CH-03 CHAPTER: 03

(INTERNAL WIRING)

General rules for wiring :-

1. To be protected near the point of entry of supply cables by a two pole linked main switch & fuse.
   - A 3pole switch and fuse unit is to be used in 3-phase supply.
   - No CB or fuse in neutral / earthed wire.
2. Conductor size depends upon the load current safely
3. The conductor installed is to be safe in all respects.
4. Every sub-ckt is to be connected to a distribution fuse board.
5. Every line is to be protected by a fuse of suitable rating as per requirements.
6. A switch board is to be installed so that its bottom lines 1.25 metres above the floor.
7. All incandescent lamps, unless otherwise required, are to be hung at a height of 2.5 meteres above the floor level.
8. Ceiling fan to be hung 2.75 metres above the floor.
9. Each sub-ckt is not to have more than a total of ten points of lights, fans & socket outlets.
10. No fuse or switch is to be provided in earthed Conductor.
11. Every apparatus is to be provided with a separate means of isolation such as a switch.
12. In any building, light and fan wiring and power wiring are to be kept separate.

13. In a 3phase, 4-wire installation the load is to be distributed equally on all the phase.
14. Metal sheath of conduit for all wiring & metal covering are to be properly earthed.
15. each sub-ckt is to be protected against excessive current by fuse or automatic CB.
16. All light conductors are to be insulated or otherwise safeguarded to avoid danger.
17. After completion of work the installations are to be tested before energisation.

Wiring Estimate:

a. Drawing Installation plan.
b. Calculations for total Connected load in amperes.
c. Selection and Rating of main switch and Sub-main switch.
d. Selection and rating of main distribution board.
e. Assumptions.
f. Calculations for Length of casing Capping or Conduit pipe

Stage-1 :- The conduit installed from switch boards upto horizontal run including from main switch or DB FOR HR.

Stage-II The Conduit on walls running parallel to floor. i.e The HR running below Ceiling.

Stage-III

The Conduit installed between HR and Ceiling and Ceiling to last point on HR.

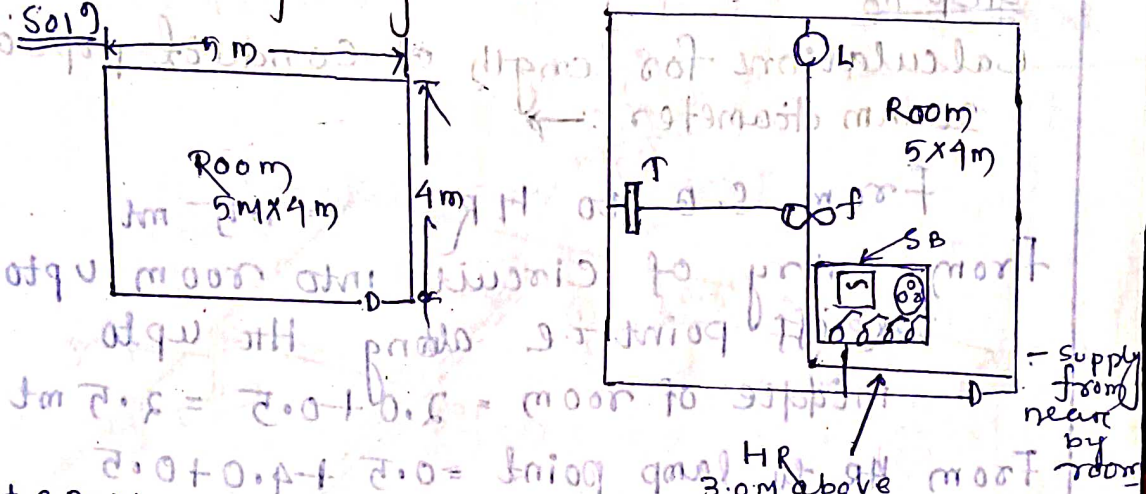
(g) Calculation for Length of phase wire & neutral wire

(h) Calculation for length of earth wire.

