

Earthing of Telecom Installations using Single Point Earthing

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Agenda

- *Reference Documents*
- *Earthing Issue & the Problems*
- *Earthing Principle as per standards*
- *Earthing Methods*
- *Recommendations & Suggestions*

Reference Documents

- *ITU-T K.27*
 - Bonding configurations and Earthing inside a Telecommunication Building.
- *T & D Circle Engineering Instructions*
 - 1001 dt 24.09.1998 and 30.04.2005
- *M/s Ericsson*
 - Guidelines on Earthing of Telecom Installations
- *M/s Lucent*
 - 5ESS Installations using Single Point Grounding.
- *M/s Nortel*
 - Grounding instructions for the GSM Mobile equipments.

- *Reference Documents*
- *Earthing Issue & the Problems*
- *Earthing Principle as per standards*
- *Earthing Methods*
- *Recommendations & Suggestions*

Earthing Issue ...

- *How many earths*
- *Lightning*
 - Failure of Power plants
 - Failure of BTS Equipment (WLL & GSM)
- *Exchange failure*
 - OCB & E10B are less
 - 5ESS & AXE are very high even if we follow same standards....
 - Do these designs bad??
- *Towers increased failures*
- *Interconnection*
 - Good or Bad??
 - More failures or less failures??
 - Interconnection of Tower Earth to Exchange Earth??
 - Connecting MDF to Equipment Earth??
- *Equip Potential Bonding??*

How many earths?

- *Civil*
- *Electrical*
- *Engine*
- *Air conditioning*
- *Lightning spike*
- *Tower*
- *MDF*
- *Equipment*
- *WLL*
- *IMPCS*
- *Etc....*

- Reference Documents
- Earthing Issue & the Problems
- Earthing Principle as per standards
- Earthing Methods
- Recommendations & Suggestions

Earthing Principle

External	Lightning	❖ Earthing Network
Building	safety	❖ Common Bonding Network
Internal	Grounding	❖ Bonding Network - Single Point Connection (SPC) Bar - Mesh Bonding Network - Isolated Bonding Network

Earthing Network

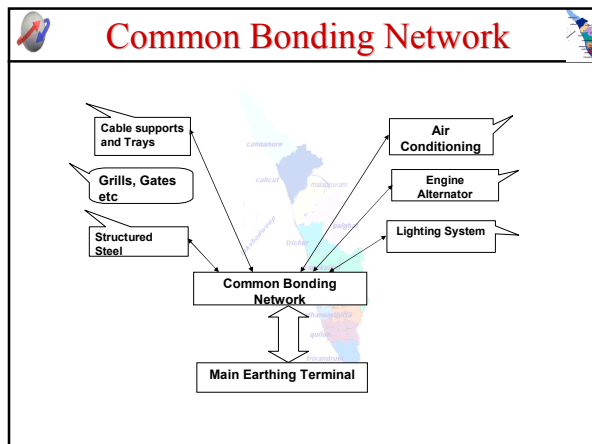
- Earth electrodes
- Its interconnections i.e. the Ring Earth
- Equi Potential Bonding Conductor
- Main Earthing Terminal

Earthing Network

Common Bonding Network

Common Bonding Network

- CBN is the interconnected network of
 - The structured steel or reinforcing rods
 - Metallic plumbing
 - Body of the water pipes entering the building
 - A/C power conduits
 - Cable supports, trays, racks, raceways etc.
 - Any other metallic parts used for the non electrical functions in the building
 - Air conditioning system Earthing terminal
 - Engine Alternator Earthing
 - Lighting System
- This forms a mesh topology
- The above elements of the CBN will have multiple connections to the Main Earthing Terminal.



Bonding Network

- A set of equipment racks say switching equipment of a vendor (System block) which are bonded together is called Bonding Network.
 - Say a CDOT exchange equipment and a SESS exchange installed on the same building form two bonding networks.
- The bonding networks types
 - Mesh Bonding Network
 - Isolated Bonding Network.
- The exchange can have some equipment following the Mesh BN architecture and some other equipment following the Isolated BN architecture.
- This purely depends on the technology adopted by the vendor

Single Point Connection (SPC) Terminal

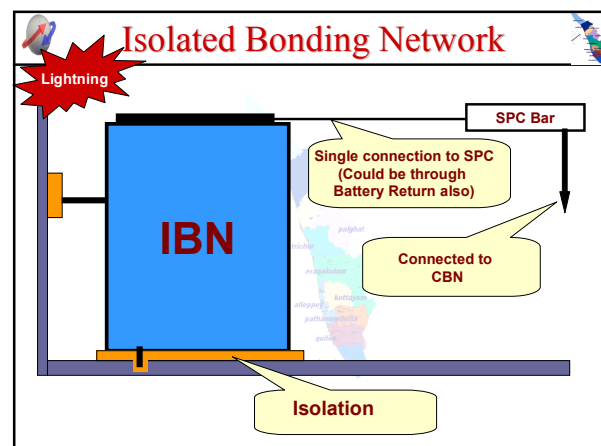
- SPC Terminal is the Bonding Network Point where various Bonding Networks are connected.
- The single point connection Terminal will be located in the power room or the MDF room.
- The SPC Terminal will have a single connection to the Isolated Bonding Network
- The DC power return and the Power Plant will be connected to the SPC Terminal.

