

## **SECTION - 3**

### **ENCLOSURES TO THE SPECIFICATION**

**SJVNL Technical Specification ( Section 8, Page no. 8-1 to 8-18)**



# **SECTION – 8**

## **420 KV POT HEAD YARD EQUIPMENT & STRUCTURES**



## 8.9 STRUCTURES FOR 420 KV POT HEAD YARD

### 8.9.1 DESIGNS

8.9.1.1 Every tenderer shall submit his minimum guaranteed weight of steel inclusive of accessories for the structures detailed in Schedule of Requirement Clause 8.43. The successful tenderer shall submit design calculations, prepare structural drawings, shop floor drawings and bill of material. The structural drawings shall be approved by the purchaser before preparation of Model Assemblies. Each structure shall constitute fabricated members, nuts and bolts, stubs and anchor bolts to connect any structure/equipment with other structures etc. Prices shall be quoted structure wise (and not by weight of each structure). In detailed design stage if the weight increased beyond the guaranteed weights, there shall be no financial implications to the purchaser. If the supplier wants to use the higher alternative sections, due to timely non-availability of designed section, then he will have to obtain the approval from the purchaser to use the higher sections but there shall be no financial implications to the purchaser on this account. Nevertheless the tenderer shall evolve the design of columns and beams keeping in view the steel sections being rolled/made available by Steel Authority of India Limited.

The bidder shall give prices for incremental changes (lengths/weights) for supporting structures due to change in layout during detailed design and construction stage.

8.9.1.2 The design of columns and beams shall be based on the technical data given in Clause 8.9.27, 8.9.28 and 8.9.29 and design calculations/drawings shall be submitted as per Clause 8.9.25 and 8.34. Climatic conditions are given in Section-1

8.9.1.3 The design for the foundation for each type of column shall have to be supplied by the tenderer for conditions as stipulated in Clause 8.9.28, 8.9.29 and 8.9.30. The technical parameters for the design of foundations are given in Clause 8.18 & 8.19. The design of foundation is part of the contract and separate rates shall be quoted for each type of foundation.

### 8.9.2 WORKING STRESSES

8.9.2.1 According to IS 2062, the following maximum stresses are permissible for steel:

2600 Kg/cm<sup>2</sup> on net sections for axial & tensile stress. The area of the bolt holes should be deducted as per ISS 802 (Part I)-1977 Clause -12 from the gross-sectional area of the member to determine the net sectional area. The bolt holes shall be taken as 1.5mm larger than nominal diameter of bolt.

8.9.2.2 In the case of the angle sections, with one flange un-connected, the area would be considered as per ISS 802 (Part-I)-1977 clause 13. For parts in



compression, the strut formula specified in aforesaid ISS shall be followed.

8.9.3 STANDARDS :

All materials and fabrication work shall comply in all respects with the latest edition of the relevant Indian Standards except with regard to particular tolerances and other details that is indicated in this specification.

8.9.4 MATERIAL :

8.9.4.1 The compression members shall consist of rolled steel angle sections and tension members of rolled steel angle section or flats. The rolled steel angle sections, flats & plates shall conform to ISS-2062 (latest edition).

8.9.4.2 The tenderer shall state the names of the makers from whom he proposes to obtain material for the fabrication of the structures. The contractor shall not (without the written permission of purchaser) any materials for the purpose of the contract from the makers other than those stated in his tender and approved by the purchaser.

8.9.5 PROCUREMENT OF STEEL

8.9.5.1 The contractor shall make his own arrangements for the procurement of structural steel, nuts & bolts, washers and other accessories etc.,. Nuts, bolts, washers and other accessories will be of best quality steel. The supplier shall keep enough stock of steel so as to match the production schedule in keeping with agreed delivery period.

8.9.5.2 The purchaser shall not share the responsibility for wastage in any form due to non-supply of the materials by the supplier of steel in exact or multiple lengths.

8.9.6 PROCUREMENT OF ZINC :

The contractor shall have to make his own arrangements for procurement of zinc. The purchaser, if required, recommend the indents of the supplier to CEA/ DGS&D for the allocation of indigenous zinc or import followed by CEA/DGS&D. Therefore, submission of indent shall be so planned so as to match production schedule in keeping with delivery period. The purchaser shall not be responsible for the arrangement/ procurement of zinc for galvanising and the delivery of structures shall not be linked with the allocation/receipt of zinc. The zinc used shall be as per Indian Standard No. 208-1979 and shall be of minimum 99% purity.

