Unit-5 Electrical Installation

Wire: It is defined as thick flexible piece with insulation or without insulation carries the electrical current is known as wire.

eg: Aluminium, copper

capable: It is defined as two or more insulated wire connected in a one part is known as capables.

classification of capables:

The classification of capables based on following groups

i) Types of material used in
   i) Aluminium conductor
   ii) Copper conductor

ii) The no. of core used in
   i) Single core capable
   ii) Double core capable
   iii) Three core capable
   iv) four core capable
   v) Two core with capable continuity

iii) Types of insulators used in
   i) PVC
   ii) Weather proof capable
   iii) flexible cord

iv) According to Voltage:
   i) No tension capable range is 1000 V
   ii) High tension capable range upto 11K
   iii) Super tension capable range 22-33 KV

iv) Extra high tension capable 33-66 KV
v) Extra super tension capable behind 132KV

Fuse: It is defined as short piece of metal in circuit to operate protection of over current is known as fuse

The classification of fuse:

The classification of fuse are classified into two type

i) Low voltage fuse
ii) High voltage fuse

Low voltage fuse are also classified into two types

i) Semi enclosed fuse
ii) full enclosed fuse

The full enclosed fuse are also classified into two types.

i) D-type
ii) Link type

The link type are also classified into two types.

i) Knife Blade
ii) Bolt fuse

High voltage fuse also classified into three types

i) liquid type
ii) expulsion type
iii) cartridge type

Capacity of Battery: It is defined the product of current and time is known as capacity of Batter. It is measured in Ampere-Hours of Batter.

$$\text{capacity of Battery} = I \times T$$

UPS: It is defined as a part of continuous Power supply without interuption is known as UPS. UPS stands for ~~uninterrupted power supply~~ uniterruptile power supply

The classification of UPS are divide into two types

i) Static UPS
ii) Hybride UPS.

The static UPS divided into two types

i) Online UPS
ii) Offline UPS

Application of UPS:

It is used in computers
It is used in Hospitals
It is used in Automobiles and Telephones exechanges

Battery: It is defined as electrochemical Power source which converts chemical energy into to electrical energy is known as battery.

This classified into two types

i) primary
ii) Secondary

The application of battery classified into 2 types
i) primary
ii) secondary

Application of Battery
i) It is used in industrial
ii) It is used in motar cars, Bikes
iii) It is used in phones, electronic devices.

factors of wiring system classified into
i) Types of material
ii) Types of load
iii) Quality of wiring system
iv) cost
v) further extension
vi) satty

Advantages of power factor improvement.
i) Reduce the voltage drop
ii) Increase the percentage of Voltage Regulation
iii) Efficiency of the system will be measured
iv) Reduce the for unit cost

Electrical energy Consumption: It is defined as utilizing of electrical energy is known as electrical energy consumption. It is measured in watt-hour

Bare conductor: It is defined as in electric conductor with out any insulation is known as Bare conductor.

Imp Types of Earthing

The classification of Earthing divided into 4 types

i) plate earthing
ii) pipe earthing
iii) strip earting
iv) Rock earthing

Batteries:

Batteries are electrochemical power source which converts ed. chemical energy into electrical energy is known as batteries.

The classification of batteries divided into two types

i) primary batteries.
ii) Secondary batteries

i) Primary batteries: It is defined as free energy which converts into electrical energy is known as primary battery

⇒ The primary batteries are not reachable and it is irreversible condition

⇒ In this type of batteries are most economically Lite weight and small size

⇒ The primary batteries Low cost, Low efficiency, Low power output and kess maintance

The several types of primary batteries.

i) carbon zinc
ii) zinc chloride
iii) Mercury cell
iv) Lithum cell
v) Silver oxide
vi) Alkane

Secondary battery: It is defined as storage of electrical energy or electrical current is known as secondary battery or Galvanic battery or storage battery

The secondary batteries are fully reachable and Reversible condition

This type of batteries most of large size, heavy weight

secondary batteries are high cost, high etticiency, high power output and high maintance

The several type of secondary batteries are

i) Lead-acid cell
ii) Nickel cadmium cell
iii) Nickel iron
iv) Nickel metal hydrate
v) fuel cell
vi) Lithum iron battery
vii) Stolau cell.

features of primary battery:

It is used in
→ Primary batteries are most economically
→ In this type of batteries are generate the electrical current and high energy density

Features of secondary battery:

The secondary batteries are fully rechargeable if the current discharging can be recharged

→ In this type of battery storage capacitance High.

