TECHNICAL SPECIFICATION

FOR

GENERAL CIVIL CONSTRUCTION

AND

SWITCH YARD STRUCTURAL STEEL WORKS
**GENERAL CIVIL AND SWITCHYARD STRUCTURAL STEEL WORKS**

1.0 GENERAL:

This part covers the requirements for soil exploration design, manufacture, testing, supply and construction of civil, structural steel works.

Relevant latest specifications shall be applicable for carrying out works at different substations.

The Contractor shall perform the works to comply with the requirements of this specification and relevant drawings.

2.0 CODES AND STANDARDS:

All equipment, materials, fabrication, galvanizing and tests shall conform to the latest applicable Indian Standards, Codes etc. mentioned herein or to equivalent applicable international standards approved by the Engineer.

Any details not specifically covered by this specification shall be subject to approval of the Engineer. In the event of contradictory requirements between any standards and the specification requirements, the terms of this specification shall apply.

If the Contractor for any purposes equivalents to or deviations from, the specification, the Contractor shall state the exact nature of the change, the reason for making the change and shall submit complete specifications of the materials, as well as copies of pertinent standards, for the approval of the Engineer and the decision of the Engineer in the matter of acceptability will be final.

3.0 SCOPE OF WORKS:

3.1 The scope of works for all Civil and structural works shall include preparation of Civil designs and approval thereof, supply of all approved materials, labour, plant and equipments, fixtures, fitting, erection, testing and all temporary and permanent works necessary for the satisfactory completion of the job in all respects including clearing and cleaning the site. The Contractor shall complete all these works so that each substation is handed over to the employer ready to use.

Brief scope of work for each substations/Sites is as given below:

3.1.1. COMMON FOR ALL SUB - STATIONS:

a) Check survey of substation areas and its surrounding upto main road, soil investigation, assessment of local conditions and requirements and collection of necessary data for establishing the parameters for design of various switchyard including control building and its super structure foundations as per site conditions.

b) Roads within substations and approach roads i.e. connecting public road to substation, including construction of RCC hume pipe conformed to IRC, Class AA loading including Kachha storm side drains etc.

   i) Main RCC/Hume pipe culvert on ZP/PWD in borrow pit area conforming to Class AA loading on main approach roads to be provided.
c) Site leveling at various substation areas for Control Room, Switchyard and Roads to the extent as marked in the respective plot plan and providing gates, fencing, supply, fabrication and erection of infrastructure facilities etc.

d) Supply of steel structures for substation.

e) Foundations for steel structures and electrical and mechanical equipment.

f) Crushed rock surfacing.

g) Drainage and sewerage system.

h) Water supply and plumbing system including bore well survey / investigation, drilling and installation of tube/ borewell with provision of pumping arrangement and storage tanks. Alternate arrangement shall be made from available local authority water supply scheme or any assured private well in case of failure of bore well within a one km. distance.

i) Control building including furniture etc.

j) Miscellaneous civil works for lighting, earthing etc.

k) Peripheral barbed wire fencing with MS gates, wicket gate, cattle arresters. In case of some natural drain coming across the fencing proper protection for safety and free waterway to be ensured.

l) Retaining wall around the switchyard wherever back filling exceeds more than 2 meters height.

m) Security fencing over retaining wall and around switchyard including provision of gate.

n) A watchman post of size 2 Mtrs x 2 Mtrs 2.5 Mtrs dimensions on the main entrance gate to be provided.

o) All other necessary works required for the completion of the job.

4.0 SURVEY:

SCOPE:

The scope of works for all substations includes topographical survey of the Project Sites including approach roads. The survey work shall interalia comprise:

a) Clearing the site for survey work.

b) Establishing and constructing minimum two permanent bench marks of approved design on site at locations approved by the Engineer.

c) Establishing the lengths of the boundary lines and their bearings with respect to magnetic north by plane table survey.

d) Establishing and construction of grid pillars at intersecting of grid lines spaced at 15 meters centers at right angle to each other and boundary posts at corners and maximum 30 meters centers on site and preparation of contour maps for entire substation area at 5 mtrs grid with 0.25 mtrs counter intervals.

4.2 Surveyor and Survey Instruments:

4.2.1 The survey shall be carried out under the direction and control of a qualified and experienced surveyor under the supervision of Engineer.

4.2.2 The Contractor shall use precision theodolites and levels.

4.3 Bench Marks, Grid Pillars and Boundary Markers.
4.3.1 Drawing/Sketches showing constructional details proposed by the Contractor for bench marks, grid pillars and boundary markers shall be subject to approval of the engineer prior to commencement of survey works.

4.3.2 Permanent bench marks shall be established as directed by the Engineer. The final value of the bench mark shall be suitably inscribed on the top of the pillar.

4.3.3 The boundary markers and grid pillars shall be established.

4.3.4 Position of ruling grid line pillars shall be connected with nearest permanent features/structures to facilitate relocation.

4.4 Survey Data

4.4.1 All field books shall be maintained neatly in metric units and shall be submitted to MSEDCL for record preservation to the Engineer for inspection/refernce at any time.

4.4.2 All Prominent features around the site, shall be identified and indicated on plane table survey map.

4.4.3 Levels shall be taken on a grid of 5 metre side or closed in case of undulating and steep areas. All spot elevations shall be recorded.

4.4.4 The Contractor shall be responsible for the correctness and accuracy of the work done. Any errors detected even in approved work, shall be corrected at his own cost by the Contractor by resurveying, as directed by the Engineer.

5.0 GEOTECHNICAL INVESTIGATIONS:

5.1 The Contractor shall carry out the confirmatory geotechnical investigations at the substation sites, 220/ 132/ 33kv and 11kv.

5.2 The geotechnical investigation for assessing suitable type and size of foundations for structures and equipment shall include bore holes, plate load tests and trial pits. The laboratory tests on soil and water samples shall be carried out establish use of type of cement in the works and suitability of water for construction.

5.3 6 nos. (Minimum) or more boreholes of 150mm dia shall be carried out upto depth of 6 meters below the natural ground level and logged accordingly.

   a) Two/ 2 nos. at take off structure foundation.
   b) One number in control building area.
   c) One number in transformer area.
   d) One number in reactor area.
   e) One number in equipment foundation area.

5.4 Number of trial pits shall be atleast 3 excluding the one at the plate load test location and shall as specified below:

   a) Two at take-off structure foundation.
   b) One in the control building area.

5.5 Depth of pit shall be at 2.5 M (Minimum) below the natural ground level and at a maximum of 6 meters or upto the top of hard rock whichever is less. The pits shall be logged.

5.6 The Contractor shall carry out a plate load test only for 132/ 220kv S/S and all other tests are common. The depth shall be taken for test at 4 mtr. And plate size should be 1mtr x 1mtr. at the site of the transformer location to assess the safe bearing capacity to be used in design. The datum bars used in the plate load test shall be
protected against direct sunlight to minimise the effect of temperature on settlement readings. After completion of the test, the pit shall be further excavated below the level of the plate to a depth equal to twice the width of the plate. The type of stratum stressed by the test shall then be examined and recorded. Ground water if encountered shall also be recorded.

5.7 The geotechnical investigations shall be carried out under the direction and control of a qualified and experienced geotechnical specialist under supervision of Engineer. The report of geotechnical specialist shall be submitted to Engineer for review. Only after approval of the report the actual construction work shall be taken up at site.

5.8 REPORT ON SUB-SOIL INVESTIGATION:

The Contractor shall make analysis of soil samples and rock cores as collected by him in the field and approved by the Employer as well as field tests and laboratory tests. A comprehensive report shall have to be prepared by him, finally incorporating all the data collected in proper tabular forms or otherwise along with the analysis. Three (3) copies of report in the draft form shall be submitted for Employer’s approval. Six (6) copies of final report incorporating Employer’s comments, if any, shall be submitted within two (2) weeks after completion of this work.

Recommendations shall include following items (a) to (o)

a) Geological information of the region
b) Past observations and historical data. If available, for the area or for other areas with similar profile or for similar structures in the nearby area.
c) Procedure of investigations employed and field as well as laboratory test results.
d) Net safe bearing capacity and settlement computation for different types of foundations for various widths and depths.
   i) Shallow foundations for tanks, transformers, sub-station structures and auxiliary buildings etc.
   ii) Recommendation regarding roads.
e) Recommendations regarding stability of slopes, during excavations, etc.
f) Selection of foundation types for towers, transformer, buildings etc.
g) Borehole and trial pit logs on standard proforma showing the depths, extent of various soil strata etc.
h) Modulus of subgrade reaction from plate load test for pressure ranging upto 6 kg/cm². The recommended values shall include the effect of size, shape and depth of foundations.
i) Deformation modulus from plate test in various test depth / stratification.
j) Co-efficient of earth pressure at rest.
k) Depth of ground water table and its effect on foundation design parameters.
l) Recommendations regarding stability of slopes, during shallow excavation etc.
m) Whether piles are necessary or not. If piles are necessary, recommendation of depth, diameter and types of piles to be used.
n) Recommendations for the type of cement to be used and any treatment to the underground concrete structures based on chemical composition of soil and sub-soil water.
5.9 **MEASUREMENT OF SOIL RESISTIVITY:**

For the purpose of grounding design, soil resistance measurements shall be taken in substation and based on which the value of soil resistance shall be derived. Wenner’s four (4) electrode method shall be used for soil resistance measurement in accordance with the procedure and the calculation detailed in IS : 3043 - 1987. At least eight (8) test direction shall be chosen form the centre of the station to cover the whole site.

5.10 For 33/22KV and 33/11kv S/S bidders shall carry out all geotechnical investigations as mentioned above except plate load test.

6.0 **DESIGN OF CIVIL WORKS:**

6.1 All Civil structural works connected with control room switchyard structures etc. shall be executed as per approved drawings. However foundations for these structures shall be designed by the Contractor as per the load data and structural drawings furnished by the Employer/Equipment manufacture and to suit the site conditions. Design of supporting structure and its foundation for equipment supplied by the Contractor shall be designed by the Contractor. In cement concrete mark 200 and Bed concrete of 75mm thicknesses in C-C Mark 75. However 33/11kv or 33/22kv substation transformer plinth will be cc mark 200.

6.2 The Contractor shall perform detailed design for each structures designed in scope of works on the basis of specification and codes specified herein. Prior to proceeding with the design work, design conditions or design values which shall include allowable stresses, safety factors, load conditions and applicable standards seismic forces for region etc. shall be approved by the Engineer.

The Contractor shall submit to Engineer for approval, his drawings and calculation sheets, bill of materials, construction methods and schedules for the construction of civil works.

In case any subsequent modification of detailed design of civil work is required, the Contractor shall promptly inform Engineer of such modification and shall submit modified designs and drawings to Engineer for approval.

7.0 **EARTH WORK:**

7.1 **SCOPE**

This specification covers the general requirements of earthwork in excavation in different soils and strata including rock, site grading, filling in areas, including bringing excavated approved material from borrow pits, filling back around foundations and in plinths including consolidation, conveyance and disposal of surplus unwanted spoils as directed by Engineer and all operations covered within the intent and purpose of this specification.

7.2 **APPLICABLE CODES:**

The latest editions of relevant IS standards or their international equivalent shall be applicable.

7.3 **DRAWINGS:**

The Contractor shall prepare the necessary detailed drawing for earthwork and submit the same to the Engineer for approval. The earthwork shall commence only after obtaining approval from the Engineer to these drawings.
7.4 GENERAL:

7.4.1 Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables etc. Whether or not such items are specifically stated herein, for completion of the job in accordance with specification requirements.

7.4.2 Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such earthwork in excavation for grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 5 m. intervals or nearer as determined by Engineer based on ground profile. These shall be checked by Engineer and thereafter properly recorded.

The excavation shall be done to correct lines and levels in all types of strata such as soil, soft murrum, hard murrum, soft rock, hard rock etc. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of adequate barricades around excavated areas and warning lamps at night for ensuring safety.