8.9.7 QUALITY OF STEEL :

8.9.7.1 The steel used shall be of tested class-I quality as per ISS 2062 (latest edition).

8.9.7.2 For all steel supplies whether from indigenous production or from imported stocks, it will be the responsibility of the contractor to verify and ensure that the supplies of steel received by him for use in the fabrication work covered by this specification are of tested Class-I quality in



accordance with the specifications mentioned therein and free from blisters, scales, laminations or other defects and conforming to the specification mentioned.

8.9.7.3 Any material made from steel of inferior quality and specification will not be accepted by the purchaser and shall have to be removed and replaced by the contractor at his own cost on receipt of the necessary instructions from the purchaser.

8.9.8 WASTAGE ON ACCOUNT OF PUNCHING, CUTTING & DRILLING:

8.9.8.1 ANGLE SECTIONS :

For calculating the weight of fabricated and galvanised structure, the per metre weights as per ISI Hand Book for structural Engineers SP:6(1)-1964 will be considered. Net lengths and sizes of ungalvanised sections, shown on the structural drawing without deducting for any hole, notches and skew/flange cuts shall be taken as the basis of payment.

8.9.8.2 FLATS AND PLATES :

The metric calculated weights shall be based on the minimum rectangular area of the plate and flats from which the member could be made without deducting for holes/cut given in the structural drawing.

8.9.8.3 WASHERS :

Weights of galvanised washers shall be in accordance with relevant ISS.

8.9.8.4 NUTS AND BOLTS :

Weights of nuts and bolts shall be in accordance with the relevant ISS.

8.9.9 CONNECTIONS AND USE OF GUSSET PLATES :

All connections shall be bolted. The use of gusset plates shall be kept to a minimum. Where possible, members shall be bolted together directly, without excessive eccentricity. Wherever connections are such that the elimination of gusset plates increases the eccentricity of a joint beyond a reasonable amount, plates shall be used. Where gusset plates are used, with members designed for compression these shall be connected to the main members with at least two bolts. Where spacers are required at two or more adjacent bolts, a single plate spacer shall be used instead of ring washer spacers. All double angle members shall be connected at suitable intervals, between the end connections by stitch bolts and washers. No welding of members of structures shall be allowed.

8.9.10 SPLICES :

8.9.10.1 The inside angle of lap-splices, and the splice angle of butt splices, shall be ground at the heel to fit the fillet of the outside angle. At splices, 1.5mm clearance shall be provided between the faces of spliced angle members. All splices shall develop the full stress in the members connected through the bolts.



8.9.10.2 Where excessive eccentricity is caused with lap splice in the leg member a butt splice joint shall be used. The thickness and size of splice angle of butt splice shall be of heavier member.

8.9.11 GALVANISING :

8.9.11.1 All parts of the structure including (anchor bolts,) shall be hot dip galvanized after fabrication, the cost of the same shall be included in the price quoted by the tenderer for galvanized structure. No extra cost for the increase in weight of the galvanized structure due to galvanising shall be paid.

8.9.11.2 All material shall be fully fabricated before galvanising. No machine or shop work, die work etc; be allowed after galvanising except the tapping of nuts.

8.9.11.3 The galvanized coating shall be sufficient in thickness and of not less than 0.610 Kg of zinc per square metre of surface. The galvanizing shall consist of continuous coating of pure zinc of an uniform thickness so applied that it adheres firmly to all surface of steel and will give the proper protection to steel after erection. Galvanising shall be free from all defects which will affect its service. The finished surface shall be clean and smooth before being galvanized, the steel shall be thoroughly cleaned of all paints, grease rust, scale or such other materials as may interfere with the proper bonding of zinc with the steel by employing accepted methods used in the process of hot dip galvanising. The preparation for galvanizing and the galvanising itself shall not adversely affect the mechanical properties of the coated material. The galvanized coating shall not flake or be loosened from the steel when struck squarely with chisel faced hammer.

