LECTURE NOTES

ON

ELECTRICAL INSTALLATION & ESTIMATING

Name of the course: Diploma in Electrical Engineering.

(6th Semester)

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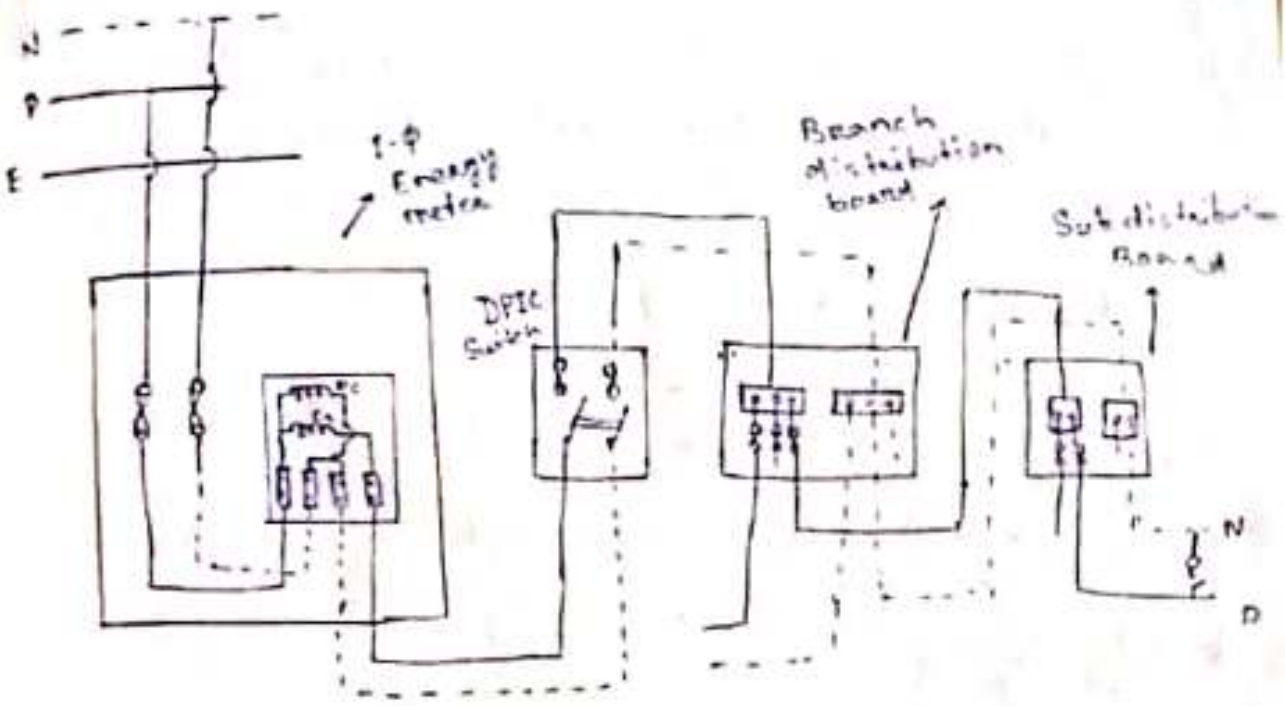
Wiring System



The network of wires connecting various accessories for distribution of electrical energy from the supplier meter board to different electrical consuming devices such as lamp / light, fans and other domestic appliances through controlling safety devices is known as wiring system.

* Internal Distribution of electrical energy :-

As per the indian standard maximum no. of points of light, fan and 5A socket outlet that can be connected in one subcircuit is equals to 10 points.

(ii) maximum load is 800 watt.

★ Distribution board System :-

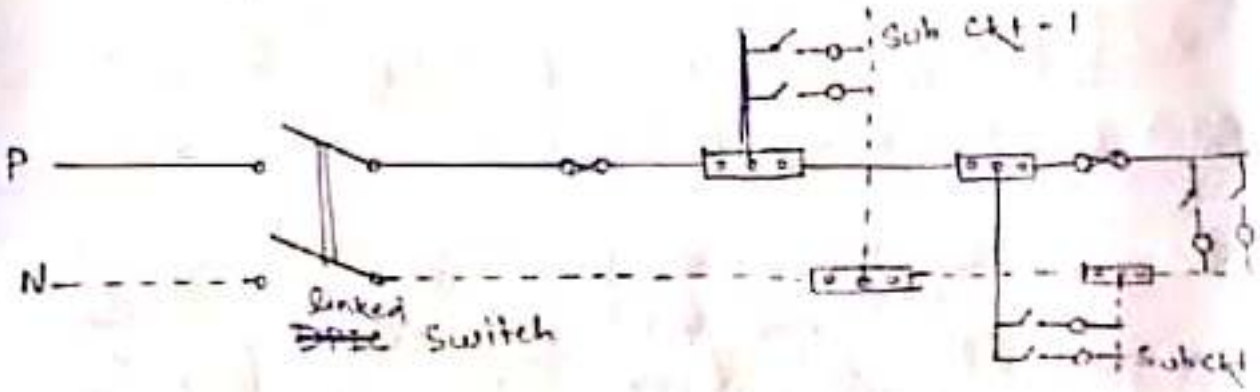
In a distribution board the loads are connected in such a way that total cost of installation will be minimum.

Fluorescent lamp - 40 watt

Incandescent lamp, Fan, Socket - 60 watt.

Power Socket - 1000 watt

★ Tree System :-



→ Smaller branches are taken from main branch

→ It resembles like a tree.

→ Each phase is connected with fuse.

Drawback :-

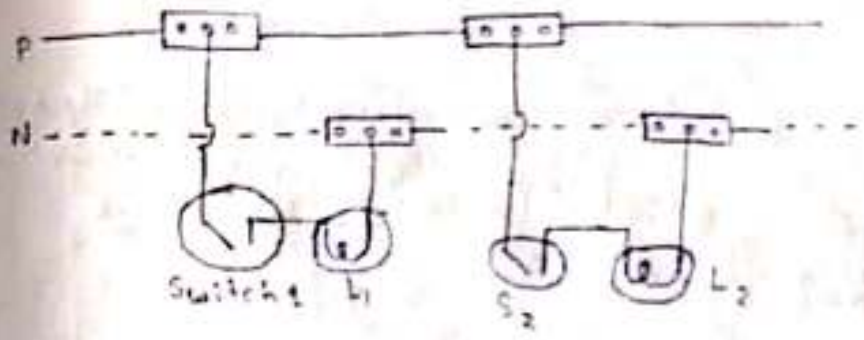
→ ΔV drop is not same (difference between receiving end volt and sending end volt)

→ More no. of joint

→ In case of fault a lot of difficulties are to be faced

Methods of wiring

joint box or Tree system.



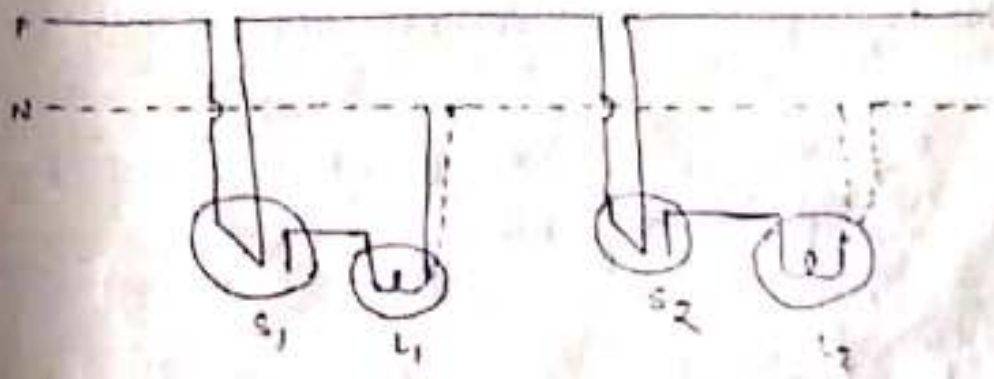
The connection to the lamp are made through joint boxes by means of switch & connector or joint cut out.

Advantages and Disadvantages :-

→ Cable will be saved.

→ Extra joint boxes are required with the system.

Loop in wiring.



Advantages :-

→ joint boxes are not needed.

→ No joint box concealed beneath the floor.

→ Easy repairing

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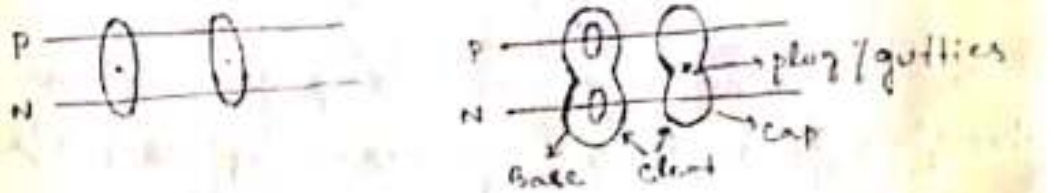
Disadvantages :-

→ Length of cable or wire require is more.
→ voltage drop is more.
→ more copper loss.

System of wiring [There are various types of internal wiring employed for transmission of electrical energy such as

1) Cleat wiring :-



→ In this system of internal wiring the cable are VIR (Vulcanised Indian Rubber). PVC (Poly vinyl Chloride)
→ The cable are held by porceline cleat.
→ cleat are made up of two halfs one is base and another one is cap.
→ The base is grooved to carry the conductor or cable and the cap is put over it. and the whole is screwed on wooden plug or gutties.

Advantages :-

→ It is a cheapest system of wiring.
→ Skill required is very less.

Disadvantages :-

→ It is not good looking.
→ The wire is exposed to mechanical stress.

