

GUIDELINES FOR INSTALLATION OF EARTHMAT

LAYING OF EARTHMAT

1. Earthmat shall be laid for entire area as per earthmat drawing even though only one transformer is installed in the first phase.
2. While installing the earthmat, the Rows and Columns shall be interleaved like a woven mat to obtain better mechanical strength and electrical continuity.
3. MS Flat of the designed cross section shall be laid at the designed depth and spacing duly straightening and removing any bends.
4. As the standard lengths of flats available in the market are around 6mtr in length, for continuous running of earthmat, straight joints are required. When such straight joints are made, a minimum overlap equal to the width of the flat shall be maintained.
5. The overlap portion shall be welded on all four sides by continuous welding. To facilitate welding on all four sides, welding work shall be done on the natural ground surface and then laid in the trench.
6. A thick 2 coats of Anti-corrosive bituminous paint shall be applied at the welded joint duly removing the deposited weld, flux and any burrs.
7. After laying the flats in the trench and interleaving, all the perpendicular crossings of the flats shall be welded and applied a thick coats of ACB paint as above. ***The ACB paint shall be applied only to the welded portion.***
8. Projections of flat at the periphery of the earthmat should be avoided and the overlap shall be in flush with the edge of the peripheral flat of the earthmat. At these Joints the welding shall be continuous on all three sides.

Note: The efficiency of the earthing system is entirely dependent on the electrical continuity of the earthmat which in turn depends on proper welding work. Hence utmost care shall be in taken while welding, duly avoiding butt joints & mere spot welds.

9. The peripheral MS round rod of 25mm dia shall be driven into the ground at locations shown in the earthmat drawing. Before driving these rods, the top 50mm portion of the rod shall be flattened and bent & then welded properly to the MS Flat of earthmat firmly. The other end of the rod shall be sharpened for easy driving.
10. When hard soils such as fissured rock/grave/laterite etc. are encountered at the substation site during excavation for laying the earthmat and chemical treatment with sodium bentonite clay is not suggested in the design, soft soil or tank clay shall be used for back filling the trenches of earthmat conductors and improvement in metal/soil contact.
11. When the substation yard is terraced i.e., at different levels, it shall be ensured that the earthmat is continuous and interconnection of the earthmat is made firmly at different levels.

EARTH CONNECTIONS:

All earth connections from equipment/ cast iron pipe electrode to the earthmat shall be made using Galvanised Steel Flats of cross section equal to the MS Flat of earthmat. All earth connections are to be made only by welding. Suitable laps and bends shall be formed while making earth connections from equipment to the earthmat.

1. POWER TRANSFORMER NEUTRAL

Two distinct continuous earth conductors (Galvanised Steel Flats without any joints as far possible) shall be run in opposite directions from the power transformer neutral to the Cast iron pipe electrode provided for the purpose by welding. Further, these cast iron pipe electrodes shall be connected to the earthmat by the welding using Galvanised Steel flats

2. LIGHTNING ARRESTERS:

Each phase of the lightning arrester base plate shall be connected to the cast iron pipe electrode provided for that individual phase by running Galvanised Steel Flat from the base plate. The cast iron pipe in turn shall be connected to the earthmat by welding using Galvanised Steel Flat. A flexible braided earth bond connection shall be made firmly between the base terminal and the Galvanised Steel Flat. The Length of the earth connection shall be as minimum as practicable.

3. LIGHTING MAST

The earth conductor from the top of the Mast shall be run up to the earthmat & welded.

5. SWITCHGEAR

A minimum of two cast iron pipe electrodes are to be provided at both ends of the switch gear.

A separate earth bus of Galvanised Steel Flat shall be run along the switch gear on the power cable entry side & cable sheath earths shall be connected to this bus, which in turn should be connected to the earthmat through the cast iron pipe electrodes.

Further, the earth bus provided in the switch gear by manufacturer shall be connected to the earth bus run as above. The inter panel earth connections shall be made firmly at the time of erection of panels.

6. CONTROL ROOM

A minimum of two cast iron pipe electrodes are to be provided around the control room. The control panel earth bus shall be connected to earthmat through the CI Pipe electrodes provided as above.

The control panel body & earth points shall be connected to the control panel Earth bus.

7. NON CURRENT CARRYING METAL PARTS:

All non current carrying metal parts such as transformer body, Circuit breaker body, current transformer body, Outdoor structure & Isolator structure are to be directly connected to the earthmat using Galvanised Steel Flats with two distinct connections run in opposite directions. For the structure, a GS Flat shall be run from the mounting pedestal channell duly welding the 3 channels to the GS Flat running down to the earthmat. The PT body shall be connected to the earthmat through an independent electrode for each phase. The operating handles of isolators are to be connected to the earth conductors (Galvanised Steel Flat) using braided earth bonds.

