factory made panel wood panels and shall conform to relevant IS code.

Fixing of frame and partitions shall generally be done with 40 mm x 6 mm x 300mm long M.S. holdfasts bifurcated at end and grouted with 1:2:4 cement concrete,

Carpentry and joinery work shall be done as per relevant L.S. Code, details shown on drawings and as directed by the Engineer. All carpentry work shall have first class workmanship to give a neat finish.

The gap between masonry and external door and window frame shall be caulked with poly sulphide mastic.

All carpentry work after finishing shall be sand papered smooth. An approved prime coat paint shall be given after inspection of the Engineer to all surfaces other than those which shall be subsequently polished or covered with laminated plastic sheet.

10.14.08 PAINTING, WHITE WASHING, DISTEMPERING ETC:

Paint used in the work shall be ready mixed oil bound synthetic enamel paint highest grade product of well known approved manufacturer. The paint shall be brought to site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. Under no circumstances, shall the paint be diluted with turpentine or linseed oil or otherwise. All material shall be subject to inspection and analysis and approved by the Engineer. All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied. Surfaces such as plastered surface, concrete, masonry, misc. steel materials should be wire brushed, sand papered clean and free from oil, grease, efflorescence, foreign loose materials to receive the approved paint.

All colour shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer in such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

White washing shall be done from pure shell lime or fat lime, or mixture of both as instructed by the Engineer and shall conform to IS:712. Samples of lime shall be submitted to the Engineer for approval and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank of water for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 gms. of gum to 6 liters of white wash water and a little quantity of indigo or synthetic ultramarine blue shall be added to the lime.

The surface shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before application of the lime solution.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat and third coat shall be applied similarly. In case the Engineer feels that more coats are required the contractor shall do so without any extra cost to the owner. No brush marks shall show on the finished surface.

Oil bound washable distemper shall be applied after surface is primed with an alkali resistant primer and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction and to the satisfaction of the Engineer.

Waterproof cement paint shall be applied as per manufacturer's instruction. Surface shall be washed and brushed down. One coat of paint shall be given as soon as the moisture has disappeared. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking; Second coat shall be applied after the drying out of the first coat (24 to 48 hrs.) Finished surface shall be kept moist by occasional sprinkling for seven days after painting.

10.14.09 ROOF WATER PROOFING, INSULATION AND ALLIED WORKS:

GENERAL:

Roof water proofing of various types of buildings shall be done in the following manner.

A) CONTROL BUILDING RESIDENTIAL AND OTHER BUILDINGS:

Water proofing with a coat of epoxy based paint on roof before laying 25 mm thick Roof tiles, laid over cement screed concrete (1:2:4) with 6 mm down stone chips of average thickness of 40 mm and with proper slope.

The surface of roof shall be roughened and thoroughly cleaned with wire brush and water. Oil patches, if any, shall be removed with detergent. The surface shall be dried thorough and swept clean.

Exposed surface of roof of building to be treated for water proofing by the epoxy based application shall be thoroughly cleaned and the epoxy based material to be applied as specified by the manufacture prior to taking up screed concreting on roof. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a

strong durable bond. It shall not be affected by short duration from fire, sun, and light traffic. The application shall be resistant to growth of fungus and proof against saltpeter action.

If desired by the Engineer, a sample shall be prepared in advance and rested for water proof ness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing materials and labours for the application.

The under bed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The under bed shall be cured under water for at least 07 days.

The under bed shall be laid to pride and ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Under bed shall usually be composed of cement concrete, as stated above.

The under bed shall be finished to receive the laying of tiles.

Now 25mm thick pre cast roof tiles made of cement concrete with stone chips as per approved strength and density set in 40 mm (average) thick lime surki mortar (1:3) as leveling course including filling depression if any to have a desired slops and filling up joint (3m wide) with Lime Surki mortar (1:1) applying cement slurry @ 1.75 kg per sq m. Over the L.S. mortar and then setting close the percentiles, finishing up the joints with silicon sealant of approved quality including providing 150mm high skirting with the same tiles flushed with the inside surface of parapet wall finishing the mouth of rain water pipes curving etc. as necessary complete as per direction of the Engineer.

10.14.10 SUSPENDED CEILING WITH SNAP GRID SYSTEM:

Suspension system shall consist of the grid supporting the ceiling panels, air conditioning pipes, intermediate runner supports for the grid if any and hangers, wall angles etc., required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspense system shall be sufficient strength and rigidity to carry the ceiling boards in a true and level plane without exceeding a deflection of $1/360^{\text{th}}$ of span.

All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls.

All drilling on structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be done as per requirement.