Characteristic of battery:

i) capacity of battery
ii) Rate of discharge
iii) Temperature
iv) Density of electrolyte
v) Watt hour efficiency
vi) Amp-hour efficiency
vii) Battery life

i) capacity of Battery: It is defined as the Product of current and Time is known as capacity of battery

$$\text{capacity of battery} = I \times T$$

It is measured in Ampere-Hour

ii) Rate of discharge: It is defined as the current discharge from the battery is known as rate of discharge

The capacitor of battery is inversly proportional rate of dischaige. If the capacity of battery decreases and rate of discharge will be increases

$$\text{capacity of battery} \propto \frac{1}{\text{rate of dischaige}}$$

(iii) Temperature: In these characteristics are completely depends upon capacitor of battery. The capacity of battery is directly proportional to Temperature if the capacity of battery increases and temp also increases.

$$T \propto CB$$

(iv) Density of electrolyte: This condition also capacity of battery is directly proportional to density of electrolyte.

If the capacity of battery increases and density of electrolyte increases.

(v) Watt-Hour efficiency: It is defined as the ratio of output energy to input energy is known as watt-hour efficiency.

The mathematicaly expression of watt-hour efficiency

$$\eta = \frac{\text{o/p energy}}{\text{I/p energy}} \times 100$$

o/p = electrical energy discharging

I/p = electrical energy in charge

$$\% \eta = \frac{V_d \times I_d \times T_d}{V_c \times I_c \times T_c} \times 100$$

Based on the above equation the percentage of watt-hour efficiency is

Where V_d = discharging voltage

I_d = discharging current

T_d = discharging Time

V_c = charge voltage

I_c = charging current

V_c = charging Time

vii) Amp-Hour efficiency: It is defined as ratio of output amp hour to Input amp hour is known as Amp-Hour efficiency.

$$\%\eta = \frac{\text{output Amp-Hour}}{\text{Input Amp Hour}} \times 100$$

$$\%\eta = \frac{I_d \times T_d}{I_c \times T_c} \times 100$$

viii) Battery Life: The Life of Battery the storage of electrical current for many years stilith out any discharging current mainly depends on the materail i.e Nickel iron, Dead acid cell, Nickel cadmium.

Now-a-days used in quality of battery in industries and Domestic purpose.

Problems:

Q) A House has the following load

a) 5 lamps, 60W, each working per 8 hours a day.

b) 4 lamps, 100W each working per 8 hours a day.

c) 2 heaters of 1000w each working per 3 hours a day

d) 5 fans of 80w each working per 12 hours a days

Calculate the January bill of if the rate of charge is Rs 0.50 per unit add Rs. 10 as meter rent per month

S.No	Loads	Watts (W)	Quantity	Total watt (W)	Working Hours (T)	Total Energy
1	Lamp	60W	5	300W	8	2400 W/h
2	Lamp	100W	4	400W	8	2000 W/h
3	Heaters	1000W	2	2000W	3	8000 W/h
4	fans	80W	5	400W	12	4800 W/h

Total Energy = 15200 W/h
15.2 Kw/h

Total energy consumed in month January

$= 15.2 \times 31$

$= 471.2$ Kwh

Given data:

Unit last = 0.50 Paisa

Rent per month for monthly charge = 10 RS

Total bill of January:

= Total energy consumed in Jan x per unit cost + Monthly rate

$= 471.2$ Kw/h $\times 0.50 + 10$

$= 245.6$ RS

∴ Total Bill of January = 245.6 RS

9) Lead-Acid cell is charged at rate of 18 amps for 10 hours an average voltage 2.26 volts it is discharged in the same time at rate of 17.2A the average voltage during discharge 1.98V. calculate the i) Amp-hour efficiency

ii) Watt-hour efficiency

Given data:

$I_c = 18A$

$T_c = 10h$

$V_c = 2.26$

$T_d = 10h$

$I_d = 17.2h$

$V_d = 1.98V$

i) Amp-hour efficiency

$$\frac{I_d \times T_d}{I_c \times T_c} \times 100$$

$$= \frac{17.2 \times 10}{18 \times 10} \times 100$$

$$= \frac{172}{10} \times \frac{1}{18} \times 100$$

$$= \frac{1720}{18}$$

$$= 95.5\%$$

ii) Watt-hour efficiency

$$= \frac{I_d \times T_d \times V_d}{I_c \times T_c \times V_c}$$

$$= \frac{17.2 \times 10 \times 1.98}{18 \times 10 \times 2.26}$$

$$= \frac{172}{10} \times \frac{198}{100} \times \frac{1}{18} \times \frac{100}{226}$$

$$= \frac{34056}{40680} \times 100$$

$$= 0.837 \times 100$$

$$= 83.71\%$$

6) find the energy consumed in a house for a month of june if the load

a) 4 lamps, 100w each working per 6 hours a day

b) 1/2 HP single pump motar used per 4 hours a days

c) 2 heaters of 100w each ~~working~~ one for 2 hours and another used for 1 hour a day.

calculate the amount of bill cost of energy 65 paise

Note: 1/2 HP single pump motar used in 373 W and 1 HP single pump motar 746 W.

S.No	Loads	Watts (W)	Quantity	Total Watts	Working Hours	Total energy
1	Lamps	100 W	4	400 W	6	2400
2	HP	393 W	1	373 W	4	1492 W
3	Heaters	1000 W	1	1000 W	2	2000 W
4	Heater	1000 W	1	1000 W	1	1000 W

Total energy = 6892 W/h
= 6.892 Kw/h

Total energy consumed in month of June

= 6.892 x 30
= 205.860 Kwh

given data:

Unit lost = 0.65 Paise

Total bill of June = 205.860 x 0.65
= 134.394 Rs.

Q) Lead-acid cell maintain constant current 1.5A of 20 hours before it terminals voltage 1.8V calculate the capacity of cell

Given data

$I = 1.5A$

$T = 20$ hours

capacity of cell $= I \times T$

$= 1.5 \times 20$

$= \frac{15}{10} \times 20$

$= 30$ Amp-hour

Q) Lead-acid cell as 13 plates, each one 25cm x 20cm the clearance between the length of the plates 1.2mm. If the restivity of the acid 1.6 Ω/cm find the internal resistance.

Given data:

No. of plates = 13

Area of cross Section (A) $= 25cm \times 20cm$

$= 500 cm^2$

Length of plate (l) $= 1.2mm$

$= 0.12cm$

Restivity (ρ) $= 1.6 \Omega m$

$$R = \rho \frac{l}{a}$$

$$= \frac{1.6 \times 0.2}{500}$$

$$\boxed{R = 3.84 \times 10^{-4} \Omega}$$

* Q) The battery of 40 cells is to charge from 180V supply the internal resistance of each cell 0.05Ω and charging current 4A with average emf each cell during 2.5V. calculate the value of Series resistance

imp

Given data:

No. of cells = 40

Supply voltage = 180V

internal resistance (r) = 0.05Ω $\Rightarrow 40 \times 0.05$

$\Rightarrow 2\Omega$

current (I) = 4A

average emf = 40×2.5

= 100V

$$I = \frac{V - Ea}{R + r}$$

$$I(R+r) = V - Ea$$

$$R + r = \frac{V - Ea}{I}$$

$$R + 2 = \frac{180 - 100}{4}$$

$$R + 2 = \frac{80}{4}$$

$$R = 20 - 2$$

$$\boxed{R = 18\Omega}$$

Q) Three lamps of rating 100w, 200w, 300w and rated voltage 230V are connected in parallel across 200V supply. calculate the power flowing in each lamp