8.9.11.4 The test shall be made for galvanising from time to time on as many samples as may be considered, necessary. The supplier/fabricator shall supply the samples and the equipment necessary to carry out the tests without any extra cost. The galvanising in all respects shall conform to the tests specified in ISS-2633 (latest edition). The tenderer shall clearly state in his tender the facilities available at his works to carry out specified tests.

8.9.11.5 Each tenderer shall state his galvanising arrangement indicating the size of galvanising bath and maximum output of the galvanising plant.

8.9.12 DRILLING AND PUNCHING :

8.9.12.1 The importance of sub-station steel structure demands accurate drilling and punching with high standard of workmanship and finish. Holes for bolts shall be drilled or punched to zig, but all holes in material over 8mm thick must be drilled. Holes for spliced joints shall be drilled through the plates and sections forming the joint in one operation. Punched holes must be square with the plates and the walls of the holes parallel.

8.9.12.2 The following maximum tolerance in accuracy of punched holes is permissible.

i) Holes must be perfectly circular and no tolerance in this
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	respect is permissible.
ii)	The maximum allowable difference in diameter of the holes on the two sides of the plates or angle is 0.8mm i.e the allowable taper in punched hole should not exceed 0.8mm on diameter or 0.4mm. on radius.
iii)	Holes must be square with the plates or angle and slant holes shall not be permitted. Bolts holes whether punched or drilled must be larger than the sizes of bolts not more than 1.5mm in diameter of bolts.

All burrs by drill or punch shall be removed completely before galvanising.

#### 8.9.12.3 SPACING OF BOLTS AND EDGE DISTANCES :

The minimum spacing of bolts and edge distances shall be as given below:

Bolt diameter (mm)	Hole diameter (mm)	Minimum bolt spacing (mm)	Minimum edge-Distance(mm)	
			Hole Centre to rolled or sawn edge	Hole centre to sheared or flame cut edge
12	13.5	32	16	20
16	17.5	40	20	23
20	21.5	48	25	28

#### 8.8.12.4 LOCKING DEVICES :

Electro galvanized spring washers of type B of thickness indicated below to bolt diameter shall be provided for insertion under all nuts.

Bolt Diameter (mm)	Thickness of Spring washers(mm)
12	2.5
16	3.5
20	4.0

#### 8.9.13 MINIMUM SIZES OF MATERIAL :

The minimum thickness of leg members shall be 6mm and other members shall be 5mm. and redundant members shall be 5mm. No bolt less than 16mm diameter is to be used. The flange width of angle section through which a bolt passes shall not be less than 45mm.

#### 8.9.14 EARTHING FACILITIES :

To facilitate making of earth connections, two holes of 17.5mm diameter at a point preferably 23cm above the bottom end of the structure are to be provided. The holes are to be provided on any two legs/gusset plates.



8.9.15 DRAIN HOLES :

Drain holes shall be provided at all places where pockets or depressions are likely to hold water even though these are not shown on the drawings.

8.9.16 STRAIN PLATES :

The strain plates for supporting conductors and ground wires on structure top are to be designed for a strength not less than that of the conductor or ground wire which they are to hold.

8.9.17 LADDER BOLTS :

Each structure, shall be provided with holes for step bolts staggered in one of the legs. The holes are required to be spaced not more than 45 cms apart from 45 cms above ground level, upto the top of the structures, staggered on both faces of the same leg angle. The holes for the step bolts shall be suitable to take 16mm dia bolts.

8.9.18 WORKMANSHIP AND FINISH :

8.9.18.1 Workmanship and finish shall be of the highest standard required by the modern practice with fabrication tolerance as indicated in this specification. All members shall be cut to zig and all holes shall be drilled or punched to zig. All parts shall be carefully cut and holes accurately located so that when the members are in position the holes will be truly opposite each other before being bolted up. Re-drilling of holes will not be allowed. All corresponding parts shall be made similar and strictly inter-changeable.

8.9.18.2 The drilling, punching, cutting and bending of all fabricated steel work shall be such as to prevent any possibility of irregularity occurring which might introduce difficulty in erection of the structure at site.

8.9.18.3 The tenderer should clearly indicate in his tender his ability to comply with the fabrication tolerances set in this specification and if he is unable to do so, he should intimate fully the proposed departure, from this specification in this respect with justification, thereof.