All M.S. sections used for supports etc. shall be given two coats of synthetic enamel paint over a coat of red lead primer.

Aluminum grid ceiling system shall be approved make. Aluminum tees as intermediate members and aluminum channels as end pieces will be assembled in the form of grid size of tees, cross tees and channels etc. shall be as shown on drawings. Main runners shall be hung by M. S flats, angles, rods etc. at maximum 1.2 meters centers. Extra hangers shall be provided at lighting fixtures those are to be supported from the ceiling system. Turn buckles shall be provided with M.S. rods for adjustment in levels.

Ceiling panels shall be of plaster of Paris boards, manufactured by reputed approved manufacturer, samples of which shall be submitted for Engineer's approval.

Cut outs in the ceiling for light fixtures, air conditioning diffusers etc. shall be provided as shown drawings.

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance free from sags, warps, disfigure or damaged board.

Prior to delivery of ceiling components, drawings of the complete suspended ceiling system shall be submitted to the Engineer for approval. Drawings shall furnish the following information.

- a) a reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.
- b) Typical intermediate framing for support where required.
- c) Hanger fastening details.
- d) Panels unit support at ceiling penetrations.
- e) Details of splicing method for main and cross runners.
- f) A table indicating load bearing capacity of main and cross runners.
- g) A note stating that suspension system member furnished will not deflect more than $1/360^{\text{th}}$ of a 1.2 meters span under the indicated loading.

10.15 WATER SUPPLY PLUMBING & SANITARY FIXTURES AND SEWAGE DISPOSAL SYSTEM:

GENERAL:

The contractor shall have to submit the design drawing of the water supply system to control building and other utilities for approval and execute the same as required.

The water supply system shall consist of sinking deep tube wells and allied water distribution system from the tube well to residential and other buildings store shed, control building etc. The sewage disposal system shall consist of drainage from control and other buildings including necessary fixtures and waste treatment unit like septic tank, soak pit etc. All design, drawings,

materials, devices, appliances, fixtures etc. shall be submitted to Engineer for approval before fixing.

Principal item of work to be performed and materials, equipment, devices and appliances to be furnished and installed hereunder, include the following:

- a) Sinking of deep tube wells and installation of submersible pumps of adequate capacity with all accessories, fittings, cubing and automatic level control switch, pump houses of adequate size.
 - i) Boring tube-well of 150x100 mm dia by rig boring method through any type of soil strata including hire and labour charges for boring pipes, scaffoldings, tools and plants etc. As necessary upto the required depth assuming guaranteed discharge of potable water.
 - ii) The work includes verticality test, water sample test, washing and developing tube well with air compressor pump and test for yield ed. Complete.
 - iii) Supply, fitting, fixing of 100 mm dia brass strainer of leading brand and approved quality having a minimum length of 18.2 mtrs. cutter piece G.I. Pipes and all types of specials as required for successful commissioning of the tube-well and pump.
- iv) Packing the annular space between the outside of the tube-well pipes, strainer and the bore with pea sized screened gravel of approved quality and size for most of the bored length excepting the top 10 to 15 mtrs. Which shall be filled with clay of impervious nature.
- v) Supplying, installation and commissioning of approved make, model and capacity submersible pump-motor set suitable for installation of 150x 100 mm dia. Tub well complete with wet winding type submersible type motor suitable for operation on 415 volt A.C.3 phase 50 cycles including supply complete with 4 core submersible cable with size and length as required along with supplying, fitting and fixing necessary panel board of suitable DOL, type MC-1 push button starter with over load and no 102.1 relays of approved make and installing non return valve of approved make and size with all necessary fittings, fixtures etc. complete as per direction of the Engineer. The installation shall comprise of pump motor set submerged in water within casting pipe with required length of submerged 150mm. Dia G.I. pipe cable fitting and fixing hooks, steel cords, foot and check valves, clamps, caps connecting with panel board, concrete encasement round about the housing pipe to discharge pipe complete in all respect.
- vi) G.I. pipes for deep tube well shall be of heavy duty.
- b) Construction of a suitable R.C.C. overhead reservoir with necessary inlet and outlet arrangements as per requirement including was outlet.
- c) Delivery piping from medium type G.I. from R.C.C. overhead reservoir individual overhead storage tanks placed on the roof of control building, stores, security barrack and residential buildings etc. with necessary bends, tees and other fitting etc. complete.
- d) Distribution mains from respecer pumps to buildings with necessary valves, fittings etc. complete where provision of R.C.C. overhead reservoirs has not been made.
- e) All floor ordains complete with piping and trap etc.

