



EARTHING & LIGHTNING PROTECTION SYSTEM

1.0 EARTHING SYSTEM

Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons.

2.0 DESIGN CRITERIA

2.1 Fault Current & Duration

For earth mat design, the size of earthing conductor shall be calculated considering maximum fault current of 50 kA for duration of 1 second.

2.2 Conductor Material

The earthing system conductors and accessories as proposed are to be as follows:

- (a) Conductors above ground level and in trenches : Galvanised steel
- (b) Conductors buried in ground or embedded in concrete : Mild Steel
- (c) Electrodes : GS Rod
GS pipe for treated pits
- (d) Lightning protection air termination and down conductors for buildings : GS Flat
- (e) Exposed lightning protection air termination : Lead coated copper chimney top

The CONTRACTOR shall undertake the soil resistivity measurements at site and select suitable type of conductors.

2.3 Size of Conductors

(i) Main Earthing Conductors

The earthing conductor sizes shall be calculated as per IS- 3043 and shall comply with IE rules and IEEE-80.

- (ii) The earth conductor dimension shall be calculated taking into account the corrosion effect of steel at a rate of 0.12mm/yr for a plant life of 30years

(iii) Rod Electrodes

Mild steel rod electrodes of suitable diameter and length shall be used as per the recommendation of IS-3043. For test pits electrodes shall be heavy duty type (Class – C) GI pipe of suitable diameter with perforations. Electrodes installed in the test pits will have disconnecting facilities.



**(iv) Equipment Earthing Leads**

The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS-3043 and also with a view to minimise the number of sizes.

(iv) Conductors for lightning protection system

The size of conductors for lightning protection system shall be decided based on mechanical strength.

3.0 EARTHING SYSTEM LAYOUT

3.1 The earthing system design and installation shall generally comply with the following standards.

- (a) IS-3043 : Code of practice for Safety Earthing
- (b) IEEE-80 : Guide for safety in Alternating current sub-station grounding
- (c) Indian Electricity Rules

3.2 General

3.2.1 Metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system. Two earthing leads shall be used if rated voltage of equipment is above 250V. If the rated voltage is 250V or below, one earth lead shall be provided. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead. Main earthing in switchyard, Transformer yard, TG and boiler area, switchgear rooms, buildings shall be in form of grids.

3.2.2 Earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm.

3.2.3 All cable trays in the plant buildings as well as inside the trenches shall be connected to earth grid at an interval of about 30m.

3.3 Earthing Conductor Layout in Switchyard

3.3.1 Main earthing conductors shall be laid in the form of a grid. Spacing between conductors, number of parallel conductors, etc., shall be decided such that step and touch potential are within safe limits.

3.3.2 The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80. The detailed design / engineering calculations be furnished.

3.3.3 Earthing conductors shall be provided around the outside edge of fence at a distance of approximately 2000 mm. This shall be connected to the switchyard earthing grid.



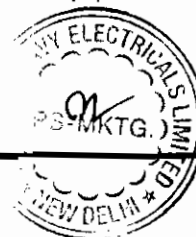
**EARTHING & LIGHTNING PROTECTION SYSTEM**

- 3.3.4 An earthing mat comprising closely spaced (about 150 mm) conductors shall be provided below the operating handles of disconnecting switches and breaker operating kiosk for the additional safety of the operating personnel.
- 3.3.5 Each earth leads of transformer neutral, lightning arrester earth leads, CVT's earth leads shall be directly connected to two separate treated earth pits. Lightning protection down conductor shall be directly connected to a separate earth electrode and inturn connected to earth grid.
- 3.3.6 The earthing conductors of switchyard equipments shall be directly connected to earth grid. Equipment supports (structures/Pipe supports) will not be used as earth continuity conductors. All earth electrodes in turn shall be connected to station earthing system. The earth grids of different areas of the plant shall be interconnected through, test pits to enable measurement of earth resistance for each area separately.
- 3.3.7 Earthing grid design shall be done in such a manner that the grid resistance is less than 0.5(zero point five) ohm.