Field of application :-

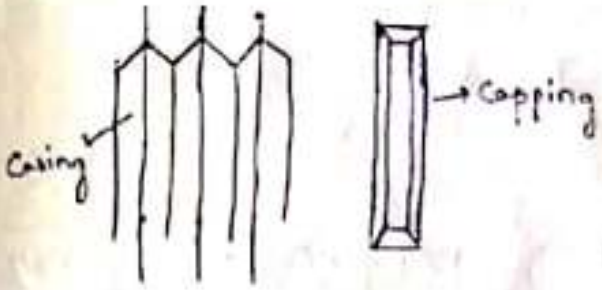
→ Suitable for temporary installation.

Precaution :-

→ Proper type of cleat should be used.
→ Cable must be laid stretch between the cleat so the

there is no contact with wall.

2. Wooden casing capping wiring :-



→ The cable used in this type of wiring are either VIR or PVC type.

→ The cable are carried through wooden casing enclosed.

→ The casing consists of V shaped groove [usually to hold the cable of opposite polarity]

→ It is covered at the top by means of rectangular strip of wood known as capping of same width as that of casing.

Advantages :-

→ Easy to install and Re wire.

→ Provide good insulation conductor are good distance apart.

Disadvantages :-

→ There is a risk of wire.

→ Labour cost is higher

→ This type of wiring can't be concealed in plastered plaster.

Field of application :-

→ Used in low voltage domestic installation.

Precaution :-

→ If no case, cable of opposite polarity should run on same groove.

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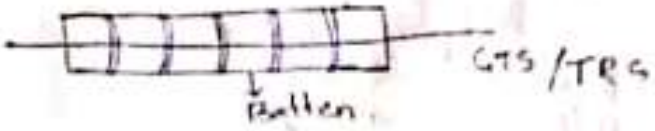
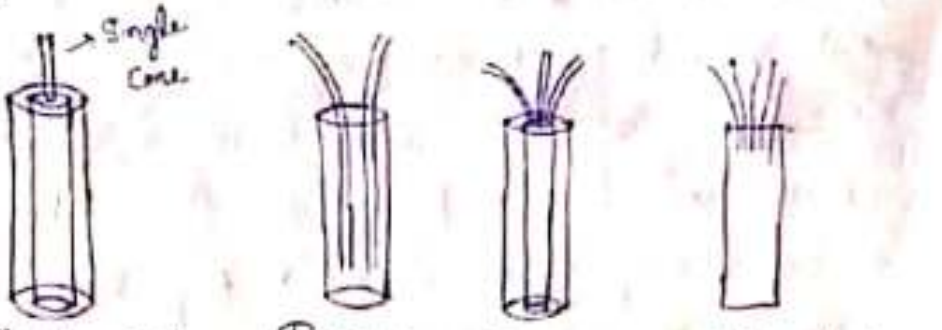
3. CTS / TRS wiring :-

CTS → cab tyre sheathed.

TRS → Tough & Rubber Sheath



→ In this type of wiring the cable is used may be single core or twin core.



→ TRS cables are circular.

→ Cables are chemical proof and water proof.

→ TRS cables are Run on perfectly straight and co. Varnished [gray colour] Teak wood batten of thickness 10 mm at least.

→ The width of the batten depend upon the numb. and size of cable to be carried through it.

→ Ex :- Width may be 13 mm, 19 mm.

Advantages :-

→ wiring life is very long.

→ within a certain limit, it is fire pr

Disadvantages :-

→ skilled labour is required.

Field of application:-

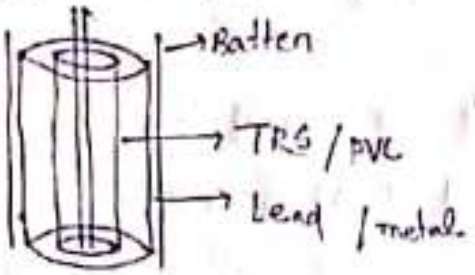
This type of wiring is suitable for low voltage installation.

Precaution:-

→ The batten should be well varnished [no moisture]

→ The end of the cable must be shield with compound or cap in damp situation.

4. Lead sheathed / metal sheath wiring :-



→ In this system of wiring the cable used are insulated wires of TRS or PVC with an outer covering of sheath of lead or alluminium alloy [Containing about 95% lead]

→ It gives protection to the cable from mechanical stress, dampness, atmospheric corrosion.

→ It runs on straight teak wood batten of thickness not less than 10 mm.

Advantages:-

→ Can be used in a situation exposed to rain and sun provided no joints are exposed.

Disadvantages:-

→ cost of wiring is high.

Field of application:-

Wiring is suitable for low voltage application.

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Precaution :-

The support must not be such a material that may Recot chemically with the sheath.

5- Conduit wiring :-

→ In this system of wiring steel tubes known as conduit are installed on the surface of wall by means of saddle / pipe necks or concealed under the plaster.

→ VIR / PVC cable are used or drawn by means of GI [Galvanised Iron] wire.

Advantages :-

→ It provides protection against mechanical damage.

→ The whole system is water proof.

Disadvantages :-

→ Costly system of wiring.

→ Experienced and highly skilled labour is requires

Field of application :-

Domestic wiring and in workshop for lights and motor wiring.

Precaution :-

→ Special care should be taken so that no moist can enter to the joint box.

→ Over loading of cable should be avoided in conduit.

* Types of Cable used in internal wiring :-

The wire used for internal wiring of building may be divided into different groups according to the Conductor used.

Ex:- Copper Conductor, Alluminium Conductor.

→ According to the No. of cores :-

According to the no. of cores the cables are divided into 3 parts. (i) Single core
(ii) Two Core
(iii) 3 Core.

and Twin core with earth continuity conductor.

→ According to the voltage rating the cable may be divided into 2 class. (i) 250/440 V
(ii) 650/1100 V

250 V → Phase to earth
440 V → Phase to phase

→ According to the types of insulation the cables are following types.

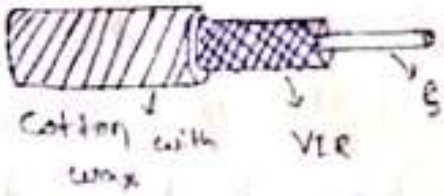
(i) Vulcanised Indian Rubber (VIR) :-

→ VIR are available in 240/415 grade and 650/1100 V grade.

→ VIR Cable consist of either tinned Cu. Conductor with a layer of VIR insulation.

→ Over the rubber insulation Cotton tape sheathed covering is provided

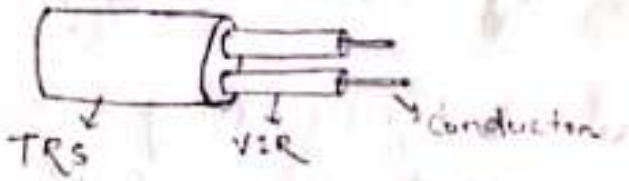
with moisture resistance compound bitumen way.



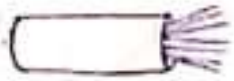
(ii) TRS / CTS Cable :-

→ This cables are available in 250 / 440 V and 650 / 1100 V grade.

→ In TRS Cable the inner insulation is VIR with outer cover is top rubber



(Twin core single stranded TRS Cable)



7 stranded Conductor.

Skin Effect -

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The voltage grade is expressed in a following form. [V_0/V]

Where V_0 = power frequency voltage between phase and earth in RMS value.

V = power frequency voltage between two phase conducton represented in RMS value.

(iii) Lead Sheathed Cable :-

The Lead sheathed cable is a VIR insulated conducton covered with continuous sheath on lead.

(iv) PVC insulated Cable :-

The conducton with insulation PVC only.

(v) Wheather proof cable :-

This cable are either PVC insulated or VIR insullation conducton suitably taped and braided and then compounded with wheather resisting material.

(vi) Flexible cord Cable :-

The flexible cord Cable consist of wire covered with silk or cotton or plastic.

(vii) XLPE cable :-

PVC and XLPE cable are basically built of insullation cable made up of polymer.

Advantages of multistrand cable

→ The multistrand cables are flexible or durable

→ The surface area of multistrand cable is more as compared to equivalent single solid conductor

→ Skin effect is better as the conductor are tubular especially in case of high frequency

General specification of cables :-

1. Size of the cable in matrix system.

19/224 (19 - no. of conductor
224 - cross section of conductor m^2 / diameter)

2. Types of conductor used. Ex :- Cu. or Al.

3. No. of core that cable consist of

Ex :- single core, Twin core, Twin core with ECC (Earth Continuity conductor

4. Voltage grade. Ex :- 240/440 V, 650/110

5. Types of cable with clear description of regarding insulation shielding, armouring and braiding.

Main switch rating :-

Accessories :-

1. Main switch and distribution board.

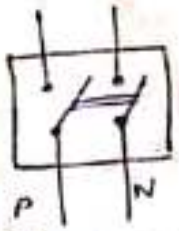
→ As per the indian electricity rule 50A, suitably linked switch is provided immediately after the main board.

→ A suitable ~~con~~ cut out must be provided just after the linked switch to protect the circuit against excessive current.

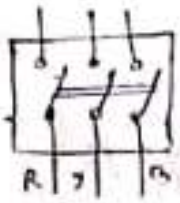
Types of linked switch :-

DPIC (Double Pole Iron Clad)

For controlling single phase two wire circuit.



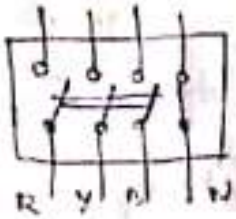
DPIC Switch



TPIC switch.
(Triple Pole Iron clad)

→ TPIC is used for controlling 3-φ, 3 wire circuit.

→ TPNIC (Triple Pole with Neutral link Iron clad)



Iron clad.

→ It is used for 3-φ, 4 wire ckt

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The specification of IC switch fuse units are given below.

→ For 2 wire DC ckt or 1-φ AC ckt :-

240 V, 16 Amp, DPIC switch fuse of any in approved by IS (Indian standard)

→ For 3 wire DC ckt :-

500V, (63/100/150 Amp) or higher Amps. IS approved TPIC switch.