- f) All waste and vent piping, with connections to each fixture and piece of equipment requiring a waste connection.
- g) All building water supply piping (internal) as required including connection to each fixture and piece of equipment requiring water.
- h) All plumbing fixtures and accessories.
- i) Pipe ends for flushing.
- j) Piping and 12 mm hose with bibcock for landscaping and gardening.
- k) Separate waste water treatment unit for various buildings including septic tank, soak pit etc. complete including disposal arrangement.

10.15.01 WATER SUPPLY:

The water supply system to the buildings covers service pipes and the necessary connecting pipes, fittings, control valves individual overhead PYC Tanks and all appurtenances in adjacent to building.

All materials, fittings, valves, stoop cocks, taps and other appliances shall be of best quality conforming to the relevant Indian Standard and shall be procured from approved manufacturer to be decided by the Engineer.

All pipelines shall be laid true to line, plumb and level and as per approved drawing. Care shall be taken to avoid chances of airlock and water hammer.

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic or other loads. The size and depth of the trench shall be approved by the Engineer. Backfilling shall be done with selected fine earth in 150 mm layers and carefully consolidated.

Where desired by the Engineer or shown on the drawings, the pipes shall be concealed in masonry or concrete of the structure.

All pipes medium or heavy type shall be seamless and of best quality galvanized iron, conforming to the relevant Indian Standard. All fittings, hangers, supports, straps, clamps etc. shall be of approved quality.

Threads shall be cut with sharp tools and before jointing all scales shall be removed from pipes by suitable means. Before jointing the threads shall be treated with approved pipe jointing compound.

G.I. pipes shall be given a coat of zinc chromate primer and two coats of best quality paint as approved by the Engineer. All brackets, supports, clamps etc. after installation shall be painted with two coats of paint. Underground and concealed pipes shall be painted with two coats of approved bituminous paint.

Layout and route shall be marked in place and approved by the Engineer before actual laying starts.

All pipes, fittings and appliances shall be inspected before laying and shall be sounded to disclose cracks. Any defective item shall be clearly marked as rejected and forthwith removed from the

After laying and jointing, the service pipes shall be slowly and carefully charged with water allowing all air to escape to avoid chances of air lock and water hammer.

The service pipe shall then be inspected under working conditions of pressure and flow. When all draw off taps are closed, the service pipes shall be absolutely water-tight. All piping, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion etc.

10.15.02 DRAINAGE AND SANITATION:

The contractor shall have to submit design & drawing of the waste water system as part of the total drainage scheme for approval and execute the work as required.

Drainage and sanitation covers the total layout and construction of ordains for roof water, surface water and sewage together with all fittings and fixtures and inclusive of ancillary works, such as connections, manholes and inspection chambers used within the building and from the building to the connection to sewer main or to septic tanks, soak pits and chlorination chamber.

All pipelines fittings and fixtures shall be installed leak proof as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, summitry and levels.

Shall be strictly ensured. The connections shall be such as to prevent any splashing or emission of foul dour and gases.

Soil, waste and drain pipes, traps and fittings for under ground work shall be heavy duty stoneware soil pipe as shown on drawings and as per instruction of the Engineer. Soil, waste, vent and drain pipes, and fittings above ground shall be of heavy cast iron as approved by the Engineer. Vent pipes shall be covered on top with a cowl made of C.I.

The cast iron pipes and fittings shall be effectively protected against corrosion by the painting two coats of approved anti corrosive paints.

Underground pipes may be supported on suitable concrete or brick supports so that there is no undue strain at the joints or on the pipes. Pipes shall be secured to the supports by approved means.

For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

Every joint in the cast iron pipe line shall be made with a gasket of hemp or yam. And pure soft lead properly caulked so as to preserve the continuity of the ordain without obstruction. All connections shall be made perfectly water tight. All bends junctions shall be supplied with watertight cleanout.

Rain water pipes shall be of C.I. of I.S. quality and of the size as specified on drawings. All rain water pipes shall have suitable gratings at the inlet opening at roof and floor shall be well secured and supported by adequately strong brackets. Where desired by the Engineer the rain water pipes may have to be installed in chases cut in the structure.

Rain water pipes shall be painted outside with two coats of anti corrosive paints over a coat of primer as approved by the Engineer.

Roof and floor drains and yard gullies shall be installed, if required by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable C.I. gratings.

Manholes and inspection chambers shall be provided at suitable distances as per standard practice and as directed by the Engineer.

Manholes shall be provided with medium duty C.I. covers of 32 kg weight (size-600 mm x 450 mm). The covers shall be close fittings so as to prevent gases from coming out.