3.4 Earthing Conductors Inside Building

- 3.4.1 Main earthing conductors shall be buried in earth around the building. Minimum two taps-off from this earthing loop shall be taken inside the building and connected to the earthing grid embedded in the floor slab with approximately 50 mm concrete cover. The earthing within the building shall be in form of grids.
- 3.4.2 In case, the building has more than one floor, each floor shall be provided with earth grid as discussed earlier. Floor earthing grids shall be interconnected.
- 3.4.3 Each RCC / Steel column of the building shall be interconnected to the floor earthing grid in the ground floor.
- 3.4.4 Cable trays, steel pipes / conduits, steel columns, etc., shall not be used as earth continuity conductors.
- 3.4.5 Instrumentation system and computer system shall be provided with a dedicated earthing system suitable for the equipment.
- 3.4.6 Earthing grids of all the buildings, outdoor yards shall be interconnected to form a single grid for the plant.
- 3.4.7 Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.

Above-ground earthing system comprises of risers drawn in continuation with the conductors protruding above the ground level from the buried earthing system, equipment earth continuity conductors and run-away conductors for cable tray earthing. For above-ground earthing, conductors of galvanised iron (GI) flats/GI wire are provided. All equipment are generally earthed at two points for reliability.





3.4.8 Earthing connections to equipment are bolted type while at the other end they are welded type. For system earthing, neutral points are grounded at two points through test-pit

For electronic system earthing, all cable screens are brought at one point (preferably at 24V DCDB) and connected to station earth through a separate dedicated riser.

4.0 EARTHING SYSTEM INSTALLATION

4.1 The spacing between two electrodes shall be at least equivalent to twice the length of the electrode.

4.2 Earthing conductor running exposed on column, walls, etc., shall be supported by suitable cleating, at intervals of 1000 mm

4.3 The earthing conductor crossing the road / track shall be laid in hume pipe or laid at a greater depth to avoid damage.

4.4 When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.

4.5 The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices.

4.6 Metallic conduits and pipes shall not be used as earth continuity conductor.

4.7 Street lightning poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.

4.8 Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles, etc..

4.9 Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound.

4.10 Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

4.11 The cable sheaths, screens armour shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only.

4.12 All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.

4.13 The contractor shall demonstrate the effectiveness of earthing system by measurement of earth resistance, step & touch potentials at different locations.

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5.0 LIGHTNING PROTECTION SYSTEM

Lightning protection system shall consist of vertical air termination rods, horizontal roof conductors, down comers, and pipe electrodes.

5.1 Need for Protection

The need for providing the lightning protection system shall be established by calculating risk index value for each building structure, etc., as per procedure given in IS-2309.

5.2 Lightning Protection System Layout

5.2.1 The lightning systems design and installation shall generally comply with IS:2309 code of practice for the protection of building and allied structure against lightning.

5.2.2 For switchyard, lightning protection masts shall be provided and the down comers from the masts shall be run along the tower connected to rod / electrode. Calculations for sizing and determining topography and number of lightning masts shall be furnished for approval by OWNER.

5.2.3 Each down conductor shall be connected to a rod electrode, which in turn shall be connected to the station earthing system through test links.

5.2.4 Lightning protection shall also be provided for Boiler and station building as well as other buildings as required by the relevant codes and subject to OWNER's approval.

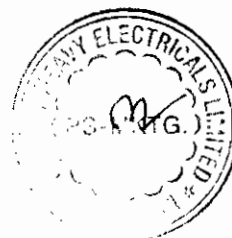
5.3 Lightning Protection System Installation

5.3.1 Conductors of lightning protection system shall not be connected with conductors of safety earthing system above ground level.

5.3.2 The down conductors shall be welded to steel structures at 1000 mm interval or cleated to wall at 1000mm interval. Wherever welded, the weld locations shall be treated to provide rust protection.

5.3.3 Each down conductor shall be provided with a test link at a height of about 1000 mm above ground level.

5.3.3 All the metallic structures within a vicinity of 2000 mm shall be connected to the lightning protection conductors. However, this requirement shall be complied with in line with relevant IS.