(i) Preparing Material Table.

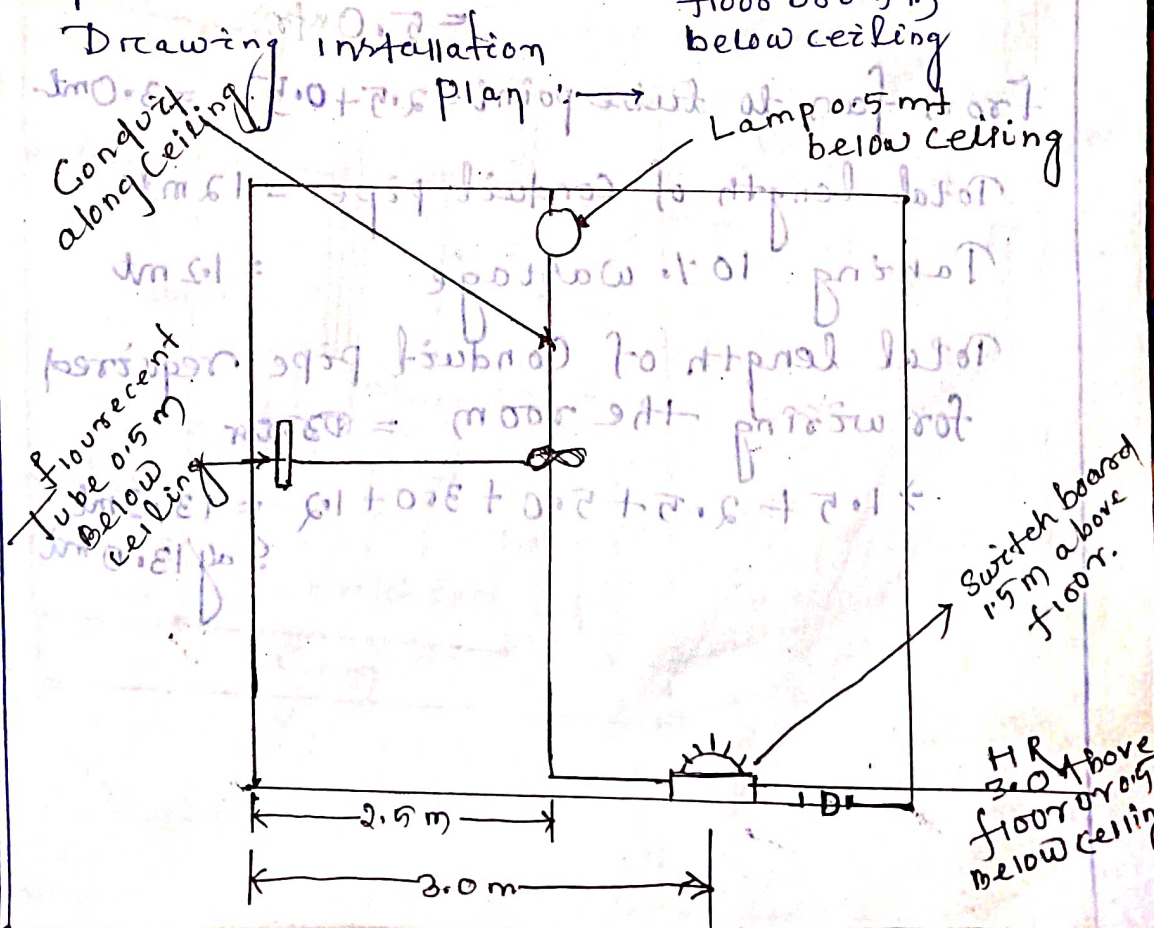
Example-01

The plan of a single room of size 5mt X 4mt given below the room is required to be provided with one lamp, one fan, one fluorescent tube and one 5 Amp socket outlet. Each of the points is controlled by its individual switch. Mark the location of the electrical points suitably and draw the installation plan. Also draw the wiring diagram. Calculate the total length of wire & other material & prepare complete list of material required for wiring the room. in Concealed steel conduit system of wiring. No main switch is to be provided as the entry of the sub-ckt. is from the adjoining room.



