

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW-226011

CODE FOR BONDING AND EARTHING

FOR

25 KV ac 50 Hz SINGLE PHASE TRACTION SYSTEM

CODE NO.ETI/OHE/71 (11/90)-REV 1

(FOR OFFICIAL USE ONLY)

ISSUED BY
TRACTION INSTALLATION DIRECTORATE
R.D.S.O., LUCKNOW- 226011

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PREFACE

The Code for Bonding and Earthing for 25 kV a.c. electrification work was originally drawn up on the basis of the recommendations of the French National Railways (SNCF), the Technical Consultants of the Indian Railways. Based on tests/trials in the field and the comments received from Railways, this CODE was simplified, redrafted and issued by the erstwhile Railway Electrification Organisation in August, 1965.

2. On the basis of comments received from the field, Earthing & Bonding Code ETI/OHE/71 was issued in November 1990.

3. As per Railway Board Directives, a separate Part-II on Earthing & Bonding of Bridges & Tunnels is included in this Code.

FINAL DRAFT

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**CODE FOR
BONDING AND EARTHING
FOR
25 KV, a.c. 50 Hz SINGLE PHASE TRACTION SYSTEM**

PART-I

1.0 Scope

This Code shall apply to 25 kV, a.c. 50 Hz single phase traction system and covers the requirements for bonding and earthing of overhead equipment masts, structures and associated rails of railway track. The bonding and earthing at traction substation including feeding posts, switching stations, booster transformer stations, 25kV/240V auxiliary transformer stations and switching station gantry as well as signaling and Telecommunication equipment are beyond the scope of the CODE.

2.0 Definitions

The following terms wherever appearing in this Code shall, unless excluded by or repugnant to the context, have the meaning attributed there to and apply as follows:

- 2.1** “Bond” means an electrical connection between two or more conductors or non-currents carrying metallic parts of traction masts or structures or supports and rails.
- 2.2** “Cross-bond” means a bond between two rails of a track or two rails of adjacent tracks. It is also called a transverse bond.
- 2.3** “Earth wire” means a conductor run on traction masts or structures or supports and bonded to their metallic parts/supports and connected to earth.
- 2.4** “Earth” means a connection to the general mass of earth by means of an earth electrode. An object is said to be earthed when it is electrically connected to an earth electrode, and the object is said to be solidly earthed when it is electrically connected to an earth electrode without intentional addition of resistance or impedance in the earth connection. The resistance of the earth electrode shall not exceed 10-ohms.
- 2.5** “Earth electrode” means a metal plate or pipe or any other conductor electrically connected to the general mass of the earth.
- 2.6** “Impedance-bond” is a bond, installed by the Signal and Telecommunication Department, which provides a low impedance path for the traction return current and a relatively high impedance path for track circuit current.

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- 2.7** “Rail-bond” mean an electrical connection across a rail joint between consecutive lengths of rails. It is also called a “Longitudinal bond”.
- 2.8** “Rail length” means a continuous length of rail with or without welded joints but with no fish plate joints.
- 2.9** “Structure- bond” means a bond connecting the non current carrying metallic parts of traction mast or structure or support to the traction rail.
- 2.10** “Signal bond” means an electrical connection across a rail joint, provided by the Signaling & Telecommunication Department, to facilitate flow of track circuit current.
- 2.11** “Short direct connection” means a connection for electrical continuity, which shall be of the shortest possible length with minimum bends.
- 2.12** “Traction rail” means a non-track-circuited rail of a wired track, not required for signaling purposes and which may be earthed. In non-track-circuited sections, both the rails of a wired track are traction rails and in single rail-track-circuited sections, the traction rail is the non track circuited rail.
- 2.13** “Welded bond” means a bond which is made of standard copper conductors with M.S. ferrules at either end, pressed on the conductors and bent to shape.
- 2.14** “Wired track” means a track provided with 25 kV, a.c. 50 Hz single phase overhead equipment.
- 3.0** **Bonding**
- 3.1** In the case of 25 kV, a.c. 50 Hz single phase traction system, the traction current is drawn from the overhead equipment by the electric rolling stock, operating in a section and passes through the traction rail. The return current flows mostly through the earth leaving the traction rail except in a zone extending over a few hundred metres on both sides of the electric rolling stock in operation in the section or in the vicinity of a feeding station and returns to the traction sub-station. Bonding of all rails is, therefore, not absolutely essential unlike in the case d.c. traction where practically the whole traction return current flows through the rail and hence bonding of rails is essential. However bonding of rail facilitates passage of the traction return current from rail to earth and vice versa and is, therefore, provided in the vicinity of traction sub-station/feeding posts where the traction return current has to flow back from the earth to the traction rails which are connected to the earthed leg of the traction transformer at the sub-station, through a buried rail opposite the feeling post. Bonding of rails also ensures the spread of flow of return current into the earth and, therefore, reduces the voltage between rail and earth. So bonding of rails is done wherever it is essential to keep the rail voltage low to ensure safety of personnel.