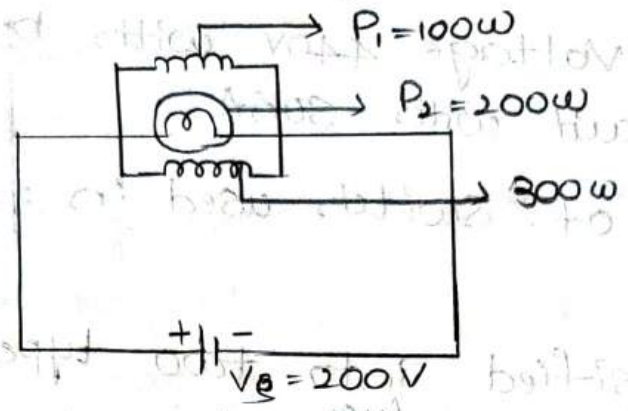
Given data

Three lamps rating = 100ω, 200ω, 300ω

Rate of voltage = 230V

Supply voltage = 200V

Power (P) = V × I



$P_1' = \frac{V_B^2}{R_1}$ $P_2' = \frac{V_B^2}{R_2}$ $P_3' = \frac{V_B^2}{R_3}$

calculating the resistence in each lamp

$R_1 = \frac{V^2}{P_1}$; $R_2 = \frac{V^2}{P_2}$, $R_3 = \frac{V^2}{P_3}$

$P_1 = \frac{(230)^2}{100} = 529\Omega$

$P_2 = \frac{(230)^2}{200} = 264.5\Omega$

$P_3 = \frac{(230)^2}{300} = 176.3\Omega$

Power blowing each lamp

$P_1' = \frac{(200)^2}{529} = 45.6\omega$

$P_2' = \frac{(200)^2}{264.5} = 151.22\omega$

$P_3^2 = \frac{(200)^2}{176.3} = 226.84\omega$

SFU (Switch fuse Unit)

⇒ This type of fuse form of integrated switch.

⇒ This type of switch two units are available in the circuit are 3 pole and 3-pole unit in circuit with rating of SFU thousand amperes.

⇒ The rated voltage 440V with breaking capacity of the circuit with 50KA.

⇒ This type of switch used in 3-phase supply only.

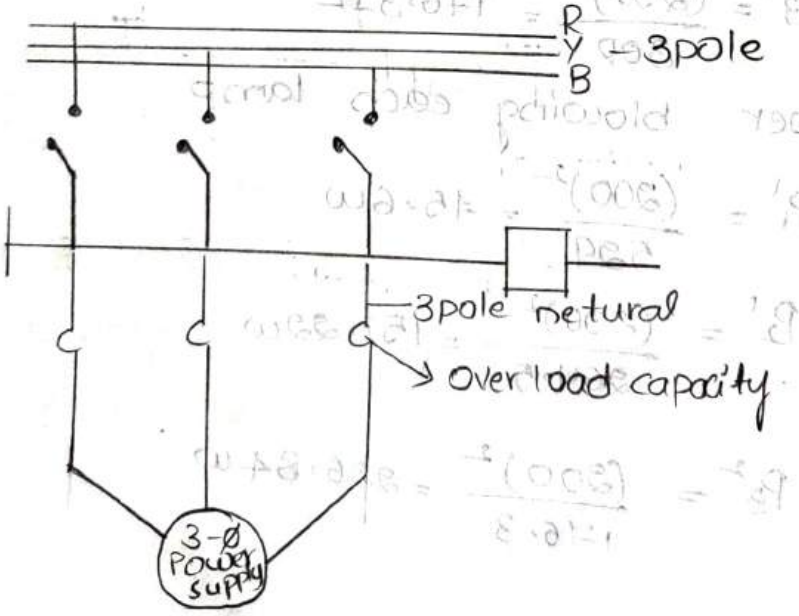
The SFU classified into two types:

i) SFU when the ~~force~~ fuse is constant

ii) SFU when the fuse is movable condition

Both units are uses the unit with ~~force~~ fuse stationary is more relable and unit with fuse movable condition less of electricial connection.