Step-01

Drawing installation plan:→



Step-02 Assume:—

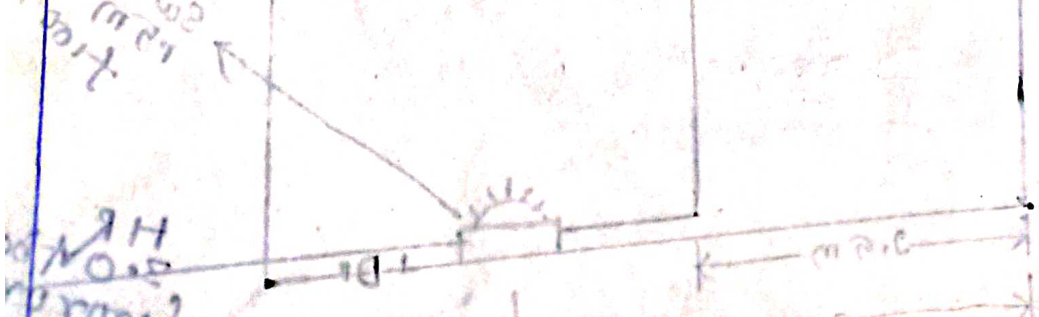
a. Total height from floor to ceiling - 3.5 mtr.
b. Height of horizontal run from floor - 3.0 mtr
c. Height of switch board from floor - 1.5 mtr
d. Light and tube points from ceiling - 0.5 mtr
e. HR: conduit ~~wiring~~ running parallel to floor half metre below ceiling.
f. VR: wires or conduit running between switchboard and HR.

Step-03

Calculations for length of conduit pipe of 20 mm diameter :→

From S.B to HR = 1.5 mt
From entry of circuit into room upto take-off point i.e along HR upto middle of room = 2.0 + 0.5 = 2.5 mt
From HR to lamp point = 0.5 + 4.0 + 0.5
= 5.0 mtr
From fan to tube point = 2.5 + 0.5 = 3.0 mt.

Total length of conduit pipe = 12 mts
Taking 10% wastage = 1.2 mt
Total length of conduit pipe required for wiring the room = ~~13.2~~
→ 1.5 + 2.5 + 5.0 + 3.0 + 1.2 = 13.2 mt
Say 13.0 mt