Septic tank and effluent disposal system shall be well designed and construction to be made as per approved drawing. Septic tank shall consist of the tank itself with inlet and outlet pipes, fittings there from complete with all necessary earthwork, backfilling, masonry, concrete, manhole etc. The effluent from the septic tank shall be disposed by allowing it into a soak pit of approved size and specific design and as directed by the Engineer.

Septic tanks and soak pits shall be designed to have capacity as follows :

a) Control building	: 50 users
b) Dormitory	: 50 users(each bldg.)
c) C-type staff quarter (single unit)	: 15 users
d) Store shed	: 15 users

The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak, for 24 hours, Next day it is again filled up by compensating the losses. If any and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm.

All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted. All Sanitary fixtures and fittings shall be of approved I.S. quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the type of the manufacture. After the fixtures are brought to site, the contractor shall arrange for their inspection by the Engineer and only after approval, the fixtures shall be installed. All broken, damaged and rejected fixtures shall be removed from the site within two days after inspections.

WATER CLOSET:

- a) Raised type water closer shall include glazed vitreous china basin with siphon, open front solid plastic, seat and plastic, cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, stern seat and cover shall be approved by the Engineer.

- b) Squatting type water closet shall include glazed vitreous china pan with foot rests and low level PVC flushing cistern of approved make with valve fittings, supply connection and necessary fittings.

Urinals shall consist of wall type glazed vitreous chin urinals, cast iron automatic flushing cistern complete with supply connections, flush pipe, connecting pipes, gratings, traps and all other necessary fittings. Automatic flushing shall be approximately once every five minutes. Two or three urinals located together may be served by one cistern of adequate capacity. All fittings shall be chrome plated.

Wash basin shall be glazed vitreous china, flat back wall hung by cast iron brackets and complete with pattern with cold water brass faucet with nylon washers, waste chain, waste washers, flexible waste pipes with traps, perforated waste complete with necessary fittings. All fittings including faucet shall be chromium plated.

Sink shall be glazed stoneware, wall hung by painted cast iron brackets and complete with one faucet with nylon washers, waste chain, waste washers, flexible waste pipes with traps, perforated waste with necessary fittings. All fittings including faucet shall be chromium plated.

Bathroom' mirrors shall be made of best quality 6 mm thick glass of size 600 mm x 450 mm and produced by a reputed mirror manufacturer, wall mounted with adjustable removing brackets. The brackets and other fittings shall be chromium plated.

Glass shelves shall consist of 6 mm thick clear glass of size 600 mm x 125 mm with guard rails, wall mounted with brackets. All brackets & guard rails etc. shall be chromium plated.

Towel rails shall be chromium plated 20 mm diameter and 450 mm long with brackets. The brackets, screws etc. shall be chromium plated.

Soap holder shall be chromium plated wall mounted with brass plated screws.

Liquid soap dispenser shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting shall be chromium plated.

All plumbing fittings and fixtures shall be installed by skilled workers and shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and floors. All cuttings in walls and floors shall be made good by the Contractor.

10.16 CABLE TRENCHES,RACKS ETC>:

Cable trenches shall be constructed in accordance with the detailed drawings to be developed by the contractor and approved by the Engineer.

The cable trenches shall be of reinforced concrete of grade M20 unless otherwise directed by the Engineer. All concrete work shall conform to oIS:456-2000

Cable trenches shall be cast in lengths not greater than 10M with alternative lengths cast at one time. Jointly between succeeding lengths shall be sealed with continuous P.V.C. water barriers of approved variety to the satisfaction of the Engineer.

Cable, trenches shall be provided with appropriate stop to facilitate drainage. On completion the trenches shall be thoroughly cleaned.

The contractor shall provide cable trays including necessary supports at intervals not exceeding 1.2 M as per approved drawing. The supports shall be of galvanized M.S. Angle of minimum section 50x50x6 mm and shall be properly welded with M.S. insert plates and Lugs of M.S. Flat section duly embedded in walls. In addition, continuous earthing of supports etc. shall be provided as per electrical requirement and specification of cabling system. The cable trays shall be of approved width and shall be made of galvanized perforated M.S. Plate having minimum thickness of 3 mm. Entry of cable at main control room will be through (minimum)

Two nos. Cable trenches of adequate size and through sufficient numbers of PVC pipes one end sealed as per approved drawing Cable trench layout should provide one separate cable trench along each bay. Cable trays should be designed to accommodate all cables required in this present scope of work as well as to accommodate all cables for future bays as specified in electrical specification in proper dressed up fashion without overlapping of cables on trays.

The contractor shall submit detailed drawings of trench cover slab and details of supporting steel works at trench inter-section along with details of design calculations for approval of the Engineer. Trench cover slab shall be designed for live load of IT/Sq.m. However, the thickness of slab shall not be less than 100 mm. The cover slab shall have proper lifting arrangement. This arrangement shall not in any way obstruct free movement over the trench.