⇒ The 3-ϕ power motar used in ~~SFU~~ SFU as show in fig.



Application of SFU:

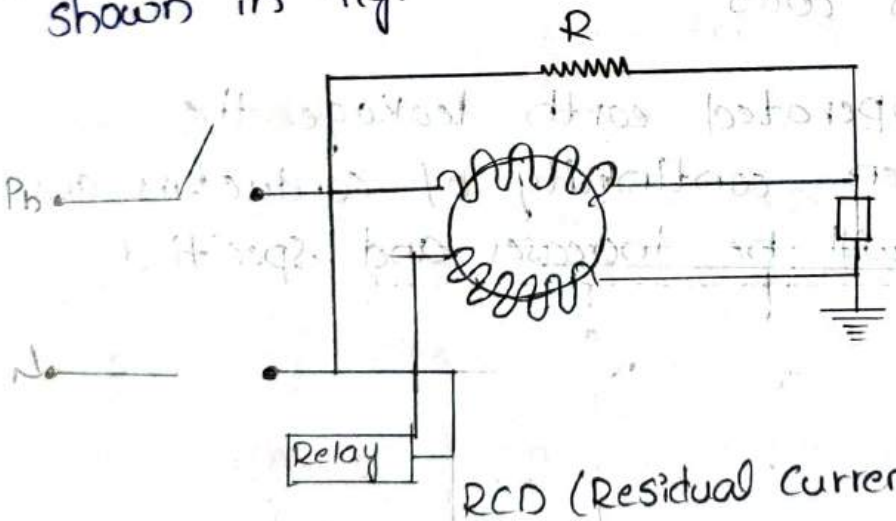
⇒ Residential
⇒ Agriculture
⇒ Industries.

Advantages of SFU:

⇒ It is less maintanance
⇒ Required space is less

ELCB [Earth leakage circuit Breaker] (or) Residual current Circuit Breaker.

⇒ It is residue current device.
⇒ this type of circuit Breaker design to provide Protection of earth leakage (or) electrical force
⇒ ELCB it is goes off condition when it is sense large leakage current in the circuit.
⇒ When RCD operating principle can be explain shown in fig.



RCD (Residual Current device)

⇒ It consisting of current transformer, relay and sensing coils
⇒ When operated RCD connected to supply and load.

⇒ The phase and neutral connected to load to Primary winding of transformer and secondary winding connected to relay which is used Sensing coils.

⇒ When phase & neutral current are equal and opposite direction then no generate current in sensing coils.

⇒ When phase and neutral current are not equal then flux is produced it should include current in secondary winding.

⇒ ELCB classified into two types
i) Current operated earth leakage trip.
ii) Voltage operated earth leakage trip.

⇒ The current operated in earth leakage used in 3-ϕ supply and three coils of current transformer is zero and no current flow in the trip coils.

⇒ The Voltage operated earth leakage the voltage between continuity of conductors and earth electrode will be increases and specified value.