8. POWER CABLES:

1. THREE CORE CABLES

The sheath of the cables is to be directly connected to the earthmat at their terminations and joints, i.e., at both switch gear and terminating pot heads.

2. SINGLE CORE CABLES

Sheaths of single core cable shall be earthed at only one end, preferably transformer end, by running a Galvanised Steel Flat from the pot head structure at the top to the earthmat and connecting the cable sheath to this Galvanised Steel Flat firmly. Wooden clamps are to be provided for single core cable in the supporting structure and metal calmps shall be avoided.

9. OUT GOING 11KV FEEDERS

1. WHEN THE FEEDERS ARE ERECTED WITHNIN THE SUBSTATION FENCE

The pothead cable sheath is to be earthed and connected to the earthmat through independent cast iron pipe electrode by running a 50 x 6mm galvanised Steel Flat From top of the structure up to the CI pipe electrodes. In turn these CI electrodes are to be connected to the earthmat. All these connections shall be made by welding. Further, the cross braces at the top of the structure provided fro line take off and GOS mounting frame shall also be connected to this GI flat by welding.

2. WHEN THE FEEDERS ARE ERECTED OUTSIDE THE SUBSTATION FENCE:

The cable sheath of the pothead shall be connected to CI pipe electrode of the feeder as mentioned in clause .

Further, an MS flat of minimum size 50 x6mm shall be run at a depth of 0.9mtr near the CI electrodes provided for the feeders and these electrodes shall be connected to the MS flat so buried by welding using Galvanised Steel Flats.

This feeder earth system shall not be connected to the station earthmat and should always be isolated from the station earth.

10. SUBSTATION FENCING:

1. Fence earthing shall be isolated From the main earthing Of the substation.
2. The substation fence and fence earthing shall be provided at distance of minimum 1.5mtr away from edge of the substation earth mat along the periphery.
3. A separate earthing conductor of minimum size 50x6mm MS Flat should be run along the perimeter of the fence at a depth, of 0.9mtr below the ground surface. The perimeter fence is to be connected to this MS Flat through independent vertical electrodes (CI Pipe Electrodes) using Galvanised Steel Flat of minimum size 50x 6mm. The connections are to be made by welding. When chain link/barbed wire fence is provided, two flats shall be welded on either side of the fence vertically abutting the fence and these flats are to be welded to the flat run below the ground through the CI pipe electrode. The Metal gate and the fence shall be firmly bonded.
4. The CI pipe electrodes shall be provided at corners and mid points of the fence if the perimeter is more than 200 mtr, other wise, CI pipe electrodes may be provided only at the corners or mid points.
5. The fence earth and station earthmat shall not have any electrical tie and should be physically separate.

CRUSHED ROCK SURFACE LAYER

25mm metal(Baby granite jelly) to a height of 100mm shall be provided over the area as mentioned in the Salient Design feature.

SEPARATION BETWEEN CAST IRON PIPE ELECTRODES:

3. The separation between any two CI pipe electrodes in the Sub-Station yard has to be maintained equal to twice the length of CI pipe electrodes. This very important due to the fact that close electrodes experience an increase in their earth resistance due to mutual interference.
It shall be ensured that the CI pipe electrodes are uncoated. Please refer enclosed sketch for general arrangement of CI pipe electrode.
4. The location of CI pipe electrodes shall be planned earlier keeping in view the following:
 - i. The CI pipe electrode for Lightning arrestor & power Transformer neutral shall be as near as practicable to the respective equipment.
 - ii. The distance between any two CI pipe electrodes should not be less than twice the length the CI pipe electrode.
 - iii. The lightning arrestor earth connection should not be run over the ground surface. They should be buried at the mat depth & connected to the earth mat at the nearest point.

POWER CABLES & CONTROL CABLES

The Power cables & control cables shall be laid in a separate concrete duct a clearance of minimum 0.6mts shall be maintained between any earthmat conductor & the power / control cables. Parallelism of power / control cables with earthing conductors should be avoided, especially so, at the entry point of control room.

LABELLING PIPE ELECTRODES

The individual pipe electrodes shall be labeled for proper identification this is a statutory requirement the labeled words shall be welded to the electrode to avoid misplacement.

1. The transformer plinth, control room & outdoor switchgear shall be surrounded by MS Flat of designed cross section at the designed depth & the earthmat conductor shall be terminated at the surrounding MS Flat by welding.
2. The earth mat shall be run below the concrete cable duct whenever the mat encounters the cable duct path.
3. When structures come in the way of earth mat conductor, one or two conductors may be slightly shifted. However the designed spacing must be maintained for other earthmat conductors.
4. Metal piping should not be used for water supply with in the substation yard
5. The station shall have a dedicated auxiliary transformer installed within the station yard with its neutral firmly connected to the station earthmat through an independent electrode for no reason the power supply from the station auxiliary transformer should be extended beyond the station yard.