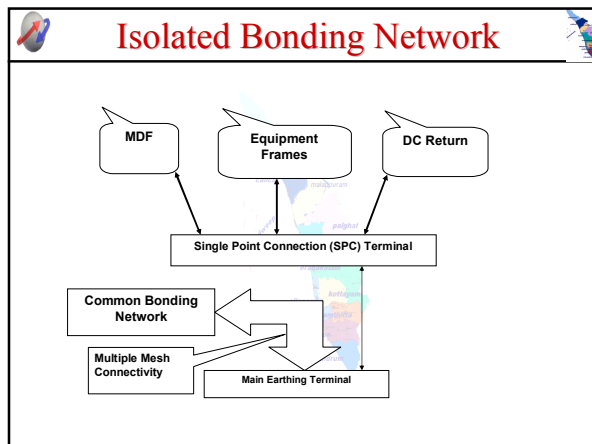
Mesh Bonding Network

- Here the Cabinets and Racks can have multiple connections to the Common Bonding Network i.e. Main Earthing Terminal.
- Equipment frames can be tightly coupled without any isolation to the Building infrastructure.
- The racks shall have unrestricted fastening to the floor and walls such that stray capacitance won't develop.

Isolated Bonding Network

- A bonding network having single point of connection to the Common Bonding Network is called the Isolated Bonding Network.
- A set of equipment racks (System Block) can form an Isolated Bonding Network.
- Each IBN will have a connection to the Earth via the SPC.
- The components of the IBN will be isolated from the Earth in all the places except at the single interconnection point.
- The antistatic flooring Earthing arrangement also shall follow the isolation.





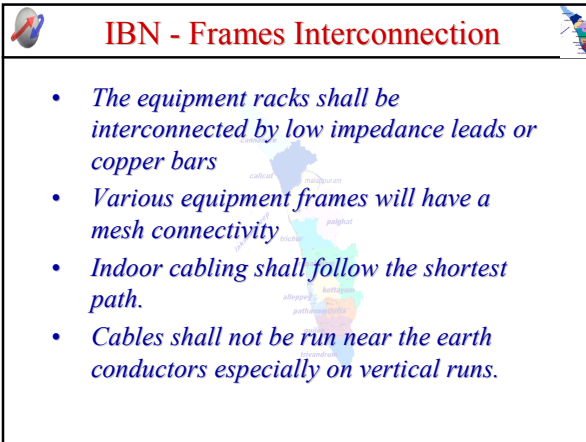
- ### Isolated Bonding Network
- The various cabinets whose frames are bonded together on a mesh shape form the IBN.
 - Single Point Connection bar
 - Earthing bar in which various isolated bonding networks will have a Single Point Connection to the Earthing Network
 - The IBN will have Single Point Connection to the Common Bonding Network at the SPC Bar.
 - In all other places it is isolated from the CBN.
 - If multiple systems are installed on the same building, then each system will form independent IBN's

- ### Isolated Bonding Network
- Components of two IBN's or an IBN and another Mesh BN shall not touch each other.
 - Equipments of AXE, 5ESS, Nortel, UTStarcom etc follow IBN architecture.
 - The IBN will have a Bonding Mat or Grid or Earth Plate supplied by the equipment supplier.

- ### IBN Separation
- The IBN parts shall be minimum 2 meters away from another IBN or Mesh BN or the SPC Terminal.
 - The 2 meter is kept for personnel safety.
 - The IBN equipments shall be separated from the Air Conditioning ducts, Cable Racks, conduit, ceiling supports, other IBN equipments etc.
 - If the 2 meter separation is not feasible, insulating screens are to be provided to prevent people touching the equipments belonging to different IBN's or the IBN and the CBN simultaneously.

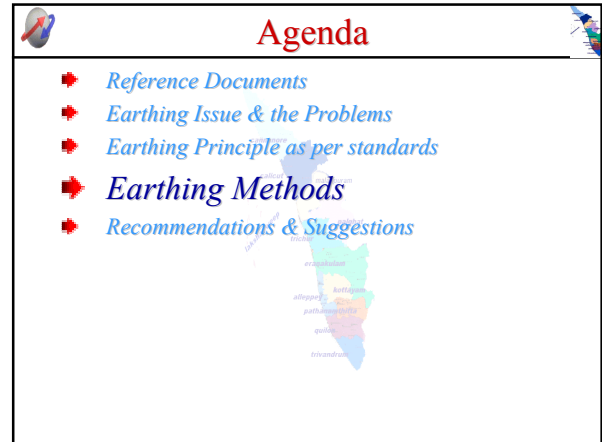
- ### Isolation
- Isolation is required to be maintained in case of IBN type installations.
 - The cabinets, the Earth Mat, the antistatic flooring etc forming part of the IBN are to be isolated from the building ceiling, walls and pillars.
 - The power and equipment cabinets are to be isolated.
 - While installing the various equipment Cabinets, Frames, Runways etc, care shall be taken to see that various installation materials supplied along with the equipment for insulation are used correctly.
 - Bakelite Panels, Insulating Bushes etc are used for isolation

- ### IBN - Bonding Mat
- The Bonding Mat will have connectivity to Equipment frames
 - It may be ensured that the Equipment Frames, MDF, Power Plant or DC Power return is no way directly connected to the Main Earthing Terminal.
 - It may also be ensured that the above equipment Frames shall not touch parts of the Common Bonding Network.
 - This ensures that the telecom equipments within the Single Point Connection Boundary are connected to the SPC Terminal and subsequently to the Earth through only one point.