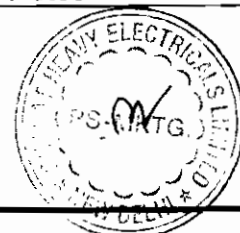


1.0 MINIMUM SIZE AND MATERIAL OF MAIN EARTHING CONDUCTORS

SLNO / SYSTEMS	SIZE IN Sq.mm	RECOMMENDED SIZE	
		Buried in earth	Above ground or embedded in concrete
1	MAIN EARTHING CONDUCTOR		
a. 400KV system		40mm dia	50x10 mm GS flat
b. MV system		32 mm dia	-Do-
c. LV system		32 mm dia	-Do-
2.	EARTH ELECTRODES		
a. Rod Electrodes	32 mm dia, 3000mm long		
b. Pipe Electrodes	40 mm dia, 3000mm long galvanised steel, class 'C' pipe		
3.	MATERIAL		
a. Above ground	Galvanised steel-Galvanizing as per IS 2629-1985		
b. Below ground & Embedded in concrete	Mild steel		

2.0 MINIMUM SIZES OF EQUIPMENT EARTHING LEADS:-

SL.No	Equipment/Structure	Earth Lead Size
1	Equipment of HV/MV/LV system	50 x 10 mm flat
2	LT switch gears and Motor Control Centres	50 x 10 mm flat
3	LT Motors	
	a. Fractional HP	8 SWG GI wire
	b. Up to 40 KW	25 x 3 mm flat
	c. 41 to 70 KW	25 x 6 mm flat
	d. 71 KW and above	50 x 10 mm flat
4.	Isolated phase bus duct and accessories	50 x 10 mm flat
5.	Generator and accessories	50 x 10 mm flat
6.	Transformer and accessories	50 x 10 mm flat
7.	Control Desks, Control/relay panels, LDBs, PDBs, Lighting Panels, Power receptacles, Lighting Masts, Lighting Poles	25 x 6 mm flat
8	LPB stations, Limit/Pressure switches, Starters, CT/PT terminal Boxes	08 SWG GI wires
9	Columns, Fence, Gates, Cable trays etc	25 x 6mm flat
10	LT bus ducts	50 x 10 flat
11	Switchyard structure	50 x 10mm flat
12.	MATERIALS	
	a. Above Ground	Galvanized steel-Galvanizing as per IS 2629-1985
	b. Below ground & Embedded in concrete	Mild Steel





