EQUIPMENT SAFETY MEASURES

Domestic Wiring:

Wiring done in domestic premises for providing electrical power for fans, lighting & domestic appliances are called as **DOMESTIC WIRING.**

FACTORS TO BE CONSIDER WHILE DOING WIRING:

a. Durability
b. Safety
c. Appearance
d. Switch closed accessibility
e. Maintenance cost
f. Over all Cost

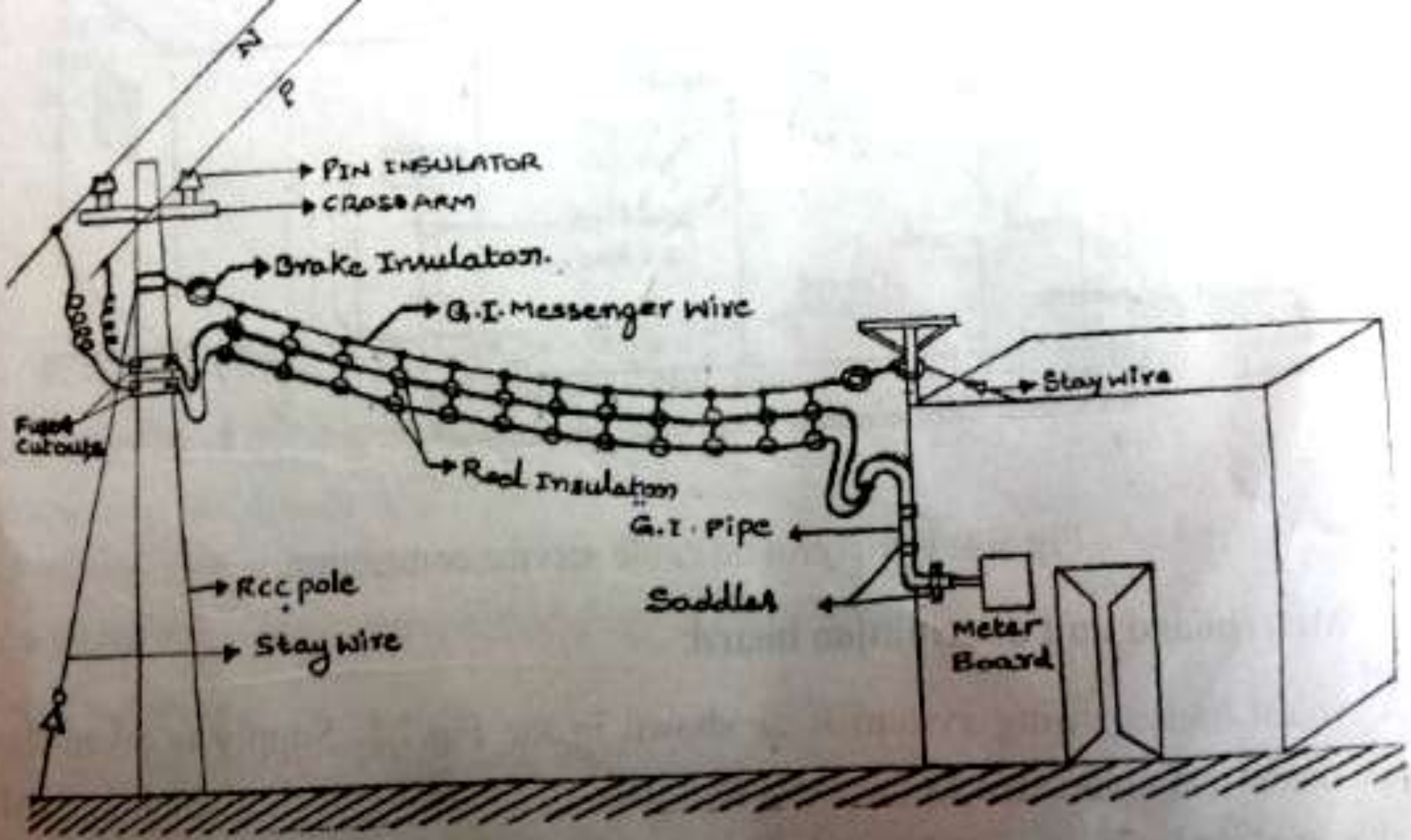
SERVICE MAINS:

1. Generally a cable which connects the distributer to consumers terminals.
2. It mainly consists of conductors which are of a few meters long, that run from the pole to consumer's premises. For single phase supply, two wires are used; a phase wire & a neutral wire.

Two types of service mains are (i) Overhead service mains (ii) Underground service mains.

1. **Overhead service mains:**

- ❖ Wires are connected from electrical pole to the meter board
- ❖ Overhead service connection is taken with the help of PVC or weather proof cable
- ❖ GI wires are run parallel to these for mechanical support.


N
P
PIN INSULATOR
CROSS ARM
Brake Insulator.
G.I. Messenger Wire
Stay wire
Fuse Cutout
Reel Insulation
G.I. Pipe
Saddles
Meter Board
RCC pole
Stay wire

Underground service mains:

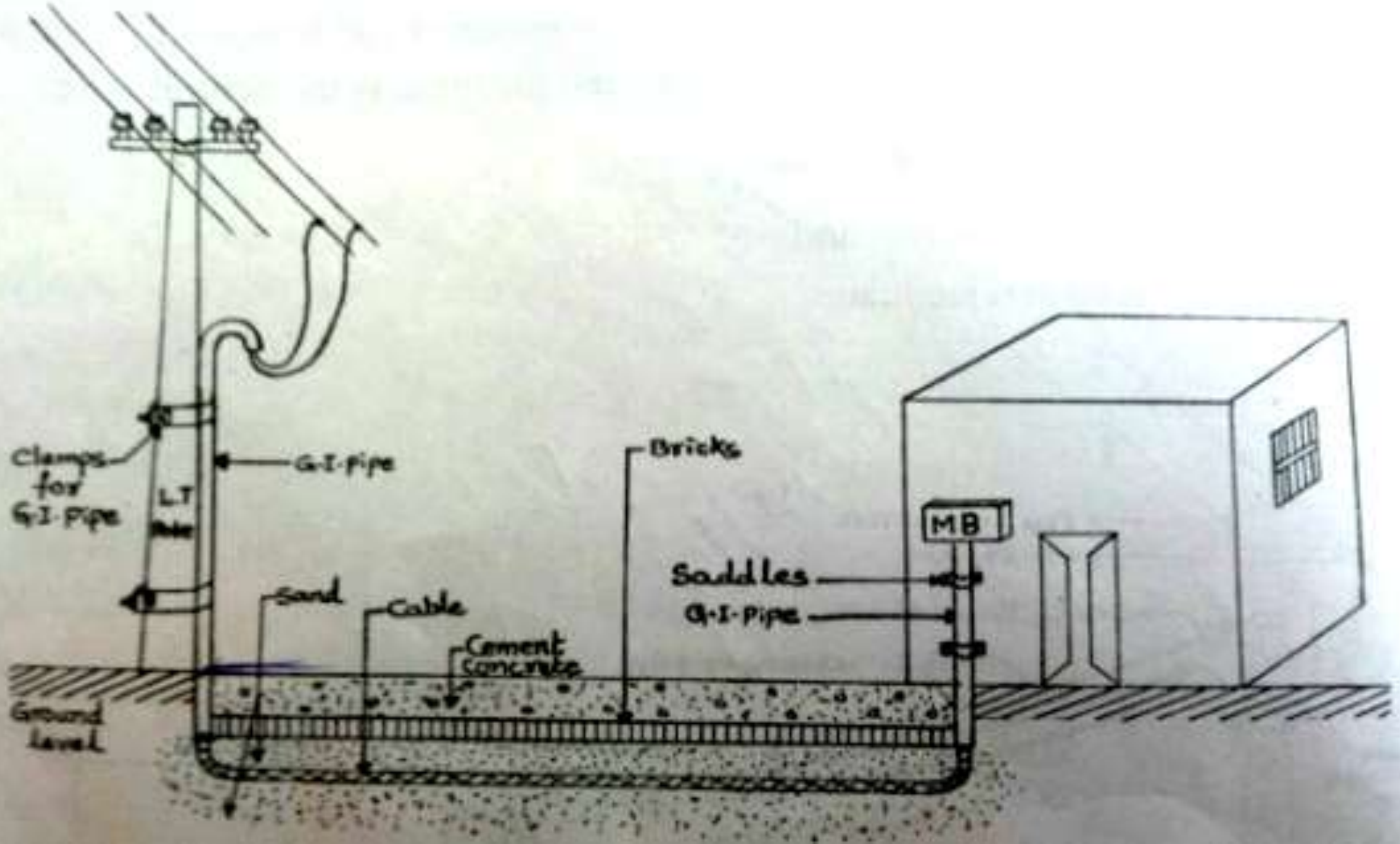
Preferred when

✓Obstructions such as buildings, trees, large sized moving vehicles etc

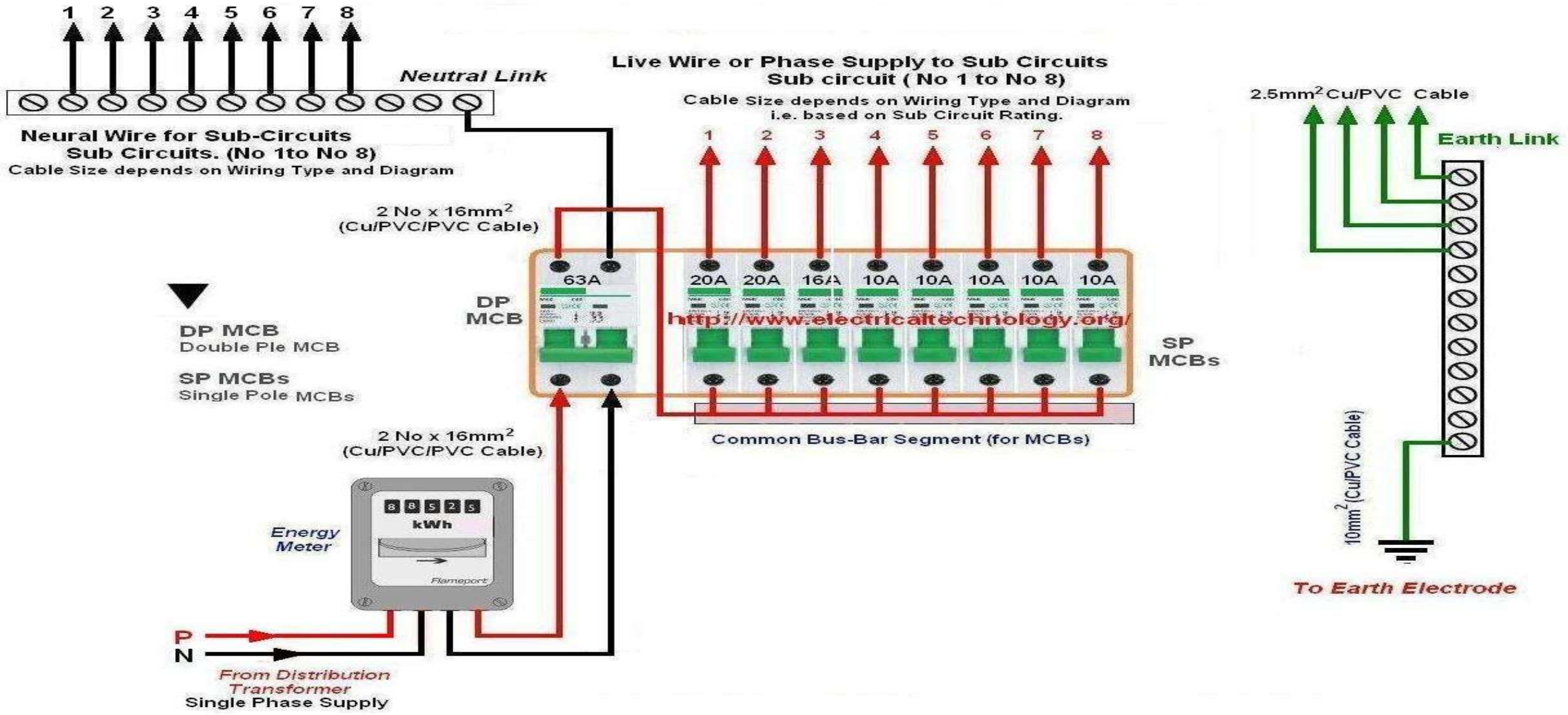
✓Overcrowding of overhead lines

✓Aesthetic point of view

✓**Disadvantages: i) Cost is high ii) Inconvenience for future excavation of earth**


Clamps for G.I. Pipe
LT
G.I. Pipe
Bricks
MB
Saddles
G.I. Pipe
Sand
Cable
Cement Concrete
Ground level

