D Y PATIL
DEEMED TO BE
UNIVERSITY
RAMRAO ADIK
INSTITUTE OF TECHNOLOGY
NAVI MUMBAI

Basic Electrical Engineering

Module 6 Lecture 40:Electrical Installations

Lecture 40

Components of LT switchgear: Switch Fuse Unit(SFU)

Switch Gear-Digging into it!!!!

DEFINITION

❖ The apparatus used for controlling, regulating and switching on or off the electrical circuit in the electrical power system is known as **switchgear.**

❖**Switchgear** is composed of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment.

❖**Switchgear** is used both to de-energize equipment to allow work to be done and to clear faults downstream.

❖ Examples of **Switchgear** are - switches, fuses, circuit breaker, isolator, relays, current and potential transformer, indicating instrument, lightning arresters and control panels.

SFU-SWITCH FUSE UNIT

- The other name of **SFU** is Iron Clad Switch.
- It is combination of a Switch and a Fuse.
- When the *breaker* is operated, the contacts get closed through switch and the supply flows through *Fuse unit* to the output.
- Types of **S.F.U**.:
  - D.P.I.C. (Double Pole Iron Clad)
  - T.P.I.C. (Triple Pole Iron Clad)
  - T.P.N.I.C. (Triple Pole Neutral linked Iron Clad)

Purpose of using SFU

The switch fuse unit (**SFU**) is used for the following purposes:

✓For isolation of the circuit

✓For the protection of the equipment in case of the short circuit faults.