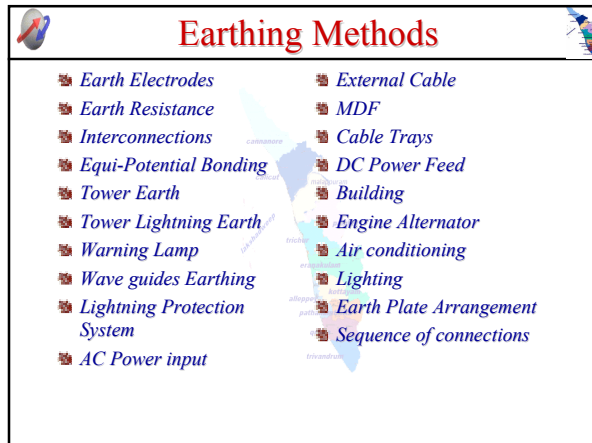
IBN - Frames Interconnection

- The equipment racks shall be interconnected by low impedance leads or copper bars
- Various equipment frames will have a mesh connectivity
- Indoor cabling shall follow the shortest path.
- Cables shall not be run near the earth conductors especially on vertical runs.



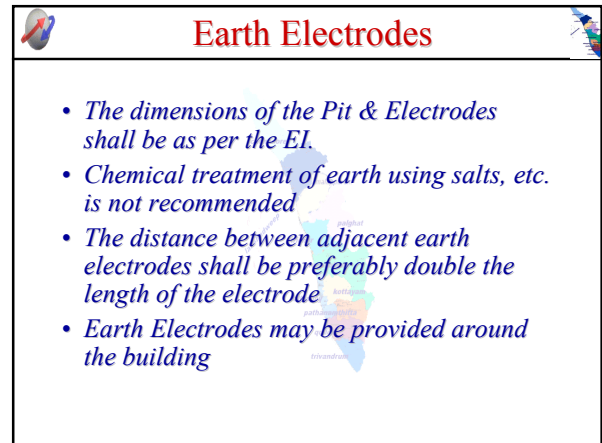
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- **Earthing Methods**
- Recommendations & Suggestions



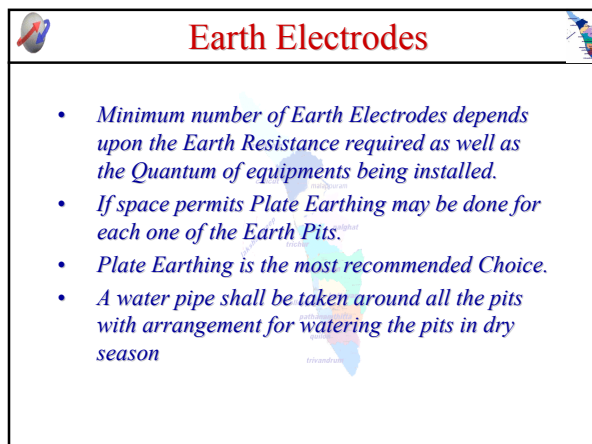
Earthing Methods

• Earth Electrodes	• External Cable
• Earth Resistance	• MDF
• Interconnections	• Cable Trays
• Equi-Potential Bonding	• DC Power Feed
• Tower Earth	• Building
• Tower Lightning Earth	• Engine Alternator
• Warning Lamp	• Air conditioning
• Wave guides Earthing	• Lighting
• Lightning Protection System	• Earth Plate Arrangement
• AC Power input	• Sequence of connections



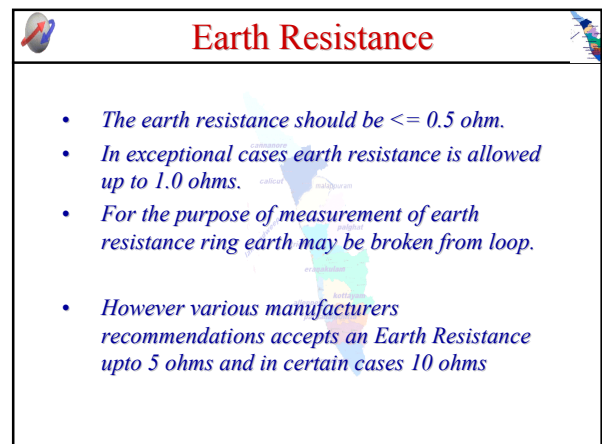
Earth Electrodes

- The dimensions of the Pit & Electrodes shall be as per the EI.
- Chemical treatment of earth using salts, etc. is not recommended
- The distance between adjacent earth electrodes shall be preferably double the length of the electrode
- Earth Electrodes may be provided around the building