7.5. CLEARING:

The area to be excavated/filled shall be cleared of fences, plants, logs, stumps, bush, vegetation, rubbish, slush etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed. The materials so removed shall be disposed off as directed by Engineer. Where earth fill is intended, the area shall be stripped of all loose/soft patches, top soil containing objectionable mass/materials before fill commences. All precious objects/relics objects of antiquity etc. which may be found in or upon the site shall be property of Employer.

7.6 EXCAVATION:

7.6.1 All excavation work shall be carried out by the Contractor by mechanical equipments unless in the opinion of Engineer, the work involved and time schedule permits manual work.

7.6.2 Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on to the drawings or such other lines and grades as may be specified by the Engineer. Rough excavation shall be carried out to a depth 150 mm above the final level. The balance shall be excavated with special care. Soft pockets shall be removed even below the final level and extra excavation filled up as directed by Engineer. The final excavation if so instructed by engineer shall be carried out just prior to laying the mud-mat.

7.6.3 Contractor may, for facility of work or similar other reasons excavate, and also backfill later, if so approved by Engineer, at his own cost, outside the lines shown on the drawings or directed by Engineer. Should any excavation be taken below the specified elevations, Contractor shall fill it up with concrete of the same class as in foundation resting thereon, upto the required elevation. No extra claim shall be made by Contractor on this count.

7.6.4 All excavations shall be done to minimum dimension required for safety and working facility. Contractor shall obtain prior approval of Engineer in each individual case for the method he proposes to adopt for excavation, including dimensions, side slopes, dewater disposal etc. This approval, however, shall not in any relieve Contractor to
his responsibility for any subsequent loss or damages. It shall be the responsibility of
the Contractor to take every precaution to prevent slips.

7.6.5 Excavation shall be carried out tools, tackles and equipment. Blasting or other
methods may be resorted to the case of hard rock; however not with out the specified
permission of Engineer.

7.6.6 Specific permission of Engineer will have to be taken by Contractor for blasting rock
and he shall also obtain valid blasting license from the authorities concern. All loose
or loosened rock in the sides shall be remained by barring, wedging etc.

7.6.7 All excavations shall be kept free of water. Grading the vicinity of excavations
shall be controlled to prevent surface water running into excavated areas.
Contractor shall remove by pumping or other means approved by Engineer, any
water inclusive of rainwater and subsoil water accumulated in excavation and
keep all excavations dewatered until the foundation work is completed and
backfilled.

7.7 FILL BACKFILLING AND SITE GRADING:

7.7.1 GENERAL:

All fill material will be subject to Engineer’s approval. If any material is rejected by
Engineer, Contractor shall remove the same forthwith from the site at no extra cost to
the Employer. Surplus fill material shall be deposited / disposed off as directed by
Engineer after the fill work is completed.

No earthfill shall commence until surface water discharge and streams have been
properly intercepted or otherwise dealt with as directed by Engineer.

7.7.1.3 MATERIAL:

To the extent available, selected surplus spoils from excavated materials shall be
used as back fill. Fill material shall be free from clods, salts, sulphates, organic or
foreign material.

If any selected fill material is required to be borrowed, contractor shall make
arrangements for bringing such material from outside borrow pits. The material and
source site be subject to prior approval of Engineer. The approved borrow pit area
shall be cleared of all bushes, roots of trees, plants, rubbish etc. Top soil containing
salts / sulphate and other foreign materials or shall be removed. The materials so
removed shall be burnt or disposed off as directed by Engineer.

filling in pits and trenches around foundations of structures, walls etc.

7.7.3.1 As soon as the work in foundations has been accepted, the spaces around
the foundations, structures, pits, trenches etc. shall be cleared of all debris, and filled
with earth in layers not exceeding 150 mm. Each layer shall be watered, rammed and
properly consolidated before the succeeding one is laid. Each layer shall be
consolidated to the satisfaction of Engineer. The required maximum dry density shall
94%.

PLINTH FILLING IN SUBSTATION YARD / SWITCHYARD:
Plinth filling shall be carried out with approved material as described hereinbefore in
layers not exceeding 150 mm watered and compacted with mechanical compaction
machine. Engineer may however, permit manual compaction by hard tampers in
case he is satisfied that mechanical compacting is not possible. When filling reaches
the finished level the surface shall be flooded with water, unless otherwise directed
for atleast 24 hours allowed to dry and then the surface again compacted as
specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/ slopes specified. Any temporary work required to contain the fill under flooded conditions shall be Contractor’s account.

Where specified, compaction of the plinth fill shall be carried out by means of 10 tonnes rollers (smooth wheeled, sheep-foot or wobbly wheeled rollers). A smaller weight roller). A smaller weight roller may be used only if permitted by Engineer. As rolling proceeds water sprinkling shall be done to assist consolidation.

7.7.4.3 The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300 mm. Engineer will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used.

7.7.4.4 Rolling shall commence from the outer edge and progress towards the center and continue until compaction is upto the satisfaction of Engineer, but in no case less than 10 passes of the roller will be accepted for each layer.

7.7.4.5 The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

7.7.4.6 At some locations/areas it may not be possible to use rollers because of space restrictions etc. Contractor shall then be permitted to use pneumatic tampers, rammers etc. and he shall ensure proper compaction.

7.7.4.7 In case site is infected by termite, pre-anti termite measures shall invariably be adopted.

7.7.5 GENERAL SITE GRADING

7.7.5.1 Site grading shall be carried out as indicated in the drawings and as directed by Engineer. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as specified above unless otherwise indicated below.

7.7.5.2 If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformity and compacted indicated above before the next layer is deposited.

7.7.5.3 Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, Contractor shall remove the affected material and make good and slip at his cost.

7.7.5.6 The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

8.0 ROADS:

8.1 SCOPE

8.1.1 This specification covers the furnishing of all materials, plant, labour, equipments, tools and services for the complete and proper construction of roads as specified herein and shown on the drawings including all surveying and setting out necessary for the same and clean up of working areas.

8.1.2 This specification covers the materials and construction of water bound macadam road including the entire necessary earthwork for the same.
8.1.3 The roads shall be 6 meters wide with metal surface and berms 2 meters wide on either side. The cutting or embankment is to be done for a top width of 10 meters. In the schedule to get the road to be formed to even level and required gradient. The scope of works includes for cutting earthwork and forming embankment, providing Hume pipe drain culvert of 600 mm dia (NP2 variety). An earthen drain shall be formed for the full width of the plot, in between the existing road and the substation site. Over this earthen drain, an RCC hume pipe culverts shall be constructed of suitable diameter and number of locations as shown in the layout plan and construction of RR masonry and CRS masonry for culverts shall be as per the Employer’s drawing and as per P.W.D. specification. The earthen side drains shall be formed for hume pipe culverts.

8.2 MATERIALS:

8.2.1 GENERAL:

8.2.1.1 All materials shall be subject to approval by the Engineer prior to use. Substitutions of material shall be approved by the Engineer and shall result in a finished structure as designated in this specification and at no additional cost to the employer.

8.2.1.2 Mineral aggregates shall consist of natural or crush stone, gravel or sand, shall be of reasonably uniform quality throughout, and shall be clean and free from soft or decomposed particles, excess clay, foreign, organic or other deleterious mater.

8.2.2 Coarse Aggregate for water bound Macadam course.

8.2.2.1 Coarse aggregate shall be in the form of crushed or broken stones and shall possess high resistance against abrasion and impact.

The crushed or broken stone shall be hard durable and free from excess of flat, elongated soft and disintegrated particles, dirt and other objectionable matters crushed or broken stone shall conform to the grading given below.

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SCREENING:

Screening shall consists of non-plastic materials such as soft decomposed rock such as murrum or gravel (other than rounded river borne material) with liquid limit and plasticity Index below 20 and 6 respectively and fraction passing 75 Micron Sieve not exceeding 10%. Murrum shall be sound and hard of a quality not affected by weather and shall be screened at the quarry and shall be free from all impurities. Only the pure murrum shall be received on the work. Any large lumps shall be broken to pass gradation given below. Gravel shall be composed of large coarse, siliceous grains, sharp and gritty to the touch and thoroughly free from dirt and impurities.

Screening shall conform to the grading indicated below:

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SOLING:

Soling shall be either trap/ basalt/ granite/ locally available approved stone and shall be hard, tough, sound, durable, dense, clean of close texture and free from unsound material, cracks, decay and weathering. Water absorption shall not be more than 5%.

The stone in the smallest dimensions shall be equal to the thickness of the soling course specified with a tolerance of 25mm. Soling stone shall be sufficiently flat bedded.

SETTING OUT:

The Contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out, establishing bench marks and giving profiles. Contractor shall be responsible for maintaining the bench marks, profiles, alignment and other stakes and marks as long as they are required for the work in the opinion of the Engineer.

8.4 EARTHWORK FOR ROADS:

8.4.1 Earthwork in Excavation.

Excavation shall be carried out as per approved drawings and/or directed by the Engineer to the specified levels.

Contractor shall on no account excavate beyond the slopes or below the specified grade unless so directed by the Engineer.

The excavation shall be finished neatly, smoothly and evenly to the correct lines, grades, sections and side slopes as shown in the approved drawings or as directed by Engineer.

Earthwork in Embankment.

8.4.2.1 Embankment shall be finished and dressed smooth and even to conform to the alignment, levels, cross sections and dimensions shown on approved drawings with due allowance for shrinkage. Any damage caused by rain, or any other reason shall be made good in the finishing operations.

8.5 Preparation of Subgrade:

8.5.1 Immediately prior to the laying of the soling, the sub grade shall be cleared of all foreign substances, vegetation etc. Any ruts or soft yielding patches that appear shall be corrected and the subgrade dressed off parallel to the finished profile. The camber of subgrade shall conform in shape to that of the finished road surface camber boards shall be used to get the required section.

The prepared subgrade shall be lightly sprinkled with water, if necessary and rolled with power roller of 8/12 tonnes. The roller shall pass over the same area of the subgrade a minimum of five runs. Any undulation in the surface that may develop due to rolling shall be made good with approved earth and rerolled.
SOLING:

8.6.1 Soling shall not be constructed on a wet subgrade. The width of the soling shall be 150mm more on either side than that of the water bound macadam wearing course. The finished thickness of each soling layer courses shall be 150mm.

8.6.2 The soling stones shall be laid with the largest face downwards and in contact with each other. The stones shall break joint as far as possible. The full thickness of the soling shall be made with one stone only.

8.6.3 The soling after it is properly laid and hand packed including filling of voids with broken metal shall be rolled dry with a 10-12 T power roller. The roller shall run over the same surface of rolling for atleast 8 times till the soling course is well consolidated. The surface shall be checked by templates and in case of unevenness, high spots shall be knocked out and depressions filled by spalls and recompacted fully.

8.6.4 Murrum/ Gravels shall be spread in thin layers over the above prepared soling surface, swept into the interstices with brooms and watered lightly to assist the filling of voids. Spreading of gravel, sweeping and watering continue till the interstices are completely filled. All times only enough water shall be sprinkled to the gravel/ murrum into the voids and so much as soften the subgrade. The process of gravel/ murrum filling shall be accompanied by rolling as for dry rolling soling with a power roller weighing not less than 8 tonnes.

8.7 WATER BOUND MACADAM COURSE (WEARING COURSE)

8.7.1 Preparation of Base

8.7.1.1 The base to receive the water bound macadam course shall be prepared to the specified grade and camber and must be free of dust and other extraneous material. Any ruts soft yielding places shall be corrected in an appropriate manner and rolled until firm.

8.7.2 Spreading Coarse Aggregate

8.7.2.1 The Coarse aggregates shall be spread uniformly upon the prepared base in such quantities that the thickness of compacted two layers shall be 150 mm.

8.7.2.2 The spreading shall be done from stockpiles along the side of the roadways. In no case shall be aggregate dumped in heaps directly on the surface prepared to receive the aggregate.