Step-04 Calculation for Length of phase wire

from point of entry of ckt into room upto

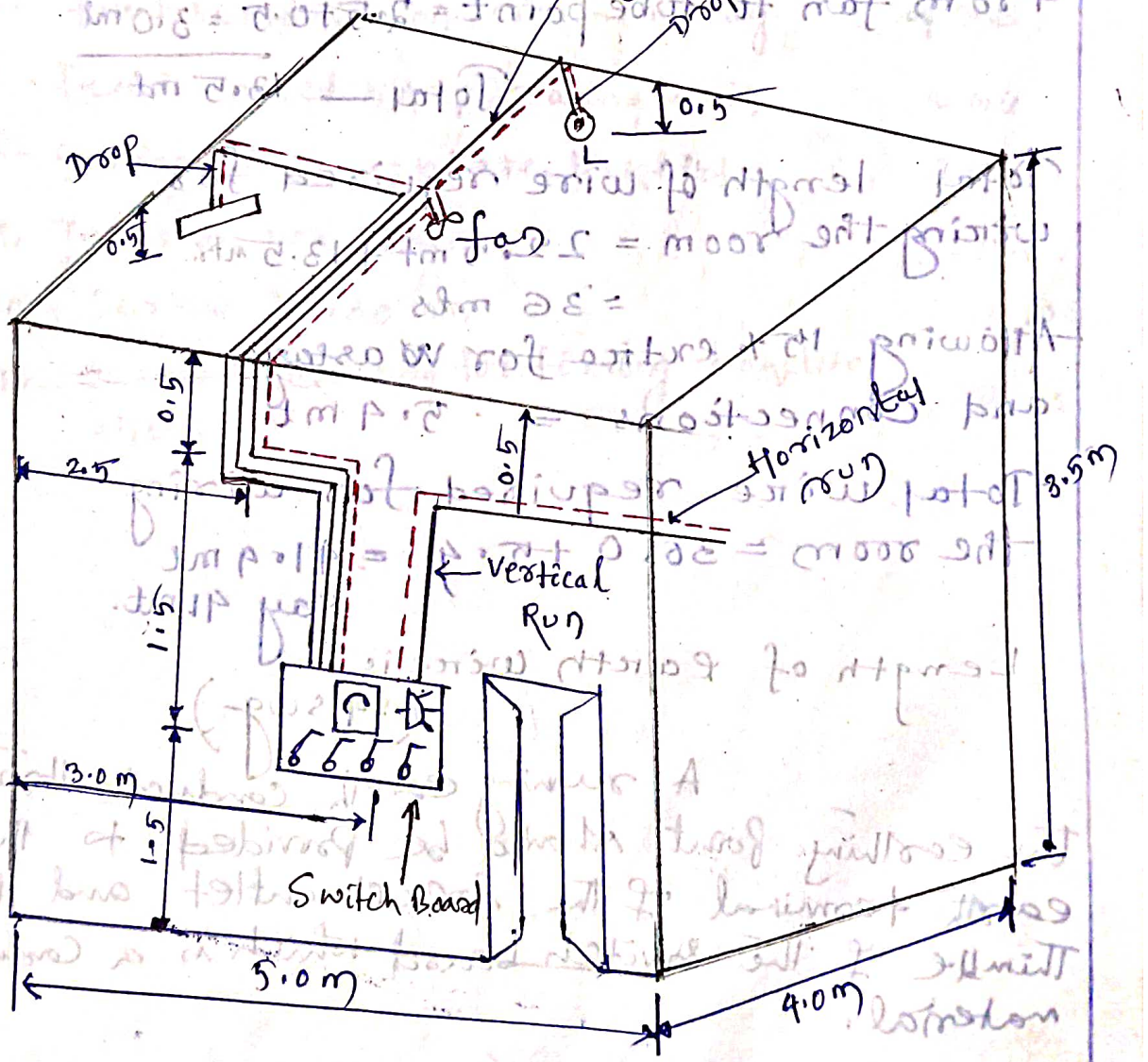
SB = 2.0 (HR) + 1.5 (VR) = 3.5 mt

From SB upto fan = 1.5 + 0.5 i.e from top point of VR upto start of rise + 0.5 + 2.0 along Ceiling upto fan = 4.5 mt

From SB to lamp = 4.5 (upto fan) + 2.0 + (0.5) drop = 7.0 mt

From SB to tube point = 4.5 upto fan + 2.5 along ceiling + 0.5 drop = 7.5 mt

22.5 mt.



Step:- 05

Calculation for length of neutral wire :-

(The neutral wire is shown in dotted line on the isometric view of the room)

- from point of entry of Ckt into room upto switch board = 2.0 along HR + 1.5 (RS) = 3.5 mt

- From SB to fan = 1.5 + 0.5 + 0.5 + 0.2 along ceiling = 4.5 mt.

- from SB to fan = 0.5 + 2.0 (along ceiling) = 2.5 mt.

From fan to tube point = 2.5 + 0.5 = 3.0 mt

Total — 13.5 mt

Total length of wire required for wiring the room = 22.5 mt + 13.5 mtr. = 36 mts

Allowing 15% extra for wastage and connections = 5.4 mt.