Earth Electrodes

- Minimum number of Earth Electrodes depends upon the Earth Resistance required as well as the Quantum of equipments being installed.
- If space permits Plate Earthing may be done for each one of the Earth Pits.
- Plate Earthing is the most recommended Choice.
- A water pipe shall be taken around all the pits with arrangement for watering the pits in dry season



Earth Resistance

- The earth resistance should be ≤ 0.5 ohm.
- In exceptional cases earth resistance is allowed up to 1.0 ohms.
- For the purpose of measurement of earth resistance ring earth may be broken from loop.
- However various manufacturers recommendations accepts an Earth Resistance upto 5 ohms and in certain cases 10 ohms

Interconnections

- *Usage of Short and thick wires*
- *No sharp bends or twists in the interconnections.*
- *Sharp bends or twists can cause high inductance effect.*
- *Bending should be done with minimum one metre radius.*
- *Earthing conductors should not pass through any metallic conduit or pipe as this will increase surge impedance.*
- *Earth conductor should not be encircled with metal clamps while taking it along the wall. This is essential to eliminate the high inductive reactance.*

Interconnections

- *GI strip to GI strip connection*
 - GI nuts and bolts with lead strip 1 to 3 mm thick in between.
- *GI strip to Copper strip connection*
 - Brass lug and nuts & bolts covered to make it moisture proof.
- *Copper to copper connection*
 - Insulation tape & should be water tight strip
 - Lugs outside the building.
- *Connections 19mm x 6 mm copper strip is used inside the building.*
- *Indoor terminations shall use Crimping*
- *Outdoor terminations shall use welding.*

Buildings with Space Limitations

- *Plate Earth is mandatory if space is not available for Ring Earth*
- *Layout & connections shall be as per EI*
- *GBT - Ring earth around the Tower is mandatory.*
- *RTT - Separate plate earth can be adopted which is interconnected to Exchange Earth at the Plate Earth Pit*

Ring Earth and Equi-Potential Bonding

FIGURE-1 (NOT TO SCALE)

Ring Earth and Equi-Potential Bonding

- *Equi Potential Bonding will keep the electrodes at substantial equal potential.*
- *Copper strip of diameter 19mm x 6 mm is most preferred for the high lightning affected areas for the Equi Potential Bonding.*
- *Ring Earthing system shall be connected to the Main Earthing Terminal through an isolation spark plug*

Main Earthing Terminal

- *Location*
 - External wall of the building or
 - On one of the Earth Electrodes near the external cable entrance
 - Close to the a/c power cable and telecommunication cable entrance facilities.
 - I.e. the a/c power cable entrance shall be through the cable duct itself.
- *Connected to the earth electrodes via the shortest path.*
- *The connecting rods shall be taken through straight paths and there shall not be any twisting.*
- *This shall be protected from corrosion by way of proper casing or vulcanized rubber insulation.*



Main Earthing Terminal

- *A copper or GI strip of 50 x 3 mm and sufficient length for welding various interconnections shall be used*
- *The following are connected to the Main Earthing Terminal*
 - Lightning Protection System
 - A/C Power distribution Protection Earthing i.e. the Cable shield of the A/C power cable
 - Sheath of the External cables
 - Tower Earth
 - The Common Bonding Network
 - Single Point Connection Bar
- *All the lightning inductions outside the building should be grounded before entering the building.*




Tower Earth – GBT

- *GBT shall have Separate Ring Earth around the Tower with set of Earth Pits.*
- *Each leg of the tower should be separately connected by 50x3mm. G.I. strips above the ground level of each leg and other end is connected to the ring earth.*
- *The connection of G.I. Strip to the tower leg is done by tower bolts & nuts with lead sheaths in between.*
- *There should be no sharp bends in the down lead.*
- *The Tower Ring Earth will be connected to Exchange Ring Earth through the Equi Potential Bar*




Tower Earth – RTT

- *Certain Earth Pits near the Point where the Earth strip is brought down may be earmarked for the Tower.*
- *This however will be part of the Exchange Ring Earth*
- *GI strip down leads should be brought down along outside of the building.*
- *Plate Earth*
 - Buildings with Space Limitations
 - GI strip down leads should be connected to plate earth.
 - There shall be a separate Plate Earth for the Tower.
 - The different Plate earths shall be interconnected for Equipotential bonding.
- *The Tower Earthing wires in no case shall be taken inside the building*




Tower Lightning Earth

- *There is no need to separately run the copper strip from lightning spike to ring earth.*
- *The lightning spike should be properly connected with tower itself which works as down conductor.*
- *However, in order to ensure good conductivity, it is specified that no structural member should be painted over before assembly.*
- *In case of separate lightning Earth strip, it shall be connected to the Tower Ring Earth*




Tower Lightning Spike – Zone of Protection

- *Zone of protection is 45 degree angle, with a base radius equal to the height of lightning spike*
- *The object near to the base of a tall conductor are less likely to be struck by lightning.*
- *In extreme cases, in order to bring the antenna structure under protection zone the height of the lightning spike is to be raised by 4 to 5 metres by putting an additional GI pipe of 10 cm diameter.*