8.7.2.3 The surface of the aggregates spread shall be carefully checked with templates and all high or low may be required.

8.7.2.4 The coarse aggregate shall not normally be spread than 3 days in advance of the subsequent construction operations.

8.7.3 Rolling

8.7.3.1 Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 8 to 10 tonnes capacity or vibratory roller of approved type.

8.7.3.2 The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing
necessary amounts of aggregate and re-rolling until the entire surface conforms to desired camber and grade.

8.7.4 Application of Screenings

8.7.4.1 After the coarse aggregate has been rolled as per above clause, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate.

8.7.4.2 The screening shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids.

8.7.4.3 The spreading, rolling and brooming of screenings shall be carried out in only such lengths of the road, which could be completed within one day's operation.

8.7.5 SPRINKLING

8.7.5.1 After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled.

8.7.6 SETTING AND DRYING

8.7.6.1 After the final compaction of water bound macadam course the road surface shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings as directed lightly sprinkled with water if necessary and rolled.

8.8 ASPHALTING OF ROAD

8.8.1 Providing and laying hot mix hot laid Bituminous 50mm average thickness with 3.5% bitumen by weight of the mix including diversion of traffic, supply of all materials, heating bitumen and chips, mixing bitumen and chips in drum mix plant, cleaning the road surface, laying mix by paver finisher including compacting with 8 to 10 tonne roller, transportation and cost of all material, bitumen from refinery etc. complete including tack coat (as per relevant M.O.S.T latest specification.)

8.8.2 Providing and laying mix seal surfacing ‘A’ Type including all leads, supplying all materials, bitumen, cleaning, preparing the base applying tack coat at the rate 2.5kg / 10 sq. mtrs. heating bitumen and aggregates in dry plant. Laying the mix seal surfacing by paver finisher including compaction with 8 to 10 tonne power roller. Transportation of all materials, bitumen from refinery complete (all as per relevant M.O.S.T. latest specification.) The finished road top level in switchyard will be 175mm above switchyard level & match with metal layer.

8.8.3 CRUSHED ROCK SURFACING IN SWITCHYARD AREA

8.8.3.1 The work shall consist of crushed rock, spread uniformly on the whole switchyard in two layers in accordance with lines, grades and cross-section and as directed by the Engineer. The approved crushed rock shall be laid in

<table>
<thead>
<tr>
<th>Description</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)  Stone dust layer</td>
<td>75mm</td>
</tr>
<tr>
<td>ii) 40/20 mm graded metal</td>
<td>60mm</td>
</tr>
<tr>
<td>iii) 20/10 mm graded metal</td>
<td>40mm</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>175mm</strong></td>
</tr>
</tbody>
</table>

The finish metal layer top will be 175mm above switchyard level.
9.0 CLEARING:

9.1 The area to be surfaced shall be cleared of plants, logs, slumps, bush, vegetation, grass, woods, roots, rubbish, slush etc. and all other objectionable matter.

9.2 LAYING AND COMPACTING

The first layer of lower size aggregate shall be spread uniformly & compacted to a thickness of approximately 40mm.

The second layer shall consist of 40mm and 20mm size aggregate mixed in a proportion of 2:1 by volume. This mixture shall be spread uniformly and compacted to a thickness of approximately 60mm so as to furnish a total finished thickness of 100 mm compacted crushed stone surfacing.

9.3 PROVIDING ANTI-WEED TREATMENT

Providing Antiweed / soil sterilization treatment in switchyard after erection of all equipments and structure and before the gravel filling using chemical of approved make.

The manufacturer’s specification shall be strictly followed for the treatment. All grades shall be maintained as per drawings or as directed by Engineer Incharge.

10.0 FENCING AND GATES:

10.1 SCOPE

10.2 This specification covers the furnishing of all materials, labour, equipment, tools and services for the complete and proper construction of fencing and gates as specification herein.

   a) Peripheral fencing around site.
   b) Security fencing around switchyard.
   c) Gates.

10.2.1 FENCING:

10.2.2 Peripheral fencing shall be provided as per employer’s drawing enclosed.

10.2.3 The M.S. Angle fence post shall be grouted in concrete block of CC mark 200 as per the chain link fencing drawing provided in UCR masonry wall as per the drawing. The height of fence post shall be 3050 mm.

   The M.S. Angle post shall be painted with 2 coats of approved oil paint over the anti-corrosive primer coat red oxide.

   The fence post shall be aligned and distance between intermediate poles shall not be more than 3.5 mtrs. The corner post and intermediate angle post at every bay of 30 mtrs shall have strut posts as per drawing.

10.3 BARBED WIRE FOR FENCING:

10.3.1 The 6 (six) row barbed wire fencing with 2 diagonal of 1.40 mtrs height above ground is to be erected as per employer’s drawing on the M.S. Angle 40 x 40 x 6mm (1800mm in total height) with dowel bars of 12mm dia, 150mm long. The distance between intermediate angle post should not be more than 20.5 mtrs.

   The corner post and intermediate angle post at every 8th bay or 20 mtrs shall have strut post as per the drawing.
In case of some natural drain/ Nala coming across the fencing, proper protection for safety and free water way to be ensured as per the directives of Employer’s Engineer without any cost to the employer.

The angle post shall be painted with approved oil paint of 2 coats over the anti-corrosive base coat (total 3 coats) of red oxide.

10.3.2 M.S.GATE: (4.86 M wide x 1.40 M high) - 2 Nos.

Providing and fixing M.S. gate of size 4.86 M x 1.40 M, wicket gate of size 1.20 M x 1.20 M with R.C.C. Columns of size 0.37 x 0.50 M including foundation with 50 mm dia of heavy duty M.S. pipe, 12 mm square bars, M.S. angles size 40x40x6 M, M.S. or G.I. plate and other accessories including locking arrangement foundation with necessary excavation connecting and M.S. reinforcement, P.V.C. pipes with weatherproof transparent dome for necessary lighting arrangement, plastering, painting gates with 3 coats of oil painting of approved shade over one coat of anti-corrosive paint and with 2 coats of water proof cement paint to columns (The entire work shall be completed as per the approved drawing supplied). Note: Two gates are to be provided one at switchyard and 2nd at peripheral fencing/ main gate.

10.4 RETAINING WALL AROUND SWITCHYARD:

The retaining wall around switchyard shall be constructed as shown in the drawing. The retaining wall shall be constructed over a bed off CC (1:4:8)/ M75 mix 100 mm thick using 20 mm size gravel metal. UCR masonry in CM (1:6) shall be constructed below the ground level and UCR masonry in CM (1:6) above the ground level. The faces of UCR masonry exposed to outside shall be pointed in CM (1:3).

11.0 CONCRETE AND ALLIED WORKS:

11.1 MATERIAL :

11.1.1 CEMENT :

11.1.1.1 Unless otherwise specified or called for by Engineer, the fresh ordinary portland cement conforming to IS-8112 of 1976 (latest revision) i.e. 43 grade shall be used for the works. Manufacturer’s test report for the same shall be submitted for approval prior to the utilization for work.

11.1.1.2 Contractor shall make his own arrangements for the storage of adequate quantity of Cement. Cement shall be stored in a perfectly water-tight and well ventilated site store capable of accommodating cement to ensure continuity of the work and having a raised and perfect dry floor. Each parcel or consignment of cement shall be stacked separately therein to permit easy access for inspection and a record shall be kept so that each parcel or consignment may be identified.

11.1.1.3 Cement which has become stale or otherwise unsuitable and any bags or the like containing hardened lumps or cakes of cement, consequent to storage at Contractor’s site stores will be rejected and shall be removed from the site and disposed of as directed by the Engineer. The cost of such rejected quantities shall be borne by the Contractor.

11.2 AGGREGATES (GENERAL):

11.2.1 Aggregates shall consist of natural sand, crushed stone and gravel and shall be chemically inert, strong, hard, clean, durable against weathering of limited porosity, free from deleterious materials and shall conform to the applicable standards. If so desired by the Engineer, they shall be washed and screened.
11.2.2 Sampling and testing shall be as per the applicable standards and shall be carried out under the supervision of Engineer. The cost of all test, sampling, etc. shall be borne by the Contractor.

11.2.3 All coarse and fine aggregates shall be stacked separately and shall avoid contamination with foreign materials. Segregates aggregates shall be rejected.

11.3 FINE AGGREGATE:

11.3.1 Fine aggregate for cement mortar and rendering shall comply with IS:383 (Latest revision). Fine aggregate shall be sharp and durable. The total percentage by weight of deleterious substances in sand shall not exceed 5% for uncrushed sand and 2% for crushed sand. The grading shall be as per grading zone IV of IS:383. The fineness modular shall be between 2.2 & 3.2.

11.4 COARSE AGGREGATE:

11.4.1 Coarse aggregate shall be with granular or crystalline surface and shall be free from elongated flaky or laminated pieces and shall be either in single size or grade as per IS 383.

11.4.2 Total percentage of deleterious substances in the coarse aggregate shall not exceed 5% for both crushed and uncrushed aggregates.

11.4.3 Unless otherwise specifically stated on the drawings, maximum size of coarse aggregate shall be 20mm, but in no case greater than \( \frac{1}{4} \) of the minimum thickness of the member.

11.5 WATER:

11.5.1 Water used for both mixing and curing shall be as per applicable standards. Potable waters are generally satisfactory. Where water can be shown to contain an excess acid, alkali, sugar or salt, Engineer may refuse to permit its use.

11.6 REINFORCEMENT:

11.6.1 Reinforcement bars shall conform to IS specification No. 432 for MS and IS 1786 for deformed bars. All reinforcement shall be clean, free from pitting grease or and other substance that will destroy or reduce bond. Contractor shall submit manufacturer’s test certificate for steel for approval. Random tests on steel supplied by the Contractor may be performed by Engineer, the cost of which shall be borne by the Contractor.

11.6.2 Steel required for reinforcement shall be supplied by the Contractor. The Contractor shall work out the requirement immediately after taking over the site and receipt of working drawings. The costs of reinforcement steel binding wire and fabrication charges for all the works shall be included in corresponding item of such schedule.

12.0 FORMWORK:

12.1 This clause is applicable for formwork/ centering etc. for all the civil works under the specification.

The formwork shall conform to clauses 10 of IS 456. The Contractor shall be entirely responsible for the sufficiency and efficiency of the formwork, which includes moulds, and also for the safe removal of the same. Before commencing the work Contractor shall submit for the approval of the Engineer, details of the of the formwork he proposes to use but such approval shall in no way relieve him of any of his responsibilities for the sufficiency and efficiency of the work. The formwork, shall be
resistant to the strains impose on it, while vibrating the concrete and shall retain all the fines in the concrete as may necessary to provide the desired concrete surface.

12.2 The formwork shall be designed and arranged so that will not settle under the load and can be stripped or removed without causing any blemish or jar to the concrete.

12.3 All forms shall be securely braced and supported to prevent any sagging or bulging during construction. In such circumstances wire ties shall be used. Camber, radial strips, Liners and cores shall be provided where necessary and shall be true to space and securely fixed. All forms shall be fixed to the proper line and trued up immediately before depositing the concrete. All joints shall be close fitted enough to prevent leakage of water and fine materials in the concrete.

12.4 Form work for all exposed faces of mass concrete and all faces of reinforced concrete shall consist of approved material so finished as to produce the concrete surface finish as to produce the concrete surface finish specified without any loos of fines and with honeycombing, bulges etc. Strutting shall be of proper design as to allow accurate adjustment and easy removal.

12.5 Strutting of formwork against the sides of the structure which is subject to movement or vibration will not be permitted.

12.6 The inside faces of the forms shall be treated with oil or other approved preparation. The treating material shall not have deteriorating effect on concrete or formwork. The treating material shall not come into contact with the reinforcement.