→ For 3 ph. balanced load ckt

~~500V~~ 415 V, (32 Amp / 63 / 100 / 150 Amp) IS approved TPIC switch.

→ For 3 ph., 4 wire ckt :-

415 V, (32 Amp / 63 / 100 / 150 or high Amp) is approved TPIC switch fuse with Neutral link.

Distribution Board :-

The distribution board is an assembly of pa including one or more fuses or circuit breaker arranged for distribution of electrical energy to various ckt or other distribution board.

Ex:- For medium residential building, 6 ways, IC 240 V. ICDB (Incomer Class distribution board) of any make approved by IS.

Earthing System :-

Earthing means connection of the neutral point of the supply system or non current carrying part of electrical apparatus such as metalic frame, metalic covering of cable, earth terminal of socket outlet, stay wire, etc. to the general mass of earth in such a manner that all time an immediate discharge of electrical energy takes place without any danger.

Rules :-

→ Internal wiring estimation :-

→ A switch board is to be installed so that it's buttom lies 1.25 m above the floor.

→ Only 3 pin, 5 Amp socket outlet are to be used in all light and fan subckt.

→ 3 pin, 15 Amp socket outlet are to be used in power subckt. [heater, (1000 watt).
AC - 2500 watt.]

~~→ In any buil~~

→ In any building light and fan wiring and power wiring are kept separately.

Voltage drop :-

Maximum voltage drop from the supply terminal to any point on the installation is not exceed the prescribed limit 2% of the supply voltage +1V for light & load wiring and 5% of supply voltage for power load wiring.

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Q. Determine the size of the conductor for a 2 core cable required to carry the maximum current of 60 Amps. It is given that length of cable 60 m and supply voltage is 240 Volt.

Ans> Given Data.

Conductors Core = 2

Current (I_{max}) = 60 Amps.

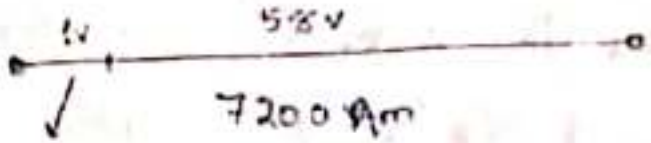
Length (L) = 60 mt.

Voltage = 240 V

Total Ampere = $60 \times 60 \times 2$ = 7200 Amp mt.

Max^m voltage can be drop = $\frac{2}{100} \times 240 + 1$

= 5.8 V



$\frac{7200}{5.8}$ = 1241.37 Amp-mt.

From table 8.3 Cu. Conductor cable having voltage drop of figure next to the fi of Amp-mt. per volt drop, is 19/1.32 mm having current carrying capacity of 74 and giving 1V drop / 1475 Amp-mt.

Q2. Determine the size of the cable required to carry the maximum current of 50 Amp. It is given that the length of the cable is 500m. and allowable voltage drop is 5% declared. (i) 400V dc.
(ii) 460·4 c

Q3. Draw the electric circuit and estimate the quantity of the material and total cost for PVC wiring system used in a hall of 15 m × 6 m × $4\frac{1}{2}$ m height. The hall is to be fitted with fan points and light points. make your own assumption for the no. of fan and light point. and other missing data.

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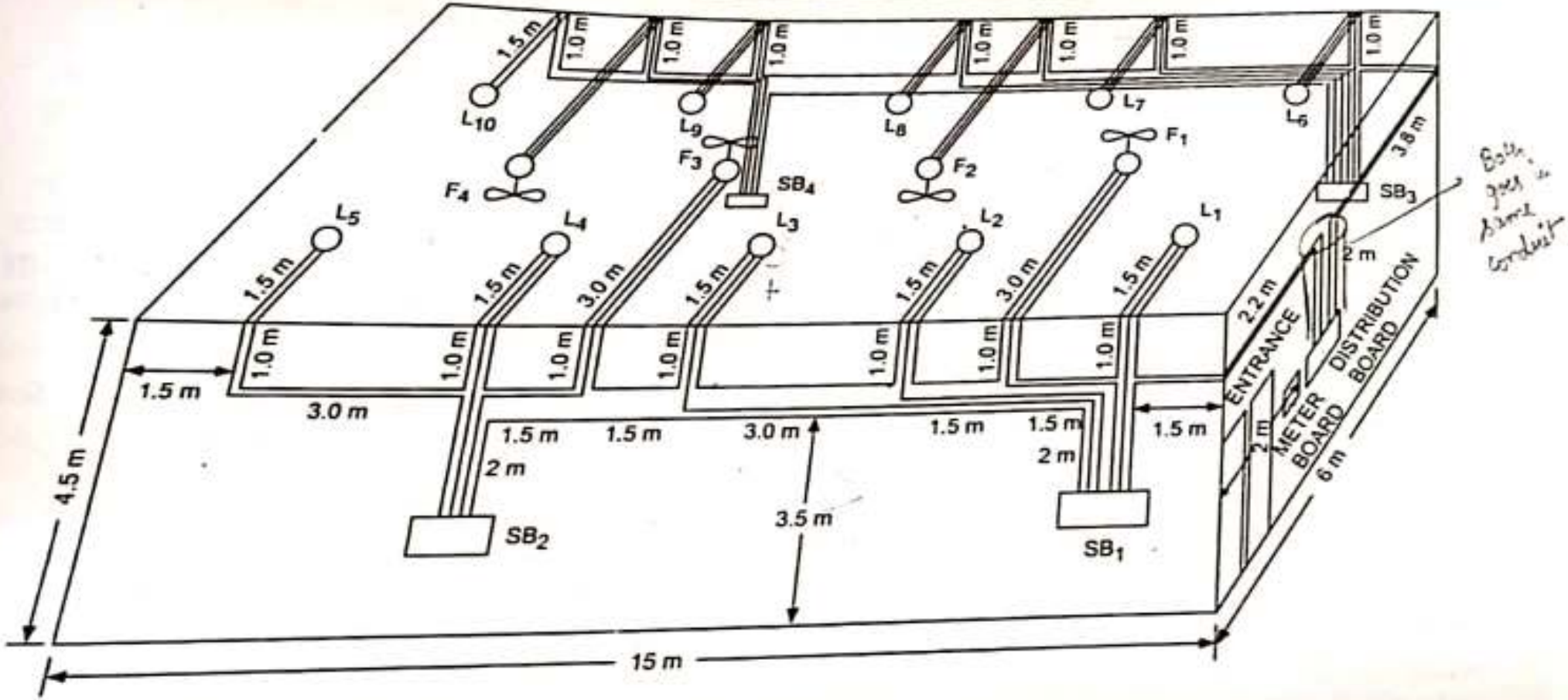

Layout of Wiring

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Total light = 10.

Fan = 4

each light of = 100watt.

Each fan of 60 watt.

Total load (P) = (10×100) + (4×60)

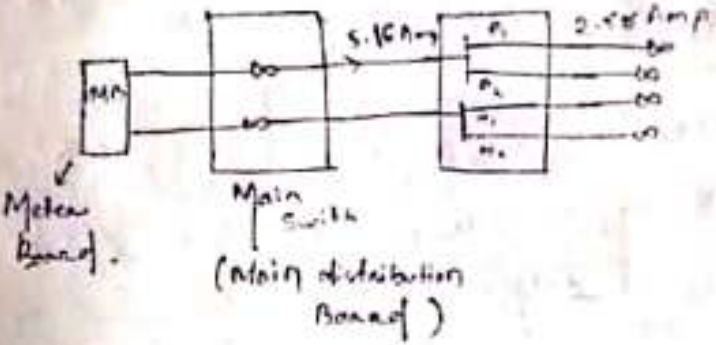
= 1000 + 240 = 1240 watt.

supply voltage = 240 V (assume)

Total current = $\frac{P}{V} = \frac{1240}{240} = 5.16$ Amp.

Load in each sub circuit = $\frac{1240}{2} = 620$ watt.

$I_1 = \frac{620}{240} = 2.58$ Amp.



→ From the meter Board to main distribution board 1/1.80, 2.5 mm² single core, 650 V grade, Aluminium conductor, PVC cable having current carrying capacity of 15 A will be used.

→ From main distribution board to the load.

1/1.40, 1.5 mm² single core, 650V grade, Al. Conductor, PVC cable having current carrying capacity of 10 A will be used.

→ Since maximum load current is 5.16 Amp and there are two ckt, 240 volt, 16 Amp DPIC switch fuse of any make approved

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by IS will be used as main switch

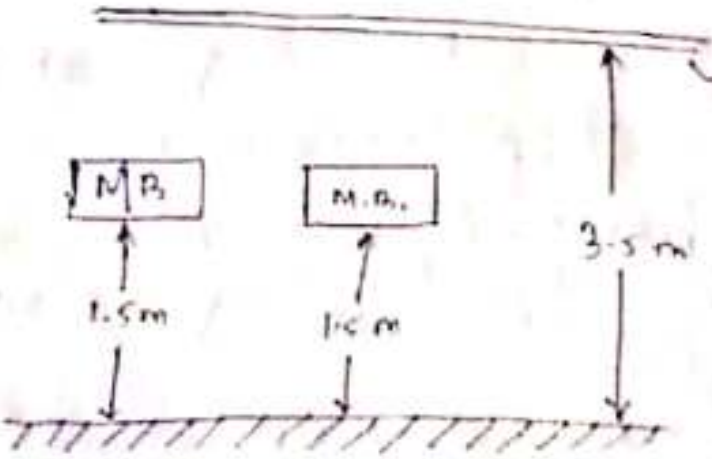
→ 2 way, 240 V, 15 Amp/way IC (iron clad) double pole distribution board of any make approved by IS will be used.