Warning Lamp Earthing

- *The sheath of the cable for warning light on tower, if armoured, should be separately connected to the tower at the top end, and to the ring earth at the bottom end by GI strips.*
- *The power supply taken for the aviation lamps shall be taken through 1:1 isolation transformers.*
- *Lightning arresters are also to be provided in both the limbs of the cable for tower warning lamp.*
- *The other limb of the arrester is to be connected to the ring earth*

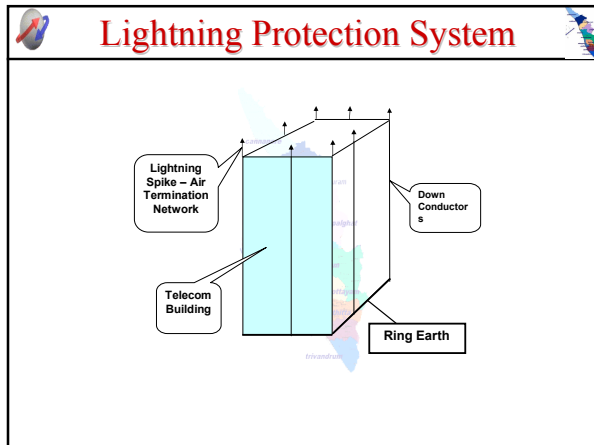


Wave Guide and Feeder Cable Earthing

- All wave guides should be individually earthed, at the top and at the bottom of the tower and at in-between intervals, by Earthing kits as recommended/specified by the manufacturer.
- All wave guide terminations are individually to be gripped by a copper strip clamp and through copper conductor is commuted at a GI strip (50X3mm.) which is run separately to the ring earth
- Suitable Earth Bars as recommended by the manufacturers may be used in these locations.
- Such Earth Bars may be connected to the Ring Earth.
- This shall not be taken inside the building

Lightning Protection System

- LPS consists of
 - Air Termination Network
 - This is basically a mesh conductor on the roofs and outside walls of the buildings.
 - A closer mesh is required in areas more prone to lightning
 - Down conductors
 - There should be several down conductors Equi-spaced around the structure to share the lightning current.
 - More number of down conductors with reduce the side flashes.
- The metal work within the structure shall be bonded to the LPS
- The Lightning Protection System will be connected to the Main Earthing Terminal.



AC Power Input Side Earthing

- The AC power feed follows the TN-S structure of the IEC
 - The neutral and the protective conductors shall be separate.
- The 3-phase network within the telecom building will have 5 wires i.e. L1, L2, L3, N and PE.
- PE stands for the Protective Earth for protection against electric shock by electrically connecting all exposed conductive parts, extraneous conductive parts and neutral i.e. the cable shield.
- The PE (Cable Shield) of the A/C power feed shall be connected to the Main Earthing Terminal.

AC Power Input Side Earthing

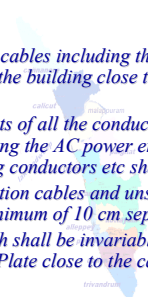
- The neutral of the Electricity Board Power Supply should be connected to separate electrical earth.
- The A/C Neutral Earth and the Transformer Earth should be minimum 20 m away from the ring earth.
- For HT supply 11KV lightning arresters shall be ensured for all the three phases

Protective Measures on AC Power Input

- Over voltage protection is required at the power entrance facility if the power lines are exposed to lightning.
- Class B & C protection shall be provided for the power line



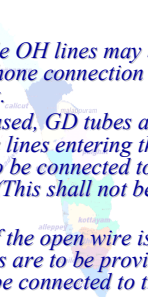
External Cable Entry and Earthing



- All the external cables including the power cables shall be taken inside the building close to the Main Earthing terminal.
- The egress points of all the conductors leaving the building including the AC power entrance, Telecom cables, Earthing conductors etc shall be close together.
- Telecommunication cables and unshielded power cables shall have a minimum of 10 cm separation.
- The cable sheath shall be invariably connected to the Main Earthing Plate close to the cable entrance point



Protection for OH Telephone Lines



- As far as possible OH lines may be avoided for providing Telephone connection inside the telecom building.
- If OH lines are used, GD tubes are to be used in both limbs of the lines entering the building and the GD tube is to be connected to the Main Earthing Plate. (This shall not be part of the MDF)
- If the distance of the open wire is more than 300 meters, GD tubes are to be provided in the Post also and are to be connected to the earth very close to the post.



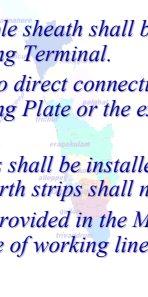
Pillar and Cable Earth



- Earth continuity with proper gauge wire shall be ensured for the cable joints.
- All the pillars shall be connected to earth.
- Cable sheath, Pillar Body and Tag Block frame in the Pillars shall be connected to earth



MDF Earthing



- The body of the MDF shall be connected to the SPC Bar
- The external cable sheath shall be connected to the Main Earthing Terminal.
- Hence there is no direct connection of MDF to the Main Earthing Plate or the external cable sheath.
- MDF Tag blocks shall be installed with earth strips and the earth strips shall not be deformed.
- IPM's shall be provided in the MDF for all the lines irrespective of working line or not.