Plate Earthing:

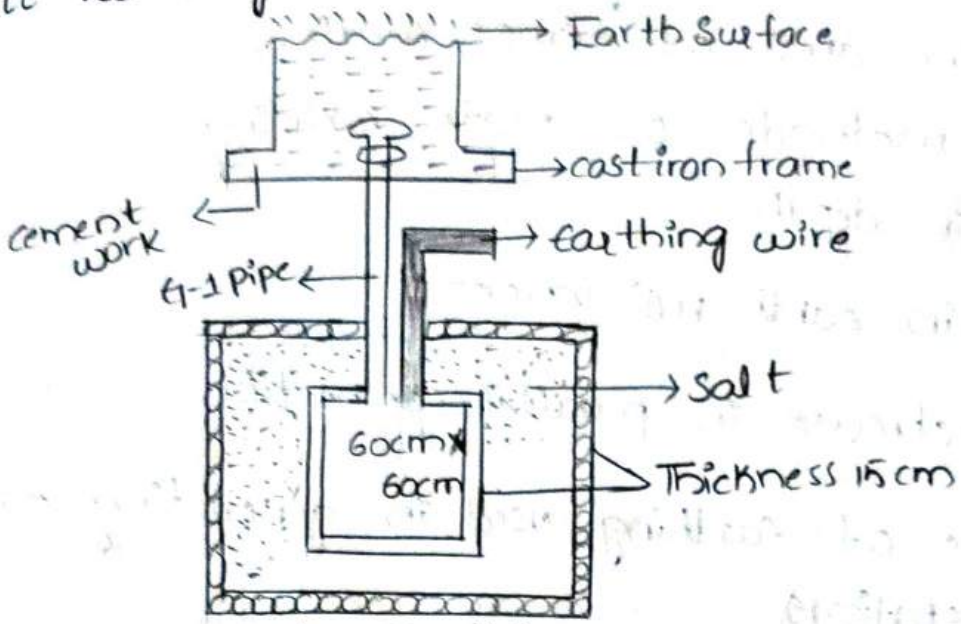


Plate Earthing

⇒ Plate earthing consisting of G-1 pipe (or) copper plate and earthing wire and charcoal & salt material and nut sand bolts.

⇒ The copper plate are efficient earth electrode and independent of soil moisture

⇒ The copper plate are inserted vertically into the bolt and plate is into the soil depth of as per requirement.

⇒ The depth is usually not less than 3 mts and alternate layer of salt and charcoal is arranged surrounding area of G-1 plate

⇒ Each layer minimum 15cm of thickness.

⇒ The mixture of charcoal and salt reduce the earth resistance.

⇒ The earthing wire inserted into the soil through G-1 plate and it is arranged 19 mm diameter and 60 cm into the soil