8.9.19 STRAIGHTENING :

All steel sections before any other work of cutting is started shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued up after being punched, and drilled.

8.9.20 MARKING:

Each member of a sub-station structure shall be given separate identification number as shown on the assembly drawing for each type of tower or beam. Each individual member shall be stamped with the typed letter of the structure to which it belongs followed by its identification number as shown on the assembly drawing. Identical parts shall have the same



identification number and absolutely interchangeable. The structure type letter and identification number shall be stamped into the steel member in letter and figure not less than 12 mm x 18mm size so that these are clearly visible after galvanising and remain permanent. These marks shall be stamped near one end and in the same relative position on each piece so as to be readily traceable.

#### 8.9.21 BOLTS, NUTS AND WASHERS :

8.9.21.1 The bolts, nuts and washers, spring washers, lock nuts shall be of M/s Guest keen and William and manufacturer's test certificate as per relevant ISS shall be submitted. Certificate of tests from relevant ISS, from the manufacturers quality control deptt. for the lots from which the material is procured is to be supplied for approval from the purchaser, before the dispatch of material.

8.9.21.2 All metal parts shall be secured by means of bolts and nuts, the minimum diameter of which shall not be less than 16mm unless otherwise specified. Assembled supporting structures shall have head on the outer surface of supporting structures and nuts on the inside. All bolts and nuts shall conform to ISS 6639- 1972. The length of bolts shall be such that the threaded portion does not lie in the plane of contact of members. Fully threaded bolts shall not be used. All bolts shall be threaded with British Whit worth standard threads to take the full depth of the nut and shall be threaded far enough to permit gripping of the members but no further. The diameter of the hole shall not be more than the nominal diameter of the bolt plus 1.5mm.

8.9.21.3 Washers shall conform to ISS 2016-1967. Heavy washers shall conform to ISS 6610-1972, spring washers shall conform to ISS 3063-1972.

8.9.21.4 Bolts and other fasteners shall be galvanised in accordance with ISS 5358-1969. Spring washers shall be galvanised in accordance with ISS 1573-1970.

8.9.21.5 Procurement of bolts, nuts, lock nuts and washers of proper size, specification and quality as herein described is the responsibility of the contractor.

8.9.21.6 Bolts at the joints of the members may be staggered such that the nuts may be tightened with spanners without fouling.

#### 8.9.22 QUANTITY OF BOLTS, NUTS AND WASHERS :

The quantity of bolts, nuts, lock-nuts and washers of various sizes to be supplied shall be 2.5 percent in excess of the actual quantity required to complete the structure. The weight of 2.5 percent bolts, nuts and washers to be supplied extra shall not be considered separately in the weight and instead the tenderers are requested to account for the same in their guaranteed weight. The corresponding quantity including 2.5 percent excess quantity of bolts, nuts and washers and spacers etc. shall be supplied along with each consignment of the fabricated steel structures.

#### 8.9.23 REPLACEMENTS:



If the material/equipment of any portion thereof is damaged or lost during the transit, the purchaser shall give notice to the contractor setting forth particulars of such material/ equipment damaged or lost during transit, the replacement of such material/equipment damaged or lost during transit shall be affected by the contractor within a reasonable time to avoid unnecessary delay in the commissioning of the equipment. Replacement of material/equipment damaged during the transit shall be made of at his own cost by the contractor.

#### 8.9.24 ASSEMBLING :

One of each type of structure shall be completely assembled at maker's works for inspection and approval by the purchaser's authorised representative. The mass production of structures shall only be started after the approval of these model assemblies.

#### 8.9.25 DRAWINGS :

8.9.25.1 The successful tenderer shall submit ten copies of the following drawings.

i)	Stress calculations for each type of structure, with tables giving stresses in different members of the structure with calculations for structure drawings.
ii)	Dimensioned drawings of each type of structure giving dimensions and sizes of all sections, , fittings, bolts etc
iii)	Any other drawings, considered necessary by the tenderer.
iv)	Dimensional drawing of foundation of different types of structures and for different conditions stipulated in Clause 2.6 with detailed design computations. The drawings for foundation shall also include the following for each type:
a)	Dimension of excavation; and
b)	Volume of concrete and dimensions of concrete foundations.

It is essential that the complete data is given to facilitate the checking of designs.