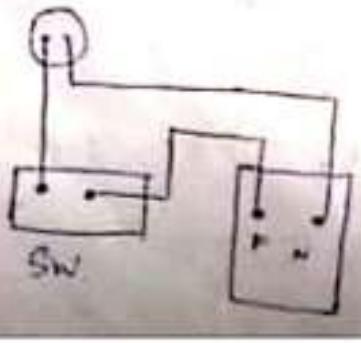
Assumption the height of the meter board

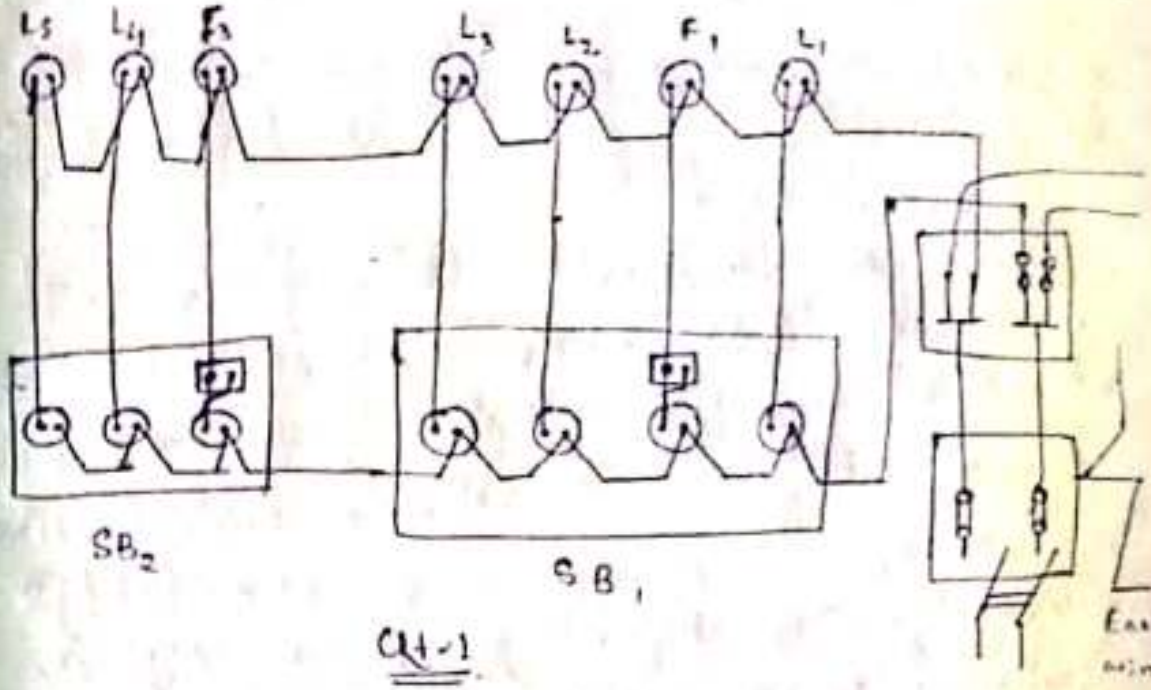
→ The height of the meter board and main switch board is 1.5m from ground.

→ The height of the conduit will be 3.5m from the ground.

→ The meter board is fixed on the entrance wall at a distance of 2m from left hand side of wall.







Ckt-1

Length of PVC Conduit Required :-

Ckt-1

→ From meter board to main board is 0.2 m.

→ Vertical run above the main board is 2m.

→ Horizontal run along the wall above the main entrance is 2.2 m.

→ Horizontal run along the left hand wall upto L_5 is 13.5 m.

→ Vertical drop along the left hand side wall upto switch board 1 & and switchboard 2 is 4m.

→ Vertical run upto ceiling and run along the ceiling upto points $L_1, L_2, L_3, L_4, \& L_5 = (1+1.5) \times 5 = 12.5$ m

→ Vertical run upto ceiling and run along the ceiling upto points F_1 and $F_2 = 8$m $(1+3) \times 2$.

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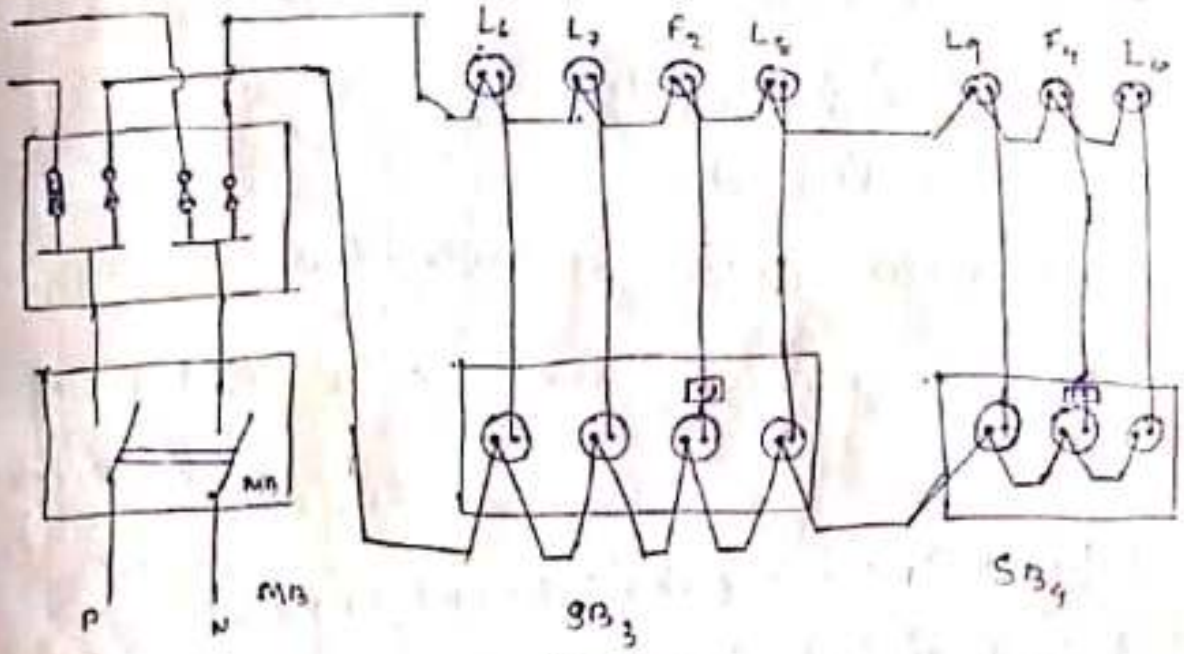
Ckt-2

→ Horizontal run along the entrance wall is 3.4.
→ Horizontal run along the right hand side wall upto L_{10} is 13.5 m.
→ Vertical drop along the right hand side wall upto switch board SB_3 and SB_4 is 4m.
→ Vertical run upto ceiling and run along the ceiling upto the point $L_6, L_7, L_8, L_9, L_{10} = (1+1.5) \times$
$= 12.5$ m.
→ Vertical run upto ceiling and run along the ceiling upto the points f_3 and $f_4 = (1+3) \times 2 = 8$m.
→ Total length of PVC conduit run is 84.2 m.
wastage = 15 %
Total length = $96.83 \left(84.2 + (84.2) \times \frac{15}{100}\right) \cong 100$ m.

Calculation of phase wire.

→ Meter board to main board = 0.5 m.
→ Main board to switch board is 7.7 m (2+2.7+
→ SB_1 to L_1 is 4.5 m (2+1+1.5)
→ SB_1 to f_1 is 7.5 m (2+1.5+1+3)
→ SB_1 to L_2 is 7.5 m (2+1.5+1.5+1+1.5)
→ SB_1 to L_3 is 10.5 m (2+1.5+1.5+3+1+1.5)
→ SB_1 to SB_2 is 13 m.
→ SB_2 to L_4 is 4.5 m.
→ SB_2 to f_3 is 7.5 m.
→ SB_2 to L_5 is 7.5 m



Ckt-2

Calculation of ~~wire~~ phase wire :-

→ Main Distribution board to SB_3 = 9.3mt (2+3+4 rl.5+2)

→ SB_3 to L_6 is 4.5 mt (2+1+1.5)

→ SB_3 to L_7 is 7.5 mt (2+1.5+1.5+1+1.5)

→ SB_3 to F_2 is 10.5 mt (2+3+1.5+1+3)

→ SB_3 to L_8 is 10.5 mt (2+3+1.5+1.5+1+1.5)

~~→ SB_3 to L_9 is 13.5 mt (2+3+1.5+1.5+3+1+1.5)~~

→ SB_2 to SB_4 is 13 mt (2+3+1.5+1.5+3+2)

→ SB_4 to L_9 is 4.5 mt (2+1+1.5)

→ SB_4 to F_4 is 7.5 mt (2+1.5+1+3)

→ SB_4 to L_{10} is 7.5 mt (2+1.5+1.5+1+1.5)

Total phase wire :-

7.7 + 4.5 + 7.5 + 7.5 + 10.5 + 13 + 4.5 + 7.5 + 7.5 + 9.3 + 4.5 + 7.5 + 10.5 + 10.5 + 13 + 4.5 + 7.5 + 7.5

wastage - 20% of 145

$= \left(\frac{20}{100} \times 145\right) + 145$

$= 174$ mt.

Calculation of Neutral wire (Ckt-1)

→ Main Distribution board to L_1 is 8.2 mt (2+2.2+1.5+1+1.5)

→ L_1 to f_1 is 8 mt (1.5+1+1.5+1+3)

→ f_1 to L_2 is 8 mt (3+1+1.5+1+1.5)

→ L_2 to L_3 is 8 mt (1.5+1+3+1+1.5)

→ L_3 to f_3 is 8 mt (1.5+1+1.5+1+3)

→ f_3 to L_4 is 8 mt (3+1+1.5+1+1.5)

→ L_4 to L_5 is 8 mt (1.5+1+3+1+1.5)

Calculation of Neutral wire for Ckt-2

→ Main Distribution board to L_6 9.8 mt. (2+3.8+1.5+1+1.5)

→ L_6 to L_7 is 8 mt (1.5+1+3+1+1.5)

→ L_7 to f_2 is 8 mt (1.5+1+1.5+1+3)

→ f_2 to L_8 is 8 mt (3+1+1.5+1+1.5)

→ L_8 to L_9 is 8 mt (1.5+1+3+1+1.5)

→ L_9 to f_4 is 8 mt (1.5+1+1.5+1+3)

→ f_4 to L_{10} is 8 mt (3+1+1.5+1+1.5)

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Total Neutral wire is

8.2 + 8 + 8 + 8 + 8 + 8 + 8 × 7 + 9.8 + 8 + 8 + 8 + 8 + 8 + 8

= 114 mt.