METER BOARD & DISTRIBUTION BOARD:



protective devices

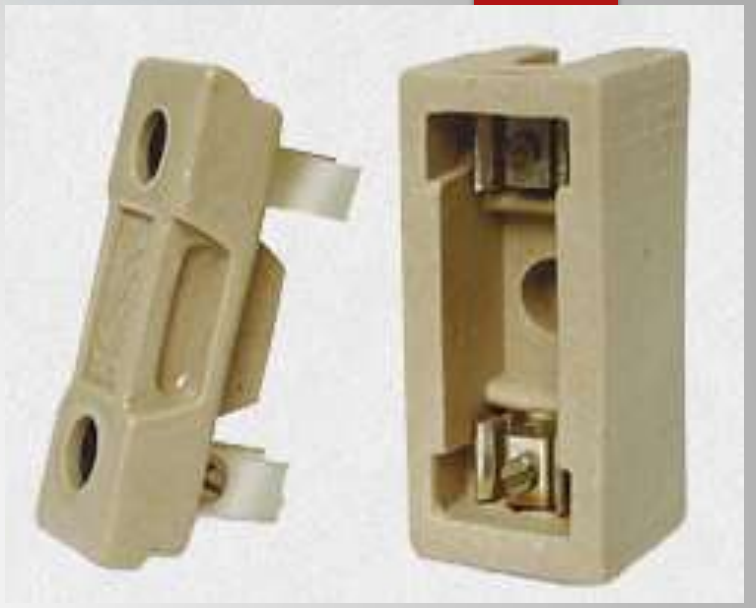
Necessity of protective devices

- Electrical & Electronics Circuits
- Excessive high current
- Excessive high voltages
- Voltage fluctuations
- Failure of insulation
- Atmospheric lightning

Various types of protective devices

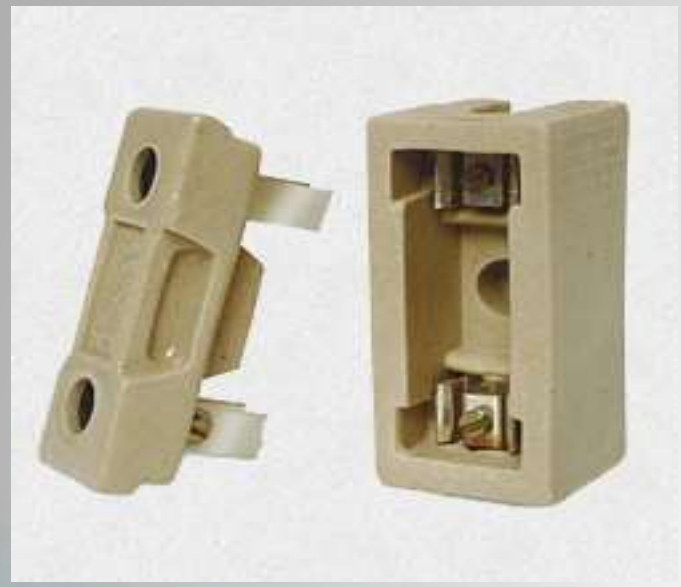
- Fuse
- Miniature Circuit Breaker-MCB
- Earthing
- Earth Leakage Circuit Breaker-ELCB
- Residual Current Circuit Breaker-RCCB

FUSES:



1. Invented by Thomas Alva Edison.
2. Fuse is a protective device used against overloading or faults.
3. It is a small piece of metal.
4. Melts when current exceeds predetermined value.
5. Fusing element, fuse carrier and a base – **fuse unit.**
6. Fuse wire must have high resistivity and low melting point.
7. It should be free from oxidation and should be non-deteriorating.
8. Fusing element materials are ,Tin, Lead, Zinc, Silver, Aluminum, Copper and their alloys.
9. Alloy of Tin and Lead is commonly used for small currents.
10. Silver is best suited.
11. No oxidation, no deterioration of the material.
12. Costly.

TYPES OF FUSES:



Kit Kat type/ Re-wirable Fuse

Cartridge Fuse

High Rupturing Capacity (HRC) Fuse

TERMS RELATED WITH FUSES:

Rated current: It is that value of current which the fuse can carry without melting.

It depends on the following factors:

- Permissible temperature rise of fuse contacts of fuse holder.
- Fusing element material.
- Degree of diminish due to oxidation.

Fusing Current: It is the minimum value of the current at which it melts to interrupt the circuit.

Fusing current> Rated current

Fusing Factor: It is the ratio of the minimum fusing current to the rated current. It is always greater than unity.

$$\text{Fusing factor} = \frac{\text{Fusing current}}{\text{Rated current of fuse}}$$

MCB-MINIATURE CIRCUIT BREAKERS:

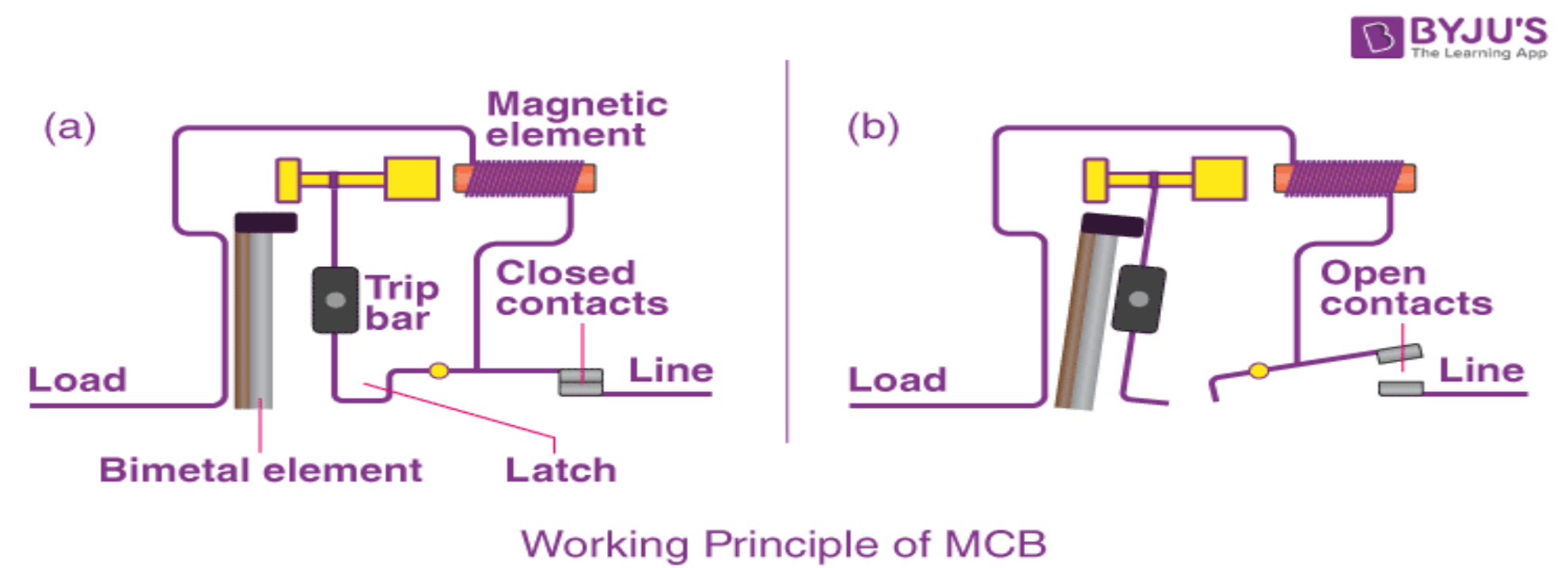
A MCB is a mechanical switching compact device used in distribution board for protection against