10.17 STORM WATER DRAINAGE SYSTEM:

The contractor shall submit the design and drawing of storm water drainage system for approval and execute the work of storm drainage system including the bath room and other waste water except the Water Closet waste water system.

Storm water drainage system shall be designed in two parts:

- h) Main drains and
- i) Auxiliary drains

Main drains shall be designed as a network covering total storm water and cable trench water of the substation, quarters and entire open area. Attempts shall be made to convert existing construction drains, if any, into main drain as far as practicable. Auxiliary/branch drains shall collect discharge from various buildings and then be connected to main drain at suitable locations. In addition, catch water pits and underground pipe lines shall be provided at required intervals to connect the same to the main drain. R.C.C. pipe culverts/ box culverts shall be provided to carry drainage at road and cable trench crossings. Underground storm water piping

shall be limited to required areas where surface drainage are not desirable or practicable from other functional point of view.

The drainage system shall be designed for precipitation intensity of 100 mm per hour (maximum hourly intensity of rainfall).

Surface drains shall be of rectangular section of RCC Grade M 20 and will have adequate slope in longitudinal direction. RCC Structures will be provided at drops/falls to prevent scouring. RCC cover slabs over drains shall be provided at all approaches as required.

All flow will be by gravity with a flow velocity of 0.6 to 1.0 metre/sec.

The storm water drainage from switchyard and utility area is to be terminated at a suitable approved location, with an adequate drop, outside sub station premises and with a dispersal structure, if so required.

Co-efficient of run off will be 0.5 except for roads and paved areas where it will be 0.9.

10.18 RAIL CUM ROAD:

The contractor shall design and construct rail-cum road for 220KV & 132 KV Sub-stations within the switchyard for transport transformers as per the tender drawings and subsequent approved drawings. Rail-cum-road shall be of RCC and with jacking and winching pads as required. It shall be of length measured from the edges of transformers foundations, extending beyond the outer road edge running orthogonally for movement of the transformer.

The contractor shall also supply and deliver all materials required for the construction of the rail cum-road.

10.19 OIL SOAK PITS:

The contractor shall design and construct for each transformer of 20 MVA or above, soak pit along with the transformer D11er foundation for collecting/draining of complete oil in the Transformer during emergencies. The size of the soak pit shall be guided by the plan size of the transformer during emergencies. The size of the soak pit shall be guided by the plan size of the transformer plus 1.2 M or so extra width on four sides. The pit shall be filled up with graded gravels of 40-65 mm size and the void volume of the soak pit shall be kept not less than 33% of the oil capacity of the transformer. The top of the RCC side walls of the soak pit shall match with the top of the foundation. The soak pit shall be filled with gravel up to a maximum depth of 300

mm. The bottom of the soak pit shall be kept below the ground level and the oil collected in the pit shall have to be drained to the oil sump by two RCC home pipes of suitable diameter. Suitable slope shall be provided so that entire quantity of oil can be quickly drained out from the soak pit to sump by gravity. A number of inspection chambers shall be provided at 20 M intervals along the pipe line length for cleaning and maintenance purpose. Suitable galvanized MSs. Grating shall be provided at the outlet of the soak pit. The walls and floor of the pit shall be of concrete grade M20 and shall be plastered and neat cemented as directed by the Engineer.

In all cases, the oil soak pit shall be designed, so as to serve towards collection of oil etc. for 50 MVA A. 132/33 KV Transformers for 132 KV sub-stations & 160 MVA, 220/132 KV Transformers for 220 KV sub-stations, in order to meet future augmentation.

10.20 OIL/WATER SUMP:

The contractor shall design and construct one oil/water tank sump for collection of oil drained from the transformers. The sump shall also be used for collecting rain water from the oil soak pits. The water collected in the sump shall be delivered to the drainage system outside Substation area through suitable arrangement. The sump shall have a wall dividing it into two chambers and this wall shall work as oil water separator. The sump shall be provided with two manholes and air vents/expulsion vents as necessary. The sides and floor of the sum shall be plastered and painted with oil bound paint. The capacity of the sump pit shall be such as to accommodate 120% of oil volume of the highest capacity transformer/reactor in the sub-station. However, as per clause 10.14.01 b) the capacity of sump pit shall not be less than 120% of oil volume of 50 MVA transformer for all 132/33 KV sub-station so as to cater the future need. Few minimum design parameters for 50 MVA. 132/3 KV transformers are provided below for guidance.

a) Transformer Plan size = 8500x8000 mm

b) Weight of Transformer including oil = 95 MT

c) Rail Gauge = 1676 mm

d) Total Oil Capacity = 26000 Litre

e) Eccentricity in all three directions = 50 mm

For transformers above 50 MVA capacity, the contractor shall design and contraction transformer soak pit and oil/water sump on the basis of design parameters of such individual transformers to be obtained from concerned manufacturer duly approved by the Engineer.