Total wire required for wiring the room = 36.0 + 5.4 = 41.4 mt Say 41 mt.

Length of earth wire is (14 swg)

A running earth conductor through the earthing point should be provided to the earth terminal of the socket outlet and the Thimble of the switch board which is a conducting material.

Material Table.

1.	Steel Conduit pipe 20mm dia black enamel, light gauge	13 mt
2.	PVC insulated, aluminium Conductor, single Core, 250 volt grade wire of size 1.5 mm^2 or 1/1.40 mm dia	41 mt
3.	Earth wire 14 SWG. GI	0.25 mt.
4.	Iron clad, Concealed type, Switchboard with bakelite Sheets 20 cm x 25 cm	1 NO
5.	conduit pipe accesories for 20mm dia CKt 1, 2, 3 way junction box.	2, 1, 2 NOS
6.	flush switch, 5 amp, rating one way	4 NOS
7.	Flush Socket 5 Amp, rating 3 pin	1 NO
8.	Ceiling roses, 2-plate, bakelite	2 NOS.
9.	Junction box covers,	2 NOS.
10.	Screw 25/30 mm	10 NOS
11.	Screw 15 mm long for fixing bakelite Sheets.	8 NOS.

Overhead Installations :→

↳ The maximum generation voltage in advanced Countries is 33 kV while that in India is 11 kV.

↳ The primary Transmission 220-765 kV depends upon the distance, the amount of power to be transmitted and System Stability.

↳ Distribution system may further be divided into feeders, distributors and Servicemains

Main components of an overhead line are enlisted →

1. Supports :→

→ The function of line support is obviously to support the Conductors so as to keep them at a suitable level above the ground.

2. Cross arms and Clamps :→

These are either wood or steel angle. Section and are used on pole structures. to support the insulators and Conductors.

3. Insulators :→

Pin, Strain or Suspension type, as the case may be for supporting the conductors and taking strain or suspending the Conductor respectively.

4. Conductors :→

- Copper, aluminium or ACSR of any other Composition depending upon the current to be carried and the span of the line

Guys and Stays :-
Brass or cables are fastened to the pole at the termination or angle poles to resist lateral forces.

6. Lightning Arrestors →
To discharge excessive voltages, built upon the line to earth due to lightning.

7. Fuses and Isolating Switches.
To isolate different parts of the Overhead System.

8. Continuous earthwire →
- Is run on the top of the towers to protect the line against lightning discharge

9. phase plate :→
- In order to distinguish the various pole.

10. Danger plate.

11. guarding of Overhead line.

12. Anticlimbing Device

13. Jumpers.

14. Corona rings.

15. Barbed wire :→ Barbed wire is wrapped on a pole at about 2.5 m from the ground for at least 1 metre.
- The prevents climbing by unauthorised persons

16. Bird Guards :→
A stick of ebonite with rounded top is fixed near the insulator on the cross arm to prevent flash-over due to birds perching on the conductors.

Rail pole:-

↳ The rail pole are used where the area is of natural Calamelic area.

↳ It is placed in gap of 75 m to 250 m.

Tubular steel pole:-

↳ The tubular steel poles are placed between 50 m to 200 m gap.

↳ Tubular steel poles are made of Corrosion free.

Lattice steel pole:-

Lattice steel pole is generally used in 33 KV overhead lines & the gap is 100 to 300 mtr.

Concrete pole:-

↳ Concrete pole are 2 types.

1. RCC pole.
2. PCC pole.

↳ RCC (Rainforced Cement Concrete)

↳ PCC (Plane Cement Concrete)

↳ In case of estimation the RCC gap is taken as 125 m & PCC as 75 m.

↳ Tubular poles are I, A, H shapes.

↳ Rail poles are H, A shapes.

↳ Lattice poles are also H & A Types but with more cross section.

↳ RCC pole are used 11 KV supply with the average distance of 200 to 500 m.