12.7 STOP ENDS:

The position of temporary stop ends for vertical joints shall be as approved by Engineer. Shuttering to form the stops shall be firmly fixed and secured round the reinforcing bars. Such concrete as passes through the stops shall be backed off and removed as soon as the concrete has set.

12.8 CONSTRUCTION JOINTS:

Recesses of approved size and type shall be formed in construction joints where required by the Engineer in order to form a key with the following concrete.

12.9 Before depositing any concrete resting or abutting on work previously carried out the surfaces and end of the existing work shall be thoroughly hacked to such an extent that no portion of the previous surface remains. Thus roughened surfaces shall be thoroughly cleaned off, brushed and watered immediately before the succeeding operations are commenced. The roughened surfaces shall be coated with cements/Sand mortar 12mm thick immediately before the concrete of the next layer is placed (special care shall be taken to put the mortar and fresh concrete thoroughly up against the hardened concrete.)

12.10 CLEANLINESS OF FORM WORK:

Before concreting is commenced all formwork shall be scrupulously cleaned and wetted, and the Contractor shall adopt all necessary measures to ensure that all debris, dirt, wash water and other refuse is removed. The reinforcement and formwork will then be inspected by the Engineer and concreting shall not be commenced until the Engineer gives permission. Such inspection shall not however, relieve the Contractor any of his responsibilities for the correctness of the work in every respect.
12.11 Under no circumstances shall the form be struck until the concrete reaches a strength of at least twice the stress due to self weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

12.12 Under normal circumstances (generally where temperature are above 200 Deg.c) forms may be struck after expiry of the following periods.

<table>
<thead>
<tr>
<th></th>
<th>Ordinary Portland Cement Concrete</th>
<th>Rapid hardening Portland Cement concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Walls, columns and vertical sides of beams</td>
<td>24 to 48 hours as directed by Engineer</td>
<td>24 hours</td>
</tr>
<tr>
<td>(b) Slabs (props left Under)</td>
<td>3 days</td>
<td>2 days</td>
</tr>
<tr>
<td>(c) Beam soffits (props left Under)</td>
<td>7 days</td>
<td>4 days</td>
</tr>
<tr>
<td>(d) Removal of props to slabs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Spanning over 4.5 m</td>
<td>7 days</td>
<td>4 days</td>
</tr>
<tr>
<td>(ii) Spanning over 4.5 m</td>
<td>14 days</td>
<td>8 days</td>
</tr>
<tr>
<td>(e) Removal of props to beams and arches.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Spanning upto 6 m</td>
<td>14 days</td>
<td>8 days</td>
</tr>
<tr>
<td>(i) Spanning over 6 mtrs</td>
<td>21 days</td>
<td>12 days</td>
</tr>
</tbody>
</table>

For liquid retaining structures no sleeves or through bolts shall be used nor shall through bolts be removed. The bolts, in this case, shall be cut as 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete mix after striking the form work.

13.0 CONCRETE:

13.1 CODE OF PRACTICE: Except where otherwise specified described, all concrete and reinforced concrete work shall be carried out in accordance with Indian standard 456-1978 Code of practice for plains and reinforced concrete.

13.2 CONCRETE:

Aggregate shall be measured in proper guage boxes. When measuring the fine aggregate due allowance shall be made for the moisture content and the bulk adjusted to suit the mix. The methods adopted for gauging the concrete material shall have approval of the Engineer.

13.3 CONCRETE PROPORTIONS:

The concrete shall be of nominal mix of grade (1:1. 5:3) for 33kv/ 22kv/ 11kv S/S and shall be of grade M20 by design mix for 132/ 220kV substations.

13.4 CONSISTENCEY:
The quantity of water used shall be sufficient to produce a dense concrete of required consistency, specified strength and adequate workability for the purpose and will surround and properly grip all the reinforcement.

13.5. CRUSHING STRENGTH:

The crushing strength of the concrete should be as specified in IS: 456 for the desired mixes.

13.6 WATER:

The General arrangements for the supply of mixing concrete shall be to the satisfaction of the Engineer who will determine the quantity of water to be employed in the mix according to the degree of moisture in the aggregate. Quantity of water thus determined shall be accurately measured for each separate mixing in a suitable container.

13.7 MIXING CONCRETE:

Concrete shall be thoroughly mixed to a uniform consistent in the mixing machine of approved types. Mixing shall continue until the cement is thoroughly distributed throughout the mass, and shall last at least two minutes or 80 turns of mixer after the whole of the water has been added. Any concrete showing signs of initial setting before being deposited shall not be used in the works shall be removed from the site.

13.8 The concrete shall be discharged from mixer on to a level watertight platform or floor or into a watertight receptacle.

13.9 Normally hand mixing of concrete will not be allowed and where the total quantity of concrete is considerably small the mixing may be done by hand subject to the approval and entirely at the discretion and satisfaction of the Engineer.

13.10 CONCRETING IN UNSUITABLE WEATHER:

In the event of rain, storms or other severe weather conditions arising, concreting shall be stopped and appropriate temporary stop ends vee-grooves etc. placed as may be necessary. To meet such circumstances, the Contractor shall always have in readiness on the site approved framed sheeting, tarpaulin etc. for the protection of newly placed concrete. Should any concrete be damaged due to rain, storms or other weather conditions, the Engineer may order the cutting/replacement of the damaged concrete at the expenses of the Contractor.

13.11 EXECUTION OF CONCRETE WORK:

Concreting shall be carried out in sections, not exceeding the limits specified for particular work.

13.12 CASTING PROGRAMME:

The Contractor’s casting programme shall be such that such section of work can be satisfactorily completed in one operation after permission has been given to proceed. No claim for overtime working to complete a casting programme will be entertained.

13.13 CONVEYANCE OF CONCRETE:

The concrete shall be conveyed from the mixer to its place in the works as rapidly as possible and in such a manner that there shall be no separation or loss of the ingredients. In no circumstances shall more than half an hour lapse between the
time when water is added to the mix and time when the concrete is finally consolidated in position. The use of concrete distribution chutes at an angle of more than 45 degrees from the horizontal will not be permitted without the prior written sanction of the Engineer. In no case shall concrete be dropped form barrows or otherwise from a height of more than one meter. The arrangements to be adopted by the Contractor for conveying depositing concrete shall be subject to the approval of the Engineer.

13.14 DEPOSITING CONCRETE:

Before any concrete is put in, the Contractor shall carry out any filling of pockets or trimming the sides when found necessary to suit the level and line of the concrete to be laid as directed by the Engineer at site. Concrete shall be placed in one operation.

13.15 CONSOLIDATING CONCRETE:

Concrete normally shall be consolidated by means of sufficient number of mechanical vibrators. Hand ramming tamping will only be allowed where specified or with prior permission of the Engineer. Hand ramming and tamping where permitted shall be sufficient and efficient so as to produce uniform consolidation.

13.16 The concrete shall be thoroughly worked all round reinforcement and against shutters to remove all voids so as to free it from the formation of air pockets, honey-combing or other defects.

13.17 The concrete shall be worked into position where placed and not allowed to flow. For sloping beams the work of depositing concrete shall start from the lower end and work upwards.

13.18 Except where arrangements approved by the Engineer are made for placing concrete under water, the areas on which concrete is to be deposited shall be made and kept free from standing water during concreting operations and running water crossing or entering such areas shall be brought under control before concreting is commenced.

13.19 FINISH OF CONCRETE SURFACES:

Immediately any wrought or metal faced formwork is struck the surface of the concrete will be inspected by the Engineer and after any remedial work directed or permitted by the Engineer has been completed to his satisfaction. The Contractor shall remove all form works and other imperfections in order to give uniform appearance.

13.20 Floor surfaces shall be worked to smooth-even finish to correct levels as indicated in the drawings or as directed.

13.21 Where so directed, concrete floor surface shall be treated with silicate of soda grade p.84 diluted with four times its volume of water applied to the work with a watering can or spray and afterwards spread evenly with a mop or brush. Twenty four hours later a second application shall be made and, if any surface still appears porous, further application of the solution shall be given until the work will absorb no more. Any excess liquid on the surface after the last coat has been absorbed shall be removed, and the surface allowed to dry. When dry it shall be washed with the plain water.

13.22 CURING:
The curing period shall commence immediately after the concrete is finally troweled or screened and continued a period of 14 days for switchyard structure foundation and for other civil works curing period shall be 21 days. The top and side surfaces of concrete shall be kept moist and be protected from the direct rays of the sun during the period. The Contractor shall submit to the Engineer’s proposals for ensuring continuous protection of the concrete during the curing period.

13.23 DEFINITIVE WORK:

Concrete which is defective from any cause whatsoever shall, if so directed by the Engineer, be cut out and work reconstructed at the Contractor’s cost. No concrete thus cut out shall be reused.

13.24 The faces of the concrete work shall be sound and sole free from honey-combing. No patching of any concrete fact will be allowed without the express written permission of the Engineer.

13.25 REINFORCED CONCRETE:

13.25.1 Reference shall be made to clause 11.6 for reinforcement. The proceeding clauses relating to concrete generally be read in conjunction with the following:

13.25.2 MIXES:

The mixes of concrete shall be as specified in the bill (Schedule) of quantities as shown in the drawings.

13.25.2 SAMPLING AND TESTING OF CONCRETE:

13.25.2.1 Sampling of materials and concrete shall be done carefully by the Contractor under the direct supervision of the Departmental staff as per IS 456-1964 at the cost of the Contractor. All necessary labour, materials, equipment, etc. for sampling, preparing test cubes, curing etc. shall be provided by the Contractor. Testing of the materials and concrete will be arranged by the department in approved laboratory at the cost of the Contractor. No plea will be entertained later, on the ground that casting of the test specimen was faulty and that the result of the test specimen did not give a correct indication of the actual quality of concrete. Compressive strength of ordinary concrete shall not be less than those specified below:

<table>
<thead>
<tr>
<th>No</th>
<th>Mix</th>
<th>Work test on 15cm cubes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Kg/ sq.cm at 7 days</td>
</tr>
<tr>
<td>1</td>
<td>1:1:2</td>
<td>158</td>
</tr>
<tr>
<td>2</td>
<td>1:1 ½:3</td>
<td>131</td>
</tr>
<tr>
<td>3</td>
<td>1:2:4</td>
<td>105</td>
</tr>
<tr>
<td>4</td>
<td>1:3:6</td>
<td>66</td>
</tr>
<tr>
<td>5</td>
<td>1:4:8</td>
<td>49</td>
</tr>
</tbody>
</table>

One set of six of 15 cm cubes shall be prepared from the concrete to be used in the work for compression test on each on the first three days operation and thereafter for every 60 cu.m. of concrete or three day’s work whichever is less, by the Contractor in the presence of a responsible officer of the Department of a rank not less than that an overseer. If the source of aggregate or grading is changed, one set of six test cubes shall be taken for each changed batch. Three cubes shall be used for test of 7 day’s age and three at 28 days.

After the relation between strengths at 7 days and 28 days is reliably established for the particular set of material from the same sources, subsequent tests may be
carried out only on three cubes at 7 days. If the average strength of the cubes show ultimate compressive strength less than the above the Engineer shall have a right to order a change in the mix or water content for the remaining concrete without extra cost. Defective concrete having strength below 80 percent of the required strength is liable to be rejected. Concrete of strength up to per cent of the required strength may be accepted as substandard work at a reduced rate provided such weak concrete is restricted to such member and in such quantities as will not endanger the safety of the structure.

13.25.2.2 KEEPING RECORD:

A day-to-day record authenticated by a responsible officer of the department and the representative of the Contractor in the proforma approved by the Engineer shall be maintained by the Contractor on the work site and kept open to inspection. This shall contain important information such as receipt of cement on the work site, daily use with details of use on various items time of starting concreting and closure, number of batches through the mixer, sources of water, water cement ratio of concrete, slump, dates of erection of formwork, passing of framework by the competent authority, dates of striking of forms, periods and methods of curing and other events worthy of notes. On completion of the work, the record shall be handed over to the Department.