The contractor shall supply, install and commission suitable sum pump of adequate capacity for pumping out oil/water from the sump pump may be installed along with storm water drainage pump in the common pump house to be constructed for storm water drainage as described in Clause 10.22. In case, the storm water drainage pump house in located away from the oil/water sump location, the contractor shall have to design and construct a separate pump house of covered area 4 sq.M to install the oil/water sump pump.

10.21 DRAINAGE SUMP SUSMP PUMP & PUMP HOUSE/DEEP TUBE WELL POUAMP HOUSE:

The contractor shall design and construct a drainage sump, a pump house (covered area = 10 sq.m.) supply and install a suitable pump of adequate capacity for efficient draining out of entire storm water from the switchyard to the nearby drainage system outside Substation. One of the deep tube well pump pump house shall be of 4 sq.m. floor area to accommodate operating switch, electrical panel etc.

The other deep tube well pump house to be placed near the control building as well as the fire fighting reservoir shall be of 10 sq.m. floor area to accommodate operating switch, electrical pane of the deep tube well, submersible pump and both fire fighting pumps to be operated by 1 electrical motor & ii) diesel motor.

10.22 BOUNDARY WALL ENCLOSING SUBSTATION AREA:

The contractor shall design and construct 2.5 m high boundary wall around entire substation area as per approved drawing. The boundary wall shall be of R.C.C. of grade M-20 and 250 mm thick brick work (1:4) with cement and sand plastering (1:4) having thickness of 19 mm and 12 mm on the external and internal side respectively. Expansion joints shall be provided at an interval of 21 m for straight run or at suitable junction points in the boundary wall. Depth of foundation shall be minimum 1.5 m from the Original Ground Level or O.G.L. At any point along the wall length, the height of the boundary wall top shall be 2.5 m from the outside E.G.L. or Existing Ground Level. Tie beams shall be provided at the bottom, top and intermediate positions at appropriate levels. The outside vertical face of the boundary wall shall be totally smooth and shall not contain any projection.

Two coats of decorative cement based paint of approved quality shall be provided on the plastered surface of the walls. Two coats of synthetic enamel paint of approved make over one coat of primer shall be provided on steel surfaces. Spacing of R.C.C. columns shall be restricted to 3 m. Lateral load in boundary wall/column due to earth fill shall be considered during design. If there is any surcharge or ground level difference between inside F.G.L. and outside E.G.L. of the substation boundary, retaining wall or retaining cum boundary wall, of approved design and drawing, shall be constructed. The substation area will have 6 m wide Steel Gate, of approved design and drawing, on its boundary wall at the entrance with a suitable cow-catcher structure beneath the gate.

10.23 RESIDENTIAL BUILDINGS

GENERAL:

The contractor shall plan , design and construct various types of residential and other buildings at specified sub stations as mentioned in the bid schedule.

The indicative outline plan drawings as attached in these documents are for bidding only. The contractor shall, on the basis of odrawing and specification made part of the document, prepare detailed architectural, structural and foundation drawings and designs including all facilities and submit to the Engineer for approval.

The contractor shall furnish front, rear and side elevations accommodating all requirements of all types of buildings for approval of the Engineer. The contractor shall provide residential and other buildings and furnish the indoor facilities in accordance with the requirements specified herein and in the accompanied bid drawings.

The residential and other buildings shall mean and include the building structure with foundations, indoor works and facilities such as masonry and carpentry, doors, windows, water

supply and sanitary facilities, painting and all other civil works as specified for control h building. The internal electrification of buildings shall be done as per approved drawing and specification.

Generally, design live loads shall be considered in accordance with IS:875 unless otherwise specified.

All building structures shall be of R.C.C. frame work and R.C.C. flat roof slab generally, if not specified otherwise.

Self weight of buildings shall be computed in accordance with IS:1911. Wind load on buildings shall be considered in accordance with IS:875. Seismic analysis shall be done as per IS: 1893 adopting basic horizontal seismic co-efficient for the relevant zone.

All designs and drawings shall be subjected to approval of Employer/Engineer.

No mission or ambiguities in the drawing or in the specifications will relieve the contractor from responsibility for adequate designs and materials or completeness of the work.

10.23.01 RESIDENTIAL BUILDINGS:

The Contractor shall design and construct the following types of residential buildings as mentioned below which may vary to suit the requirement of individual sub station.