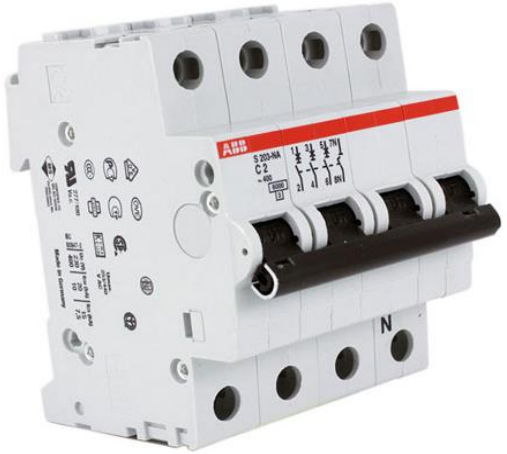
Lecture 40

Components of LT switchgear: MCB

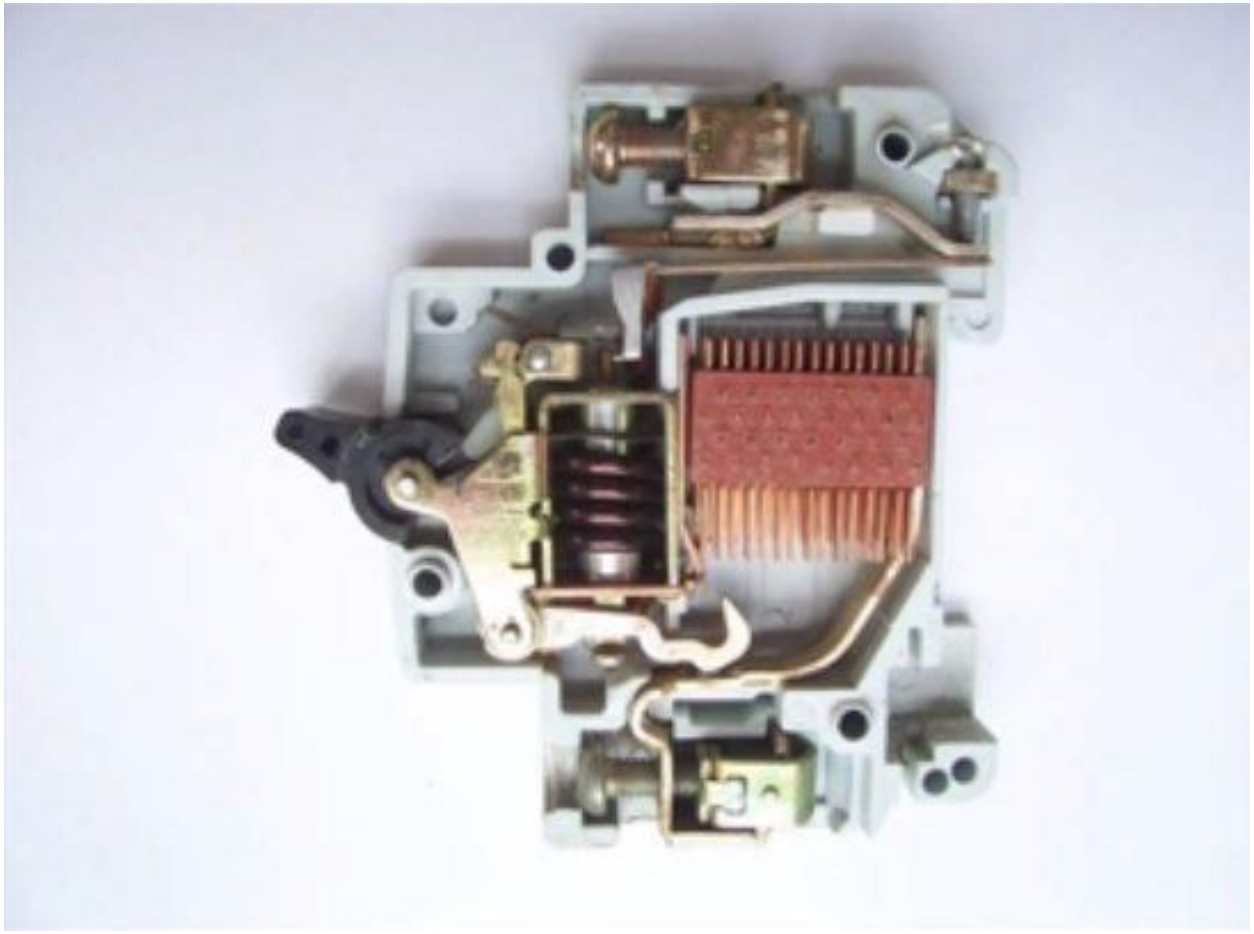
MCB-MINITIATURE CIRCUIT BREAKER

❖A miniature circuit breaker **(MCB)** automatically switches off electrical circuit during an abnormal condition of the network means in overload condition as well as faulty condition.

❖ Nowadays we use an **MCB** in low voltage electrical network instead of a fuse. The fuse may not sense it but the miniature circuit breaker does it in a more reliable way. MCB is much more sensitive to over-current than fuse.



This is how MCB looks from INSIDE !!!



MCB-MINITIATURE CIRCUIT BREAKER

❖ An MCB is very simple, easy to use and is not generally repaired. It is just easier to replace.

❖The trip unit is the main part, responsible for its proper working. There are two main types of trip mechanism:

✓A bi-metal provides protection against overload current and

✓An electromagnet provides protection against short-circuit current.

Lecture 40

Components of LT switchgear: ELCB

ELCB-EARTH LEAKAGE CIRCUIT BREAKER

❑ An **Earth-leakage circuit breaker** (**ELCB**) is a safety device used in electrical installations with high Earth impedance to prevent shock.

❑ It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected.

❑ Once widely used, more recent installations instead use residual current circuit breakers which instead detect leakage current directly.

ELCB-EARTH LEAKAGE CIRCUIT BREAKER

❖ The main purpose of Earth leakage protectors is to prevent injury to humans and animals due to electric shock.

❖There are two types of Earth-leakage circuit breaker:

✓ voltage operated (referred as ELCB in this article) and,

✓current operated (referred to as RCCB in this article).

Lecture 40

Components of LT switchgear: MCCB

MCCB- Molded Case Circuit Breaker

MCCB- Molded Case Circuit Breaker

- **MCCB** stands for Molded Case Circuit Breaker.

- It is another type of electrical protection device which is used when load current exceeds the limit of a miniature circuit breaker.

- The **MCCB** provides protection against overload, short circuit faults and is also used for switching the circuits.

- It can be used for higher current rating and fault level even in domestic applications.

- The wide current ratings and high breaking capacity in **MCCB** find their use in industrial applications.

- **MCCB** can be used for protection of capacitor bank, generator protection and main electric feeder distribution. It offers adequate protection whenever an application requires discrimination, adjustable overload setting or earth fault protection.

Difference between MCB and MCCB

S.No	MCB	MCCB
1	It stands for Miniature Circuit Breaker.	It stands for Molded Case Circuit Breaker.
2	Rated current not more than 125 Ampere.	Rated Current up to 1600A
3	Its interrupting current rating is under 10KA	Their interrupting current ranges from around 10KA -85KA
4	Judging from their power capacities, MCB is mainly used for low Breaking capacity requirement mainly domestic.	MCCB is mainly used for both low and high Breaking capacity requirements mainly industrial.
5	Its trip characteristics are normally not adjustable since they basically cater to low circuits.	Its trip current may be fixed as well as adjustable for overload and magnetic setting.

