NOTES Class 53

Earthing

Earthing or grounding is the process of transferring the immediate discharge of electricity directly to the earth plate, by means of low resistance electrical cables or wires. Earthing really is one of the most important aspects of electric networks, since it makes the most readily available and dangerous source of power much safer to use.

In case of a short circuit due to leakages arising from weak insulation or damage, the grounding wire safely removes excess electricity and passes it on to the ground

Earthing or Grounding in an electrical network works as a safety measure to protect human life as well as equipment, the main objective of the Earthing system is to provide an alternative path for dangerous currents to flow so that accidents due to electric shock and damage to the equipment can be avoided.

Metallic parts of equipment are grounded or connected to the earth and if the equipment insulation fails for any reason, then the high voltages that can be present in the equipment covering or outer box need some path to get discharged. If the equipment is not earthed, these dangerous voltages can be transferred to anyone who touches it resulting in an electric shock.

The circuit gets shorted and the fuse will blow immediately, in case a live wire touches the earthed case.

Why Do You Need an Earthing System in an Electrical Network?

This question generally arises when you have all the right equipment, wires, sockets and well maintained electrical devices. Yet, why is there a need for an Earthing system?

The answer is very simple…

Earthing system makes the equipment electrically shock free and gives you a safe place to stay.

Here are some advantages of the Earthing system:

1. **Safety for Human Life, Electrical Devices and Buildings**

It saves the human life from the danger of electrical shock which can cause death, by blowing a fuse. It protects your electric equipment or devices. It provides a safe path for lighting and short circuit currents and saves the building from structural damage.

2. **Voltage Stabilization**

Electricity comes from many sources, every transformer can be considered as a separate source. If there is no point which will act as a common point, then it is impossible to make a calculation between these sources.

In an electrical distribution system, Earth is the omnipresent conductive surface, which makes it a universal standard for all-electric systems.

3. Over Voltage Protection

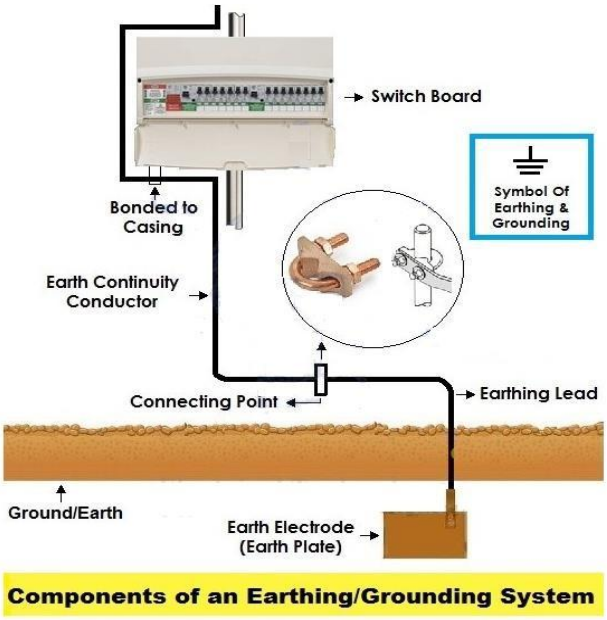
Earthing System provides an alternative path in the electrical system to minimize the dangerous effect in the electrical system which happens at the time of lighting and unintentional contact with high voltage lines.

Now that you have got an idea of the Earthing system, it is time to know how to set up an Earthing or Grounding system at your home, office or shop.

Components of Earthing System

A complete electrical earthing system consists on the following basic components.

- Earth Continuity Conductor
- Earthing Lead
- Earth Electrode



Components of an Earthing/Grounding System

Earth Continuity Conductor or Earth Wire

That part of the earthing system which interconnects the overall metallic parts of electrical installation e.g. conduit, ducts, boxes, metallic shells of the switches, distribution boards, Switches, fuses, Regulating and controlling devices, metallic parts of electrical machines such as, motors, generators, transformers and the metallic framework where electrical devices and components are installed is known as earth wire or earth continuity conductor as shown in the above fig.

The resistance of the earth continuity conductor is very low. According to IEEE rules, resistance between consumer earth terminal and earth Continuity conductor (at the end) should not be increased than 1Ω. In simple words, **resistance of earth wire should be less than 1Ω**.

Size of Earth Continuity Conductor

The cross sectional area of the **Earth Continuity Conductor** should not be less than the half of the cross sectional area of the thickest wire used in the electrical wiring installation.