⇒ The earth efficiency will be increase with increase in area of cross section

Reducing methods of plate earthing

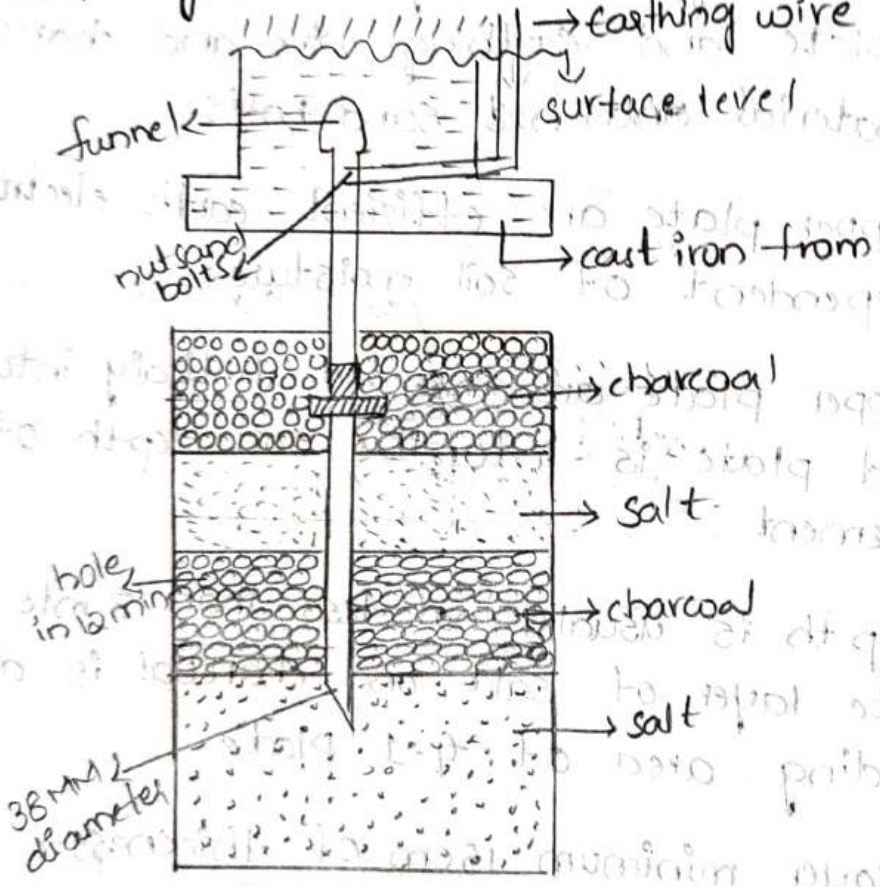
1) Increase in depth

2) Decrease in earth resistance

3) Earth electrodes in parallel connection.

⇒ This type of earthing used in generating stations and sub-stations

ii) Pipe Earthing:



Pipe earthing

⇒ Pipe earthing consisting of galvanic iron pipe in specified length and diameter

⇒ The mixture of charcoal and salt, nut and bolts and earthing wire pipe acts as a earth electrode

⇒ Pipe is a cross sectional area and large leakage current can be carried out and same

Size of electrode :

⇒ And 4-1 plate is inserted Vertically into the hole and alternater layer of charcoal and salt

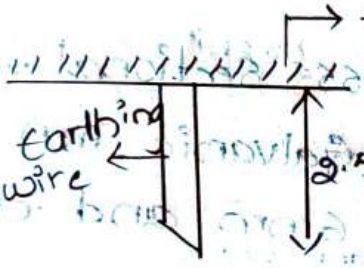
⇒ Depth in the hole 2.5 mts on earth surface.

⇒ The mixture of charcoal and salt improving earth efficiency and reduce the earth resistance.

⇒ The standard size of pipe 38mm diameter and hole in the standard size pipe 12mm.

⇒ The pipe earthing used in sand areas [outside building areas]

iii) Rod Earthing



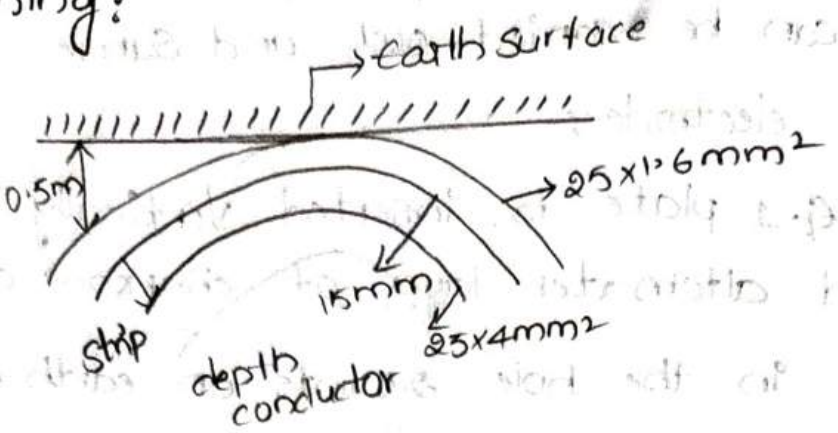
⇒ In this method of earthing Solid rod 12.5mm and diameter of solid rod 16mm and the depth in the soil of earth electrode 2.5 mts

⇒ Sometimes length rod will be increases and earth resistance decreases

⇒ This type of earthing used in sand areas.

⇒ This type of earthing method increase in cross sectional area and efficiency of earthing also increase and 4-1 plate inserted into the soil Vertically 25mm

1) Strip farthing:



⇒ Strip earthing is done an earthing wire is inserted horizontally this type of earthing complete opposite of plate and pipe earthing

⇒ The minimum depth of the soil in electrode 0.5m

⇒ If the copper plate used in the size of $(25 \times 1.6)mm^2$ and galvanic iron used in the size of $(25 \times 4)mm^2$.