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3.2 The traction rail of a wired track when bonded or laid on metallic sleepers provides generally an earth better than an earthing station with earth electrode. If, therefore, any non-current carrying part of an equipment or metallic structure is required to be earthed, it shall ordinarily be connected to a traction rail.

3.3 Track Circuited Sections

3.3.1 In sections equipped with single rail-track-circuits, the traction rail shall be bonded to ensure that:

i)The a.c. voltage along its length is reduced so as to minimize the risk of a.c. voltage being applied to the track relay;

ii)As low a resistance path as possible is provided both for traction return as well as signaling currents as fish plate joints can not be relied upon for low resistance.

3.3.2 In sections with double rail-track-circuits, both rails are longitudinally bonded to ensure a low resistance path for traction return and signaling currents; and also to distribute the return current more evenly in both the rails. Impedance bonds are installed at insulated joints to provide a continuous path to the traction return current. All track-circuited-rails are, in addition, provided with signal bonds.

3.4 Structure Bond

All non-current carrying metallic parts of traction masts or structures or supports or metallic parts of concrete/wooden masts, supporting the traction overhead equipment shall be connected by means of the structure-bond to the nearest traction rail or to an earth wire run on the traction mast /structures/supports or to an earth. **In the case of a portal structure, both legs of the portal shall be provided with the structure bond**, whereas for head span masts, each mast of the head span shall be bonded to the traction rail nearest to it. **Alternatively flexible stranded steel structure bonds can also be used in theft prone areas.**

Where traction masts or structures or supports are located on railway platforms and are bonded to the nearest traction rail, a cross-bond shall be provided at the location of the structure-bond to connect the rail to the adjacent traction rail.

To avoid inconvenience to passengers at PF area & damage to PF floors for providing structure bonds, earth wire may be provided in station platform area with the approval of PCEE. Earth wire is to be connected to all the structures of the same track and when the earth wire exceeds 1000 metres, it shall be made electrically discontinuous by providing a cut-in-insulator so that no section of the earth wire is greater than 1000 metres electrically. Each such section of the earth wire shall be connected to an earth at two traction masts or structures or supports at a distance not exceeding 500m apart. Earth wire shall be provided for each track separately.

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3.5 Track Bonding

In station yards or elsewhere, where a track is not wired for its entire length, it shall be deemed to be wired for a distance of upto 50m beyond the traction mast at which the overhead equipment has been terminated. Rail-bonds and one cross-bond shall be provided for a distance of upto 50m beyond the last traction mast.

3.6 Mode of Connection of Bond

3.6.1 All types of bonds i.e. rail-bond, cross-bond and structure bond shall be of mild steel of not less than 200 sq.mm cross sectional area.

3.6.2 A structure-bond shall be rigidly connected by means of galvanized steel fasteners to the traction rail and the metallic part of traction mast or structure or support.

3.6.3 A rail-bond shall be rigidly connected by means of galvanized steel fasteners longitudinally across the fish-plate joint of the traction rail and the track-circuited-rail in a track circuited section except at the insulated joint of the track circuited rail.

3.6.4 A cross-bond shall be rigidly connected by means of galvanized steel fasteners between two traction rails of a track or non-track-circuited rails of an adjacent track.

3.6.5 Procedure for making holes in Rails for 'fixing Structure Bond' is given in Drawing No. ETI/OHE/P/7000(Mod-F).

3.6.6 The bond for connecting return conductor to the traction rail through the buried rail shall normally be made with Galvanised steel nuts and bolts with spring washer and check nuts.

3.6.7 The cross-section of an earth wire used for bonding traction masts or structures or supports or the metallic parts supporting the traction overhead equipment in a tunnel or in double rail-track-circuited section shall be not less than 50 sq.mm copper equivalent.

3.6.8 During maintenance of bonds, rail and bond contact surfaces should be cleaned and refitted with graphite grease. Greasing should be carried out with periodicity of six months.

3.7 Bonding in single Rail-Track-Circuited Sections

3.7.1 The traction rail in a single rail-track-circuited Sections shall be provided with rail-bonds not only over the entire length upto which the track circuited rail exists but also for a distance of 50m on both sides of the track circuited length. In addition, the traction rail shall be cross-bonded to the traction rails, if any, of adjacent tracks wherever they exist at intervals of not more than 100m. The traction rails of such adjacent tracks shall also be provided with rail-bonds over the entire length of the track circuits and for a further 50m on both sides. In case the length of a track-circuited rail is not more than 350m, a cross-bond shall be provided between the rails of the track immediately outside the track circuited length at both of its end.