(i) Overload (ii) Short circuit

Features:

- ✓ Protection against overload and short circuit(SC) currents
- ✓ Thermal trip mechanism using bimetallic strip for overload protection
- ✓ Electromagnetic trip mechanism for SC protection
- ✓ Operation is very fast & opens in < 1msec

WORKING PRINCIPLE:



Working Principle of MCB

Working Principle of MCB

When the overflow of current takes place through MCB – Miniature Circuit Breaker, **the bimetallic strip gets heated and it deflects by bending**. The deflection of the bi-metallic strip releases a latch. The latch causes the MCB to turn off by stopping the flow of the current in the circuit.

I. The Operating Mechanism of Miniature Circuit Breaker provides the means of manual opening and closing operation of miniature circuit breaker.

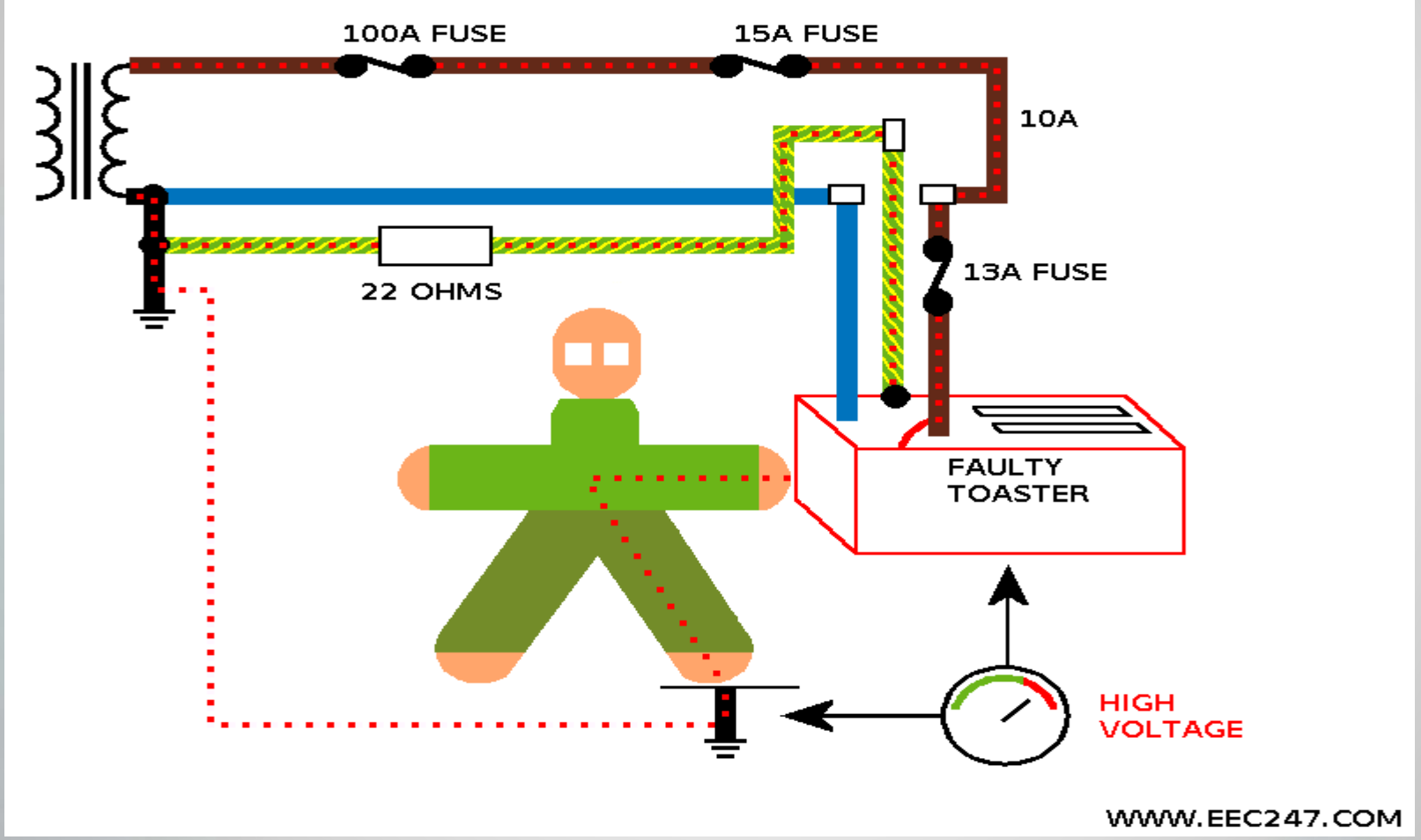
II. It has two-positions “ON” “OFF” .

III. When manually switch off the MCB, the switching latch will be in “OFF” position. In close condition of MCB, the switch is positioned at “ON”.

IV. By observing the positions of the switching latch one can determine the condition of MCB whether it is closed, tripped or manually switched off.

EARTHING:

The process of connecting metallic bodies of all the electrical apparatus and equipment to huge mass of earth by a wire having negligible resistance is called Earthing.



PURPOSE OF EARTHING:

- To protect the operating personnel from danger of shock in case they come in contact with the charged frame due to defective insulation.
- To maintain the line voltage constant under unbalanced load condition.
- Protection of the equipments
- Protection of large buildings and all machines fed from overhead lines against lightning