Wastage is 10 %

$\frac{10}{100} \times 114 = 11.4$ mt.

Total wire required = 114 + 11.4 = 125.4 mt.

Total phase and Neutral wire = 174 + 125.4 = 299.4

≅ 300 mt.

→ The length of phase wire is taken approximately 2 times that of neutrals.

→ Total wire required (Phase & neutral.) is approximately 3 times that of conduit.

→ Length of earth wire is 0.25 mt.

(For house wiring earth wire is 14 SWG)

Sl. No. 13

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Sl. No.	Description	Quantity
1.	240 v, grade 16 Amp DPIC Switch fuse	→ 1
2.	2 way 240 v, 16 Amp per way MCB type Double pole Distribution board.	→ 1
3.	Teak wood board of Size 30 cm x 25 cm.	→ 1
	25 x 20 cm	→ 4
4.	PVC Conduit pipe 25 m diameter	→ 100 m.
5.	1/1.80 mm Single core 650 v grade Al. conductor PVC cable	→ 0.5 mt.
6.	1/1.40 mm Single core 650 v grade Al. conductor PVC Cable	→ 300 mt.
7.	Piano switch one way 5 A Surface type	→ 14
8.	Round wooden block 10cm x 4cm	→ 14
9.	Ceiling rose 2 plate PVC type	→ 14
10.	Pendent holder	→ 10
11.	Flexible wire 23/0.193	→ 25 mt.
12.	Eartwire 14 SWG G.I. wire	→ 0.25 mt

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13. Earthing thimble ⟶ 4

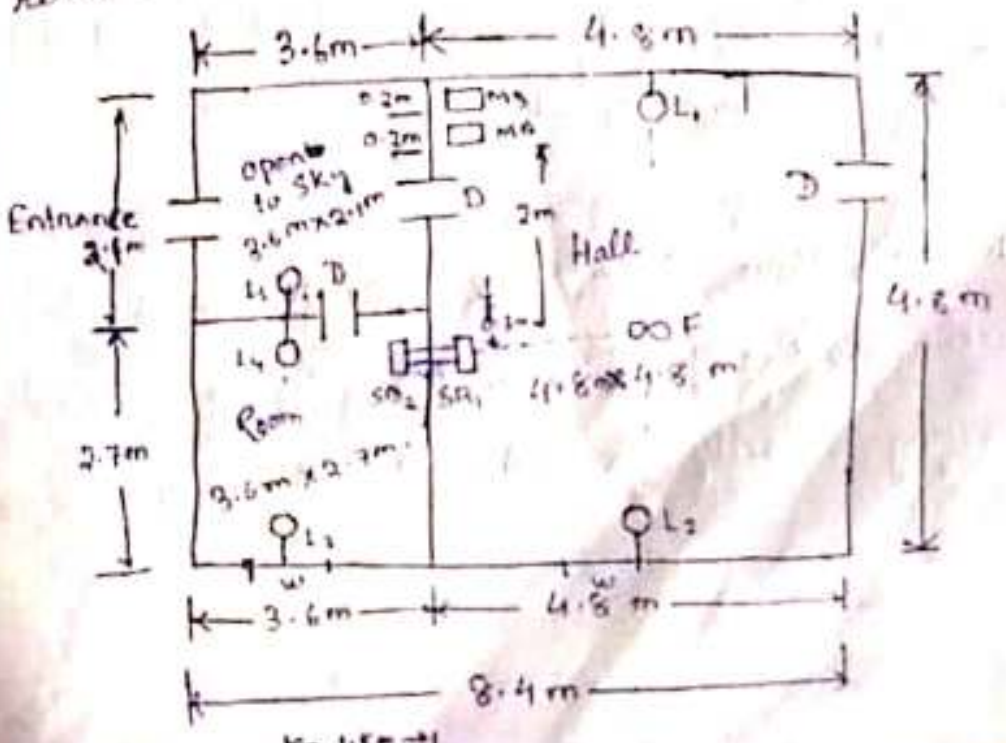
14. Wooden Screw 51 mm for switch board ⟶ 10 packets
19 mm for switches ⟶ 10 packets.

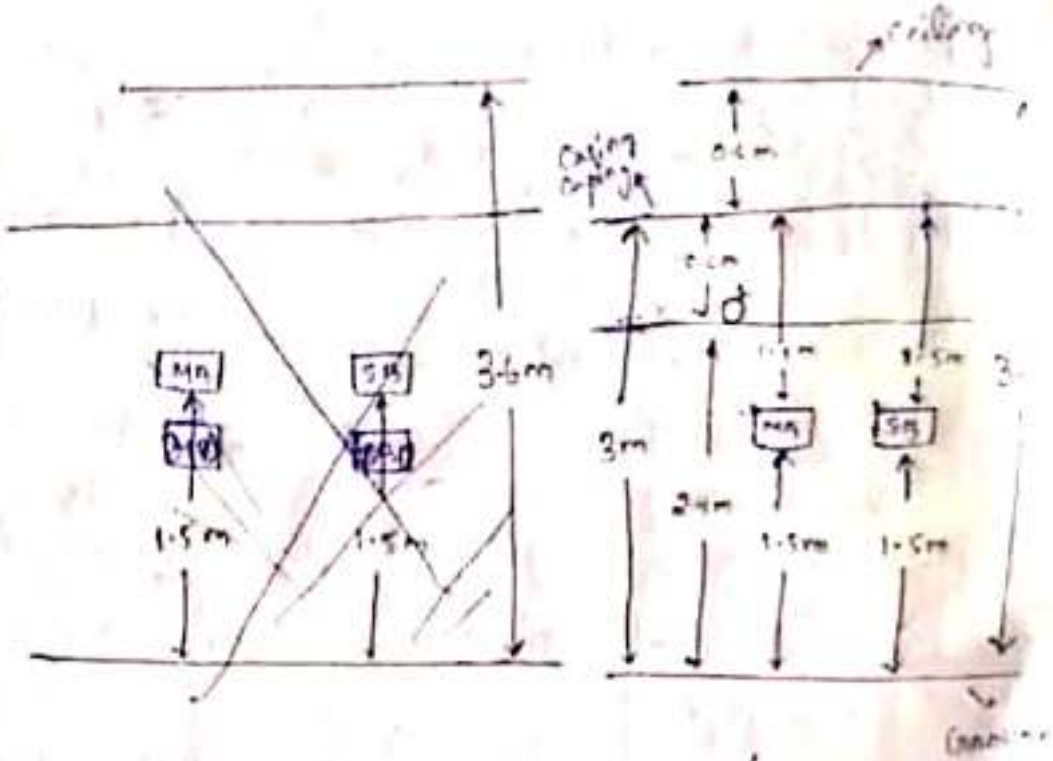
15. PVC sheet (for mounting switch board, switches and ceiling fans.) → As per required

16. Cement sand paint → As per required
Varnish

17. Labour charge ⟶ Lumps Sum.

Q2. Draw an electrical ckt and estimate the quantity of the material required for PVC casing capping used in a house the plan of which is shown in the figure. Assume the height of the ceiling as 3.6m and plug point is to be provided in each room.





Assumption.

Total Load.

Light → 5

Fan → 1

Plug → 2

8 point.

Each point → 60 watt.

Total power = 60 × 8 = 480 < 800 (Hence only one switch needed)

$I = \frac{P}{V} = \frac{480}{240} = 2$ Amp.

1.5 mm^2, 1/1.40 mm Aluminium Conductor single Core, 650 V grade PVC Cable having current Carrying Capacity of 15 A will be used.

Length of PVC Casing Caping.

→ Meter board to main board = 0.2 m.

→ Main board to SB_1 = 1.5 + 2 + 1.5 = 5 m

→ SB_1 to F : 2.4 + 0.6 m. = 3 m.

→ F to L_1 = 2.4 + 0.6 + 0.6 = 3.6 m.

→ F to L_2 = 2.4 + 0.6 + 0.6 = 3.6 m.

→ SB_1 to SB_2 = 0.25 m (assumption)

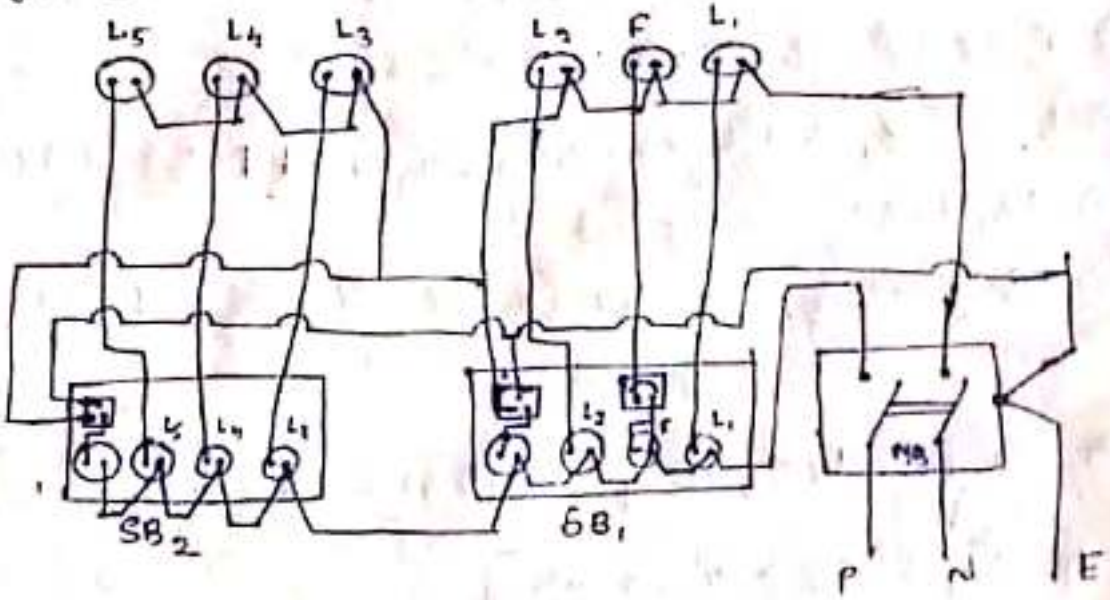
→ SB_2 to L_4 = 1.5 + 0.3 + 1.8 + 0.6 = 4.2 m.