Lecture 41

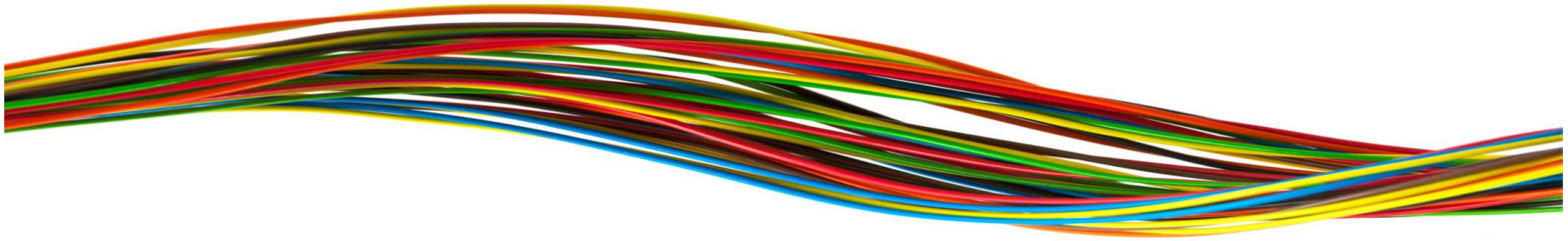
Types of Wires and Cables

Wires and Cables

✓ More often, the terms **wire** and **cable** are used to describe the same thing, but they are actually quite different.

✓ **Wire** is a single electrical conductor, whereas a **cable** is a group of wires swathed in sheathing.

✓ The term cable originally referred to a nautical line of multiple ropes used to anchor ships, and in an electrical context, cables (like wires) are used to carry electrical currents.



Size of Wires

- Sizing of wire is done by the American wire gauge system.
- Common wire sizes are 10, 12 and 14 – a higher number means a smaller wire size, and affects the amount of power it can carry.

Types of Wires

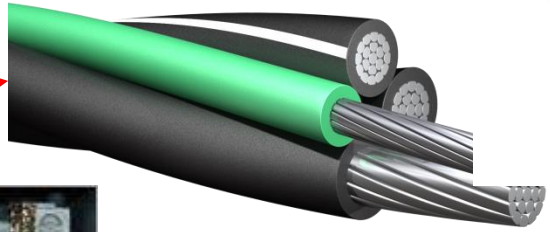
There are mainly 5 types of wire:

Wires and Cables

There are mainly 5 types of wire:

1)Triplex Wires

1)Main Feeder Wires



1)Panel Feed Wires

Wires and Cables

4) Non-Metallic Sheathed Wires

5) Single Strand Wires

Cable Size

❖ Cable size is the gauge of individual wires within the cable, such as 14, 12, 10 etc. – again, the bigger the number, the smaller the size.

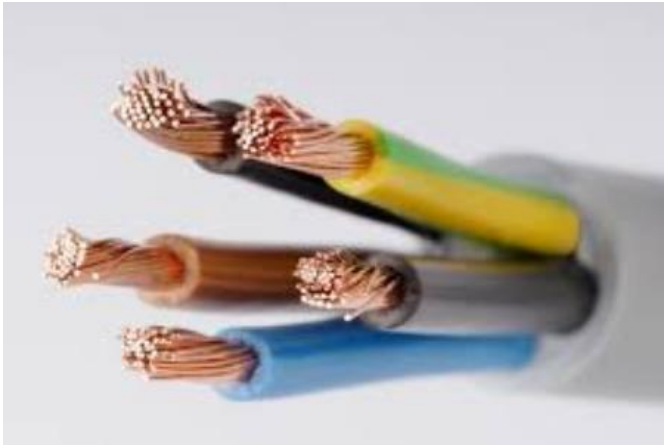
❖ The number of wires follows the wire-gauge on a cable.

❖ So, 10/3 would indicate the presence of 3 wires of 10-gauge within the cable. Ground wire, if present, is not indicated by this number, and is represented by the letter ‘G’.