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3.7.2 In single line section, whether or not doubling of the section is foreseen in the future, provided with single rail-track-circuit, the non-track-circuited rail shall be provided with rail-bonds over the entire length and for a further 50m on both sides. It shall also be connected to an earth at distances not exceeding 100m from each other. The connection of the non-track-circuited rail to each of the earths shall be made by two separate mild steel strips/flats each of cross-section not less than 200 mm². The need for providing an earth wire is thus obviated.

3.8 Bonding in Double Rail Track-Circuited Sections

In a double rail-track-circuited section, both the rails shall be provided with rail-bonds. At insulated joints of the double rail-track-circuit an impedance bond shall be provided. Since no traction rail is available for structure bonding, an earth wire shall be run on the traction mast or structure or support. In case, the length of the earth wire exceeds 1000m it shall be made electrically discontinuous by providing a cut-in-insulator so that no section of the earth wire is greater than 1000m electrically. Each such section of the earth wire shall be connected to an earth at two traction masts or structures or supports at a distance not exceeding 500m apart. No cross-bond shall be provided between the rails of the same track or between the rails of different tracks in a double rail-track-circuited section.

3.9 Bonding adjacent to Traction sub-station/Feeding Post

3.9.1 Commencing opposite to a traction sub-station/feeding post, all the traction rails shall be provided with rail-bonds for a distance of 1000m on either side of the traction sub-station/feeding post. In addition, these traction rail shall be cross-bonded at approximate distances of 300, 500, 700 and 1000m from the traction sub-station/feeding post on both sides of the traction-station/feeding post.

3.10 Bonding of Rails on Wooden/Concrete Sleepers

A wired track shall be deemed to be on wooden or concrete sleepers if there are not more than six metallic sleepers in any length of track not exceeding 350m. The traction rail of such a track shall be provided with cross-bonds at distances of not more than 350m apart. No rail-bonds shall be provided.

3.11 Bonding of Tracks in Loco Sheds and Loco/EMU Stabling Sidings

All traction rails of loco sheds and loco/EMU stabling siding shall be provide with cross-bonds at distances of not more than 100m apart. Further, all sidings and /or dead ends, whether wired or not, shall be connected by rail bonds. The rails on wooden or concrete sleepers/supports in loco/EMU inspection pits shall be provided with rail bonds for the entire length of the pit and also upto a length of 50m on both sides and connected to an earth.

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3.12 Bonding of Rails on a Weigh-Bridge

Both the rails of a wired track on weigh-bridge shall be provided with rail-bonds for a length of upto 50m on both sides of the weigh-bridge. If the rails are on wooden or concrete sleepers/supports, they shall be connected to an earth.

3.13 Bonding at a Level Crossing

All the traction rails shall be provided with cross-bonds at only one location which shall be within five meters from either of the transverse edges of the level crossing.

3.14 Bonding at Oil Depot Sidings

3.14.1 Unwired sidings leading to a oil depot or installation shall be provided with duplicate insulated block joints as near as possible to the turn-out from the main track from which they take-off and before entry into the oil depot or installation.

3.14.2 Where a siding or a secondary loop line is to be wired to serve the purpose of loading and unloading of petroleum products, the arrangements to be made and precautions to be taken are:

- i) A neutral zone shall be set up at either end of the length of the siding or secondary loop line over which the vehicles containing the petroleum products are to be earthed and loaded/unloaded. The neutral zone is created both in the track as well as in the traction overhead equipment (OHE) by provision of insulating joints and section insulators with isolators as done for locomotive inspection pits respectively. The neutral zone is to ensure that the rest of the railway network is kept isolated when the loading/unloading operations are in progress so as to avoid propagation of stray currents.
- ii) Both the rails of the siding or secondary loop line shall be provided with longitudinal-bonds. Besides transverse-bonds shall be provided between the rails at distances not exceeding 30m apart.
- iii) The rails of the siding or secondary loop line shall be connected to an earth at both ends immediately outside neutral zone.
- iv) An equi-potential link/switch shall be provided between the metallic portions of the petroleum installations i.e. the earth and the rails of the siding or the secondary loop line. This equi-potential link/switch is to be kept closed during the loading/unloading operations.
- v) Each and every non-current carrying part of a traction mast or structure or support and other metallic structures in the vicinity of the siding or secondary loop line shall be provided with structure-bonds. Only copper rivets shall be used for connection between the non-current carrying metallic part or rail and the bond.