13.26 COVER TO REINFORCEMENT:

The reinforcement shall in all cases be covered with no greater and not less than the minimum thickness of concrete cover specified and as shown in the drawings. Where two bars cross, the outer bar should have the minimum cover and no more.

13.27 FORM BOLTS:

Any form bolts that are in the concrete shall be withdrawn when the forms are stripped. They shall not be placed within 50mm of any steel reinforcement, so that the holes they leave do not reduce the effective cover on the steel.

13.28 BENDING REINFORCEMENT:

Bends, or other fabrication on reinforcing bars shall be done gradually and carefully formed exact in accordance with the drawings, otherwise, all bars shall be truly straight. Bends shall be made cold round a former having a diameter of at least four times the diameter of the bars. Heating of bars of any purpose whatsoever will not be allowed. No bending shall be done when ambient temp is below 5 degree centigrade.

13.28 SPlicing REINFORCEMENT:

Where splices or overlapping in reinforcement are required, the bars shall be provided with such splices or overlaps as are shown in the drawings. No bars may be jointed by welding unless special permission in writing has previously been given by the Engineer. While applying for such permission the Contractor shall supply full details of the method he proposes to use.

13.32 FIXING REINFORCEMENT:

The number size, form and position of all steel reinforcing bars, ties, links, stirrups and other parts of the reinforcement shall be exact in accordance with the drawings, and such parts shall be kept in the correct positions in the forms without displacement during the process of working the concrete into place. Space bars, supporting stools and distance pieces to maintain the reinforcement in the correct position shall be provided by the Contractor as directed by the Engineer, without any
extra cost of the Employer. Binding wire shall be 16 guage soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

The use of timber blocks for welding the steel of the forms will not be permitted.

All straight bars shall be fixed parallel to each other and to the sides of the forms. Any ties, links or stirrups connecting the bars shall be tied so that the bars are properly braced. The inside of their curved parts shall be in actual contract with the bars around which they are intended to fit.

14.0 **SCAFFOLDING:**

Materials and labour required for scaffolding shall be arranged by the Contractor himself.

14.1 **OTHER REQUIREMENTS:**

Type of concrete for blinding shall be 1:4:8 Type of reinforced concrete for columns, beams brackets, slabs, footings, trenches and foundations to be M15 grade unless noted.

Minimum Cover to reinforcement shall be as follows:

- a) Columns & Beams - 40 mm.
- b) Slabs - 40 mm on sides
- c) Pedestal & Footing - 50mm Top & Bottom.

15.0 **SUBSTATION STEEL STRUCTURES:**

15.1 **GENERAL:**

15.1.1 Hot dip galvanized or M.S. lattice structures as per site requirement of self supporting type are to be used for substation gantries, beams and equipment support structures in various switchyards covered in this specification. The structural drawing of towers, gantries and equipment supporting structures shall be spared to the successful Bidder. The bidder shall fabricate proto of each type of structure and offer the same for inspection and testing, if required, by the representation of Employer before taking up mass production.

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

15.2 **MATERIALS:**

15.2.1 All material for rolled shapes and plates shall be hot rolled structural mild steel and/or high strength structural steel and shall conform to IS: 2062 for structural steel. All structural members shall be galvanized after fabrication as per site requirement.

15.2.2 All connection bolts, U-bolts nuts washers (flat spring washers, beveled, washers), fillers and filler plates shall conform to relevant IS standard. All items shall be galvanized for G.I. structures.

15.2.3 Step bolts shall conform to relevant IS Code shall be galvanized for G.I. structures.

15.2.4 Steel pipes shall conform to requirements of relevant Indian Standard Code, all pipes shall be galvanized for G.I. structures.
15.2.5 All anchor bolts shall conform to relevant IS code and shall be galvanized for G.I. structures. The minimum diameter of anchor bolt shall be 16 millimeters.

15.3 FABRICATION:

15.3.1 WORKMANSHIP:

15.3.1.1 All pieces must be straight, true to detail drawings and free from flaws, twists and other defects. All clipping backcuts, grinding, bends, holes, etc. must be true to detail drawings and free of burrs. No additional splices than those indicated on the approved drawings permitted in members of the structure.

All identical pieces bearing the same erection number must be exactly interchangeable with each other and interchangeable in their relative position in all towers or structures of which they form a part.

15.3.2 STRAIGHTENING:

All materials shall be reasonably straight and if necessary, before being worked shall be straightened and/ or flattened by pressure, unless required to be of curvilinear form and shall be free from twists. Straightening shall not damage the material. The adjacent surfaces of the parts when assembled shall be in close contact throughout keeping in view the tolerance specified. Hammering shall not be permitted for straightening and/ or flattening of members, sharp bends shall be cause for rejection.

15.3.3 CUTTING:

Cutting may be effected by shearing, cropping, flame cutting or sawing. The surfaces so cut shall be clean, smooth, reasonably square and free from any distortion.

15.3.4 BENDING:

15.3.4.1 Mild steel sections upto 75x75mm (upto 6mm thick) shall be bent cold and including bend angle of 10 Degrees. Angles above 75x75mm (thickness upto 6mm) and upto and including 100x100mm (thickness upto 8mm) may also be bent cold upto the bend angle of 6 Deg. All other angle sections and bend angles not covered above shall be bent hot.

15.3.4.2 All plates upto 12mm thickness shall be bent cold upto a maximum bend angle of 15 Deg. Greater bends and other thickness shall be bent hot.

15.3.4.3 Bends on all high tensile steel sections shall be done hot.

15.3.4.4 All hot bent material shall be air cooled.

15.3.4.5 The bends shall be of even profile and free from any surface damages.

15.4 HOLING:

15.4.1 Holes in the members shall be either be drilled or punched and shall not be formed by flame cutting process. All burrs left by punching or drilling shall be completely removed.

15.4.2 Punching may be adopted for sections upto 12 mm thick. For thicker sections, drilling shall be done.

15.4.2.1 The holes near the bend line of a bent, on both sides of bend line, shall be punched/ drilled after bending and relative position of these holes shall be maintained with the use of proper template/ jigs and fixtures.
15.5 FASTENERS AND JOINTS:

15.5.1 It shall be ensured that the fasteners provide positive attachment at all times and under the conditions when the structure is subject to vibratory loads.

15.5.2 BOLTS:

15.5.2.1 Bolts used for erection shall preferably be of 12, 16 and 20mm diameter and in no case bolt diameter shall be less than 12mm.

15.5.2.2 The length of the bolt shall be such that the threaded portion does not lie in the plane of contact of members.

15.5.2.3 It shall also be ensured that the threaded portion of the bolt protrudes not less than 3mm and not more than 8mm over the nut after it is fully tightened.

15.5.2 HOLES FOR BOLTING:

15.5.2.1 Holes shall be cylindrical and perpendicular to the structural members. Oval or lobed forms of holes shall not be permitted. The diameter of the holes shall be equal to the diameter of the bolt plus 1.5mm.

15.5.2.2 The accuracy of the location of holes shall be such that for any group of members when assembled the holes shall admit the bolt at right angles to the plane of connection.

15.5.4 SPACING OF BOLTS AND EDGE DISTANCE:

15.5.4.1 The minimum spacing of bolts and edge distance shall as given in the following table.

<table>
<thead>
<tr>
<th>Bolt Dia (mm)</th>
<th>Hole dia (mm)</th>
<th>Bolt spacing (mm)</th>
<th>Edge Hole centre to rolled or sawn Edge (mm)</th>
<th>Distance Minimum Hole center to sheared or flame cut Edge (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>13.5</td>
<td>32</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>16</td>
<td>17.5</td>
<td>44</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>20</td>
<td>21.5</td>
<td>80</td>
<td>25</td>
<td>28</td>
</tr>
</tbody>
</table>

15.5.5 LOCKING DEVICE:

15.5.5.1 Spring washers of positive lock type of the following thicknesses shall be provided for insertion under nuts.

<table>
<thead>
<tr>
<th>Bolt diameter</th>
<th>Thickness of Spring washer</th>
</tr>
</thead>
<tbody>
<tr>
<td>12mm</td>
<td>2.5mm</td>
</tr>
<tr>
<td>16mm</td>
<td>3.5mm</td>
</tr>
<tr>
<td>20mm</td>
<td>4.0mm</td>
</tr>
</tbody>
</table>

15.5.6 To obviate bending stress in bolts or to reduce the to a minimum, no bolt shall connect aggregate thickness of more than three times the bolt diameter and also number of members carrying stress to be connected by single bolt shall not generally exceed three (excluding gussets and packing).

15.6 TOLERANCES:

15.6.1 The maximum allowable difference in diameter of the structure on the two sides of a plate or angle shall be 0.8mm that is, the allowable taper in a punched hole shall not exceed 0.8mm on diameter.
15.6.2 Tolerance cumulative and between consecutive holes shall be within +/- 0.5mm. Tolerance on the overall length of a member shall be within +/- 1.6mm. Tolerance on gauge distance shall be within +/- 0.5mm.

15.6.3 GALVANISING OF STRUCTURES:

15.6.3.1 The galvanizing of steel structure members shall be carried out as per standard practice and as per the guidelines stipulated in the relevant I.S. Specifications with due consideration of latest amendments thereof.

16.0 FOUNDATION WORKS:

16.1 GENERAL REQUIREMENT:

16.1.1 The foundation for all the substations gantry and equipment support structures as per the furnished load data in Annexure - I enclosed to this specification to be designed shall be the responsibility of the Contractor. All designs and details shall be subject to the prior approval of the Engineer. The substation foundation top level for gantries and equipment support shall be 300mm above switchyard level.

16.1.2 The Contractor shall supply installation drawings giving full erection particulars for approval to the Engineer. Safety factor of foundation for uplifting force shall not be less than 2. The safe allowable bearing stress of founding stratum may be assumed to be 15 to 20 tonnes/ Sq.m. which shall be verified during field exploration.

16.1.3 The weight of earth may be assumed to be 1.6 tonne/ Cu.m. The angle of repose shall be reckoned as 15 degree. The seismic coefficient shall be taken as 0.2. All the data shall be verified by the Contractor at site after necessary geotechnical investigations are made before final detail designs are undertaken.

16.1.4 The above information has been given to bidder in good faith. It shall be the responsibility of the Contractor to ascertain these values after carrying out necessary geotechnical investigation.

16.2.1 STEEL STRUCTURE FOUNDATIONS:

16.2.1.1 The foundations shall be designed such that the upper structures shall be securely supported. Any unbalanced displacement that may cause harmful effect to the upper structures shall not be allowed. The safety factors for all types of stability of the foundations shall not be less than 2.0.

16.2.2.1 The foundations shall be designed so that the upper equipment shall be securely supported. The effect of vibration of the equipment impact load when in operation and turnover force due to abnormal condition of equipment shall be considered in foundation design. The safety factor for stability of the foundations shall not be less than 2.0.

16.2.3 DETAILS:

16.2.3.1 DETAILED CALCULATIONS:

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

i) Detailed calculations of loads acting on foundation under different load conditions.

ii) Calculated safety factor for each type of stability and condition.

iii) Maximum stresses in concrete and in steel reinforcement at any critical section.
16.3.2 DETAILED DRAWINGS:

16.3.2.1 Details of each type of foundation submitted for the 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 the Engineer. The details drawings shall at least include:

a) Detailed dimensions of foundation
b) Details of setting dimensions of foundation
c) Details of placing of all reinforcing steel which shall conform to the latest IS Specification.
d) Details of type, size and length of each reinforcing steel including details of bar bending.