→ L_4 to L_5 : 0.25 m

Total of L_4 to L_3 = 0.6 + 0.6 + 2.7 + 0.6 + 0.6 = 5.1

Total : 25.2 m + 3.76m
: 28.98 m ≈ 29m

Length of Phase wire :-



→ meter board to main board = 0.2 mt.

→ main board to SB_1 = 1.5 + 2 + 1.5 = 5 mt.

→ SB_1 to L_1 = 1.5 + 2.7 + 0.3 + 2.4 + 0.6 = 6.9 mt.

→ SB_1 to L_1 = 1.5 + 0.6 + 2.4 + 2.4 + 1.2 = 8.1 mt.

→ F to L_2 = 2.4 + 0.6 + 0.6 = 3.6 mt.

→ SB_1 to F = 1.5 + 0.6 + 2.4 = 4.5 mt.

→ SB_1 to L_2 = 1.5 + 0.6 + 2.4 + 2.4 + 1.2 = 8.1 mt.

→ SB_1 to SB_2 = 0.25 mt.

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→ SB_2 to L_3 : 1.5 + 0.3 + 1.8 + 0.6 + 2.7 + 0.6 + 0.6 = 8.1 mt.

→ SB_2 to L_4 : 1.5 + 0.3 + 1.8 + 0.6 mt = 4.2 mt.

→ SB_2 to L_5 : 1.5 + 0.3 + 1.5 + 0.25 + 0.6 = 4.45 mt

Total phase wire : 42.9 + $\frac{10}{100}$ × 42.9 (wastage 10%

= 42.9 + 4.29 = 47.19 ≃ 48 mt.

Length of Neutral wire :

→ Meter board to main board = 0.2mt

→ main board to L_1 = 1.5 + 2. + 0.6 + 2.4 + 2.1 + 0.6 + 0.6 = 10.1 mt.

→ ~~F to L_2 = 2.4 + 0.6 + 0.6 = 3.6 mt.~~

→ L_1 to F = 0.6 + 0.6 + 2.4 = 3.6 mt.

→ F to L_2 = 2.4 + 0.6 + 0.6 = 3.6 mt

→ L_2 to SB_1 = 0.6 + 0.6 + 2.4 + 2.4 + 0.6 + 1.5 = 8.1 mt

→ SB_1 to SB_2 = 0.25 mt

→ SB_2 to L_3 = 1.5 + 0.3 + 1.8 + 0.6 + 2.7 + 0.6 + 0.6

= 8.1 mt.

→ L_3 to L_4 = 0.6 + 0.6 + 2.7 + 0.6 + 0.6 = 5.1 mt

→ L_4 to L_5 = 0.25 mt.

Total neutral = 39.3 +

wastage = 10 % of 39.3 = 3.93

= 39.3 + 3.93 = 43.23 ≃ 44 mt.

Total phase and neutral

48 + 44 = 92 mt.

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Length of earth wire :-

→ main board to meter board = 0.2 +
→ meter board to SB_1 = 1.5 + 2 + 1.5 = 5 mt.
→ SB_1 to SB_2 = 0.25 mt.

Total earth wire = 0.2 + 5 + 0.25 = 5.45 mt ≈ 6 mt.

Sl. no.	Description	Quantity.
1.	240 V, grade 16 Amp. DPIC Switch Fuse with neutral link.	→ 1
2.	Casing Capping of size 35 mm width	→ 29 mt.
3.	14 SWG G2 earth wire	→ 6 mt.
4.	Earthing thimble	→ 4
5.	1.5 mm^2 single core 650 V grade Aluminium Conducter PVC Cable	→ 92 mt.
6.	Piano switch one way 5 Amp surface type	→ 8
7.	Ceiling rose, 2 plate PVC type	→ 1
8.	Brass bracket with holder.	→ 1
9.	water tight bracket with holder	→ 4
10.	Plug shocket 3 pin, 5 Amp	→ 2
11.	Teak wood Board 25 x 20 cm 20 x 15 cm	→ 2 → 1
12.	Round wooden blocks 10 cm x 4 cm	→ 1

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Sl. no.	Description	Quantity
13.	Teak wood gittis	→ As per 10 packets
14.	Screw	→ 10 packets
15.	Cement, Sand, Varnish	→ As per requirement

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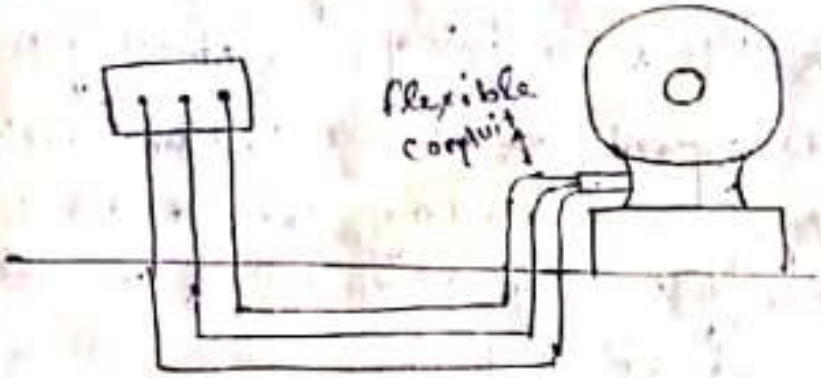
Electrical Installation for Power Wiring

Important points regarding motor installation wiring :-

(i) All equipment used in power wiring shall be of Iron clad construction and wirings shall be armoured cable or conduit type.

(ii) Looping of conductor and use of joint shall not be done.

(iii) The length of flexible conduit shall not exceed 1.25 m.



(iv) Every motor should be provided with one switch and fuse.

(v) Every motor should be provided with starter.

(vi) Laying of cable must be in separate conduit or separate motor.

(vii) The minimum cross section of the conductor should not be greater less than 2.5 mm^2 for Alluminium and 1.25 mm^2 for copper.

(viii) The current rating of cable for supply to the motor may be based on the normal full load current of the motor

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but fuse rating should be based on starting current. In no case the rating of the fuse is greater than twice the rating of the cable.

(ix) For motor capacity above 12 kW having starting current lower than twice the normal full load current, the current rating of the cable is to be based on normal full load current of motor and the current rating of the fuse based on starting current

(x) For motor capacity of below 12 kW which have very large starting current the fuse rating should be ~~greater~~ based on the starting current and the cable rating should be not lower than 1/2 of the current rating fuse.

(xi) The conduit should be electrically continuous through out and connected to the frame of the motor.

(xii) While deciding the current of the main switch controlling a group of motors, starting current of one motor of highest rating + full load current of remaining motor should be considered.

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Determination of Input power :-