Types of Electrical Cables

1) Non-Metallic / Metallic Sheathed Cable

1) Multi-Conductor Cable



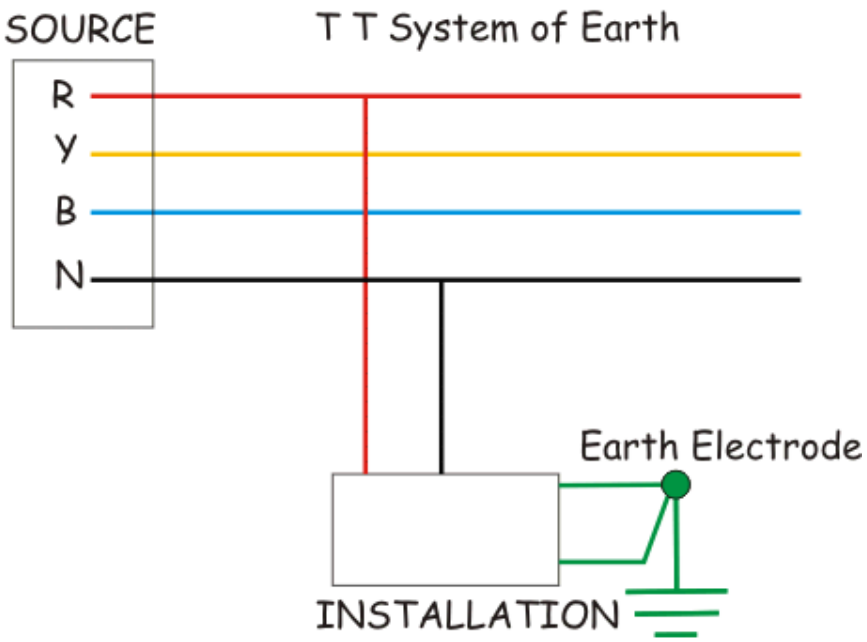
Types of Electrical Cables

3) Coaxial Cable

4) Ribbon Cable

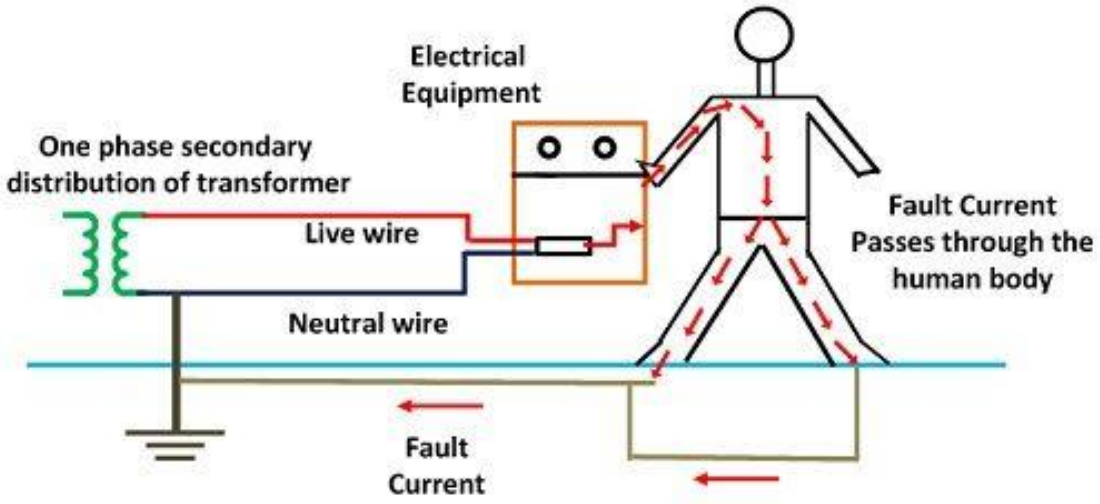
Earthing

Earthing



❑ In an electrical installation, an **earthing** system or grounding system connects specific parts of that installation with the Earth's conductive surface for safety and functional purposes.