Earthing Lead or Earthing Joint

The conductor wire connected between earth continuity conductor and earth electrode or earth plate is called earthing joint or "Earthing lead". The point where earth continuity conductor and earth electrode meet is known as "connecting point" as shown in the above fig.

Earthing lead is the final part of the earthing system which is connected to the earth electrode (which is underground) through earth connecting point.

There should be minimum joints in earthing lead as well as lower in size and straight in the direction. Generally, copper wire can be used as earthing lead but, copper strip is also used for high installation and it can handle the high fault current because of wider area than the copper wire. A hard drawn bare copper wire is also used as an earthing lead. In this method, all earth conductors connected to a common (one or more) connecting points and then, earthing lead is used to connect earth electrode (earth plat) to the connecting point.

To increase the safety factor of installation, two copper wires are used as earthing lead to connect the device metallic body to the earth electrode or earth plate. I.e. if we use two earth electrodes or earth plats, there would be four earthing leads. It should not be considered that the two earth leads are used as parallel paths to flow the fault currents but both paths should work properly to carry the fault current because it is important for better safety.

Size of the Earthing Lead

The size or area of earthing lead should not be less than the half of the thickest wire used in the installation.

Earthing Electrode or Earth Plate

A metallic electrode or plate which is buried in the earth (underground) and it is the last part of the electrical earthing system. In simple words, the final underground metallic (plate) part of the earthing system which is connected with earthing lead is called earth plate or earth electrode.

A metallic plate, pipe or rode can be used as an earth electrode which has very low resistance and carry the fault current safely towards ground (earth).

Size of Earthing Electrode

Both copper and iron can be used as earthing electrode.

The size of earth electrode (In case of copper)

2×2 (two foot wide as well as in length) and 1/8 inch thickness i.e. 2' x 2' x 1/8". (600x600x300 mm)

In case of Iron

2' x2' x ¼" = 600x600x6 mm

It is recommended to bury the earth electrode in the moisture earth. If it is not possible, then put water in the GI (Galvanized Iron) pipe to make possible the moisture condition.

In the earthing system, put the earth electrode in vertical position (underground) as shown in the above fig. Also, put a 1 foot (about 30cm) **layer of powdered charcoal and lime mixture** around the earth plate (don't confuse with earth electrode and earth plate as both are the same thing).

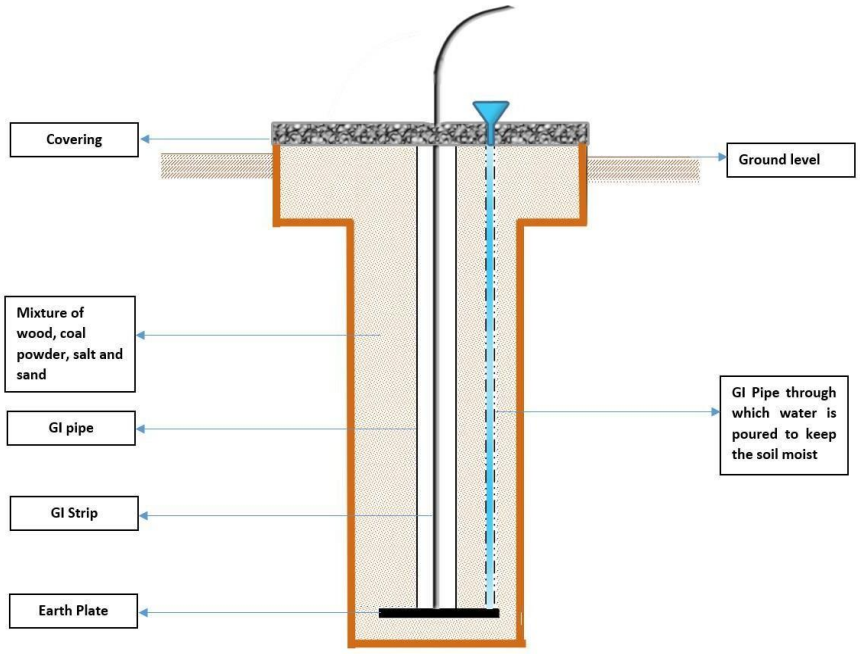
This action makes the possible increase in the size of the earth electrode which leads a better continuity in the earth (earthing system) and also helps to maintain the moisture condition around earth plate.