17.0 CONTROL BUILDING:

GENERAL:

The specifications for various items of works shall conform to the relevant Indian Standard Specifications (latest editions)

17.1 CONTROL BUILDING:

All designs and details of control building to withstand for the following worst caseload combination:

i) All possible combination of dud load and service load.
ii) Wind indicated loads as per IS:875 (Part 3) – 1987
iii) Inertial forces due to seismic activities as per IS: 1893–1989.
v) Live loads as per IS:875 (Part 2) – 1978 and or as per service requirements
vii) Loading due to thermal effects wherever applicable should be as per IS:875 (Part 5) – 1987.

The employer shall have the right to ask the Contractor without cost to the employer, to make any changes in the structures conform to the specification.

No omissions or ambiguities in the drawings or in the specifications will relieve the Contractor from his responsibility from adequate design and materials and workmanship or completeness of the work. The grade of concrete of foundation and super structure and for switchyard tower and equipment foundation cable trench shall be M20 design mix conforming to IS: 456-1978. A cement concrete mix of 1:4:8 using 40mm metal/ broken stone) may be used for beam concrete under columns and/ foundations trench, padding of towers, equipment supporting structure foundations, transformer foundation.

Above ground level, the required drawings supplied by MSEDCL. The Contractor has to execute accordingly. Below ground level, the Contractor has to design the foundation.

17.1.1 TYPE OF CONSTRUCTION :

The building is proposed to be constructed with RCC framed structure. The RCC columns, footings shall be provided. The superstructure shall be in brick masonry 230 mm thick for external walls in CM 1:6 and 115 mm thick for internal walls which shall be in reinforced brick masonry in cement mortar (1:4) duly providing, two 6 mm reinforcing bar at every fourth layer. Plinth height above developed ground level shall be 600mm.
17.1.2 SITE LEVELING:

The site is to be leveled 3 meters all round the building areas including removal of vegetation. The ground also should be raised to the required level if necessary with excavated/borrowed earth as directed by the Engineer.

17.1.3 FOUNDATION:

Open type foundation for walls with 150 mm thick leveling course in CC (1:4:8) using 40mm size granite metal and RR masonry in CM (1:6) shall be constructed. For RCC footing a leveling course of 100 mm thick CC (1:4:8) shall be provided.

17.1.3.1 BASEMENT: Basement with RR masonry in CM (1:6) shall be provided for internal walls. CRS masonry in CM (1:6) shall be constructed for external walls and the exposed faces shall be pointed with cement mortar (1:3).

17.1.4 BED BLOCKS UNDER LINTELS:

Bed blocks in CC 1:3:6 proportion using 20 mm size granite metal under lintels with necessary formwork shall be provided including cost and conveyance of all materials leads and lifts and at all heights and curing etc. finished item of work.

17.1.5 REINFORCED CEMENT CONCRETE:

17.1.5.1 RCC column footings, columns and beams.

RCC of concrete Grade M20 using 12mm to 20 mm approved size well graded granite metal shall be provided as approved detailed drawings for reinforcement details column footings, columns, portico slab at lintel level roof slab beams. All drawings enclosed to this specification. RCC construction shall conform to IS: 456.

17.1.5.2 LINTELS:

RCC of concrete grade M20 proportion nominal mix for lintels using 12 mm to 20 mm size granite metal including centering, scaffolding, machine-mixing, vibrating curing finishing, cost and conveyance of all materials, all lead and lifts in all positions of the buildings and at heights shall be provided.

17.1.5.3 SUN SHADES:

RCC of concrete Grade M20 proportion nominal mix for such shade of 75 mm thick and 0.61 m wide using 12 mm to 20 size granite metal including scaffolding, centering, machine-mixing vibrating, curing and finishing to the required slopes and providing lip at the bottom ends including cement plastering 12 mm thick with CM 1:5 proportion sponge finish to the exposed faces of sunshades, including the cost and conveyance of all materials.

17.1.5.4 RCC ROOF SLAB:

RCC of concrete grade M20 nominal mix using 12mm to 20 mm size granite metal. The concrete used for RCC works shall be machine mixed and vibrated. RCC roof slab shall be plastered immediately after laying the roof slab with CM (1:2) 20 mm thick using water proof cement compound at 1 kg per bag of cement complying with IS: 2645 and finishing surface by fine rendering duly forming necessary slopes towards rain water pipes.

17.1.5.5 RCC RACKS:

RCC racks shall be in CM (1:2) 50 mm thick with chicken wire mesh and reinforced suitably and plastered over with cement mortar (1:3) 12 mm thick including neat finishing.
17.1.6 SUPERSTRUCTURE:

The superstructure shall be in Brick masonry 230 mm thick in cement mortar (1:6) for external wall, internal main wall and in CM (1:4) for internal walls of 115 mm thickness as per approved drawing with well burnt second class bricks of approved quality. The bricks used in all the works under this specification shall have a minimum crushing strength of 70 kgs. Per square centimeter. The 115mm thick brick wall will be provided with mild steel longitudinal reinforcement of 2 bars of 6mm diameter or 2 hoop iron strings 25mm x 1.6mm at every third layer/course.

17.1.7 FILLING FOUNDATION AND BASEMENT:

The work of refilling the foundations and basement is to be done with non expansive excavated soils or sand including waterling ramming and consolidating thoroughly in 150mm layers complying to standard specification etc. complete.

17.1.8 FLOORING:

17.1.8.1 Providing CC 1:4:8 with granite metal of 50% of 40 mm size and 50% of 20 mm size to a thickness of 100 mm for all the rooms including cost and conveyance of all materials all lesas and lifts etc. complete.

17.1.8.2 Providing flooring with blue double polished first quality icota stones 25 mm thick over cement mortar bed of CM1:8 proportion 25 to 40 mm thick inclusive of cost and conveyance of all materials all leads and lifts curing etc. complete for finished item of work. Skirting with black polished stone to 150 mm height shall be provided all round the walls inside the control room and office room.

17.1.8.3 BATTERY ROOM:

Providing of approved acid proof flooring in ceramic tiles of standard thickness and standard make using 25 mm thick cement mortar(1:8) bed using cement slurry and acid proof ceramic tiles of 150 mm high skirting all around the walls of battery room including cost of all materials.

17.1.8.4 STORE ROOM:

Plastering is to be done in cement mortar 1:3, 20 mm thick finished smooth to the required slope and thread lined for flooring including curing, cost and conveyance of all materials, all leads and lifts etc. complete.

17.1.8.5 W.C. AND BATH

The earthen tiles of size 100x100x6mm shall be reputed make covered with glaze of approved colour and design. The tiles of approved quality, size shade shall be flat and true to. They shall be uniform in colour free from flaw like cracks chips etc. The edges and the underside of the tiles shall be free from glaze and shall have proper indentations for proper bond. Before the tiles are used the same shall be immersed in water for one hour in advance. Ever the bedding of CC (1:4:8) a neat gray cement slurry of honey like consistence be spread at the rate of 3.30 Kgs of cement per Sq.M over such an area as would accommodate about 20 tiles. The joints shall be as thin as possible (less than 1.50 mm) and shall be filled with colour/white cement where full size tiles cannot be fixed these shall be cur (sawn) to the required size and their edges rubbed smooth to ensure straight and true joints. The finished floor shall not sound hollow when tapped with wooden mallet. The ceramic tiles shall be commercial type (next to class I).

17.1.9 TECHNICAL SPECIFICATION FOR DOORS AND WINDOWS.
17.1.9.1 THE SCOPE OF WORK COVERED UNDER THIS SPECIFICATIONS IS AS FOLLOWS:

A) Supply of MS cold formed hollow frames with chemical treatment/finish for doors.
B) Supply of prelaminated particle Board flush doors (water, termite proof) with teak wood lipping.
C) Supply of MS Windows with glass panels of 4 mm thick duly providing with 10 mm square horizontal safety MS bars at 100 mm C/C.

17.1.9.1.1 Description of the cold formed MS hollow door frames. The cold formed steel frames shall be manufactured from cold rolled sheet metal of 1.25 mm thickness. The frames shall be free of rust, mill scale, dirt, oil etc. by mechanical and chemical means before giving an anticorrosive red oxide primer. The selection of raw materials and construction of frames shall be as per the recommendations of IS: 513 and IS: 4351.

a) Material Finish: The door frames shall be applied with one coat red oxide as primer.
b) Tolerances: Tolerances on thickness and other dimension of the materials shall be as per IS: 513 and 4351 later issues.
c) Packing: Door frames shall be packed in knockdown conditions ready to be erected at site. Each frame shall be packed separately along with corresponding accessories in the gunny wrapping.

The section of the doorframe shall be of size 105 x 60 mm. The thickness of MS sheet used shall be 1.25 mm.

ACCESSORIES: The following accessories shall be supplied along with each door frame.

i) Built in (welded) hinges 100 mm long 2.5 mm thick 3 Nos. for single shutter door and 6 Nos. for double shutter door shall be provided.
ii) Hold fasts-6 (six) Nos.
iii) Bottom tie of 10 mm square rod – 1 (One) No.
iv) Fastening bolts & nuts – 8 (Eight) Nos.
v) Stiffeners – 4 No of either side and 3 Nos. on top at suitable intervals.

The following provisions shall be made in the Doorframes:

i) Mortised lock slots.
ii) Aldrop hole.
iii)Tower bolt holes.

17.1.9.2 SHUTTERS: Shutters shall be of 30 mm thick prelaminated particle Board exterior grade both sides laminated with 15 mm teak wood lipping around. The rate shall include cost of shutter, cost of fittings, panting the surface in contact with masonry with one coat of solignum paint and painting the teak wood lipping and frame with two coats of best quality synthetic enamel pant over a primary coat (total3 coats).

17.1.9.3 SIZES OF SHUTTERS FOR DOORS: The overall sizes for doors are mentioned in the drawings. The actual sizes of doors shutters shall be manufactured duly deducting thickness of door frame.

17.1.9.4 ACCESSORIES:

The following aluminum accessories shall be supplied along with each door.

i) Tower bolts for double leaf - 3Nos.
   (200 mm Long)

ii) Tower bolts for single leaf - 2 Nos.
iii) Aldrops - 1 No (200 mm Long)
iv) Stopper for double leaf - 2 Nos.
v) Stopper for single leaf - 1 No.
vii) Handle - 2 Nos. (150 mm long)

17.1.9.5 WINDOWS AND VENTILATORS:

Steel windows and ventilators as per the designs approved conforming to relevant IS specification shall be supplied and fixed in position. The windows shall be fixed with thick white plain/figured glass. The glass shall be fixed by pins and putty etc. Safety bars of 8mm MS square shall be provided with required MS handles, peg stays closing arrangement etc. The windows shall be painted primer of red oxide paint before fixing in position windows and ventilators shall be painted with two coats synthetic enamel paints over a primer coat of red oxide.

17.1.9.6 FIXING:

It is the responsibility of the Contractor to fix the shutters with accessories for the doors and windows.

17.1.9.7 PLASTERING ITEMS:

i) Plastering to the walls of super structure is to be done with cement mortar (1:5) proportion 12 mm thick on even surface side and 20 mm thick on uneven surface side with neeru/ce ment finish. The item is inclusive of scaffolding cost and conveyance of all materials, all leads and lifting and curing etc. complete.

ii) Plastering to ceiling shall be done in CM (1:3) 12 mm thick including cost and conveyance of all materials leads and lifts and curing etc. complete.

iii) For external walls providing sand faced externally using harsalia/kasaba or similar type of sand in all position including base at of 15 mm thick in cement mortar 1:4 using water proofing compound @ 1 kg per cement bag curing the same for not less than 2 days and keeping the surface of base coat rough to receive the sand faced treatment 5 to 8 mm thick in CM 1:4 finishing the surface by taking out grains and curing for 14 days etc. complete.

17.1.10 PAINTING ITEMS:

Cost of tools and plant, paint, brushes labour etc. required for the work shall be arranged by the Contractor. The painting work involves.

17.1.10.1 Painting to wood work 2 coats with synthetic enamel paint 1st grade of approved make and colour over a primary coat (total 2 coats) including cost of paints and primer etc.