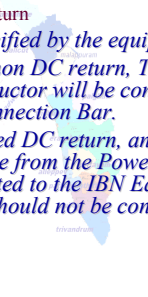
Cable Trays and Run ways



- The run ways forming part of different bonding networks shall be isolated.
 - E.g. if 5ESS and AXE are installed in the same building, both cable trays shall be isolated



DC power feed

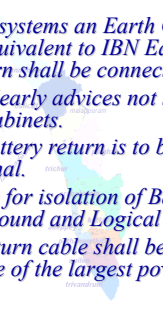


- The DC return
 - Isolated DC return
 - Common DC return
- This will be specified by the equipment supplier.
- In case of Common DC return, The DC power feed return conductor will be connected to the Single Point Connection Bar.
- In case of Isolated DC return, an isolated DC return shall come from the Power Plat itself and shall get connected to the IBN Earthing Mat. The DC return should not be connected to the cabinets



DC power feed

- AXE switching systems an Earth Collection Bar is provided (Equivalent to IBN Earthing Mat) where DC return shall be connected.
- M/s Ericsson clearly advises not to connect DC return to the Cabinets.
- Nortel - The Battery return is to be connected to the SPC Terminal.
- Nortel specifies for isolation of Battery Return from Frame Ground and Logical Ground.
- The Battery Return cable shall be more than or equal to the size of the largest power feeder cable



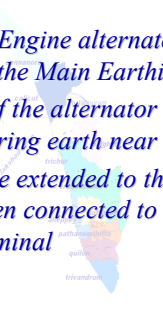

Structured Steel and Metallic Parts of Building and Surroundings

- Following are to be connected to the Main Earthing Terminal through GI strips.
 - External tube light fixtures
 - Steel window frames
 - Fencing wire
 - Gates
 - Any other metallic substances




Engine Alternator

- The frame of Engine alternator is to be connected to the Main Earthing Terminal.
- The neutral of the alternator should not be connected to ring earth near the engine.
- This should be extended to the power board and then connected to the Main Earthing Terminal



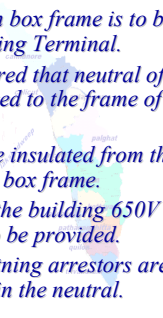

Air Conditioning System

- The Air Conditioning System Earthing Terminal is to be connected to the Main Earthing Terminal




Lighting System

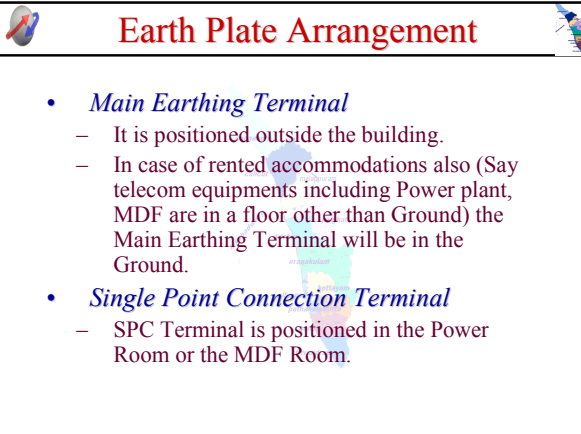
- The distribution box frame is to be connected to the Main Earthing Terminal.
- It shall be ensured that neutral of the switches are not connected to the frame of the power board.
- Neutral shall be insulated from the switch and the distribution box frame.
- For LT side in the building 650V lightning arrestors are to be provided.
- Additional lightning arrestors are also required to be provided in the neutral.




Earth Plate Arrangement

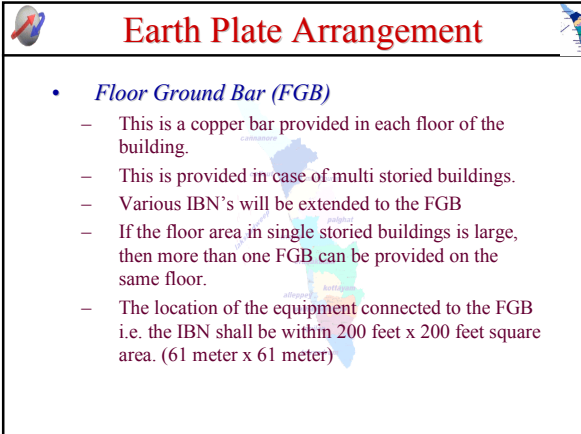
- Main Earthing Terminal
- Single Point Connection Terminal
- Floor Ground Bar (FGB)
- Vertical Ground Riser (VGR)