$\eta = \frac{O/P}{I/P}$ } for motor

$\Rightarrow I/P = \frac{O/P}{\eta}$

For DC motor

$P = VI$

$\eta = \frac{O/P}{I/P}$

$I/P = \frac{O/P}{\eta}$

$V \cdot I = \frac{O/P}{\eta}$

$\Rightarrow \boxed{I = \frac{O/P}{\eta \times V}}$

For 1-φ AC motor

$P = VI\cos\phi$

$\eta = \frac{O/P}{I/P}$

$\Rightarrow I/P = \frac{O/P}{\eta}$

$\Rightarrow VI\cos\phi = \frac{O/P}{\eta}$

$\Rightarrow \boxed{I = \frac{O/P}{\eta V \cos\phi}}$

3 For 3φ AC motor

$P = \sqrt{3} V_L I_L \cos\phi$

$\eta = \frac{O/P}{I/P}$

$I/P = \frac{O/P}{\eta}$

$\Rightarrow \sqrt{3} V_L I_L \cos\phi = \frac{O/P}{\eta}$

$\Rightarrow \boxed{I_L = \frac{O/P}{\eta \times \sqrt{3} V_L \cos\phi}}$

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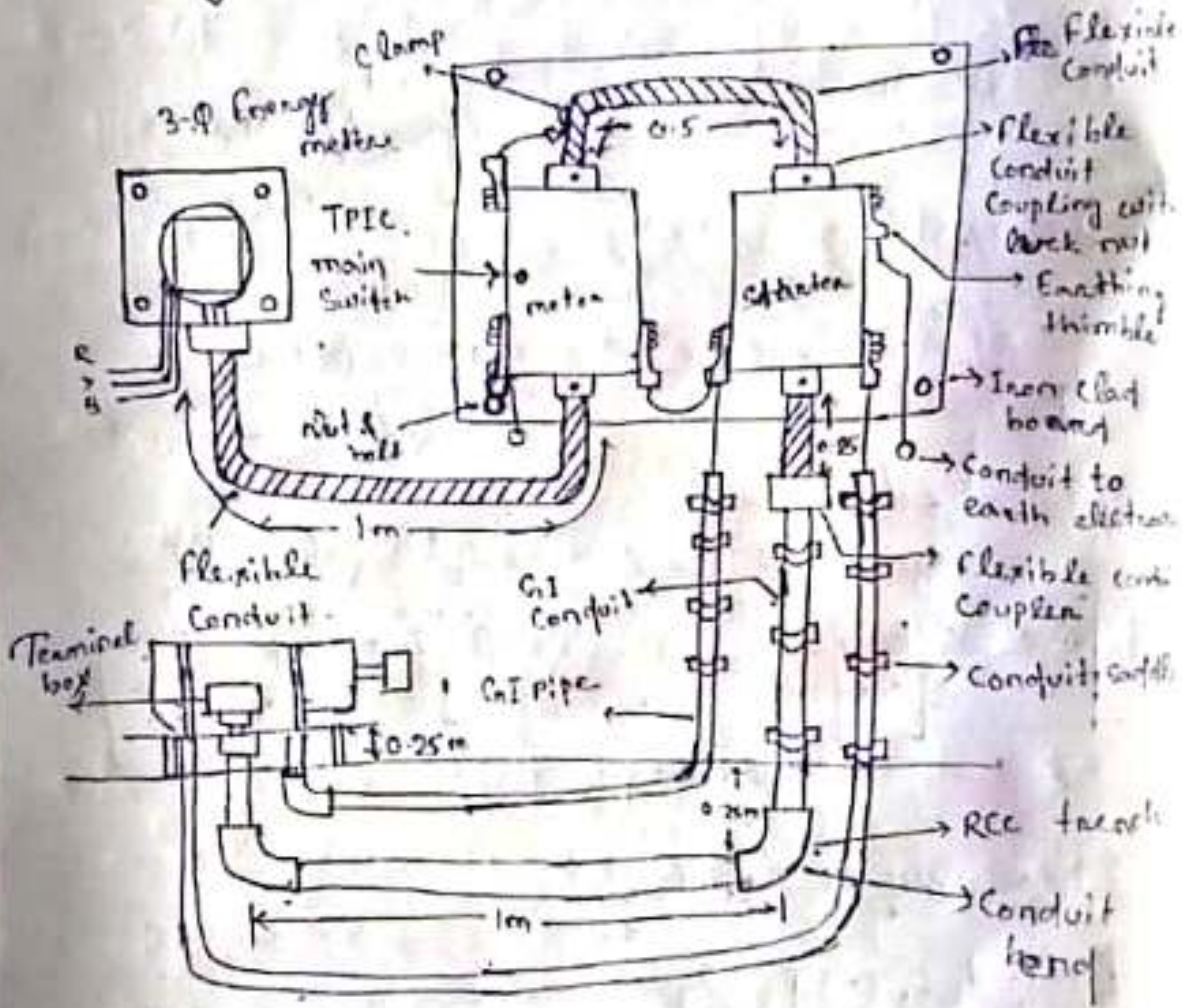
Determination of types of starter

(i) 0 to 0.75 KW ⟶ DOL starter.

(ii) 0.75 to 11 KW ⟶ Star delta starter.

(iii) 11 KW above ⟶ Auto Transformer starter



It is proposed to install a power connection of 3-φ, 5 HP Induction motor in a room of size 3m x 3m x 3m height. The motor is 1m away from the 2 nearest wall. Prepare the estimate in the following order. Draw the installation lamp (i) showing the location of meter board and motor etc.

(ii) single line diagram of showing the earthing

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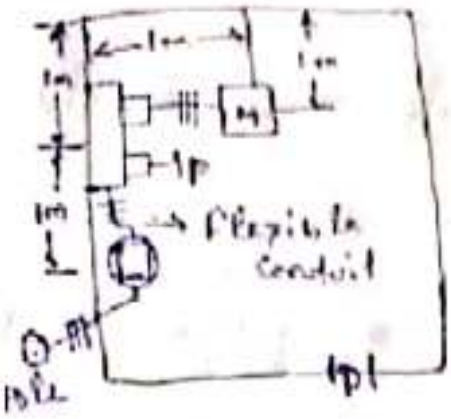
(ii) Estimate the quantity of material required



Assumption :-

→ Height of meter board from the floor is 1.5m.

→ The motor is installed 0.25 meter above the floor on a suitable foundation.

Calculation of load :-

Efficiency = 0.75

Power factor = 0.85

$I/P = \frac{O/P}{\eta}$

$I_L = \frac{O/P}{V \cos\varphi}$

$I_L = \frac{5 \times 746}{\sqrt{3} \times 0.75 \times 460 \times 0.85} = 7.29$ Amp 7.67 Amp

Rating of main switch

$I_{FL} + 50\% I_{FL}$

$= 7.67 + \frac{7.67}{2} = 11.50 \simeq 16$ Amp (Hence 32 Amp switch is used)

TPIC main switch of 32 Amp of 500 V grade

From the table 8.7

Size 6mm², 1/2.80 ; single core aluminium Conductor will be used.

* Calculation of length of heavy gauge (H.G) Cond. pipe of 25 mm dia.

→ Main board to top of motor foundation.

= 1.5 + 0.25 + 1 + 0.25 + 0.15 = 3.25 m.

→ wastage 10 %

Total length = $3.25 + \frac{10}{100} \times 3.25$

= 3.25 + 0.325 = 3.575 mt ≃ 4 mt

* Length of H.G. conduit pipe of 15 mm dia for earth wire. = (1.5 + 0.25 + 1 + 0.25 + 0.25) × 2

= 6.5 mt.

Total length = $6.5 + \frac{10}{100} \times 6.5$

= 6.5 + 0.65 = 7.15 ≃ 7 mt

* Calculation of length of flexible conduit of size 25 mm. = 1 + 0.5 + 0.25 + 0.25 = 2 mt

*

* Calculation of length of wire 6mm², 1/2.80

= (4 + 2 + 1) × 3 = 18 mt.

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(Actual length of flexible conduit + Actual length of rigid conduit) 3

$= (3.25 + .2) \times 3 = 15.75$ mt.

10 % wastage

$15.75 + \frac{10}{100} \times 15.75 = 17.325 = 17$ mt

★ Calculation of GI earth wire :

6.5 mt

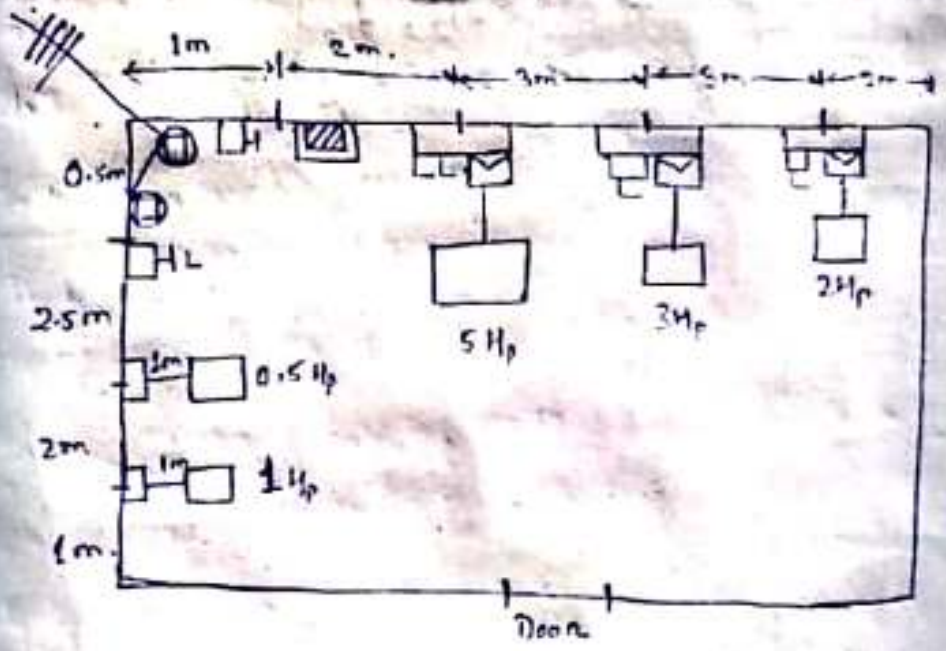
wastage = 10 %

Total length $= 6.5 + \frac{10}{100} \times 6.5$

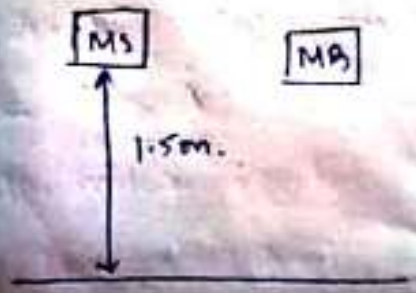
$= 7.15 \simeq 7$ mt

Q. A small workshop of size 10m x 6m x 4m hight is under construction. It is required to be provided with following electrical power connections for motors. The electrical connections to motors are to be taken along walls, i.e. floor is not to be provided with any wiring loop.

1. One 5Hp 3-ϕ motor for lathe
2. one 3Hp 3-ϕ motor for small lathe
3. One 2Hp 3-ϕ ~~motor~~ induction motor for an automatic tool manufacturing machine.