8.9.25.2 The successful tenderer shall prepare the structural assembly drawings of the structures in accordance with the design calculation submitted by him and approved by the purchaser. The detailed structural drawings shall be supplied to the purchaser for his approval. Any improvement in the various structures shall be considered and if approved, the supplier shall have to amend the structural drawing incorporating such approved improvement. The bill of material of each structure shall be prepared by the supplier and got approved from the purchaser before commencement of supply of structures. The detailed drawings and bill of material will constitute the contract drawings, and one complete set of structural drawings shall have to be supplied on reproducible/ tracing cloth before commencement of supplies. In addition, the supplier shall have to supply the soft copies of all the drawings .

8.9.25.3 Approval to the contractor's structural drawings and bill of material shall not relieve the contractor of any part of the contractor's obligations to meet



the requirements of the specification or of the responsibility for the designs and correctness of the modified drawings.

8.9.26 SUPPORTING STRUCTURE FOR CVT, LA & LINE TRAP:

8.9.26.1 The supporting structure for CVT, LA & Line Trap shall be hot dip galvanised with minimum 610 gram/sq. mtr. zinc.

8.9.26.2 Minimum vertical clearance from any energised metal part to the plinth shall be 8.0 mtr. for 420 kv.

8.9.26.3 Minimum vertical distance from bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the structure, where the structure rests on the foundation pad shall be 2.55 meters.

8.9.26.4 The design calculations taking into account the environmental conditions of the sub station shall be furnished for sizing of the structure.

8.9.26.5 The centre line of connection from the equipment shall be 9.0 mtr. minimum from ground level.

8.9.28 Special consideration for Design

a) BEAM TYPE AB-I

This beam shall be designed to carry 4000 kg tension of Triple snow bird ACSR conductor in bundle at each phase point. The span of feeder shall be maximum 300 meters and can have deviation in horizontal plane from 0° to 40° from normal to beam in horizontal plane and in vertical plane from 0° to 40° upwards or downwards from normal to the beam in horizontal plane.

b) COLUMN TYPE AT-I

This type of column is required to support one no. beam type AB-1 in the same direction, carrying the tension of feeder conductor. This column shall also be designed to support peak AP-1.

c) PEAK TYPE AP-I

This peak shall be designed to support three nos. wires.

Peak AP-1 shall be connected with column wherever required.

d) EQUIPMENT SUPPORTING STRUCTURES.

S1, S2, S3 are supporting structure for 420kv equipment, these are equipment for capacitor voltage transformer, lightning arrester and line trap respectively. The base plate should be fixed to leg member angle iron, as shown in sketches.



The top of the equipment structure on which the equipment is mounted shall be of channel iron so that moments offered by the equipment weight etc. are transferred to the structure properly.

The top of the structures can be suitably modified to mount the particular equipment but the base plate at the point of bolt connections shall not be less than 12mm thick.

In place of fabricated angle iron steel structures, or other fabricated structure section can also be considered.

#### 8.9.29 Special Structures

The outline drawing & loading of special structures, if any, shall be intimated later. The tenderers may quote unit rate per structure for supply of special tower.

#### 8.9.30 TEST :

##### 1. Quality of Steel :

Certificates of tests as per relevant I.S.S from the manufacturer quality control deptt. for the lots from which the steel conforming to I.S.S 2062 is procured be supplied for approval of the purchaser before the start of fabrication.

##### 2. Galvanising Fabricated Steel Structure :

Each lot of fabricated galvanised material before dispatch shall be tested for following tests galvanising as per ISS 2629.

##### a. Freedom from Defects :

The zinc coating shall be adherent, smooth, reasonably bright, continuous and free from such imperfections as flux, ash and dross inclusions, bare and black spots, lumpiness and runs, rust strains, bulky white deposits and blisters.

##### b. Uniformity in Thickness

Galvanized articles shall be tested for uniformity in thickness of coating in accordance with prece test given in IS: 2633-1966\*. For quick approximate measurements of thickness, magnetic gauges may be used, such instruments shall be suitably calibrated before use.

##### c. Mass of Coating

The mass of zinc coating may be determined in accordance with IS: 6745-1972.



d. Adhesion Tests :

- i) Pivoted Hammer Test for zinc coated Fabricated Products (Fabricated from Plates, Bars, Strip, etc.).