→ PCC pole are used to supply household which are placed in distance of 100 to 400 mtr.

Cross-Arms :→

↳ Cross arms may be steel & wooden.

↳ which provides support to the wiring Insulation.

→ There are 3 types.

1. Wooden Cross arm.
2. V-shape Cross-arm.
3. U-shape Cross arm.

A Overhead Line uses 33KV uses Lattice Steelpole which cost 3000 perpole and installation cost is 500 per 100 MTR. The bracket cost 70 rupee per piece clamps. Cost 20 per piece the conduction wire cost is 3 rupee per mtr. and the wire is combination of Cross 10 wire find an estimation for installation of 10km

Solution

Braker = 3

Clamp = 6

No of pole = 200 = 1

~~1~~ ~~200~~

$\Rightarrow 10000 \times \frac{1}{200}$

$\Rightarrow 50$

Pole cost = 3000

Pole Cost per pole = 50 X 3000

= 150,000

Labour Installation →

1000 x 50 = 50000

Cable Installation → 100 mtr = 500

$\Rightarrow 1 = \frac{500}{100}$

$\Rightarrow 10000 \times \frac{500}{100}$

$\Rightarrow 50000$

$\Rightarrow 50000 \times 3 = 150000$

Braket → 3 x 50 = 150

Bracket Cost 70 rupee = 150 x 70

= 10500

Clamp = 6 x 50 = 300

clamp cost 20 per piece = 20 x 300

= 6000

1m = 30

$\Rightarrow 10000 \times 30 = 300000$

Conduction wire cost is 3 rupees/metr.

⇒ 300000 x 3 = 900000

Total estimation = 150000 + 50000 + 150000 + 10500 + 6000 + 900000 = 1266500

CHAPTER: 05

Overhead service lines :→ Ch-05

Components of service lines →

Conductor :→ Aluminium conductors of diff types and sizes are used for drawing overhead lines, whether they are HT or LT lines.

AAC - All Aluminium Conductors :→

→ This type of conductor is made up of one or more strands of hard drawn 1350 aluminium alloy

→ It used in low & high voltage overhead line.

→ AAC is used extensively in urban areas where spans are usually short but high conductivity is required.

ACSR - Aluminium conductors steel reinforced

→ It is a type of high-capacity, high-strength stranded conductor typically used in overhead power lines.

→ Its excellent conductivity, low weight and low cost.

* AAAC :→ All Aluminium Alloy Conductors →

→ These conductors are made of high strength Aluminium Magnesium-Silicon alloy.

→ These conductors are designed to get better strength to weight ratio and offer improved electrical properties, excellent sag-tension characteristics and superior corrosion resistance when compared with ACSR.

Cables :→

→ Electrical cable and wires are considered as a same thing, in fact they are quite different.

Bearer Wire :→

Bearer wires shall be described either in length or weight stating Cross Sectional area in square millimetres.

→ Metallic bearer wire used for supporting insulated wire of low and medium voltage overhead lines should be efficiently earthed or insulated.

Lacing rod :→

→ Lacing rod to help apply strapping underneath pallets.

→ This tool slides into strap dispensers to easily and quickly feed strapping underneath large loads.

Aerial fuse :→

→ It is used to every field of constructions either a house or pole or any commercial buildings required this fuse.

→ It act as a ckt protectors which control the flow of electricity. It's a stabilizers for the electricity consumption of a buildings.

Service support :→

→ The different types of structure used for supporting the overhead lines or wires, such types of structures are called line supports.

→ It also maintained the specified ground clearance. These clearance are decided by the electrical and mechanical considerations

Energy Meter :→

→ The meter which is used for measuring the energy utilizes by the electric load is known as the energy meter.

→ It is used in domestic and industrial AC ckt for measuring the power consumption. The meter is less expensive and accurate.

Energy Meter Box :→

→ For billing purposes, electric utilities use electric meters installed at customers land to measure electric energy delivered to their customers.