⇒ The copper plate cross sectional area of diameter 3mm and galvanic iron cross sectional area of diameter 6mm and depth of the conductor used in 15mm.

⇒ The strip earthing used in rock areas.

⇒ Difference between MCB and MCCB

MCB	MCCB
1) MCB stand for miniature circuit beaker	1) MCCB stand for moulded case circuit beaker.
2) The rating of current MCB are 1 KA	2) The rating of current MCCB 3KA
3) It is used in 3-Ø 1-Ø supply.	3) It is used in only 3-Ø supp

The application of MCB domestic, lighting circuits.	The application of MCCB DC circuits, transformer distributed system.

MCB

⇒ It is electromechnical device and MCB stand for "miniature circuit Breaker."

⇒ It is used in only low voltages and current in the form of determine the values when the switch is automatically off then the current flow more than limited value

⇒ The normal current rating are available from 0.5-63A short circuit breaking capacity 3-10KA, rated voltage 230/440V.

⇒ MCB is designed to protect against overcurrent and over temperature fault.

⇒ There are two contact one is fixed and other is moveable

⇒ MCB turns off, there by stopping the current from flowing in circuit

⇒ It mainly consist of one bi-metalic strip; one trip coil and one hand operated on-off level

⇒ Electric current carrying path of MCB is as follows.

⇒ first left hand side power terminal then bimetallic strip then current coil then moving contact then fixed contact

⟹ Lastly right hand side power terminal, and all arranged in series

diagram

Application of MCB

1) Industries
2) Residential
3) Computers
4) Power loads
5) Refrigeneators
6) Lighting circuits

Advantages:

⟹ It is automatically switch is off protecting overload (or) short circuit condition.

⟹ It is quick idention of faults in the circuit at any time

⟹ No need of fuses, and no serving

diagram.

MCCB:

⇒ It is electromechanical device, it stands for moulded case circuit beaker.

⇒ In this type of circuit beaker which protect the overload capacity and short circuit connection.

⇒ In this type of circuit beaker switch off automatically then the flow of current more than limited value.

⇒ MccB is an alternative to fuse, since, it does not require replacement once an overload is detected.

⇒ MccB can be easily reget after a fault and offers improved opertional safety.

⇒ Molded case circuit Breakers generally have.

* Thermal element for over current
* Magnetic element for short circuit release which has to operate faster.

⇒ The MCCB are five major components.

1) Molded case (or) frame
2) Operating mechanism
3) Contact
4) Trip components
5) Arc extinguishers

The range of circuit breaken are available from 63A up to 3000A and rating voltage 440V with frequency 50Hz

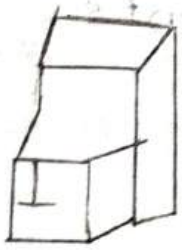
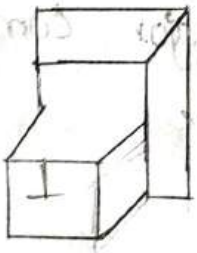
Diagram

Application

1) DC circuit
2) capacitor switching
3) Transformer distributed systems
4) Industries

Advantage.

1) This MCCB's are current falls in 1-ø occur and remaining phases are disconnected
2) This type of circuit breaker totally independent manual operation
3) The switching life is more


Advantages and Disadvantage of 3-ø transformer

Advantages:

1) Less cost
2) Less weight
3) Less size

4) Less time require to assembling
5) Require less space
6) Delieiver more power
7) Higher efficiency
8) Easier to install
9) Easy transportation and installation
10) Easy to repair
11) Easy assembling

Disadvantages

1) Greater cost of stand by units
2) Increased cost and inconvenience of repairs
3) Transformer still supply the power, while it is not possible in case of failing a three phase transformer.