The adherence of the zinc coating on steel shall be determined by the pivoted hammer test. The hammer shall be made of normalized 0.3-0.4 percent carbon steel. The hammer blow shall be controlled by holding the pivoted base of the handle on a horizontal surface of the galvanised member and allowing the hammer head to swing freely through an arc from vertical position to strike the horizontal surface. The test shall consist of two or more standards blows forming parallel impressions with 6mm spacing and a common axis. No part of an impression shall be closer than 12mm to the edge of the member. Removal of lifting of the coating in the area between the impressions shall constitute failure. An extruded ridge less than 2mm wide immediately adjacent to the impression shall be disregarded. The specimen is tested in several places throughout its length.

- ii) Knife Test for Zinc Coated Hardware and Assembled Steel Products -

When the coating is cut or pried into, such as with a stout knife applied with considerable pressure in a manner tending to remove a portion of the coating, it shall only be possible to remove small particles of the coating and it shall not be possible to peel any portion of the coating so as to expose the under laying iron or steel.

3. Dimensional check and quality of fabrication:

Prototype of each type of assembled structure shall be offered for inspection for dimensional check as described in clause No.8.9.25.

4. Nuts, bolts and washers :

Certificate of test as per relevant ISS. from the manufacturer Quality Control Deptt. for the lots from which the material is procured is to be supplied for approval from the purchaser before the despatch of material.

**8.18 FOUNDATIONS :**

- 8.18.1 The tenderer will be required to furnish the volume of excavation, volume of R.C.C and volume of lean concrete for evaluation of cost of foundation with his tender.



- 8.18.2 The lean concrete shall be of 1 : 5 : 10 mix and 150 mm thick, and it shall extend 150mm beyond the foundation pedestal base. The volume of excavation shall be considered the area of lean concrete multiplied by the depth of foundation only.
- 8.18.3 The foundation pedestal shall be of R.C.C with concrete of 1:2:4 mix. The bidder has to give the guaranteed technical particulars of each type of foundation in cubic metre of excavation, cubic metre of 1:5:10, 1:2:4 mix concrete & reinforcement in weight for each type of structures for different cases.
- Prices shall be quoted for complete foundation of each type separately.
- 8.18.4 The tenderer shall furnish sample calculation of foundation for column type AT-1 with two beams with conductor tension of 4000 Kgf at each phase point, and for W.T structure along with the tender.
- 8.18.5 Tenderer will be required to furnish construction drawings for the foundations for various conditions. foundations shall be provided for structures.
- 8.18.6 The type of foundation to be used for each structure shall be subject to approval by the purchaser. The design of foundations shall be based on data given in Clause 8.19 and guaranteed technical particulars be given as illustrated in Annexure-IV.
- 8.18.7 Foundation design should be such that it is capable of taking full vertical loads moments and torsional moments with sufficient factor of safety and shall be got approved from the purchaser.
- 8.18.8 The successful tenderer shall furnish full particulars of the foundations for various type of structures. The tenderer shall also furnish detailed design calculations for foundations to prove that the design offered are safe. The loads which the foundations have to stand, shall also be worked out by the successful tenderer and clearly spelt out in his design.
- 8.18.9 The drawings for foundations for each type of structure should also include following information:
- a) Dimensions of excavation.
  - b) Volume of concrete and dimensions of concrete foundations.
- 8.18.10 The successful bidder has to give the foundations of different structures for different conditions.

### **8.19 SOIL DATA :**

8.19.1 Safe bearing capacity = To be designed at per site conditions.

Cohesion = 0.025 Kg/sq.cm.

Angle of internal friction = 33 °

The soil may contain boulders and at some location it may have rocks. Blasting shall not be permitted. The excavation has to done with pick axis and jumpers.

**8.19.2 OTHER PARAMETERS FOR DESIGN :**

Weight of dry earth	=	1440 kg/cu.mtr.
Weight of RCC	=	2400 Kg/cu.mtr.
Factor of Safety against uplift	=	1.5
Concrete mixture to be used for		
a) Pad	=	1:2:4
b) Pyramid or stepped part of foundation	=	1:2:4
c) Seismic data		Given under climatic condition in section 1.