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- vi) During the time the loading and unloading of a petroleum product is taking place, proper electrical continuity shall be maintained between the petroleum installations, the rails on which the vehicles containing the petroleum products are earthed and the OHE which has already been made dead and connected to the rails.

3.15 Bonding of Exposed Metallic Parts

All exposed metallic parts such as platform structures sheds, metallic fencing, wires, pipes and such other items, not likely to come into direct contact with the 25 kV a.c. overhead equipment and located within a distance of 20 m from the nearest electrified track and running parallel to it for a distance of more than 20 m but less than 350 m shall be connected to traction rail . If parallelism with the nearest electrified track exceeds 350 m, all such exposed metallic parts shall be connected to a separate earth **with two MS/GS flat** at distances not exceeding 350 m apart.

No special precaution is required in case such metallic parts are fitted on metallic supports direct buried in the ground if the natural earth resistance of such metallic support is less than 10 ohm.

3.16 Bonding of Earthing Heel of Isolator Switch

The earthing heel of an isolator switch shall be connected by two mild steel flats of cross-section not less than 200 sq.mm each to the supporting metallic traction mast or structure or support. The connection shall be as short and as direct as possible. Such a traction mast or structure or support shall, in turn, be connected to a traction rail or an earth wire and, in addition, to an earth.

3.17 Bonding of Over Line Structure

The metallic parts of foot or road over-bridges or other over-line structures over wired tracks shall be connected either to a traction rail or to an earth by means of two mild steel strips/flats of cross-section not less than 200 mm² each.

Touch and accessible voltages shall not exceed those stated in IEC-62128-1 -2013

4.0 Drawings:

The drawing issued by RDSO in connection with the practices prescribed in this CODE are listed below:

S.No.	Description	Drawing Number
i)	General arrangement of earth wire on mast	ETI/OHE/G/05201-1
ii)	Arrangement of transverse bonds.	ETI/OHE/G/05251 Rev A
iii)	Connection of RC to track	ETI/OHE/G/05306 Rev F

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- iv) Structure bonds. ETI/OHE/P/7000 Rev F
- v) Earthing station ETI/OHE/P/7020 Rev B
- vi) Longitudinal rail bond. TI/OHE/P/7030Rev F

5.0 Guidelines:

- i) Guidelines for provisions of OHE Mast for Electrification at New and Existing Bridge Pier/Abutment (RDSO Report No. BS-121)
- ii) Instruction no. TI/IN/0038 for making connections/welding/drilling holes on steel bridges structure

PART-II

Earthing & Bonding in Tunnels and Bridges

1.0 Bonding of Rails in a Tunnel in non track circuited section

In a tunnel all the traction rails shall be provided with rail-bonds not only over the entire length inside the tunnel but also for a length of upto 50m on both sides outside the tunnel. Besides, a cross-bond shall be provided between the traction rails at every 100 m inside the tunnel and at both ends of the tunnel.

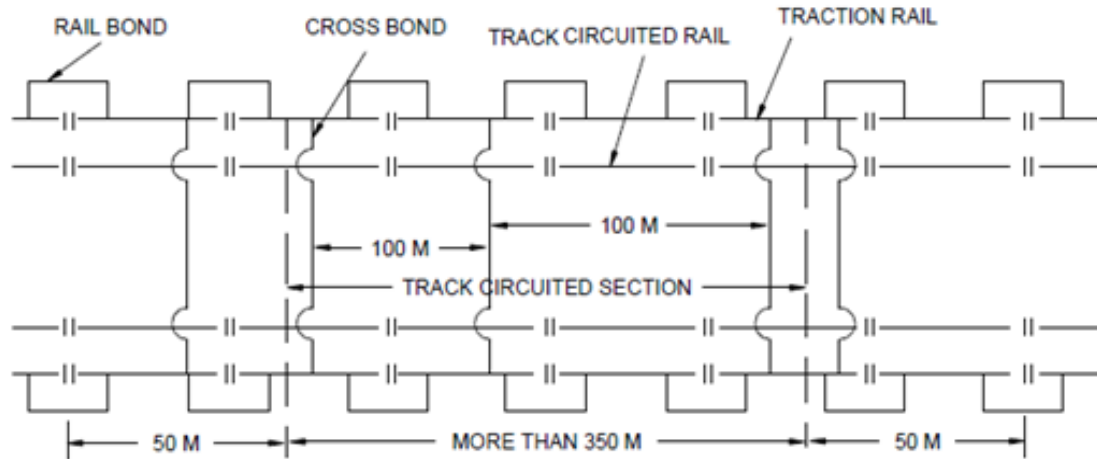
The cross-section of an earth wire used for bonding traction masts or structures or supports or the metallic parts supporting the traction overhead equipment in a tunnel or in double rail-track-circuited section shall be not less than 50 mm²copper equivalent.