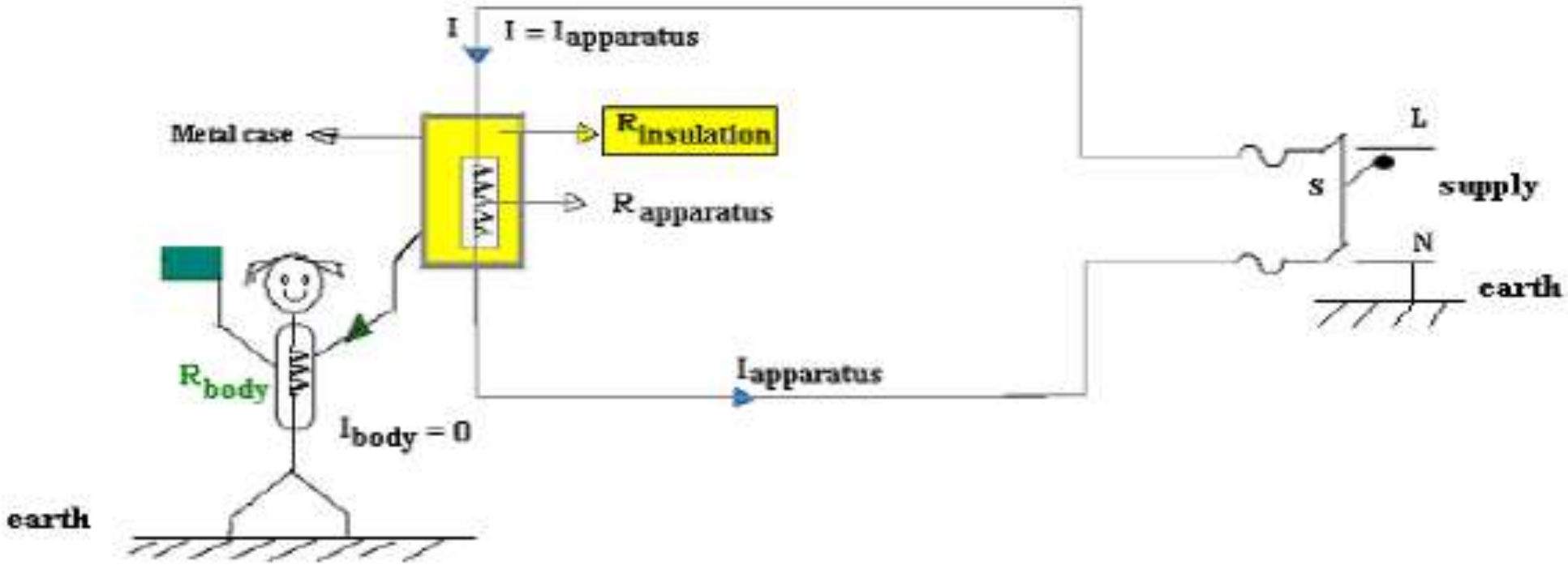
QUALITIES OF GOOD EARTHING:

- Must be of low electrical resistance
- Must be of good corrosion resistance
- Must be able to dissipate high fault current repeatedly

Case I

Healthy insulation

Apparatus not earthed

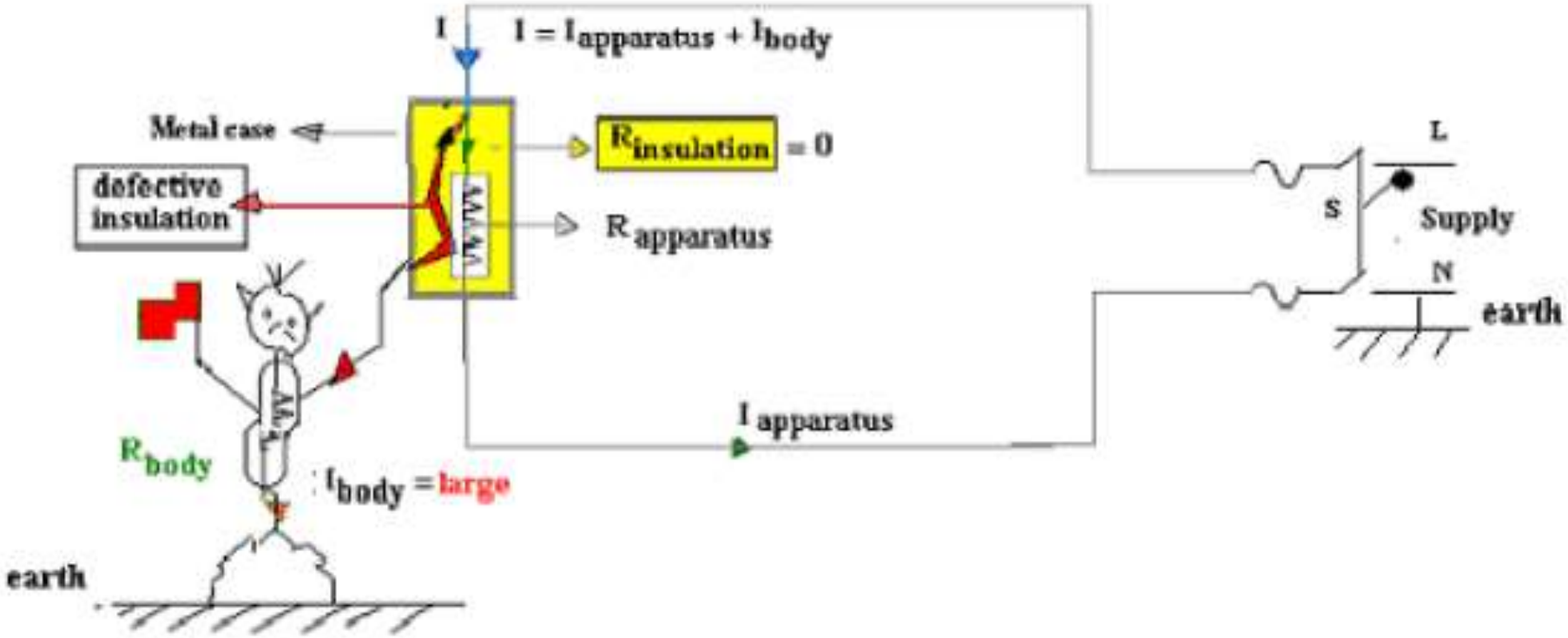


1. Insulation is healthy ($R_{insulation} = \infty$)
2. Supply current flows through the resistence of the apparatus only ($R_{apparatus}$)
3. No current flows through the body resistance ($I_{body} = 0$)
4. The person is safe even if the apparatus is not earthed