RAICHUR POWER CORPORATION LIMITED

YERAMARUS TPS - 2x800 MW

EARTHING & LIGHTNING PROTECTION SYSTEM

SECTION: D2.16

VOLUME-IV

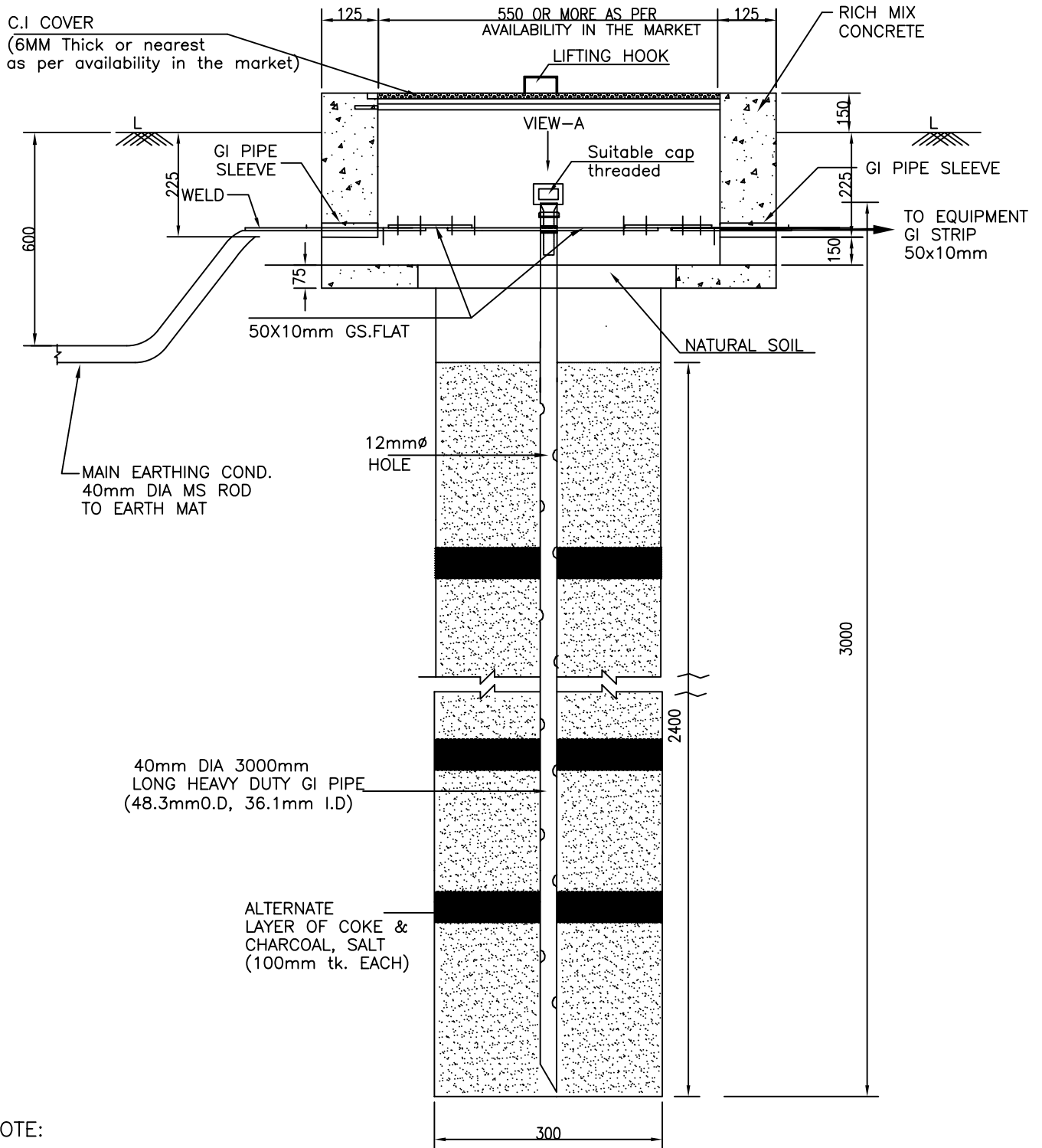
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3.0 MINIMUM SIZES AND MATERIALS OF LIGHTNING SYSTEM CONDUCTORS:

SL No.	Description	Sizes
1	Roof Conductors and down conductors building and boiler areas	25 x 6 mm GI flat
2	Horizontal Air termination for Chimney	25X6 lead coated copper conductor.
3	Vertical air termination for chimney	20mm dia copper rod coated with lead, approx. 2000mm long
4	Down Conductor for Chimney/Cooling Towers	25 x 6 mm galvanised steel conductor OR mild steel embedded in concrete

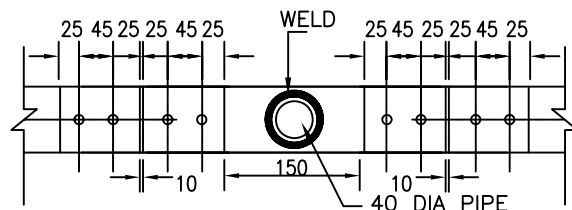
Galvanizing as per IS 2629-1985





NOTE:

1. ALL NUTS, BOLTS AND WASHERS, GI PIPE AND WIRE MESH SHALL BE GALVANISED AS PER SPECIFICATION.
2. PIPE SLEEVE ENDS SHALL BE SEALED AFTER COMPLETION OF WORKS.
3. FOR WELDING DETAIL REFER SHEET 26 & 27
4. TO BE USED FOR CONNECTING TRANSFORMER NEUTRAL, GRID INTERCONNECTIONS, CVT & LA.