17.1.10.2 Painting 2 coats to the steel work (Grills and frames for window or ventilators) with synthetic enamel paint of approved make and colour over a primary coat (total 3 coats) including cost of the paint and primer.

17.1.10.3 Painting 2 coats with approved epoxy based acid resting paint to the walls and ceiling of the battery room over one primer coat as per manufacturer’s specification including cost of the paint.

17.1.10.4 Painting outside of the walls with two coats of cement paint snowcem/durocem or other paint of identical quality of approved colour and make over a primary coat (total 3 coats) in all heights, including cost and conveyance of material, all leads and lifts, scaffolding and curing etc. complete.
17.1.10.5 Internal wall shall be painted with 2 coats of oil bound distemper of approved quality over one coat of cement primer paint. The rate quoted shall include scaffolding cost and conveyance of all materials, all leads and lift complete.

The paints used shall conform to relevant IS specification and samples shall be submitted and got approved by the Engineer.

17.1.10.5.1 WATER-PROOF CEMENT PAINT:

Water proof cement paint shall be approved brand and manufacture and shall be applied on the surface to be treated in accordance with the manufacturer’s specification if directed by Engineer. However, for guidance of contract the following specifications are given. The surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, grease and any other foreign matter by brushing and clean water before the waterproof cement paint is applied.

Waterproof cement paint shall be mixed in such quantities as can be sued up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Water proof cement paint shall be mixed with water in two (2) volumes of water proof cement paint and one volume of water stirred thoroughly and allowed to stand by five (5) minutes care shall be taken to add the water proof cement paint gradually to the water and not vice versa. The second storage shall comprise of adding further one (1) volume of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all case the manufacturer’s instructions shall be allowed meticulously. The solution shall be applied on the clean solution shall be dept well stirred during the period of application shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The completed surface shall be applied after the first coat has set at least twenty four (24) hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three (3) coats of water proof cement paint to get a uniform shade.

17.1.10.7 OIL BOUND DISTEMPERING:

Oil bound distemper of approved make, colour and shade shall be used.

PRIMER: The primer used on the new work shall be cement primer of distemper primer. These shall be of the same make as oil bound distemper.

APPLICATION: The primer coat shall be with distemper primer or cement primer. This distemper primer shall be applied with a brush on a clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation shall constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for atleast 48 (Forty Eight) hours before oil bound distemper is applied.

The distemper coat, after the primer coat has dried for atleast 48 (Forty Eight) hours, the surface shall be lightly rubbed by sand paper to make it smooth for receiving the distemper taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner shall be applied with brushed in horizontal strokes followed immediately by vertical strokes which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or three coats of distemper as specified shall be applied over the primer coat to obtain an even shade.
A time interval of at least 24 (Twenty Four) hours shall be allowed between coats to permit the proper drying of the preceding coat.

17.1.10.8 SYNTHETIC ENAMEL PAINTING:

All rust and scales shall be removed by scraping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken. The priming coat shall be of ready made primer of approved brand and manufacture. The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off. The crossing and laying off consist of covering the even with paint, brushing the surface hard for the first time over and then brushing alternatively in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

The priming coat shall be dried up completely before painting is started. Superior quality ready mixed synthetic enamel paint shall only be used and shall be of approved manufacture and of required shades. They shall conform in all respects to the relevant Indian standard specification. Where so stipulated the painting shall be done with spray, spray machine shall be of approved type. Skilled and experienced workmen shall be employed for this class of work. Spraying would be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation. Each coat except the last coat, shall be legibly rubbed down with sand layer or fine pumice stone cleaned of dust before the next coat is laid. No left over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed. No hair marks from the brush of moulding etc. shall be left on the work. In painting doors and window the putty around the glass panes must also be painted. So care must be taken to see that no paint stains etc. in left on the glass. Tops of shutters and surface in similar or clogging of paint puddles in the corners of panels angles hidden locations shall not be left out in painting. In painting steel work, special care shall be taken while painting over bolts, nuts, revete, overlaps etc.

17.1.10.9 GENERAL:

All painting shall be performed, generally in accordance with the detailed descriptions. In the selection of colours, agreement shall be made with the Engineer. All painting finishing materials (other than white wash, colour was etc.) shall be obtained ready mixed in sealed containers from approved manufacturers, these shall be of best quality of approved make and having engineer’s approval. Generally, iron and steel work etc. would have received its primary shop coat being delivered to site. No painting work shall be started, unless specimens and colours are submitted in advance to the Engineer for approval. Such approval of paint specimens by the Engineer does not relieve the contractor of his full and entire liability as to the life and quality of paints. No products prepared in the field by the workmen shall be used, except for those not available in the market. In this case, however, the paints shall be prepared with the greatest care and best methods known in a sufficient good quality to assure uniform colouring. They shall be of a density and body such as to cover perfectly the surfaces to which they are to be applied. The Engineer may while work is in progress, take samples for the products employed in the different operations, in order to have them analysed and tested as deemed fit, all at the Contractor’s expenses.
The Contractor shall be responsive for evident or hidden fault which may become apparent even after work is finished up to the time of final inspection and acceptance. The Contractor shall take into account the conditions of the surface to be painted (for example, ageing of plaster etc.) and adopt the preparation thereto, using any special operations which in practice may have approved necessary and which have been approved by the engineer.

All reconditioning or extra work which the Engineer may deem necessary for the removal of defects shall be at the Contractor’s expenses.

All paints shall be of the best type used for that particular purpose, possessing the highest wear resistance, and shall be submitted for approval to the Engineer, who is entitled to demand such tests as he may deem fit. The Contractor shall give notice to the Engineer of each stage of painting that is to be performed and obtain approval for each in special register prepared for the purpose. Painted surfaces shall appear absolutely even and free from any trace of brush marks and a good finish is required for those having pumice treatment.

17.1.11 APPLICABLE CODES AND SPECIFICATION:

The following codes, standards and specifications make a part of this specification. All standards, tentative specifications, codes and practice referred to herein shall be the latest edition including all applicable official amendments and provisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS : 777 : Glazed earthenware wall tiles.
IS : 428 : Distemper oil emulsion, colour as required.

17.1.12 SANITARY ARRANGEMENTS:

The porcelain materials such as WC wash basins and pillar taps, bibcocks, pit valves etc. are to be supplied by the Contractor himself and work executed. Samples of these materials shall be got approved by Engineer before fixing these materials shall conform to relevant IS in all respects and IS test certificates shall be produced at the time of supply.

17.1.12.1 WASH BASIN, MIRROR TOWELL RAIL AND LIQUID SOAP HOLDER:

Wash basins shall be white/ colour vitreous China of standard size 630 mm x 450 mm with flat back. Wash basin shall be one piece construction including a combined over flow and a soap holder. Wash basins shall be provided with approved quality chromium plated pillar taps (15 mm) dia along with chain and plug stop cocks, brackets, completed. The wash basins shall in all respects conforms to IS: 2556 and shall be provided with a looking glass mirror and towel rail and liquid soap holders. Wash basins shall be provided with 32 mm dia CP bottle trap and waist 75 mm CP Nahani floor trap and connecting pipes. A mirror of Belgium or other approved quality of size 450 x 600 mm of 6 mm thick levelled edge frameless with C.P. brass screws shall be provided over the wash basin.
Liquid soap holder shall be of best quality plastic variety of approved make with C.P/brackets and C.P. screws in the wall.

17.1.12.1 WATER CLOSETS:

These shall be of Indian type (Orissa pattern) of size 580 mm. Each pan shall have integral flushing of suitable type. It shall also have an inlet or supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self drainage type. It shall have weep hole at the flushing inlet of the pan. The flushing inlet shall be in the front unless otherwise specified or as ordered by the Engineer. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to unable easy and quick of disposal which flushing. In all cases a pan shall be provided with a 100 mm ‘P’ traps with approximately 50 mm effectively water seal and 50 mm diameter vent horn, where required the Engineer. Each pan shall be provided with instant flush of approved make, manufacture and quality including traps, connecting pipes etc., complete for proper functioning of the pan and shall conform to IS: 2556.

17.1.12.2 GENERAL:

The work shall be carried out, complying in all respect with the requirements of relevant Indian standard and by laws of the local authority. Any damage caused to the building or to electric, sanitary, water supply or other installation etc. therein either due to actual requirement of the work, shall be made good and the building and the installation shall be restored to its original conditions by the Contractor. Nothing extra shall be paid for it, except where otherwise specified.

For making good the damage to masonry work, concrete work, plastering and any other items shall be as specified in this specification.

All sanitary appliances including sanitary fittings, fixtures, toilet requisites, shall be of size, make and design as specified in the item of work as per sample approved by the Engineer. Samples of all fixtures shall be got approved before supply. All sanitary and plumbing work shall also be got approved. On completion of the work site shall be cleaned and all rubbish disposed off as directed by the Engineer.

17.1.13 CONSTRUCTION OF SEPTIC TANK:

Septic Tank of size 2x0.9.x2.3 meters (inner dimensions) is to be constructed. It shall be provided with sand filling 150 mm thick CC:1:3:6 mix 150 mm thick with 20 mm granite metal at the bottom and brick masonry walls on all four sides in CM 1:6 for the septic tank. Baffle walls as required from the inlet pipe level towards floor of the septic tank in RCC 1:2:4, 75 MM thick and with roof slab of 100 mm thick in RCC 1:2:4 with 12 to 20 mm granite metal with an opening of 0.6x0.6 meters for manhole shall be provided. The septic tank is to be provided with 4.5 m long 100 m dia AC ventilating pipe with cowl. The outlet from the septic tank should be standard “T” fitting of glazed earthen ware pipe. The floor and sides of the septic tank should be plastered in cement mortar (1:3) 20 mm thick. The thickness of the wall should be 230 mm. The floor of the tank should slope at in 1 in 30 towards one end to facilitate cleaning of deposits and the manhole should be above this. The reinforcement for the roof slab and baffle wall should be with 12 mm and 6 mm dia MS rounds at 150 mm C/C. The tank should be provided with 0.6x0.6 meter size C.I. frame and cover. A manhole of size 0.45 x 0.45 meters shall be constructed with heavy duty manhole covers on sewage line. The SWG pipe line shall be laid from the toilet to the septic tank upto a maximum distance of 15 m. The SW pipes and specials shall conform to IS 651 (Latest revision) for salt glazed stone ware pipes and fittings. Laying, jointing including testing shall be carried out in accordance to the latest IS specifications to
the satisfaction of the department. Inspection chambers of suitable size of required numbers as per size condition need to be provided with R.C.C. cover.

17.1.14 APPLICABLE CODES:

The following standards and codes are made part of this specification. All standards, codes of practice shall be the latest editions, including all official amendments and revisions.

- IS:651  - Salt glazed stone ware pipes & fittings.
- IS:1239 - Mild steel tubes (part-I) and mild steel tubular and other wrought steel pipe fittings (Part –II)
- IS:458  - Concrete pipes (with or without reinforcement)
- IS:774  - Flushing cisterns for water closet and urinals (valveless symphonic type).
- IS:775  - Cast iron brackets and supports for wash basin and sinks.
- IS:781  - Sand cast brass screw down bib taps and stop taps for water services.
- IS:1729 - Sand cast iron spigot and socket soil waste and ventilating pipes, fitting and accessories.
- IS:2470 - Code of practice for design and construction septic tanks.
- IS:2556 - Vitreous sanitary appliances (Part-I to Part–II)
- IS:2963 - Copper alloy waste fittings for wash basins and sinks.
- IS:3311 - Waste plugs and its accessories for sinks and wash hand basins.

17.1.15 A.C. Rain water down take pipes of 150 mm dia shall be provided with required specials such as bends, shoes and fixed with clamps on teak wood gutties with screws etc. The pipe joints will be filled in with cement paste.