Case II

Defective insulation

Apparatus not earthed

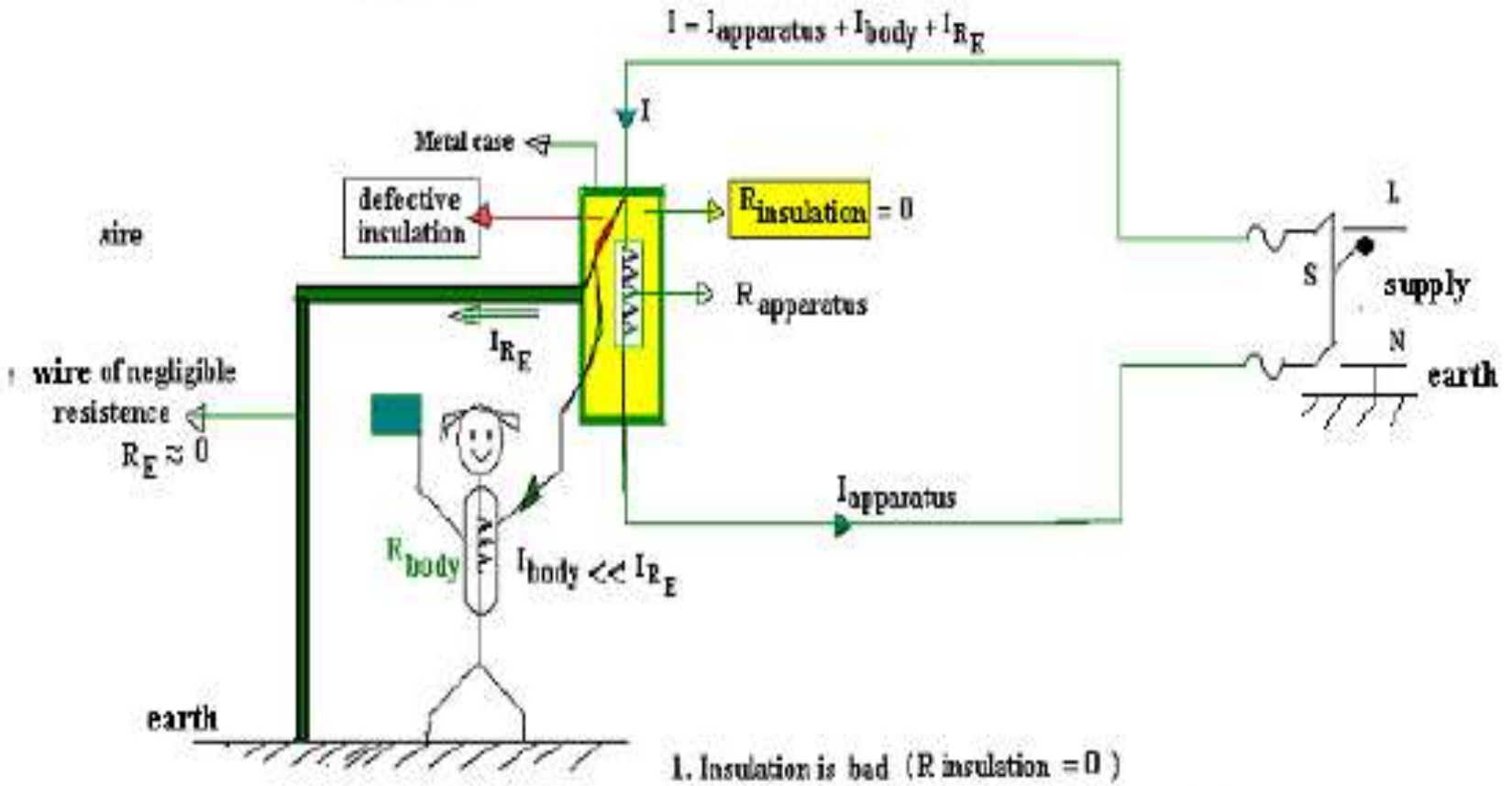


1. Insulation is bad ($R_{insulation} = 0$)
2. Supply current now divides into $I_{apparatus}$ and I_{body}
3. A part of the supply current flows through the body to the ground I_{body}
4. The person experiences shock as the apparatus is not earthed

Case III

Defective insulation

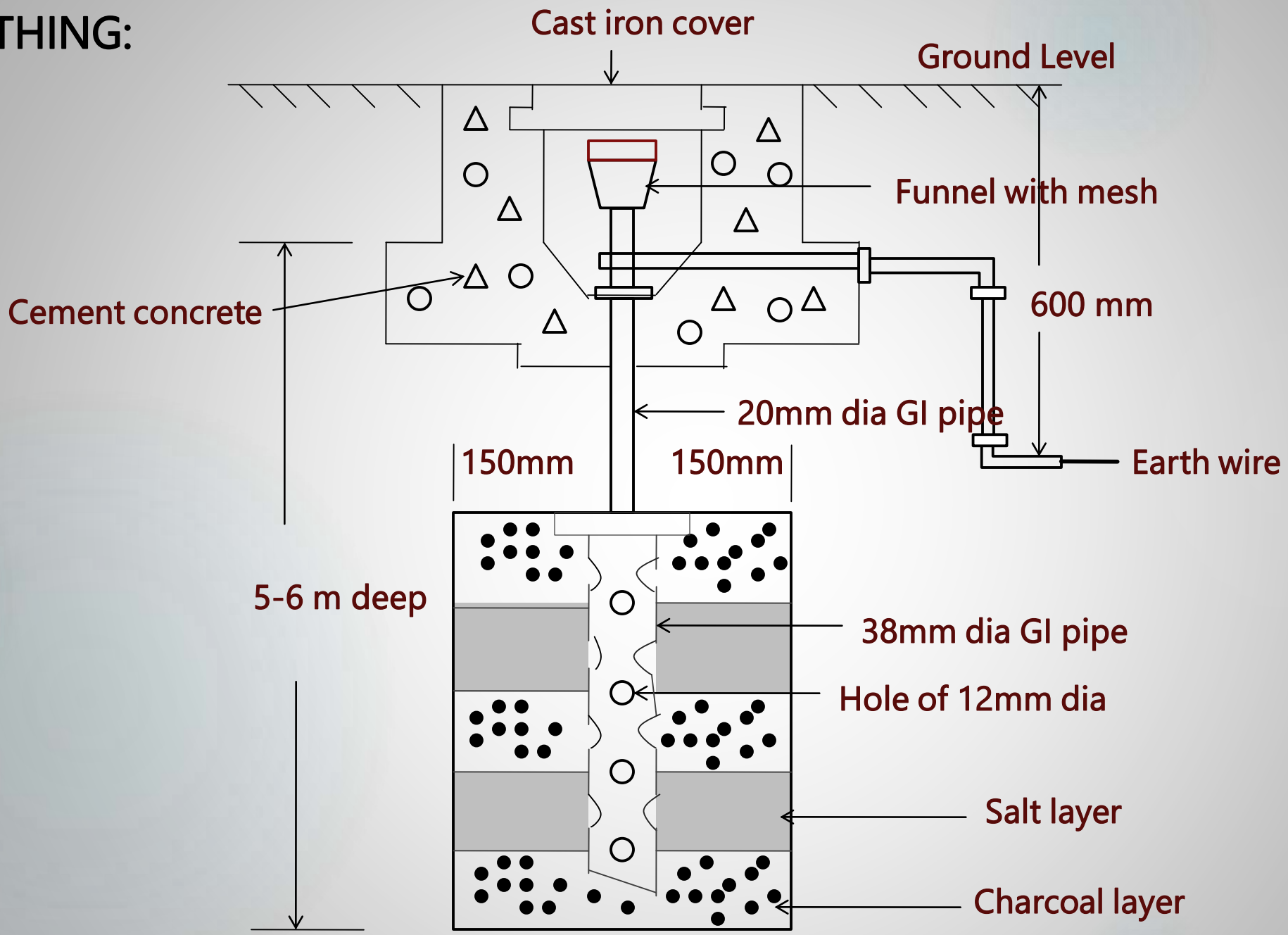
Apparatus earthed



1. Insulation is bad ($R_{insulation} = 0$)
2. Supply current now divides into $I_{apparatus}$ I_{body} and I_{R_E}
3. A part of the supply current I_{body} flows through the body to the ground
4. Now I_{body} is very less compared to the current flowing through wire of negligible resistance connecting the apparatus metal case to ground