→ Every home or office contains electric meter and the electric meter are usually placed in the meter box.

→ The meter box is usually mounted on the wall of the premises.

CHAPTER: 06

CH.06

Estimating for distribution Substations:-

→ In the present day, electrical power is generated, Transmitted and distributed in the form of alternating current.

→ The place where stepping up and stepping down of Voltage is done is known as "Sub-station".

Classification of sub-stations:-

The sub-stations can be classified in several ways. The two important ways of classifying the sub-stations.

According to Service requirement:→

1. switching Sub-stations.
2. Transformer Sub-stations.
3. power factor Correction Sub-stations.
4. frequency Changer Sub-stations.
5. Converting sub-stations.
6. Industrial sub-stations.

According To design or Constructional features →

1. Indoor Sub-stations
2. Outdoor Sub-stations
3. Underground Sub-stations.
4. pole mounted & plinth mounted sub-stations

Main Components of pole or plinth mounted sub-stations.

1. pole →
   • The poles may be of steel or pcc type having a length about 8m to 12m.

In pole mounted sub-stations the Transformer is erected on mild steel Channel of H-type or 4-pole structure.

2. plinth
Transformers of capacity more than 250KVA are placed on plinth. The plinth is constructed with bricks or stones.

3. Transformer: →
→ It is generally called as distribution Transformer.
→ It is a 11KV/400V step-down transformer.

4. Insulators: →
Generally this sub-station is located at dead end of 11KV, hence 11KV disc insulators are used to connect 11KV line

5. Cross-arms: →
→ Different sizes of mild steel Cross arms are used to erect disc, insulators, gang operating switch, horn gap · fuse etc.

6. Fuses: →
→ Horngap fuses are provided on 11KV side, where as open type rewirable fuses are used on 400V LT side

gang Operating switch or air breaan switch →

- It is used to switch ON and off 11 KV line.

Core Cable →

The o/p of distribution transformer is Connected to L.T line through 3½ Core aluminium Conductor armoured 1100 V grade pvc Cable.

Stays →

At lease 2 stay sets are provided to support poles.

Distribution Box: →

The L.T Supply of distribution Transformer is fed through distribution box which Consists of fuse unit.

Jumpers →

- These are used to Connect 11 KV lines. generally ACSR Conductor is used for this purpose.

Construction of pole-mounted sub-station :→

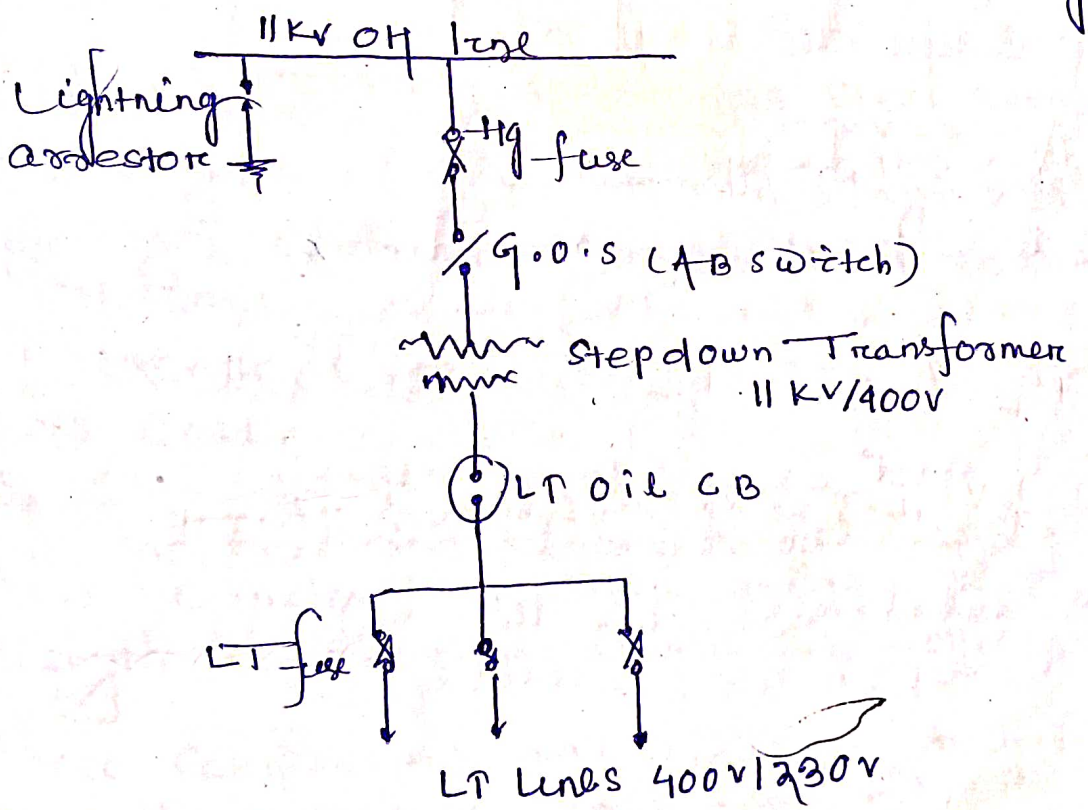
→ This type of sub-stations are erected for distribution of power in localities.