VIEW-A



EQUIPMENT EARTHING DETAILS
 DETAILS OF PIPE ELECTRODE
 IN TREATED EARTH PIT

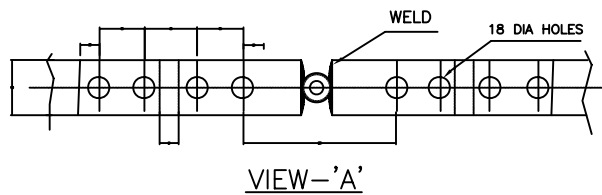
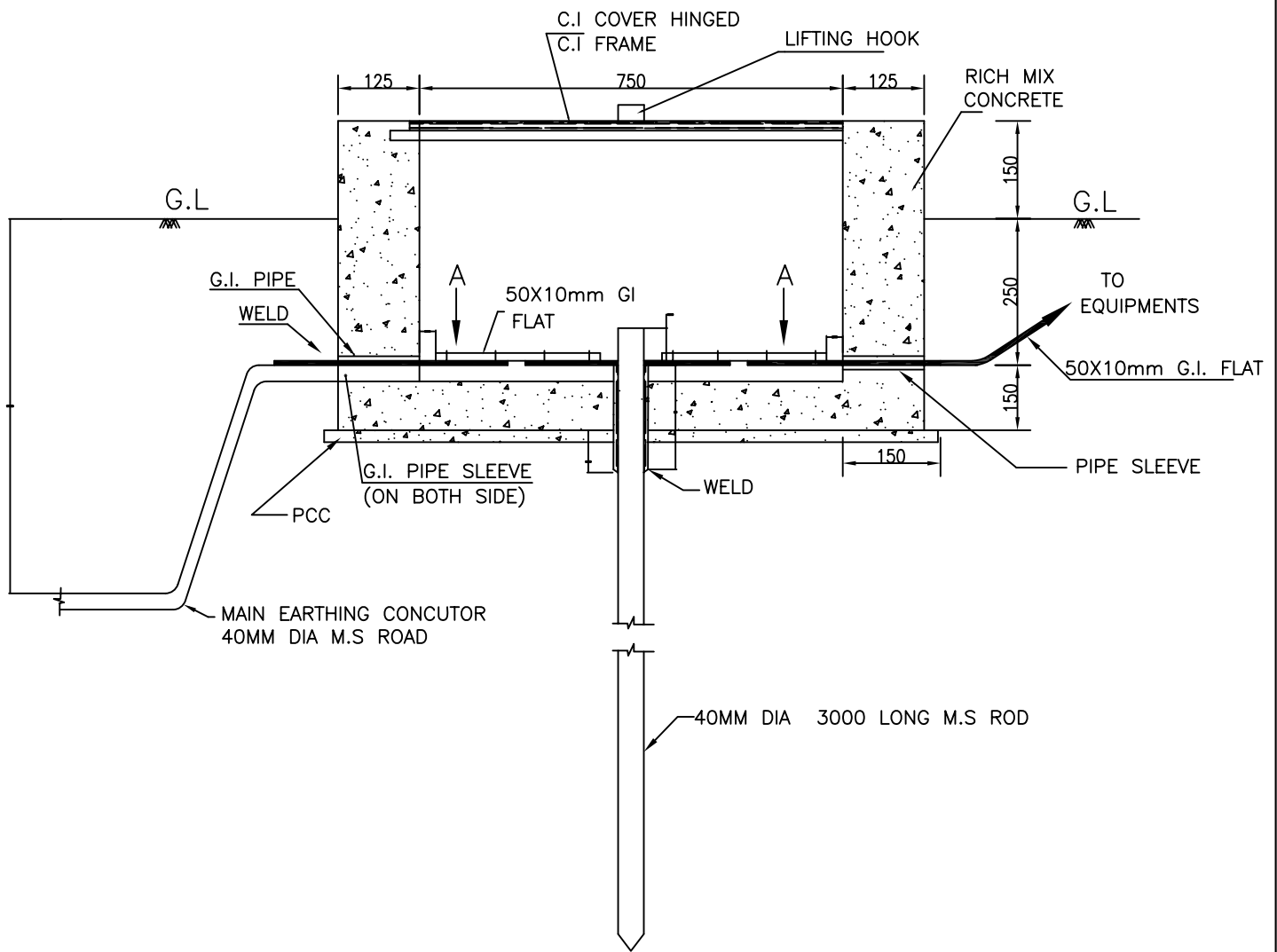
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15