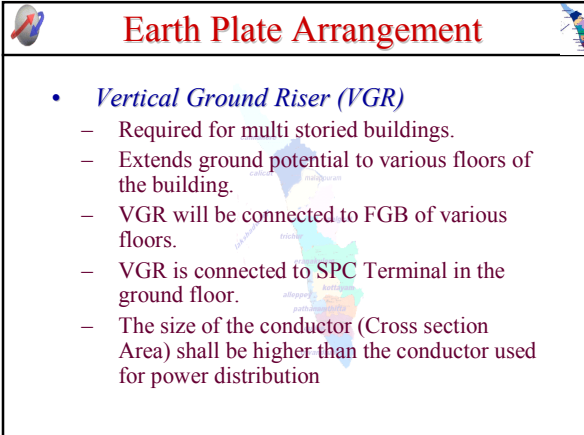
Earth Plate Arrangement

- **Main Earthing Terminal**
 - It is positioned outside the building.
 - In case of rented accommodations also (Say telecom equipments including Power plant, MDF are in a floor other than Ground) the Main Earthing Terminal will be in the Ground.
- **Single Point Connection Terminal**
 - SPC Terminal is positioned in the Power Room or the MDF Room.



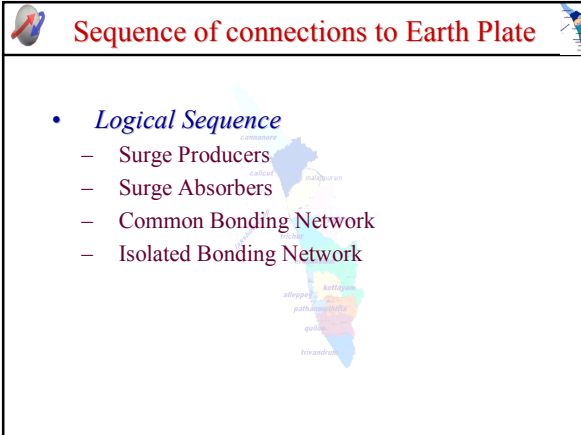
Earth Plate Arrangement

- **Floor Ground Bar (FGB)**
 - This is a copper bar provided in each floor of the building.
 - This is provided in case of multi storied buildings.
 - Various IBN's will be extended to the FGB
 - If the floor area in single storied buildings is large, then more than one FGB can be provided on the same floor.
 - The location of the equipment connected to the FGB i.e. the IBN shall be within 200 feet x 200 feet square area. (61 meter x 61 meter)



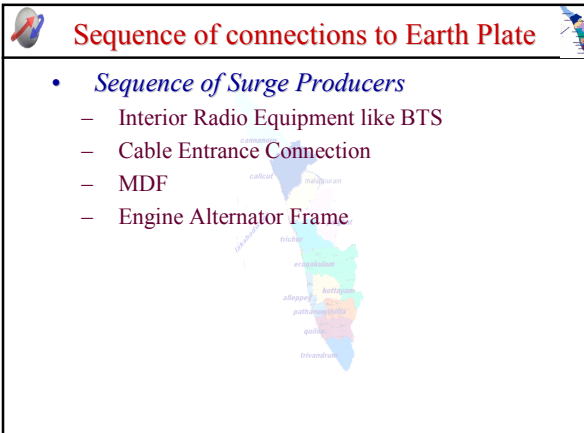
Earth Plate Arrangement

- **Vertical Ground Riser (VGR)**
 - Required for multi storied buildings.
 - Extends ground potential to various floors of the building.
 - VGR will be connected to FGB of various floors.
 - VGR is connected to SPC Terminal in the ground floor.
 - The size of the conductor (Cross section Area) shall be higher than the conductor used for power distribution



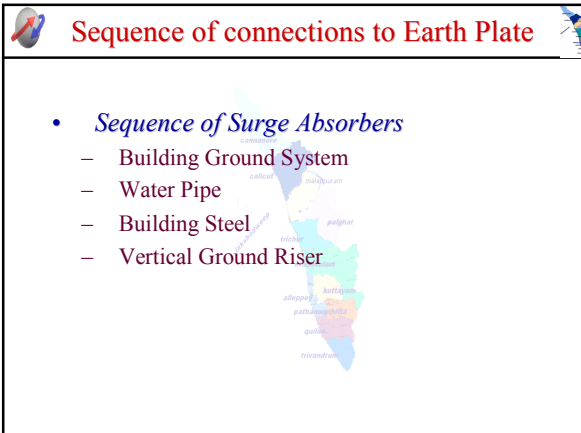
Sequence of connections to Earth Plate

- **Logical Sequence**
 - Surge Producers
 - Surge Absorbers
 - Common Bonding Network
 - Isolated Bonding Network



Sequence of connections to Earth Plate

- **Sequence of Surge Producers**
 - Interior Radio Equipment like BTS
 - Cable Entrance Connection
 - MDF
 - Engine Alternator Frame



Sequence of connections to Earth Plate

- **Sequence of Surge Absorbers**
 - Building Ground System
 - Water Pipe
 - Building Steel
 - Vertical Ground Riser



Sequence of connections to Earth Plate

- *Sequence of CBN*
 - CBN Power Plant Battery Return
 - CBN Frames
- *Sequence of Isolated BN*
 - IBN Power Plant Battery Return
 - IBN Bonding Mat
 - Logic Returns



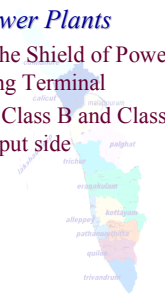

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- *Earthing Methods*
- *Recommendations & Suggestions*
 - Resolving the Problem
 - Earthing as an Equipment
 - Acceptance Testing
 - Recommendations



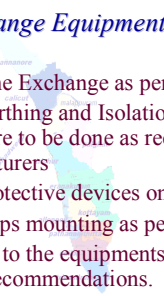

Problems Resolved !!