**8.20 GRAVEL :**

Gravel of about 25mm size 80mm thick layer shall be spread on different terraces in pot head yard. The bidder has to quote for supply and laying of high resistivity gravel in different terraces in pot head area per square meter basis.

**8.21 CABLE TRENCHES :**

Cable trenches as per standard practice of brick masonry with 1:4 cement sand mortar is to be constructed. The scope of the construction include the installation of cable racks and top chequered plate cover. The scope include the cable trench ladder (lowering cables from one terrace to other) shall be considered as cable trench for measurement purpose. The bidder has to quote for all type of cable trenches, but it shall be the prerogative of the purchaser whether to get the work of cable trenches executed from the bidder or from other agency. It shall be the prerogative of the purchaser, to incorporate the cost of cable trenches in the evaluation of bid or not.

The bidder has to quote per metre length of the cable trench. The lengths shall be measured from centre line.

**8.22 IMPORTANT NOTES :**

1. The successful bidder shall submit the design calculations of columns beams and equipment structure taking into consideration the loading conditions of structures.
2. Structural drawing along with foundation design for columns.
3. Structural drawing of beams along with its connecting arrangement with columns
4. Structural drawing foundation design and mounting arrangement of equipment for all types of equipment structure.
5. Submission of bill of material.



6. Inspection of prototype assembly and checking of bill of material.
7. Inspection of galvanised material.
8. Further limitations of designs:
  - i) Design shall conform strictly to ISS-802 (latest addition), unless otherwise stated.
  - ii) Beam shall be designed by considering the following tensions separately at any time.
    - a) tension in phase conductor on one side only.
    - b) tension in phase conductor on both sides.
  - iii) Columns shall be designed by considering phase conductors for one side of beam only;
  - iv) Following dimensions of the structures shall not be changed at any cost.
    - a) Height of tower upto peak level;
    - b) Centre of beam from ground level;
    - c) Center to centre distance between towers;
    - d) Phase to phase distances;
    - e) Maximum base and maximum dimensions of columns at beam levels.
- 9) All the members shall be designed out of structural steel, angle section or plate having their sizes and properties as per relevant Indian Standard specifications. Members shall be connected together by mean of nuts and bolts only. Use of M.S rounds will be permissible only for making the U bolts for supporting the insulator string at the base and the foundation bolts for supporting the tower at ground level.
- 10) The structural design should conform to relevant Indian code of practice.
- 11) Bolts and nuts shall be arranged by the supplier. The tenderer shall submit the weight of steel members inclusive of foundation bolts and nuts separately.
- 12) Foundations bolts, plates and other accessories are part of structures. As such no separate rates shall be quoted by the tenderer for these items, weight of nuts and bolts shall be quoted separately.
- 13) The design calculations shall be strictly in accordance with ISS-802 latest edition unless other wise specified in this specification.
- 14) All the structures shall be so designed that only rationalized IS metric of Mild steel and of tested quality, currently being rolled in the country



as per ISS-2062 (Latest edition) are used in the structures.

- 15) Beams shall be so designed that the same are suitable for every combination of forces. Beams and column should be designed for proper mounting on each other.
- 16) Peaks shall be designed separately so that same can be fitted with the requisite tower when required. However, while designing the towers the corresponding loadings of peak may be taken into account.
- 17) Tension of feeder conductor means tension due to feeder conductor at each phase point. Tension due to feeder conductor can have deviation of  $0^{\circ}$  to  $30^{\circ}$  normal to the beam horizontally &  $0^{\circ}$  to  $15^{\circ}$  normal to beam in vertical direction.
- 18) a) Plan cross bracing be provided to each tower at the point where slope changes and where there is provision of fixing beams.  
b) beam at each phase point, cross sectional bracings to provide as shown in respective sketches.
- 19) At each phase point the beams shall have provision of fixing string insulator on three sides (two vertical face and one bottom face).
- 20) The beams should be attached to columns with arrangement of angle cleats. The number of bolts for fixing each member of beam at each end with column should not be less than three.
- 21) The beam should also be in position to take turning moment because of wind acting at the CG of equipment mounted on it.
- 22) The design of columns shall be made both with anchor bolt type and stub type of foundation and rates be quoted separately.
- 23) Anchor bolts and pack washer shall be considered as fabricated steel structure (not nuts and Bolts).
- 24) For design of beam, the live load of man with tool shall be assumed at each phase point.
- 25) For design of column and equipment structures, the live load of man with tool shall also be assumed.
- 26) Flange cuts of the lattices and bolts are to be avoided at such location, the two lattices be connected by separate bolts side by side.
- 27) Loads due to any attachment/equipment not given in this specification are to be suitably assumed.