- a) 'C' type single storied residential buildings : Each building consisting of single unit.
- b) Three storied family dormitory : Each building consisting of six unit.

The building foundations under Sl. No. (a) & (b) above shall only be designed for future construction with provision of one additional story.

10.23.02 SECURITY BARRACK AND STORESHED CUM GARAGE AND OFFICE :

The contractor shall design and construct two types of covered sheds of specified are as mentioned in the bid schedule:

- a) Store shed-cum-garage : plinth area 118 sq. III (approx)
- b) Security barrack : Plinth area 122 sq.m. (approx)

The contractor shall prepare detailed architectural and structural drawings on the basis of indicative drawings and specifications for approval of the Engineer.

Truss of required span shall be made of M.S. tubes conforming to IS: 1161. All structural wildings shall be conforming to IS: 816.

The bay to bay distance between trusses shall be 3.6 M to 4.0M Ties at various level shall be provided as required.

The trusses shall rest on R.C.C. Columns (M-20) The clear room height of the shed shall be 4.5 M from floor level.

External walls including gable ends shall be 250 mm thick brick work (4:1) plastered on both sides (19 mm thick and 12 mm thick)

Roof sheeting's shall be corrugated galvanized iron sheet 22 gauge thick and shall be fitted and fixed with 10 mm diameter 'J' or 'L' hook bolts and limpet and bitumen washers etc. The roof sheeting shall have a projection of 450mm (min.) from the wall face.

A steel rolling shutter of size 3 M x 2.7 M and a collapsible gate of adequate size both manually operated with suitable locking arrangement shall be provided as stipulated in the concerned bid drawings.

The flooring in general, shall be 38 mm thick grey artifice stone flooring C.C. (1:2:4) over 100 mm thick C.C. (1:3:6) and 75 mm thick brick flat soling layer of polythene sheet of approved quality shall be laid over the soling before placing of concrete. The flooring of workshop and garage shall be provided with 13 mm thick Ironite topping to be laid over 25 mm thick C.C. (1:2:4) as per specifications stipulated in the concerned bid drawing.

The inside of the store sheds shall be finished with 3 coats of white washing and the outside shall be finished with 2 coats of decorative cement based paint approved by the Engineer.

Adequate Nos. of wooden doors, windows and ventilators, shall be provided for proper lighting and ventilation in the store sheds & office building as per approved drawing.

A toilet unit comprising of one W.C. (Orrisa type), one urinal (430 x 350 x 260 mm size) and one wash basin (550 x 400 mm size) with water supply arrangement shall be provided in store shed. A separate R.C. roof shall be provided over the toilet block: One no. Approved quality PVC water tank of 500 liters capacity shall be suitably accommodated over the slab including necessary pipe connections, fittings, fixtures etc. for supply of water to toilet block Provision of separate wash basin with arrangement of water supply shall also be made at a location to be decided by the Engineer.

10.24 ANTI TERMITE TREATMENT ;

Necessary soil treatment for prevention of termite attack shall have to be undertaken by the contractor before construction of the control room and other utility structures conforming of IS Code No. 6313)Part-II)

10.25 : FANS, LIGHTS AND A.C. MACHINE:

These are to be installed as per electrical specification

10.26 WEIGHT OF SUB STATION STRUCTURES:

Self weight of line tower, A-frame and equipment structures for different 132/33 KV and 220/132 KV structures shall be noted as below (These are indicative weights only):

For 220 KV portion:

Name of structure/equipment structure	Self weight of structure in KG
1 220 KV Tower	
i) 2TI/2TIA	3800

	ii) 2T2	2800
	iii) 2C1	2000
	iv) 2C2	1400
	v) 2C3	1200
	vi) 2T4/2T4A	3800
	vii) Beam/ Girder	1450
2	Wave Trap	230
3	Isolator	
	i) 3 phase	1000
	ii) 1- phase	348
4	Tandem Isolator	985
5	Bus Support	250
6	CT	160
7	PT	182
8	LA	197
9	CVT	180

For 132 KV & 33 KV Portion

Name of structure/equipment structure		Self weight of structure in KG	
		For 132 KV	For 33 KV
i)	Line Tower	1700	650
ii)	'A' Frame in plain bus	2000	660
iii)	A' Frame in plain bus	1150	570
iv)	High level isolator	1930	800
v)	Beam/truss	700	290
vi)	Isolator	682	375
vii)	Isolator (3 Ph)	165	212(3-Ph)
viii)	LA	155	295 (3-Ph)
ix)	PT	157	320(3-Ph)
XI	CVT	150	-
xi)	BPL	180	340 (3-Ph)
xii)	BPL		160(1-Ph)
xiii)	LM	4910	-

10.27 ADDIDTIONAL WORK:

However, any other details "not included in the above specification" but necessary for execution for successful commissioning of the Substation is to be taken up by the contractor.