Earthing

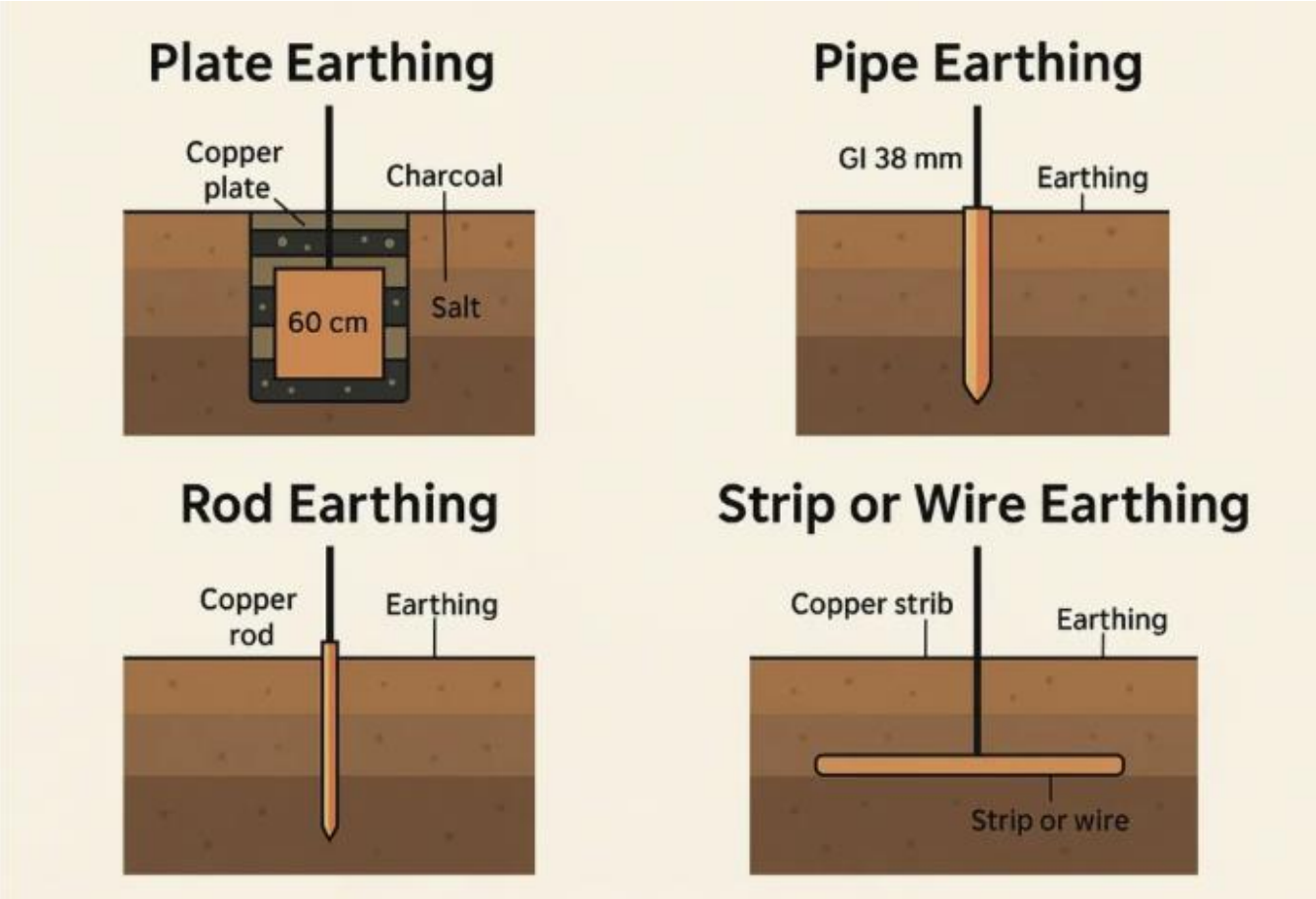


Electrical System Without Earthing

Circuit Globe

- **Earthing** is the method of transmitting the instant electricity discharge directly to the ground through low resistance wires or electrical cables.
- This is one of the significant features of electrical networks.

Types of Electrical Earthing Systems



Why is Earthing Necessary in Electrical Systems?

Earthing is important in day-to-day life as the absence of proper earthing or grounding can lead to electric shocks, appliance damage, or even loss of life:

- It diverts the fault current away from the human body hence prevents electric shock.
- It helps safely release excess charge and guards against appliance damage.
- It ensures balanced voltage levels and preserves voltage stability.
- It gives a point of reference for the electrical system's correct operation.

What are the Basic Components used in an Earthing System?

Let's understand what materials or components are usually involved in any earthing setup:

1. The main component used is a **metal rod, plate, or pipe** that is buried in the ground which makes direct contact with the soil is called an **earth electrode**.
2. Second one is the conductor that joins the electrical system to the ground electrode is called an **earthing lead or wire**.
3. Other one is the **electrode** which is placed in an earth pit, which is a hole scooped out of the ground.
4. Last but not the least, **moisture and salt or charcoal** are frequently added to the pit to increase the soil conductivity.

Why is My Earthing System not working properly?

There are multiple factors due to which your earthing or grounding may not work properly and identifying the underlying issues is very crucial for your electrical setups to ensure protection and avoid any tragedy. Lets discuss such issues one by one:-

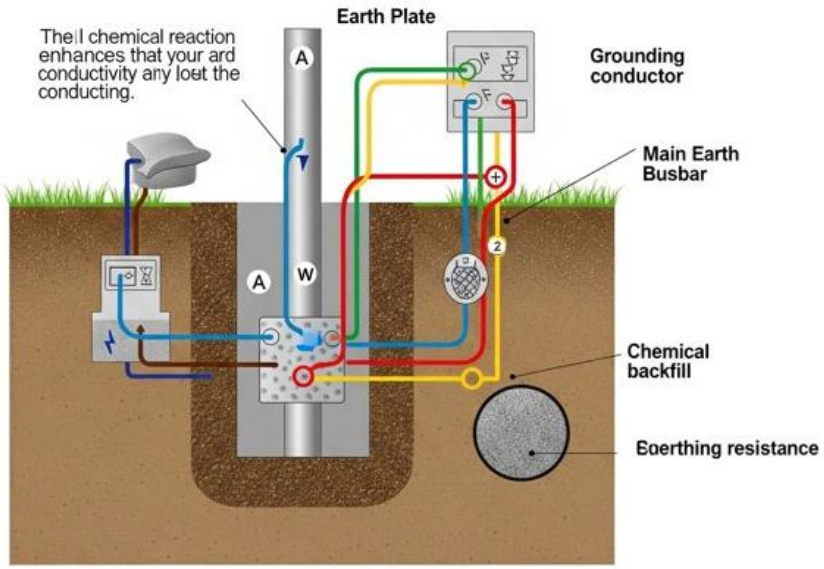
1. **Type of soil:** Check the soil where earthing is setup as sandy or rocky soils have higher resistance, which make them poor conductors and unsuitable for efficient grounding. On the other hand, Soils which are rich in clay and moisture (like black cotton soil) are excellent conductors and ideal for earthing.
2. **Moisture content:** Check the moisture content in the soil as it greatly enhances soil conductivity. Dry soil increases resistance, which weakens the earthing system. That's why regular watering or using **backfilling compounds like bentonite or charcoal-salt** is common to maintain consistent moisture.
3. **Temperature:** As the temperature drops, especially below freezing, soil loses its ability to conduct electricity effectively. Frozen soil acts like an insulator, which can temporarily disable proper earthing unless deeper grounding is done.
4. **Electrode depth:** As Deeper electrodes reach cooler, moister soil layers, which ensures lower resistance and more stable grounding. Surface-level installations often fail during dry seasons due to drying of the topsoil.