17.1.15.1 The rain water pipes shall have beaded reshoulders 100 mm distance from the lower ends and fitted so that each length rests on the pipe section below. The upper part of the 150 mm long shoulder shall be wrapped in hemp or yarn and coated with linseed oil putty and to form tight sealed joint with the length below. Any surplus putty shall be nearly cleaned off.

17.1.15.2 All rainwater pipe shall be fixed 40 mm clear of extreme outer face of walls with strong galvanized malleable steel holder bats having a 125 mm long ragged tail and circled strap in two pieces with galvanized bolted connections.

17.1.15.3 The rainwater pipe shall be fixed in positions shown by the Engineer. The Contractor shall provide proper purpose made swan-neck bends, plinth bends shoes, stopped ends etc. where required.

17.1.15.4 WATER PROOFING TREATMENTS:

Providing cement based water proofing treatment to terrace (Indian water proofing treatment of 100 mm thick with large size (65mm) well burnt bat laid in required slope to drain the water for any span, after cleaning the base surface, applying two coats of cement slurry and mixed with approved water proof compound and laying the well burn brick bat on bottom layer of cement mortar 1:5 and mixed with approved water proofing compound, filling up to half depth of brickbats, curing. This layer for three days applying cement slurry over this layer, jointing of brick bats with 1:3 finally top
finishing with average 20 mm thick layer of same work added with jute fibre at one Kg per bag including finishing the surface smooth with cement slurry and mixed with approved water proofing compound, marking the finished surface with false squares of 300 x 300 mm making the junctions at the parapets rounded and tapered towards top for required height with drip mould at the junction of plaster and curing etc. complete with a guarantee of 7 (seven) years, Contractor to give pending test to the same.

17.1.15.5 PLINTH PROTECTION:
Providing and laying plinth protection 750 mm wide with 100 mm thick cement concrete of grade CC X-150 finished smooth with 12 mm cement plaster in CM 1:4 below the subgrade concrete. Please provide 230 mm soling laid on the compacted soil surface with adequate slope.

17.1.15.6 STORM WATER DRAIN:
These shall be provided in the switchyard, sides of bituminous roads and all round the control building and involve the following activities:
   b) 12 mm plaster in CM 1:4 with 3 mm neat cement finish to brick masonry wall in drains as directed.

17.1.15.7 BATHROOM/ TOILET BLOCK:
The Bathroom/Toilet block invariable be provided with a tap shower, 1/2 round flat – bak urinals, flushing cistern and overhead tank of suitable capacity, 1 mirror, 2 towel rods, glazed tiles flooring with 2 mtr. skirting, necessary stop and bibcodes Nhani and gully taps and connection to external drains etc. complete as directed.

17.2.1 GENERAL SCOPE OF WORK OF ALUMINIUM DOORS AND WINDOWS:
Providing, fabrication and supplying including erecting and fixing in position of Anodised aluminium door fully glazed in single or double leave with 5.5 mm thick clear vision sheet glass and all fixtures and fastening complete.

17.2.1.1 ANODISED ALUMINIUM SECTIONS:
All aluminium anodized sections intended to be used in all fabrication works will conform in general to quality to following I.S. codes.
   a) IS 733 –1956 (since revised)
   b) IS 1285 –1958 (since revised)
The same will be got approved prior to actual fabrication work and will meet dimensional tolerances and sizes as stipulated therein. Al aluminium frames shall be powder quoted.

17.2.1.2 GLAZING:
5.5 mm thick clear vision sheet glass shall conform in general to I.S. code 1761-1960 and will be fixed with metal beading with neoprene rubber lining.

17.2.1.3 All fixtures and fastenings of best approved make like hinges, fancy handles, concealed tower bolts, floor springs hydraulically operated door closer, mortise lock etc. including all accessories complete.

17.2.1.4 EXECUTION AND FIXING:
All the fixing works will be done in conformity with the I.S. code 1081-1960 and further amendment thereof and glazing will be carried out as per the standard approved practice or as per manufacturer’s instructions.

17.2.1.5 The item includes all labour, materials and equipments required for

i) Providing, fabricating, supplying, erecting and fixing aluminium anodized door in single or double leaves with 5.5mm thick clear vision plain sheet glass in metal bedding and neoprene rubber lining with all fixtures and fastenings complete in aluminium glaze partition at all leads and heights as per detailed drawings, specifications and instructions of Engineer-in-Charge.

ii) Execution and fixing changes with necessary hand work.

iii) Removing and cleaning of protective coating and other debris.

iv) Repairing and finishing of all cement concrete, brick masonry, R.C.C. work.

17.2.2 ALUMINIUM ENTRANCE DOOR:

Designing, providing, fabricating, supplying including excavation and fixing aluminium anodized entrance door (Partly fixed/ partly moving) and as per detailed design and drawing to be submitted and got approved to RCC columns or cement concrete block masonry in single or double leaves with side light and fan light using anodized aluminium sections conforming to IS codes and glazed with 5.5 mm thick. Clear vision sheet glass in field partition and 12 mm clear plate glass in door shutters with metal bead glazing in neoprene rubber lining and with all fixtures and fastening of best approved make like fancy door handles, supporting hinges, concealed tower bolts, floor springs, hydraulic door closers, mortise lock etc. complete to entire satisfaction of Engineer-in-charge.

17.2.2.1 MATERIAL:

a) Aluminium Sections : intended to be used in all fabrication works will conform in general to quality to following I.S. codes.

   a) IS 733-1956 (since revised)
   b) IS 1285-1958 (since revised)

and will be got approved prior to actual fabrication work and will meet dimensional tolerance and sizes as submitted with the detailed design approved.

b) Glazing :

   i) 5.5 mm thick clear vision sheet glass shall conform general IS code 1761-1960
   ii) 12 mm thick plate glass of best quality and make will used in shutter leaves with all edge preparation, hole drilling for accommodating fixtures etc.

   iii) All glass panes will be fixed with metal- beading and neoprene rubber lining as per good approved practice.

   c) Fixtures :

      Supplying, providing and fixing all door fixtures like fancy handles, hinges, concealed tower bolts, floor springs, hydraulic door closers, mortise lock etc. of approved best make.

17.2.2.2 ERECTION AND FIXING:

All the fixing work will be done in conformity with the code 1081-1960 and amendments thereof and glazing will be carried out as per standard approved practices or as per manufacturer’s instructions.

17.2.2.3 ITEM TO BE INCLUDED:

All labour, materials and equipments required for:
i) Designing, providing, fabricating, supplying including erection and fixing main entrance door of anodized aluminium sections with plain clear vision sheet glass of 5.5 mm and 12 mm thickness all as per detailed design in screwless metal beading with neoprene rubber lining including at fixtures and fastening specified.

ii) Erection and fixing in brick masonry, C.C. brick masonry and RCC work with suitable hold fasts at all heights and leads as per detailed specifications, drawing and instructions of Engineer-in-charge.

iii) Removing and cleaning of protective coating and other debris.

iv) Repairing and finishing of all CC, B.M. and RCC works.

17.2.3 Providing, fabricating, supplying and fixing in position in RCC/ CC work aluminium anodized sliding windows and ventilators as per detailed drawing and design with 5.5 mm thick clear vision plain sheet glass with metal beading and neoprene rubber lining with all fixtures and fastening at all heights and leads compete as per detailed specifications. All aluminium frames shall be powder coated and all glass shall be 5.5 mm thick tinned. Provide aluminium grill for all windows.

17.2.3.1 MATERIALS:

All aluminium anodized sections intended to be used in all fabrication works will conform in general to quality to following IS codes.

a) IS 733-1956 (since revised)

The same shall be got approved prior to actual fabrication work and will meet dimensional tolerances and sizes as stipulated.

17.2.3.2 GLAZING:

i) 5.5 mm thick clear vision sheet glass shall conform in general IS code 1761-1960 and will be fixed with beading with neoprene rubber lining.

ii) All fixtures and fastenings associated with them in good approved practice.

iii) All anodized aluminium channel sections required meet specific requirement at site to suit detailed drawing.

17.2.3.3 All the fixing and glazing work will be carried out conformity with the IS code 1081-1960 and glazing work be completed in a approved manner only.

17.2.3.4 ITEM TO BE INCLUDED:

All labour, materials and equipments required for:

i) Providing, fabricating, supplying and fixing anodized aluminium sliding windows filled with 5.5 mm thick clear vision plain sheet glass in metal beading and neoprene rubber lining with all fixtures and fastening.

ii) Erection and fixing charges.

iii) Removing and cleaning of protective coating and other debris.

iv) Repairing and finishing of all CC, B.M. and RCC works.

18.0 WATER SUPPLY SYSTEM:

18.1 The Contractor shall drill and install borewel l for source of water The Contractor shall also establish the suitability of water for drinking purpose by carrying out necessary laboratory tests on water samples from approved libratory.

18.2 PRINCIPAL ITEMS:

18.2.1 Principal items of work to be performed, and materials, equipment, devices and appliances to be furnished and installed hereunder shall include the followings:

a) Investigation for and subsequently drilling a borewell, installing necessary pump, providing and laying of supply pipe line.
b) Providing 1000 liters PVC water storage tank and providing distribution main from this tank to control building.

c) All building water supply piping as required including connection to each fixture and fastening of equipment requiring water.

d) All plumbing fixtures and accessories.

e) Water cooler fitted with water filter operating on electric supply.

18.2.2 Specification for drilling and installation of Borewells.

18.2.3 The work involves investigation for, drilling and installation of tube wells as per specifications given below at the substations site.

18.2.4 It is emphasized that the tube well will be the sole source of water for the substation and hence a continuous and adequate supply must be ensured. The required total yield is approximately 100 liters per minutes.

18.2.5 The Contractor shall take suitable precautions to guard against caving in of soil into the bore hole.

18.2.6 The bore of 150 mm dia shall be drilled into the soil with a rotary rig up required depth into the water bearing strata, subject to a maximum of 75M depth in a lumpsum. In case boulder formations not penetrable by the rig in use, are encountered before reaching the desired depth, the hole drilled shall be encased provided strata samples indicate presence of some water bearing formations. Otherwise shall be abandoned as per the discretion of the Engineer. Where caving material is encountered, the casing shall be sunk as fast as the drilling proceeds. After drilling of borewell as casing pipe of PVC to suit the 150 mm dia bore shall be lowered to a depth of 15M, installation and commissioning of suitable borewell pump alongwith associated G.I. pipe and electrical fitting for smooth and trouble free operation. Pump to be protected from weather and there by providing suitable shed.

A 20mm dia GI pipe line shall be supplied and laid from the borewell and connected to the PVC water storage tank in stalled over control building. The length of the pipe line shall be including fittings. Two separate suitable dia pipe lines from the water tank shall be laid. One connection shall lead to the toilet and the other line shall be laid upto switchyard. Necessary brass taps of ISI standard shall be supplied and fixed as per requirement. The scope of the contract includes cost of pipes, GI specials (viz. Unions, couplings, bends, tees, nipples, GM wheel valves etc.). Final scheme will be subject to approval of drawing by the Engineer at site.

19.0 RAIL TRACK:

19.1 Providing, supplying and fixing 90 yard M.S. rail for rail track including transportation fixing on concrete foundation base in correct line and level including necessary inserts, bolts, stiffeners of M.S. angle of size 45x45x6 mm, fish plates, nuts and bolts etc. complete for movement of transformer/ heavy material etc. painting spreading of metal in inside track etc. complete. As per site requirement and sub-soil strata if required RCC foundation and structural steel need to be designed, finalized and adopted.

20.0 FURNITURE & FIRST-AID BOX:

20.1 Providing of furniture for the sub station shall be of standard quality as per ISO-9001 and of pattern resembling to that mentioned in the enclosed list.

20.2 Standard First -Aid Box consisting of all required medicines and items meant for providing First Aid treatment should be supplied in the Sub. Station control room as below:
1) For 220 KV & 132 KV S/Stns – 2nos. of boxes each.
2) For 33 KV & 22 KV S/Stns – 1 no. box each.