If the tracks in a tunnel are track-circuited, the procedure in clause 1.1 & 1.2 shall be followed.

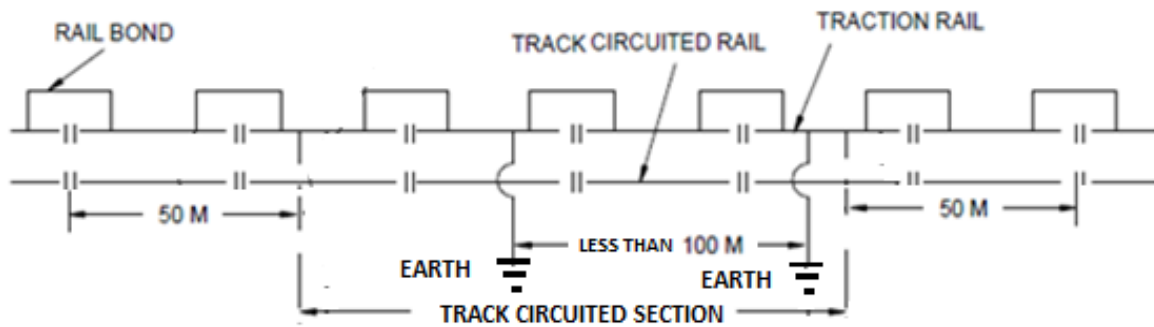
1.1 Bonding in single Rail-Track-Circuited Sections

- 1.1.1** The traction rail in single rail-track-circuited Sections shall be provided with rail-bonds not only over the entire length up to which the track circuited rail exists but also for a distance of 50m on both sides of the track circuited length. In addition, the traction rail shall be cross-bonded to the traction rails, if any, of adjacent tracks wherever they exist at intervals of not more than 100m. The traction rails of such adjacent tracks shall also be provided with rail-bonds over the entire length of the track circuits and for a further 50m on both sides. In case the length of a track-circuited rail is not more than 350m, a cross-bond shall be provide between the rails of the track immediately outside the track circuited length at both of its end.

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1.1.2 In single rail section, whether or not doubling of the section is foreseen in the future, provided with single rail-track-circuit, the non-track-circuited rail shall be provided with rail-bonds over the entire length and for a further 50m on both sides. It shall also be connected to an earth at distances not exceeding 100m from each other. The connection of the non-track-circuited rail to each of the earths shall be made by two separate mild steel strips/flats each of cross-section not less than 200 mm².

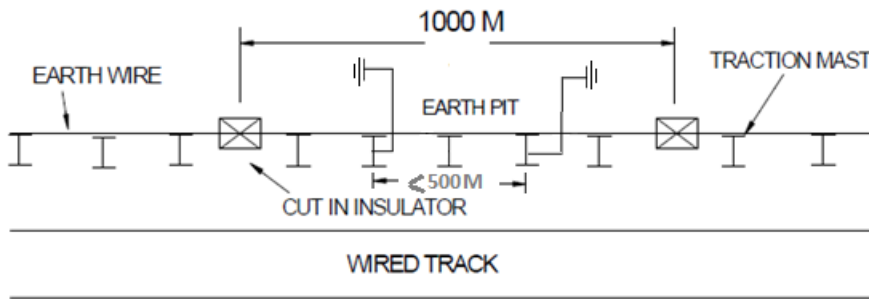


1.2 Bonding in Double Rail Track-Circuited Sections

In a double rail-track-circuited section, both the rails shall be provided with rail-bonds. At insulated joints of the double rail-track-circuit an impedance bond shall be provided. Since no traction rail is available for structure bonding, an earth wire shall be run on the traction mast or structure or support. In case, the length of the earth wire exceeds 1000m it shall be made electrically discontinuous by providing a cut-in-insulator so that no section of the earth wire is greater than 1000m electrically. Each such section of the earth wire shall be connected to an earth at two traction masts or structures or supports at a distance not exceeding 500m apart.

No cross-bond shall be provided between the rails of the same track or between the rails of different tracks in a double rail-track-circuited section.