Earthing

1. Plate Earthing

In both households and businesses, this is one of the most widely employed techniques. This process involves **burying a copper or galvanized iron (GI) plate**, typically **measuring 60 cm by 60 cm**, vertically in a pit between **three and five feet below the surface**. To improve conductivity and ensure proper earthing, salt and charcoal are added to the pit and moisture, through chemical compounds, is added on a regular basis.

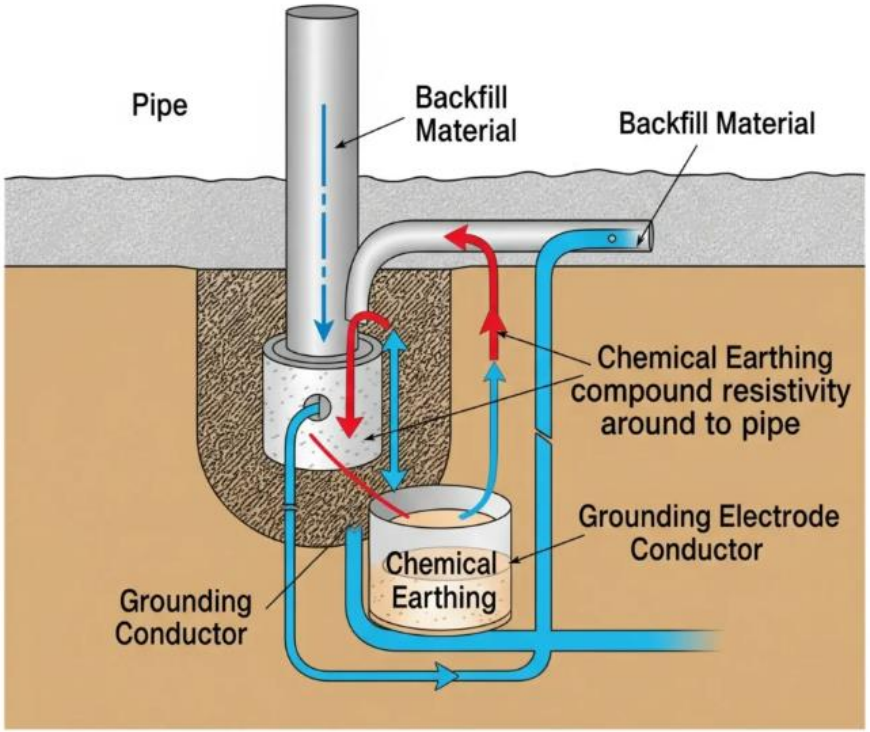
Plate Chemical Earthing System



2. Pipe Earthing

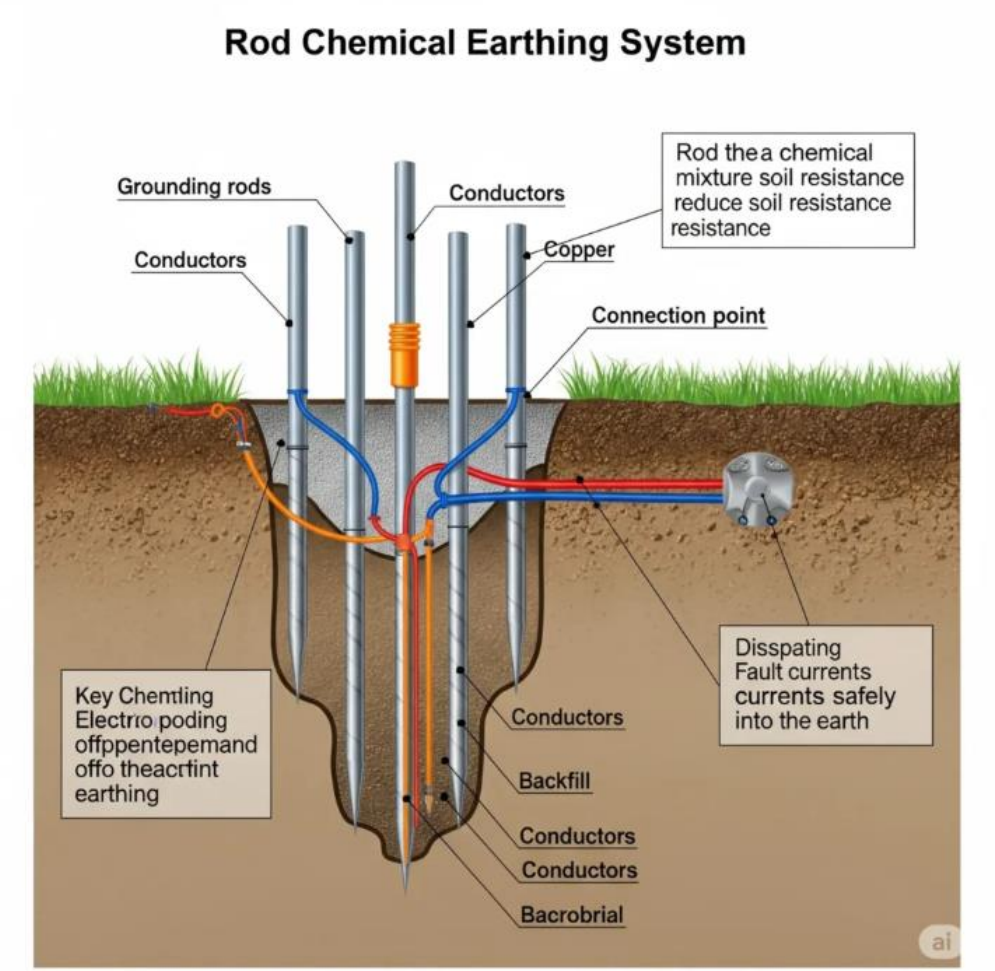
In this type of earthing a **GI pipe (Galvanized iron) is inserted vertically** into the ground **which is usually 2-3 meters long** and **38 mm in diameter**. Holes are bored in the pipe to let moisture in. In the pit, salt and charcoal is utilized