→ These are cheap, simple and smaller in size.

⇒ The transformer is of step-down type which stepdowns 11KV into 400/230V.

→ A gang operating switch is used for switching ON and OFF of H.T (11KV) line.

→ The sub-station is earthed at two or more places. The oil CB installed in the L.T side automatically cuts of the Transfer from the consumers in the event of any fault.



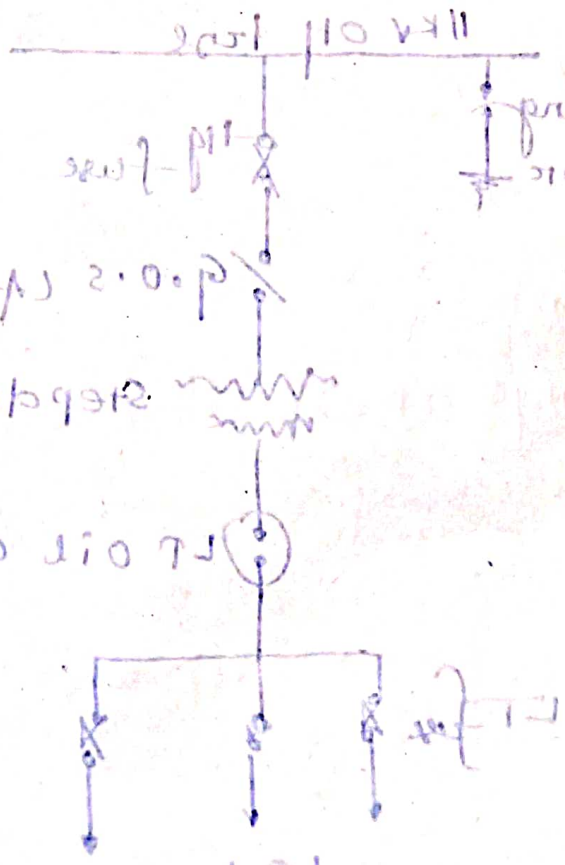
(Shematic diagram of pole-mounted Sub-station)

Plinth Mounted sub-station ⟹

→ The Transformers of capacity above 250 KVA are heavy in weight and will not suitable for mounting on H-type structure.

→ All the equipment and accessories are arranged on a LT pole. Sometimes two poles can be used for feeding two LT lines.

→ The plinth is built with bricks or stones with cement concrete and Transformer is located on a plinth, hence the name plinth Mounted sub-station. It is also called as Foundation Mounted Substation.



Schematic diagram of pole-Mounted sub-station