NOTES:-

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. PIPE SLEEVE ENDS SHALL BE SEALED AFTER COMPLETION OF WORK.
3. TO BE USED FOR CONNECTING DOWN CONDUCTOR OF LIGHTNING PROTECTION SYSTEM.



EQUIPMENT EARTHING DETAILS

ROD ELECTRODE WITH TEST PIT

COMPU. DRG. REF.

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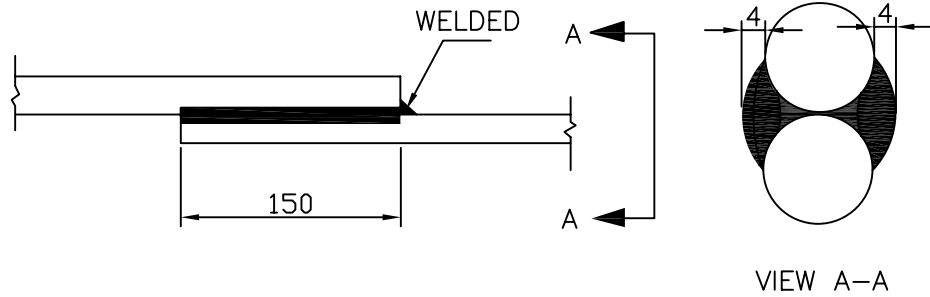
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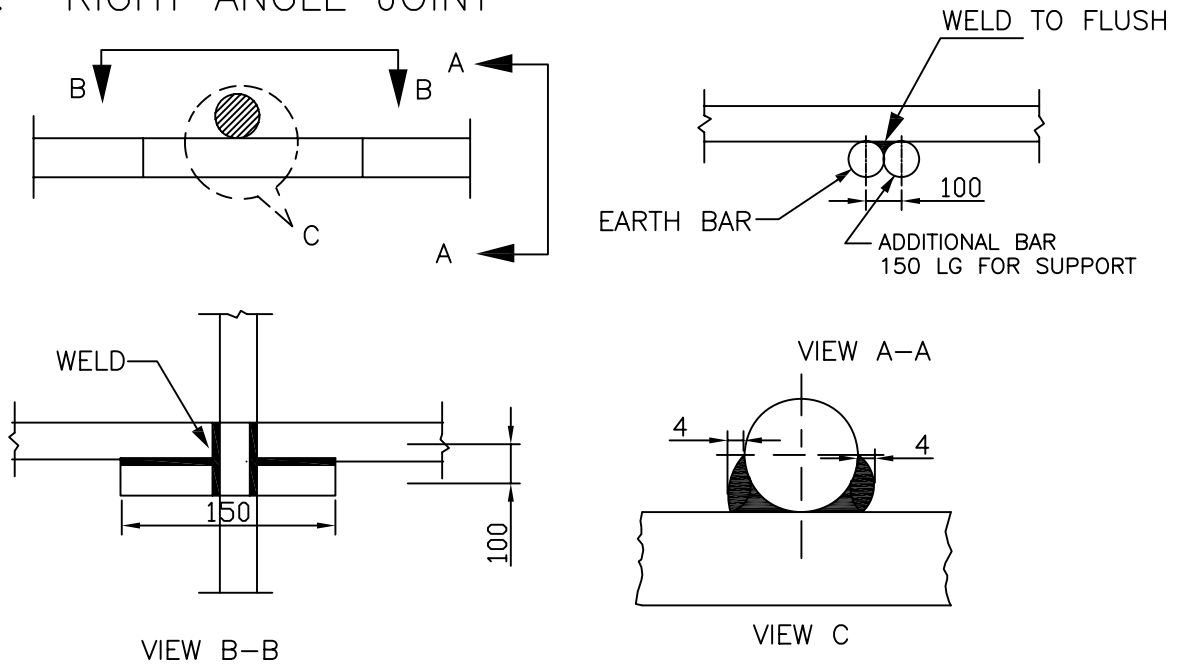
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ROD TO ROD