$I_{body} << I_{R_E}$

PIPE EARTHING:



PIPE EARTHING CONSTRUCTION:

i. Pipe earthing is best form of earthing and it is cheap , also in this system of earthing a GI pipe of 38 mm dia & 2 Mts. length is embedded vertically in ground to work as earth electrode but the depth depend upon the soil conditions, there is no hard and fast rule for this.

ii. But the wire is embedded up to the wet soil.

iii. The earth wire are fastened to the top section of the pipe with nut and bolts.

iv. The pit area around the GI pipe filled with salt and coal mixture for improving the soil conditions and

v. efficiency of the earthing system.

vi. It can take heavy leakage current for the same electrode size in comparison to plate earthing.

vii. The earth wire connection with GI pipes being above the ground level can be checked for carrying ou continuity test as and when desired, while in plate earthing, it is difficult.

viii. In summer season to have an effective earthing three or four bucket of water is put through the funnel for better continuity of earthing.

PLATE EARTHING:

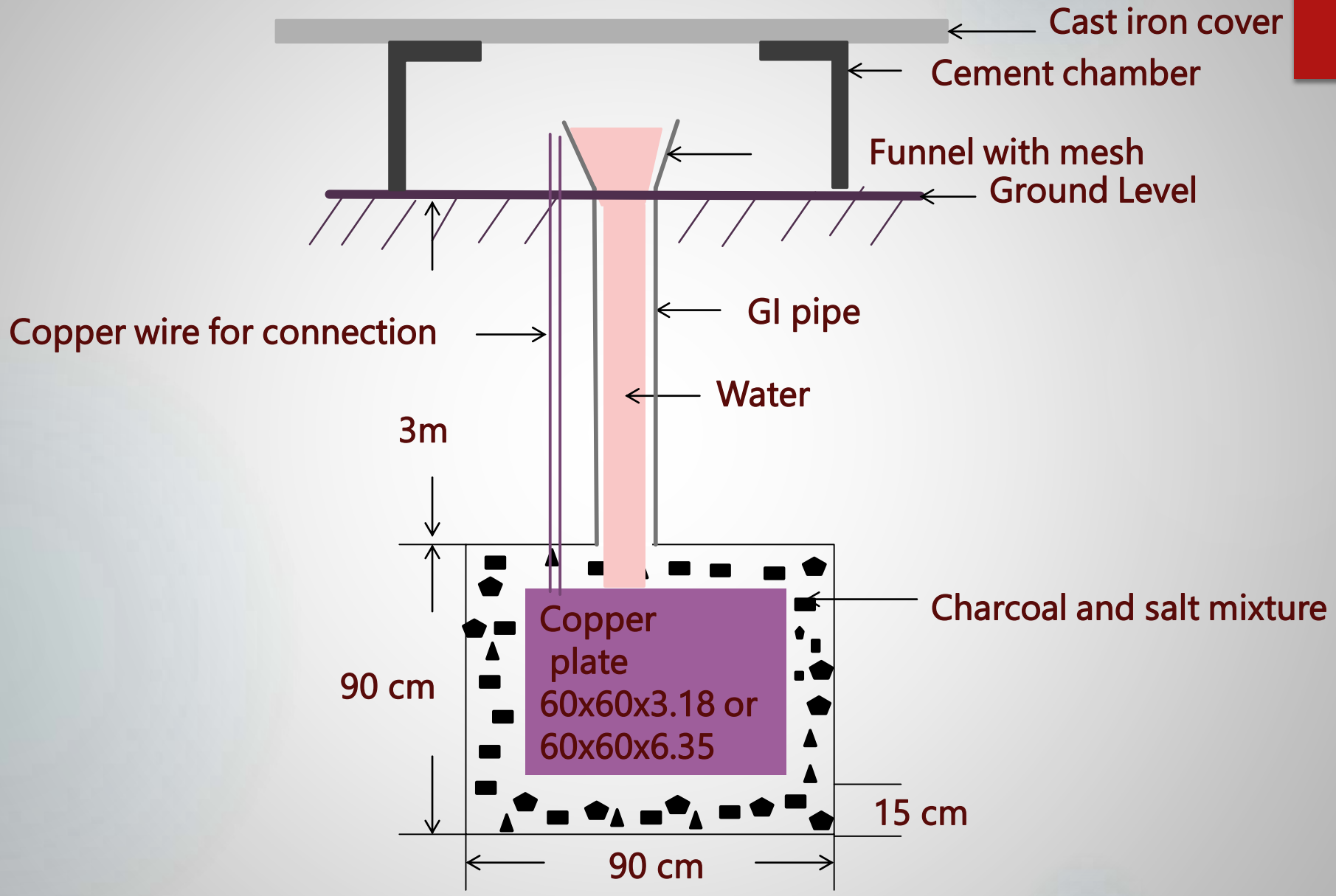


PLATE EARTHING CONSTRUCTION:

- Earth resistance for copper wire is 1 ohm
- Earth resistance for GI wire is less than 3 ohm
- Plates used
  - Copper plate of size 60 cm x 60 cm x 3.18 cm
  - GI plate of size 60 cm x 60 cm x 6.35 cm
- Plate is placed vertically down inside the ground at a depth of 3m
- Plate is embedded in alternate layers of coal and salt for a thickness of 15cm.
- Water is poured to keep the earth electrode resistance well below 5 ohms
- Earth wire is bolted to the earth plate
- Cement masonry chamber is built with a cast iron cover for regular maintenance

Cause for Electric Shock:

By poorly insulated wires or ungrounded electrical equipments

By using electrical equipment while in contact with water

By being struck by lightning

What may happen when we Get an Electric Shock

Burns (which are the most common)

Damage to body parts

Death

PRECAUTIONS AGAINST ELECTRIC SHOCK:

- Operators should use insulated tools and gloves.
- Metal parts of the equipment should be earthed properly.
- Cover all electrical sockets with insulating caps.
- Replace all worn out electrical chords and cables.
- Avoid operating electrical equipments with wet hands.
- Use footwear while operating the electrical equipments.
- Avoid operating electrical equipments with both the hands.
- Inspect power cords and extension cords, do not allow children to play with any electric cords.
- Limit the use of extension chords and be sure that the chords are rated for the current.
- Use the outlet covers to protect infants.
- Explain to adolescent children that they should not climb on power tower, play near transformer systems and electrified train rails or other electrical systems.
- Use common sense can help reduce electrical injury. People who work with electricity should always check that the power is off before working on electrical systems.
- Avoid use of any electrical device near water be careful of standing in water or when working with electricity.