- *Failure of Power Plants*
 - Earthing of the Shield of Power Cable to the Main Earthing Terminal
 - Provision of Class B and Class C Protection at the Power input side



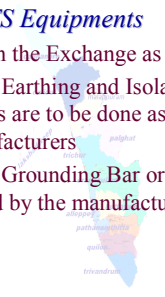

Problems Resolved !!

- *Failure of Exchange Equipment (5ESS and AXE-10)*
 - Ring Earth in the Exchange as per the EI
 - Single Point Earthing and Isolation arrangements are to be done as recommended by the manufacturers
 - Provision of protective devices on the MDF
 - MDF Earth Strips mounting as per standards
 - DC Power feed to the equipments as per manufactures recommendations.



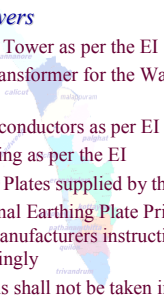

Problems Resolved !!

- *Failure of BTS Equipments*
 - Ring Earth in the Exchange as per the EI
 - Single Point Earthing and Isolation arrangements are to be done as recommended by the manufacturers
 - The Internal Grounding Bar or the Grounding Mat supplied by the manufacturer shall be used




Problems Resolved !!

- *Failure due to Towers*
 - Ring Earth for the Tower as per the EI
 - Use of Isolation transformer for the Warning Light Power feed as per EI.
 - Earthing of down conductors as per EI
 - Wave guide Earthing as per the EI
 - Usage of Earthing Plates supplied by the manufacturers.
 - External and Internal Earthing Plate Principle has to be adopted and the manufacturers instructions are to be interpreted accordingly
 - External inductions shall not be taken inside the building





Problems Resolved !!

- *Failure due to Tower and Exchange earth Interconnection*
 - Exchange and Tower shall have the Ring Earth as per the EI
 - The interconnection shall be as per the EI.
 - Equi Potential Bonding is a must.
 - Connections should be at the Earth Pit and not in the Earthing Plate
 - The Tower / Wave Guide Earthing should have been done as per standards.



Problems Resolved !!

- *Failure due to MDF and Exchange Earth Interconnection*
 - External cables sheath is connected to the Main Earthing Terminal
 - MDF is connected to the Single Point Connection Bar.
 - The equipments are connected to the Earth Mat and follow Single Point Earthing
 - Cable Runway is isolated
 - There is no direct connection between these.



Earthing as an equipment

- *The installation team shall consider earth installation as a separate activity*
- *Acceptance Testing shall be done first for the earth.*
- *The earth shall be handed over to the telecom building in-charge with the complete layout diagram*
- *All other installation activities shall start after this*



Equipment installation

- *LPS shall be installed if required.*
- *The Earthing network with earth electrodes, interconnections, Equi potential bonding, Main Earthing Terminal, Watering Arrangement etc shall be installed*
- *This shall take into consideration all the present and future requirements by various units including switching, transmission, WLL, IMPCS, Engine Alternator, A/C plant, Lighting etc.*



Equipment installation

- *Common Bonding Network shall be installed.*
- *SPC Terminal, FGB and VGR for interconnection of various telecom equipments shall also be provided.*
- *All other subsequent equipment installations shall use this earth equipment and shall be connected to its various points based on the standards.*



Acceptance Testing

- *Now A/T is limited to Earth Resistance*
- *Prepare a complete check list*
- *Verify*
 - Installation based on standards
 - Earth resistance



Earth Maintenance

- *This is very important.*
- *Whenever new equipment is connected it shall be ensured that it is as per the Earthing standards.*
- *Periodic Measurement of Earth Resistance*
- *Chart indicating the Earth values and date of measurement shall be displayed*
- *The earth pits shall be periodically watered to ensure proper earth values. Gardening the area and periodic watering of the plants is a suggested option*



Recommendations

- *Earthing Network*
 - Ring Earth / Plate Earth with Equi Potential Bonding as Recommended in the EI
- *External Components*
 - Earthing of the Tower as per the EI.
 - Earthing of the wave guides as per the EI and manufacturers instructions.
 - Earthing of External Cable Shields



Recommendations

- *Building Parts*
 - Bonding of the Building Structured Steel and other components of CBN
 - Lightning Protection System for all departmental buildings
 - Earth Plate Arrangements in the Building
 - Sequence of Connections as suggested here. (Nortel)
 - Protection for the AC Power input side
- *Installation and Testing*
 - Installation and A/T of the Earthing
 - Audit of the Existing Installations



Recommendations

- *Exchange Equipment*
 - Single Point Earthing Requirements for equipments as recommended by the manufacturers.
 - Isolation requirements as recommended by the manufacturers.
 - DC Power feed requirements as recommended by the manufacturers.




Thank You