### **8.23 QUALITY ASSURANCE : Refer Section 25**

### **8.24 MATERIAL**



All materials used in the manufacture of the 420kV Pot Head Yard equipment and its components/ accessories and structures shall conform strictly to standards as mentioned in these specifications and where these specifications have not been specifically mentioned, same shall be the best available for such use considering strength, durability and best engineering practice conforming to the latest applicable Indian standards or its approved equivalent standards to the satisfaction of the purchaser.

If the supplier desires for any reason to deviate from or to use materials, not covered by the above specifications, he shall state the exact nature of deviation and shall submit for the approval of the purchaser, complete alternative specifications for the materials that he proposes to use.

All materials and articles which are bought out items, be the products of recognised reputed manufacturer and shall meet all the requirements of these specifications. The name of the manufacturer(s) contractor(s) of such materials along with test certificates of such material(s) shall be furnished for perusal and approval by the purchaser.

#### **8.25 MANUFACTURE :**

All works under these specifications shall be performed and completed in a through workman-like manner conforming to the best engineering practice in the fabrication and manufacture of equipment. The work shall be of high grade and finish and shall be carefully performed to the satisfaction of the engineer-in-charge. The contractor shall guarantee all equipment, material and workmanship furnished by him to be of high standard/ quality and free from any defects.

#### **8.26 WELDING :**

Welding shall be done in accordance with ASME and the AWS code and Indian Standard Specifications IS: 2825 and other relevant IS codes. All surfaces to be welded shall be clean and free from scale, rust, paint, oils and other foreign materials. Welding shall be done by a process which will exclude the atmosphere from the molten metal. The type of joint to be welded, shall be duly indicated in the design computations and drawings to be approved by the purchaser.

#### **8.27 CLEANING & PAINTING**

Before shipment, the surfaces of all material to be painted shall be cleaned, filled, if necessary, and painted with suitable priming coat. Painting of all parts of the Pot Head Yard equipments and structures which will be inaccessible after installation shall be done by the contractor before shipment. Final painting of all other parts of Pot Head Yard equipments and structures shall be done by the contractor after installation. Necessary quantity of paint for this purpose shall be supplied by the contractor.

#### **8.28 INSPECTION:**

The Purchaser and his duly authorised representative(s) shall be inspecting all Pot Head Yard equipments and structures prior to its preparation for dispatch, to inspect its packing when ready for dispatch, to witness all shop



tests of furnished products and to witness any or all other tests whose results under the specifications, are required to be approved by the Engineer-Incharge and his duly authorised representative(s).

The purchaser's authorised representative/ Inspector shall, at all times, have reasonable access to those parts of the contractor or sub contractor's works concerned with the manufacture of the Pot Head Yard equipment and structures covered in these specifications for the purpose of witnessing tests, ascertaining that the material being supplied conforms to the requirement of these specifications. contractor shall furnish material specification certificates for the various components and he shall be in a position to co-relate these certificates with the actual material used for these components.

Supplier shall make available, without charges to the inspector all reasonable facilities, like provision of appropriate drawings etc. during his inspection visit to the contractor's or sub contractor's work.

## **8.29 TRANSPORTATION**

Before shipment or transportation, the contractor shall ensure that all works required to be completed in shop, been duly-attended to and all parts have been suitably match marked to facilitate assembly and proper installation in the field. Further, such transportation will be started only after obtaining approval of the Purchaser for undertaking despatch from the Supplier's works.

The Supplier shall include and provide suitable crating, packing or fastening for protecting Pot Head Yard equipment & structure or controls in transit so as to avoid damage to them or to the paint done in shops. contractor shall be fully responsible for all losses or damages caused by or occasioned by any defect in handling or transportation. All exposed, finished surfaces shall be adequately protected against abrasion, damage to their finish, size or shape during transportation shipment. All protruding pieces, long and slender parts shall be adequately supported and blocked.