Electricity Bill

Power ratings of the household applications:

Home Appliance	Wattage
Zero Watt Bulb	15 Watt
CFL Bulb	15 Watt
Bulb	60 Watt
Tube Light	40 Watt
Ceiling Fan	60 Watt
Fridge 165 Litre	100 Watt
Mixie	450 Watt
Washing Machine	325 Watt
Iron Box	750 Watt
Water Pump	750 Watt
Vacuum Cleaner	750 Watt
Television	100 Watt
Tape Recorder	20 Watt
Video Player	40 Watt
Mobile Charger	5 Watt
Computer	80 Watt
Air Conditioner	1500 Watt

Definition of UNIT : Unit is also called as kWh.

It is defined as One kilowatt-hour is the electrical energy consumed by an electrical appliance of power 1 kW when it is used for one hour.

Ex: If a 1000W equipment (1 Ton AC)is allowed to operate for 1Hr then it is said to be consumed 1 Unit of electricity.

TARIFF: Definition: The amount of money framed by the supplier for the supply of electrical energy to various types of consumers is known as an electricity tariff. In other words, the tariff is the method of charging a consumer for consuming electric power.

TWO PART Tariff: In such a type of tariff, the total bill is divided into two parts. The first one is the fixed charge and the second is the running charge. The fixed charge is because of the maximum demand and the second charge depends on the energy consumption by the load.

$$C = Ax + By$$

$$C = A(kW) + B(kWh)$$

This type of tariff is mostly applicable to industrial consumers who have appreciable maximum demand.

Advantages:

(a) is easily understood by the consumers.

(b) It covers the fixed charges which depend upon the maximum demand of the consumer but are independent of the units consumed.

Disadvantages:

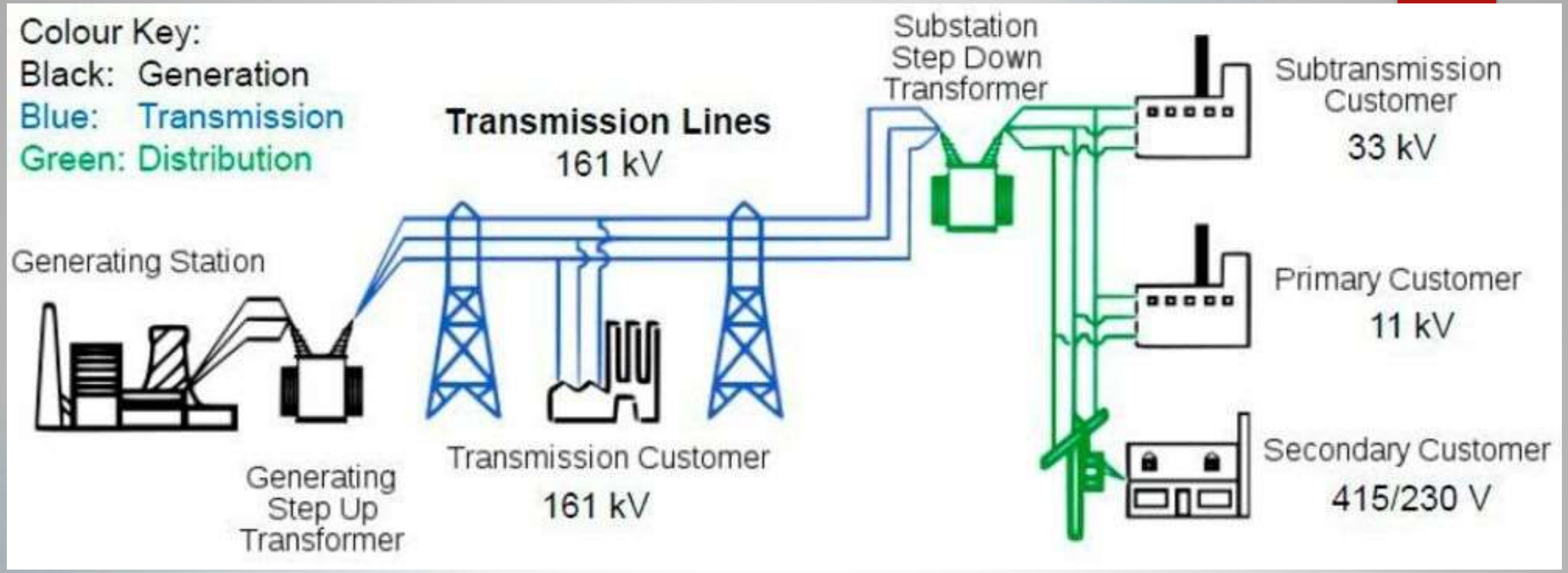
(a) Consumer has to pay the fixed charges irrespective of the fact whether he has consumed or not electrical energy.

(b) There may be errors in assessing the maximum demand of the consumer.

POWER TRANSMISSION AND DISTRIBUTION

Basics of an electrical power transmission system:

Electrical power transmission involves the bulk movement of electrical energy from a generating site, such as a power station or power plant, to an electrical substation where voltage is transformed and distributed to consumers or other substations. The interconnected lines that enable the movement of electrical energy are known as a “transmission network,” and these form an



Primary transmission: When it is generated at a power station, electrical energy will typically be anywhere between 11kV and 33kV. Before it is sent to distribution centers via transmission lines, it is stepped up using a transformer to a voltage level that can be anywhere between 100kV and 700kV or more, depending on the distance that it needs to be transmitted; the longer the

Reason:

(i) The reason electrical power is stepped up to these voltage levels is to make it more efficient by reducing the I2R losses that take place when power is transmitted. When voltage is stepped up, the current reduces relative to the voltage so that power remains constant, thus reducing these I2R losses.

(ii) This stage is known as primary transmission—the transfer of a large quantity of electrical power from the initial generating station to the substation via overhead electrical lines. In some countries, underground cables are also used in cases where transmission takes place over a shorter distance.

Secondary transmission and distribution:

(i)When electrical power reaches a receiving station, the voltage is stepped back down to a voltage typically between 33kV and 66kV. It is then sent to transmission lines emerging from this receiving station to electrical substations closer to “load centers” such as cities, villages, and urban areas. This process is known as secondary transmission.

(ii) When electrical power reaches a substation, it is stepped down once more by a step-down transformer to voltages closer to what it was generated at—usually around 11kV. From here, the transmission phase graduates to