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1. 3 Bonding and Earthing of Rail & Metallic Parts in a Tunnel

1.3.1 Earthing of Metallic Parts inside a Tunnel

For Bonding in Non track circuited section, Single & Double track circuited section, procedure given in para 1.0, 1.1 & 1.2 shall be followed. For each track, an earth wire connecting all non-current carrying metallic parts which form parts of the supports for the overhead equipment, shall be run inside the tunnel. The earth wire shall be connected to an earth as well as to the traction rails at both ends just outside the tunnel. In case, all the rails are track circuited, the earth wire shall be connected to an earth at both ends just outside the tunnel. If the length of the earth wire exceeds 1000 m, the stipulation in regard to making it electrically discontinuous may be examined if the earth wire is local and not a part of the return current circuit.

If the length of the earth wire exceeds 1000 m, it shall be made electrically discontinuous by providing a cut-in-insulator so that no section of the earth wire is greater than 1000m electrically. Each such section of the earth wire shall be connected to an earth at two traction masts or structures or supports at a distance not exceeding 500m apart.

- 1.3.2 In a tunnel, **in case of single rail track circuit** a cross bond shall be provided between the traction rails **at every 100 m** and at both ends of the tunnel and provided with a local earth. The traction rail shall be cross-bonded to the traction rails, if any, of adjacent tracks wherever they exist at intervals of not more than 100m. If the tracks in a tunnel are single track-circuited, the typical drawing is given in **Anexxure-I**.

2.0 Bonding of Girder Bridge

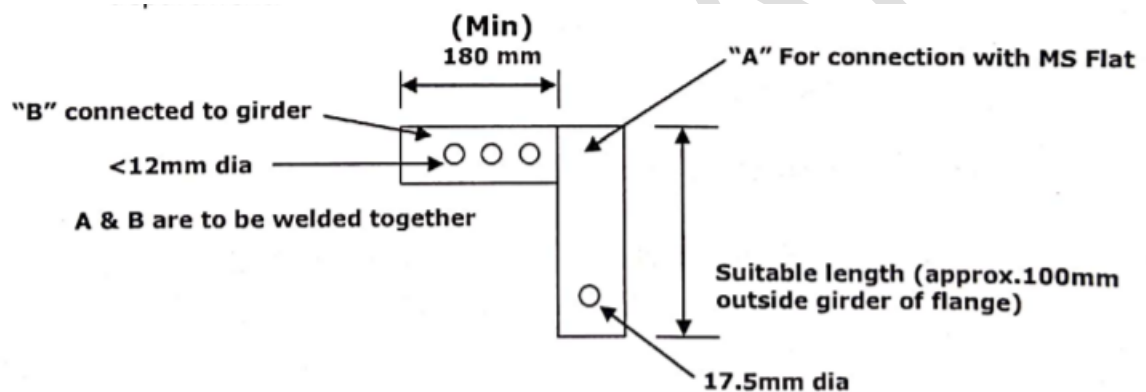
- 2.1 Steel structures of a girder bridge shall be connected to a traction rail or to an earth by means of two mild steel strips/flats of cross-section not less than 200mm² each. The traction rails (where there are two or more such rails) on the bridge shall be connected by cross-bonds at distances not exceeding 100 metres apart.
- 2.2 In a single rail-track-circuited section, the non-track-circuited rail which is the traction rail shall be provided with rail-bonds (refer clause 1.1 Part - II) and connected to an earth at both ends of the bridge. The connection of the non-track-circuited rail to each of the earths shall be made by

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two separate mild steel strips/flats each of cross-section not less than 200 mm². The steel structures of the girders should be interconnected with each other with 2 nos. MS/GS flats. Guard rails/check rails & running rails of traction rails shall be interconnected by MS/GS flats at every 100 m.

2.3 Following guidelines as per Instruction no. TI/IN/0038 for making connections/welding/drilling holes on steel bridges structure for earthing and bonding shall be followed.

- (i) **No holes by gas cutting** shall be made in steel parts of any type of bridges.
- (ii) **No holes by any means** shall be made in the web of the steel girder of any type of bridges.
- (iii) Following process can done over steel parts of the bridges with the permission of competent authority of engineering department by submitting proposal with sketch:
 - a. Circular Holes (not more than 12mm in diameter) by **drilling**.
 - b. **L-shape** steel Part shall be used for weld joint to the steel part of bridges. Welded part shall be painted as per the guidelines of engineering department.



- (iv) The attachment through welding or drilling of holes (hole diameter less than 12mm) shall be done in the End-portion of the bridge span beyond the support bearings i.e. the connection/attachment shall not be done within the **effective-span** of the bridge.
- (v) Provisions available in the Bridge drawing for Earthing & Bonding connections shall for welding/bolting.

3.0 Bonding of Rail & Structures on Bridges

3.1 Bridge mast/structures shall be connected to a traction rail or to an earth by means of two mild steel/GS strips/flats of cross-section not less than 200mm² each. The traction rails (where there are two or more such rails) on the bridge shall be connected by cross-bonds at distances not exceeding 100 metres apart.