10.28

ANNEXURE

1. Sand shall conform to the relevant IS Codes and sourced from Ajay River.
2. Coarse Aggregate shall conform to the relevant IS Codes and sourced from Rampurhat/Panchami.
3. The cement used in concrete shall conform to IS standards. In all construction works, Ordinary Portland Cement OPC of 53 Grade shall be used. Cement shall be strictly of 53 grade (OPC) and of make – Birla / Lafarge / Ultratech / Ambuja / ACC. Portland Slag Cement PSC of 53 grade or Portland Pozzolanna Cement PPC of 53 grade may also be used only if 53 grade OPC is unavailable in the market, and also if the proposed PSC or PPC is found qualified in due laboratory grade testing; but, in that case, the requisite documents e.g. OPC non-availability certificates, from competent authority, shall have to be submitted periodically by the contractor, and also, frequent quality testing of the proposed PSC or PPC cements in approved labs shall have to be conducted by the contractor at his own cost, as and when demanded by DPL.
4. Reinforcement steel shall be SAIL/TISCON make and if not available (the requisite documents to be submitted), SRMB/ELEGANT/SHYAM make may be accepted if qualified in die testing.
5. Axle Load on the road shall be taken as 20MT for design and construction.
6. Back filling of land by Fly Ash with proper consolidation/compaction (Proctor Density test shall have to be carried out). Fly Ash will be issued free cost at the point of DPL's Ash Pond. Depth filling of land is 2.5 mtr.

- (Average). The work includes Lifting of Fly Ash, Carriage of the same and Sprinkling of Water followed by Compaction, as desired by the EIC.
7. Fire Fighting System –Reservoir, Fire Pump and Hydrant are to be provided by the successful Bidder. Water will be provided by DPL (at a radial distance of 100 mtr. – connection point). Supply and laying of pipe lines, water flow meter is to be procured and installed and installed by the successful bidder.
 8. Concrete: Notwithstanding what is contained in the Tender documents/specifications, grades of concrete are to be obtained by Nominal / Volume Mix. i.e., ioM-10 – 1:3:6, M-15 – 1:2:4, M-20-1:1:5:3, M-25 – 1:1:2.
 9. Length of Boundary/Retaining wall will be as per perimeter of the land. Whether there will Surcharge (level difference of earth on outside and inside) of earth /back fill, perimeter wall shall be designed as 'Retaining Wall' General Specification of Boundary Wall : RCC Columns # 2.75 m C/C. Plinth and Tie Beams (at Bottom, mid-height and top). Filler Wall 125 mm thick. Plaster on both sides (1:4). Both Interior and Exterior sides of wall to be provided with 2 coats of Cement based paint (Snowcem or equivalent). One MS Gate covering a width of 5 m shall be made out of MS structural Steel duly painted with a coat of Red Oxide Primer and 2 coats of High Gloss Synthetic Enamel Paint.
 10. Drainage Scheme- A part from Internal drainage Scheme, a drain all along the exterior of the perimeter wall has to be constructed.
 11. The successful bidder has to execute the job of Investigation of soil and recommend/design accordingly.
 12. Floor level of Control Room Building is to be raised by 300 mm from level of the Switch Yard.
 13. Compressive Strength of local Bricks- Minimum value shall be 75 Kg. per Sq. cm.
 14. Cable Trench – Cables will be laid in RCC Cable Trench.
 15. Finished G.L. (Item No. 16 of Price Schedule : GI) is revised as "The bidders may refer to the enclosed drawing showing SPOT CONTOURS AND TENTATIVE LAYOUTS for bidding purpose only. All utilities like Roads, Drainage are to be designed accordingly."
 16. The plumb of column & walls must be checked before and after concreting & must be ensured to be proper. The tolerance limit should be within the range:-
 - a) Before Concreting : +/- 3 mm
 - b) After Concreting : +/- 5 mm
 17. Model shuttering schemes along with necessary drawings & design sheets must be submitted to DPL before commencement of that particular job. If ply boards are used for shuttering, then maximum no. of use of a particular board should not be more than 5 times. If found not suitable then the same will be rejected even if it is used less than 5 times. All the shuttering boards or plates must be oiled with shuttering oil only.
 18. For working of the workers & checking of EIC, proper staging should be erected keeping in mind all the safety aspects. This includes stairs, side rails, railings etc.
 19. Anti weeding chemical :- HIJACK 41
 20. Anti termite chemical :- HILBAN.