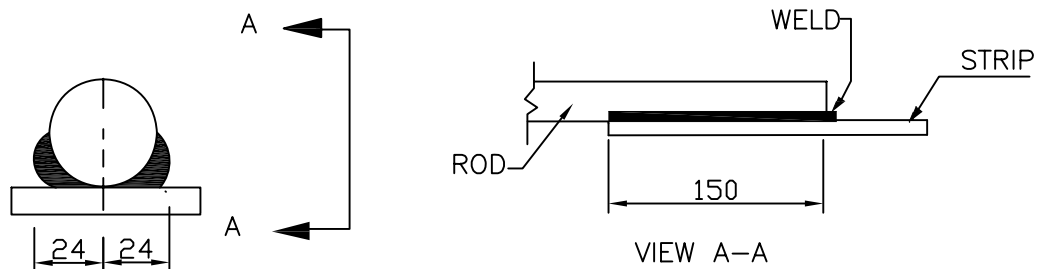
1. STRAIGHT LAP JOINT/RISER



2. RIGHT ANGLE JOINT



3. ROD TO STRIP



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TRANSMISSION PROJECT
DIVISION

ENGINEERING MANAGEMENT

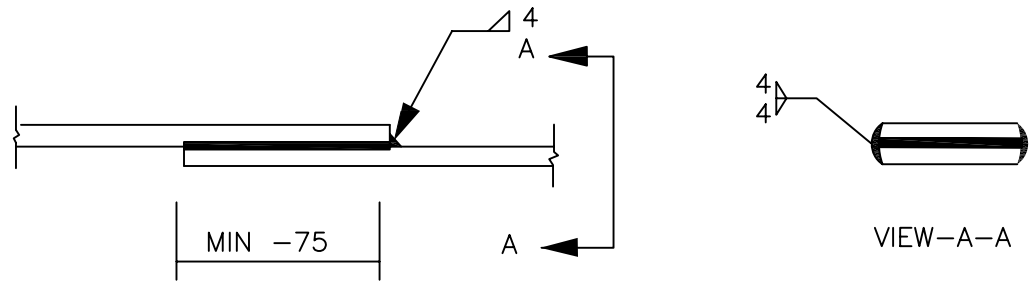
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PROCESS SPECIFICATION
WELDING DETAILS-2

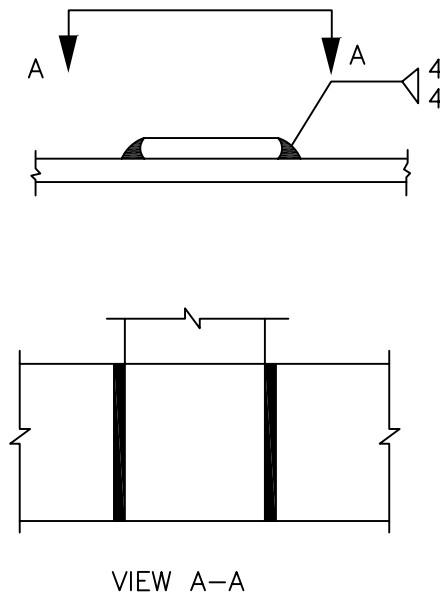
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C. STRIP TO STRIP (FOR 50x10/ 25x6 G.S. FLAT)

1. STRAIGHT LAP JOINT / RISER



2. CROSS LAP JOINT



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