3.2 In a single rail-track-circuited section, the non-track-circuited rail which is the traction rail shall be provided with rail-bonds (refer clause 1.1-Part II) and connected to an earth at both ends of the bridge. The connection of the non-track-circuited rail to each of the earths shall be made by two separate mild steel/GS strips/flats each of cross-section not less than 200 mm². Bonding of

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Rail & Mast/structure on Bridges on Single Track circuited section is shown in drawing at Annexure-II.

3.3 For Bonding in Double track circuited section, procedure given in para 1.2 (Part-II) shall be followed.

4.0 Bonding of Exposed Metallic Parts

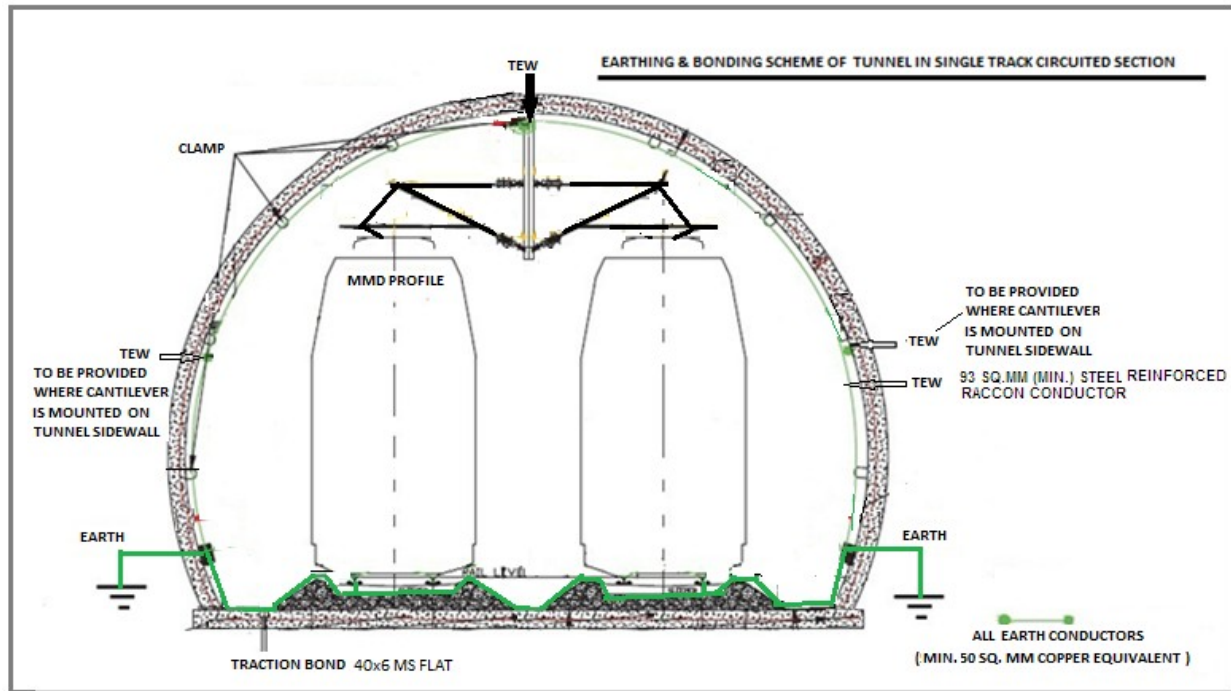
All exposed metallic parts such as platform structures sheds, metallic fencing, wires, pipes and such other items, not likely to come into direct contact with the 25 kV a.c. overhead equipment and located within a distance of 20 m from the nearest electrified track and running parallel to it for a distance of more than 20 m but less than 350 m shall be connected to traction rail **in single rail track circuited section** and to an earth by means of two MS/GS flats in double rail track circuited section. If parallelism with the nearest electrified track exceeds 350 m, all such exposed metallic parts shall be connected to a separate earth at distances not exceeding 350 m apart.

No special precaution is required in case such metallic parts are fitted on metallic supports direct buried in the ground if the earth resistance of such metallic support is less than 10 ohm.