General method of Earthing / Proper Grounding Installation (Step by Step)

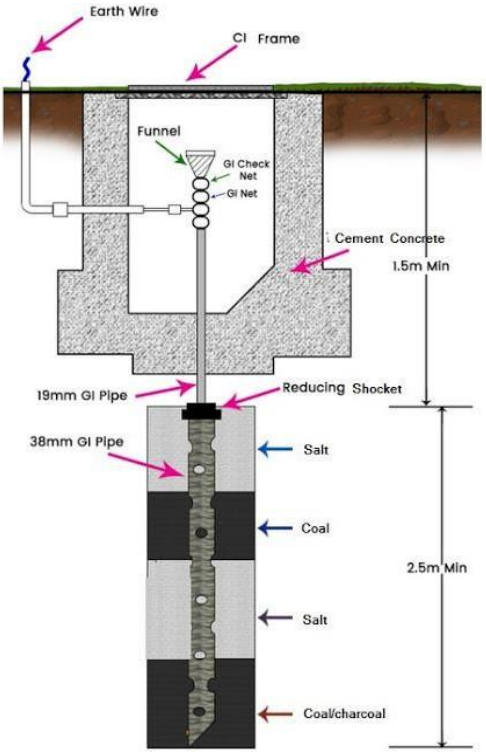
The usual method of earthing of electric equipment, devices and appliances are as follow:

1. First of all, dig a 5x5ft (1.5×1.5m) pit about 20-30ft (6-9 meters) in the ground. (Note that, depth and width depends on the nature and structure of the ground)
2. Bury an appropriate (usually 2' x 2' x 1/8" (600x600x300 mm) copper plate in that pit in vertical position.
3. Tight earth lead through nut bolts from two different places on earth plate.
4. Use two earth leads with each earth plate (in case of two earth plates) and tight them.

5. To protect the joints from corrosion, put grease around it.
6. Collect all the wires in a metallic pipe from the earth electrode(s). Make sure the pipe is 1ft (30cm) above the surface of the ground.
7. To maintain the moisture condition around the earth plate, put a 1ft (30cm) layer of powdered charcoal (powdered wood coal) and lime mixture around the earth plate of around the earth plate.
8. Use thimble and nut bolts to connect tightly wires to the bed plates of machines. Each machine should be earthed from two different places. The minimum distance between two earth electrodes should be 10 ft (3m).
9. Earth continuity conductor which is connected to the body and metallic parts of all installation should be tightly connected to earth lead.
10. At last (but not least), test the overall earthing system through earth tester. If everything is going about the planning, then fill the pit with soil. The maximum allowable resistance for earthing is 1Ω. If it is more than 1 ohm, then increase the size (not length) of earth lead and earth continuity conductors. Keep the external ends of the pipes open and put the water time to time to maintain the moisture condition around the earth electrode which is important for the better earthing system.



PROCEDURE FOR PIPE OR ROD ELECTRODE EARTHING



- Make a borehole of 500 mm diameter and 3.5 meters deep or as per the approved design and drawing.
- Lower the Pipe electrode made of a 65 mm diameter GI perforated pipe of 3.0-meter length attached at the top with a funnel covered with wire mesh. A G.I. strip is fixed to the electrode to act as an earthing connection. For rod earthing, a copper rod of required diameter is used in place of the pipe.
- Fill the annular space between the electrode and borehole walls with alternating layers of coke or charcoal and common salt.
- Inspection chamber: Construct brick chamber of size 450 x 450 x 450 mm with 100 mm thick brick walls over a P.C.C. layer. Keep 100 mm of the chamber above ground level. Cover the top with a cast iron (CI) cover.
- Follow the approved design and drawing for fixing and laying of earth wires or GI/copper strips between the earth electrode and the electrical room.

SUGGESTED ITEM DESCRIPTION FOR G.I. PIPE ELECTRODE EARTHING:

Supply and erection of G.I. earth pipe electrode 65 mm diameter, at least 3.0 meter below ground with 40 Kg alternate layers of charcoal and salt with and with wire mesh funnel for watering, 230 brick masonry chamber (450 mm x 450 mm x 450 mm), C.I. cover 300mm x 300mm (10 Kg) complete with necessary length of double G.I. earth wire no. 6 SWG bolted with lug to the plate and covered in 12 mm dia G.I. pipe 3.0 meter long complete connected to the nearest switchgear with end socket and duly tested by earth tester.