to improve conductivity. It is used in **places with rocky or dry terrain** and frequently found in electrical substations and power networks. This approach is very economical and efficient.

Pipe Chemical Earthing System



3. Rod Earthing

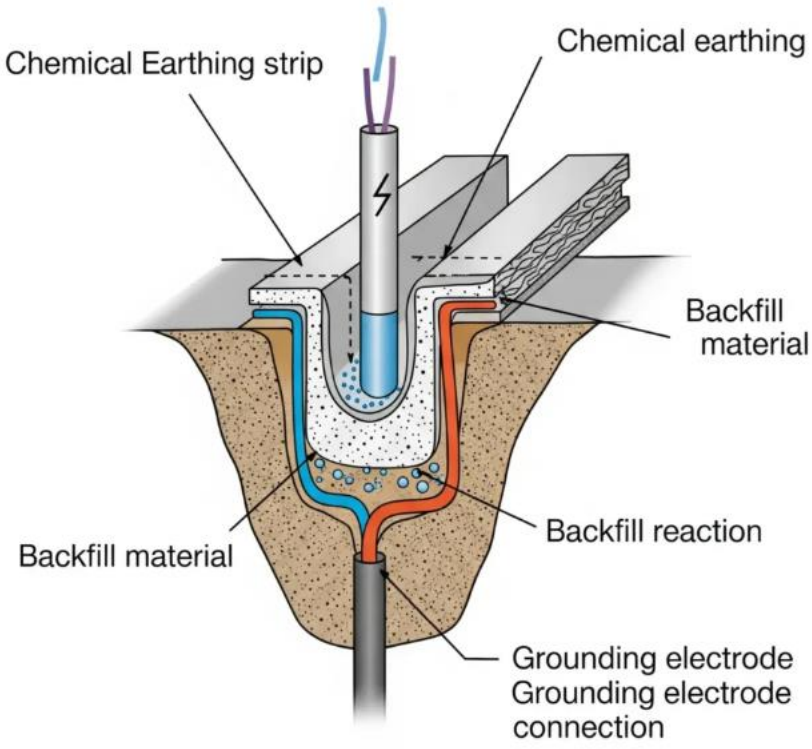
In Rod Earthing a solid rod made of **copper or GI** is driven directly into the ground. This process requires less room and is easier to install than the plates and pipes. This is a more **straightforward and modern alternative**.



4. Strip or Wire Earthing

In this type of earthing **a strip or wire (copper or GI) is put horizontally** in a trench in the ground. The conductor used in this might be many meters long. It is commonly used in power plants, transmission towers, and substations where **large area of contact with the earth** is required.