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ANNEXURE-I

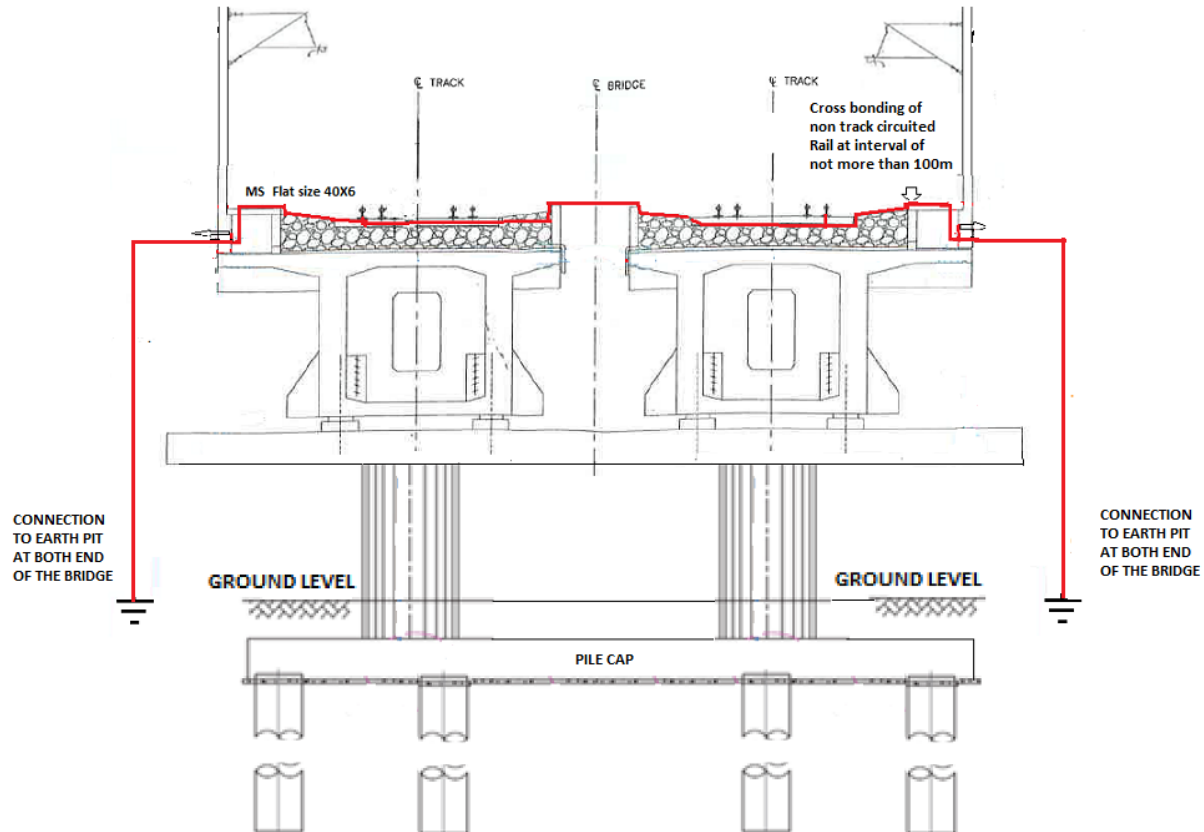


NOTE:

1. PROVISION OF CONNECTION OF TRACTION BOND FROM RAIL TO EARTH.
2. CROSSBONDING OF TRACTION RAILS AT INTERVALS OF NOT MORE THAN 100M.
3. PROVISION OF TUNNEL EARTH WIRE (TEW) CONNECTING AT EACH SUPPORT & CONNECTION OF TEW TO RAIL THROUGH MS/GS FLAT OF SIZE 40MM X 6MM.
4. PROVISION OF EARTH AT BOTH ENDS OF TUNNEL.
5. PROVISION OF TUNNEL EARTH WIRE ON BOTH SIDE OF TUNNEL ALONG THE TRACK IF CANTILEVER /SUPPORT IS PROVIDED ON SIDE WALLS OF TUNNEL.
6. THE SCHEME IS NOT APPLICABLE FOR TUNNELS WITH SYNTHETIC INSULATING SHEETS FOR WATERPROOFING.

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Annexure-II



Bonding of Rails & Structures in Single Track Circuited Section on Bridges

NOTE:

1. PROVISION OF CONNECTION OF TRACTION BOND FROM MAST TO RAIL.
2. CROSSBONDING OF TRACTION RAILS AT INTERVALS OF NOT MORE THAN 100M.
3. PROVISION OF EARTH AT BOTH END OF BRIDGE & PROVISION OF CONNECTION OF RAIL TO EARTH AT BOTH END OF THE BRIDGE.
4. BONDING OF CHECK RAIL AND GUIDE RAIL TO TRACTION RAIL THROUGH MS/GS FLAT

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Reference:

1. AC Traction Manual
2. ETI/OHE/71 Rev.0
3. CAMTECH Hand Book on Earthing& Bonding
4. IEC-62128-1 (2013) & EN 50122-1(2011)

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