Strip Chemical Earthing System



Comparison of Types of Earthing

Type of Earthing	Material Used	Installation Depth / Layout	Conductivity Enhancers	Maintenance Level	Common Applications
Plate Earthing	Copper or GI Plate (60×60 cm)	Buried vertically, 3–5 feet or more	Charcoal and salt	Medium	Homes, offices, small industries
Pipe Earthing	GI Pipe (38 mm dia, 2–3 m long)	Inserted vertically into ground (up to 9 feet)	Charcoal and salt	Medium	Dry soil areas, power stations, substations
Rod Earthing	Copper or GI Rod	Driven directly into the earth (depth varies)	None or minimal	Low	Temporary setups, small buildings
Strip/Wire Earthing	Copper or GI Strip/Wire	Laid horizontally in trenches	Not required	Medium	Transmission lines, substations, large areas

Lecture 41

Characteristics of Batteries

Characteristics of Batteries

❖ **The following battery characteristics must be taken into consideration when selecting a battery:**

✓Type.

✓Voltage.

✓Discharge curve.

✓Capacity.

✓Energy density

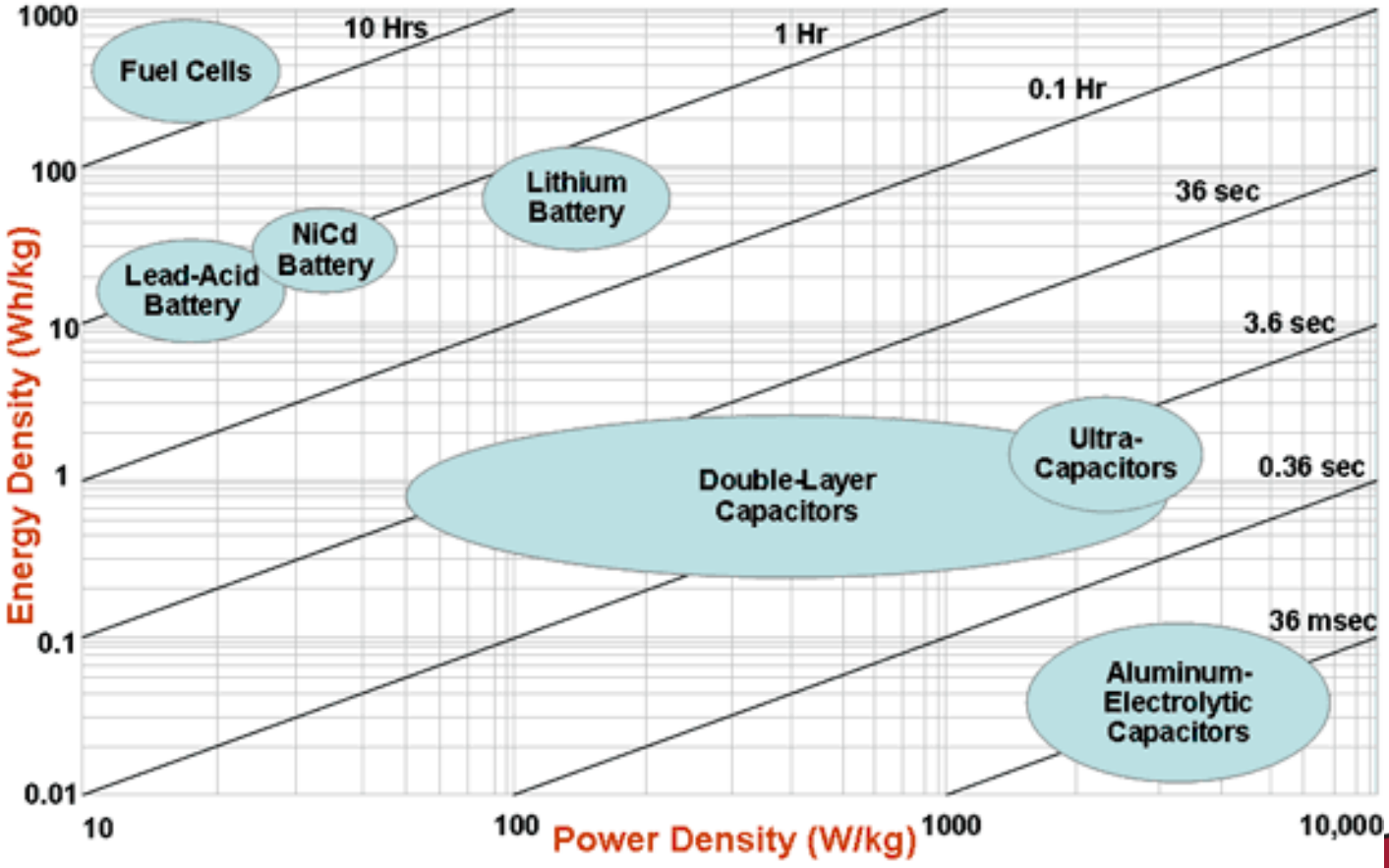
✓Specific energy density.

✓Power density.

✓Temperature dependence.

Characteristics of Batteries

Ragone Plot of Electrochemical Devices



Source US Defence Logistics Agency

D Y PATIL
DEEMED TO BE
UNIVERSITY
RAMRAO ADIK
INSTITUTE OF TECHNOLOGY
NAVI MUMBAI

Thank You