4. One drilling machine driven by a 1-ϕ .1 Hp. motor
5. One grinding machine driven by a 0.5 Hp. 1-ϕ motor



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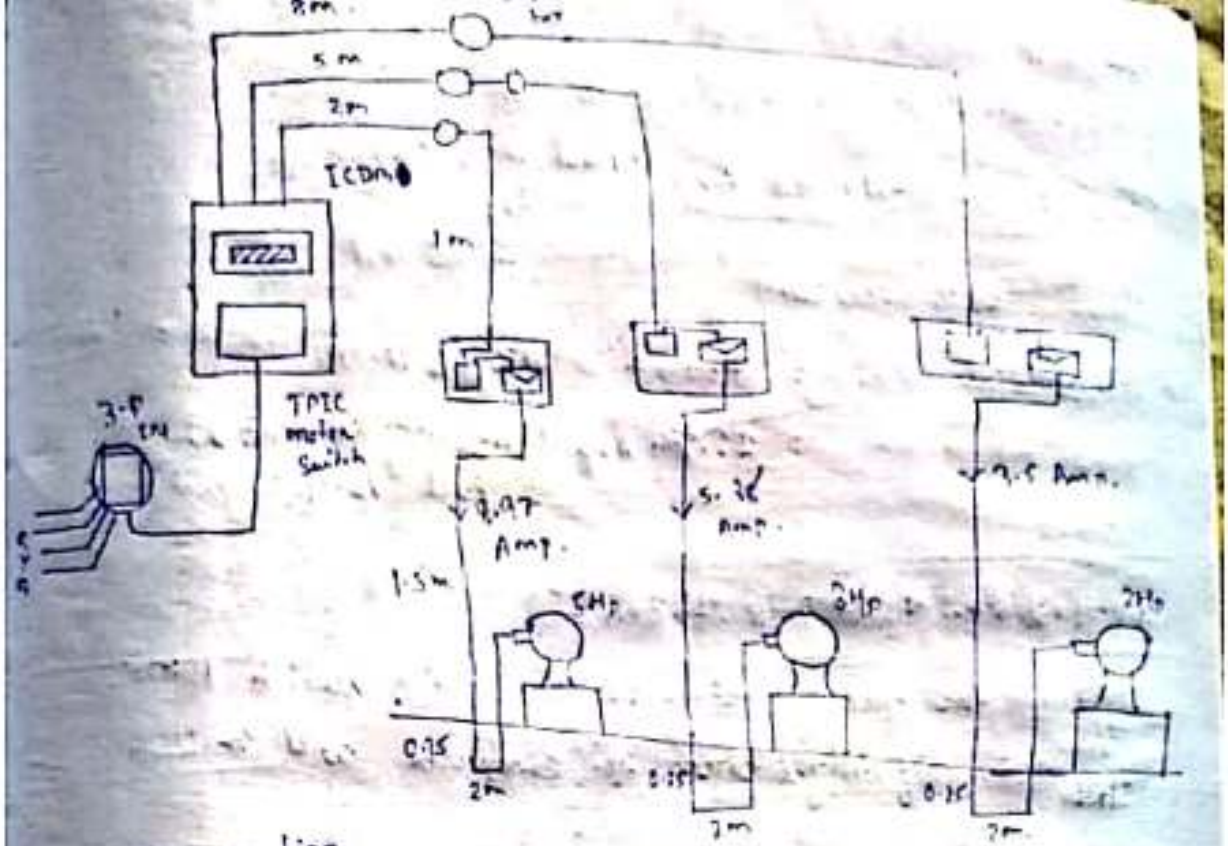
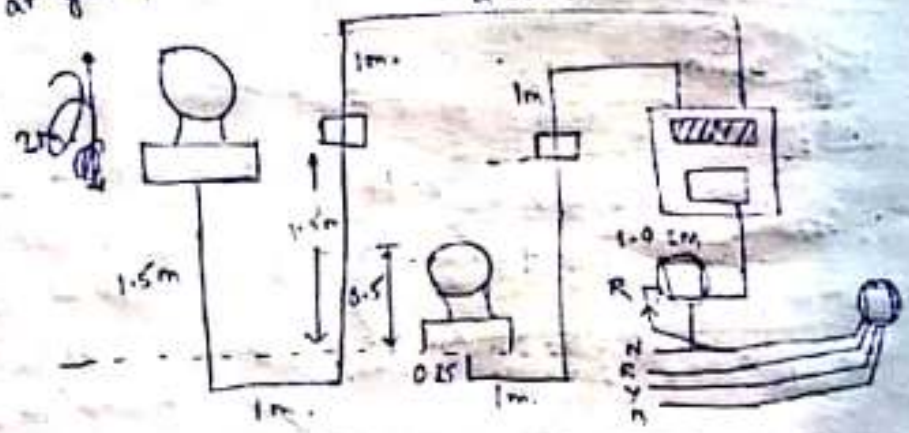


Drilling machine is not kep at ground level.



Calculation of Load in Ampere.

Assumptions

Efficiency (η) = 0.75

$\cos\phi = 0.8$

$V = 400V$

$P = \sqrt{3} V_L I_L \cos\phi$

For 5Hp motor.

$$I_L = \frac{P}{\sqrt{3} V_L \cos\phi \times \eta}$$

$$= \frac{5 \times 746}{\sqrt{3} \times 400 \times 0.75 \times 0.8} = 8.97 \text{ Amp.}$$

For 3Hp motor.

$$I_L = \frac{3 \times 746}{\sqrt{3} \times 400 \times 0.75 \times 0.8} = 5.38 \text{ Amp.}$$

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For 2HP motor.

I_c = 3.5 Amp.

Total current = 17.93 Amp (Full load current I_{FL}.

Taking 50% over load.

So total current = 17.93 + 50% of 17.93

= 26.895 Amp (starting current / Full load current)

From table = 29 Amp. Taken.

From the energy meter to 3φ main switch 16mm², 7/1.70 mm, 4 single core Al. conductor will be used

★ 3-φ main switch rating.

High loading

I_{FL} = 8.97

I_{sl} = 8.97 + 50% of 8.97

= 8.97 + 4.485 = 13.455.

Rating = 13.45 + 5.38 + 3.58

= 22.41 Amp.

From table.

45 Amp loading. (For 2nd we have no loading)

45 Amp TPIC main switch. 500 volt grade should be used.

5HP motor switch rating :-

I_{FL} = 8.97 Amp.

I_{sl} = 150% of 8.97 (8.97 + 50% of 8.97)

So I_{total} = 13.45 Amp.

So 32 Amp or 16 Amp TPIC motor switch will required for 5HP motor.

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3HP motor :-

I_{FL} = 5.38

I_{st} = 5.38 + 50% of 5.38 = 8.07

16 Amp TPIC switch is required for 3HP (2.1T motor)

1-ϕ main switch :-

0.5HP

$P = VI \cos\phi$

$I = \frac{0.5 \times 746}{240 \times 0.8 \times 0.75} = 2.59$ Amp

1HP

I = 5.18 Amp.

Total full load current = 2.59 + 5.18 = 7.77 Amp.

For extra fan & light = 8A 7.77 Amp.

total current = 15.54 Amp

(Extra 50% may be taken)

DPIC main switch of rating 32 Amp, 2 pole will be used.

* Calculation of length of HG conduit 25 mm dia for 3-ϕ motor m.

For 5HP

1 + 2 + 1 + 1.5 + 0.25 + 2 + 0.25 + 0.5 = 8.5 m.

For 2HP motor

1 + 5 + 1 + 1.5 + 0.25 + 2 + 0.25 + 0.5 = 11.5 m

for 2HP motor

1 + 8 + 1 + 1.5 + 0.25 + 2 + 0.25 + 0.5 = 14.5 m.

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Total conduit required.

= 8.5 + 11.5 + 14.5 = 34.5 mt.

wastage = 10%

total = 34.5 + 3.45 = 37.95 ≈ 38 mt

*Calculation of length of HG conduit pipe of 20 mt. dia

For 1-φ motor.

0.5 HP

1 + 2.5 + 1 + 1.5 + 0.25 + 1 + 0.25 + 0.5 = 7 mt.

1 HP

1 + 4.5 + 1 + 1.5 + 0.25 + 1 + 0.25 + 1.5 = 11 mt.

Total 20mm conduit required = 19

wastage 10% = 1.9

So total = 19 + 1.9 = 20.9 ≈ 21 mt.

For 5HP motor.

6mm², 1/2.80 mm, Single core Al. conductor PVC insulated wire will be required.

5 HP → 12 (Rated)
18 (starting)
6mm² or 1/2.80 mm. Al/Cu.
3 HP → 8 (Rated)
12 (Starting)
6mm² = 1/2.80 mm

For 3HP and 2HP motor.

6mm², 1/2.80 mm, Al conductor PVC insulated will be required.

Calculation of length of wire of 6mm² for 5HP, 3HP m

2HP motor.

Wire = Conduit × 3 = 34.5 × 3 = 103.5.

Wastage = 103.5 × 15% of

= 15.525

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Total : 103.5 + 15.525 = 119.025 ≃ 119 mt

wire required for 3-1-ϕ motor

For 0.5 HP / 1 HP.

1.5 mm², 1/1.40 mm single core. Al conductor will be used.

For

wire : 19×2 = 38 mt. wastage = 10 %

Total = 38 + 3.8 = 41.8 ≃ 42 mt.

* Calculation of 8 SWG earth wire for 3-ϕ motors.

For 5HP ; 2HP, 3HP. :

34.5 × 2 = 69 mt.

For 1-ϕ.

19×2 = 38 wastage 10 %.

Total = 107 mt. total => 107 + 10.7 = 117.7 mt ≃ 118 mt.

* Calculation of length of 15 mm dia GI pipe to enclose earth wire from motor control board to motor for 3-ϕ motor only.

1.5 + 0.25 + 2 + 0.25 + 0.5 = 4.5 (length)

2 earth Conductor = 4.5 × 2 = 9mt (For one motor)

Total (3 motors) = 9 × 3 = 27 mt.

Wastage = 10 % = 2.7 mt.

So total = 27 + 2.7 = 29.7 ≃ 30 mt

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Sl No.	Description	Quantity
1.	TPIC main switch 63 amp rating 500 volt built in HRC fuse.	1
2.	TPIC motor switch 32 Amp rating 500 volt ~~gun~~ grade HRC fuse	1
3.	TPIC motor switch 16 Amp rating 500volt grade HRC fuse	2
4.	ICDB@(Iron clad distribution board) for 3-ϕ, 500v, 45Amp. with built in Co. bushing and fuses. [used after main switch)	1
5.	DPIC main switch of 30 Amp rating 250 volt grade	1
6.	ICDB 3 way, with neutral link 30Amp rating 250 volt grade	1
7.	15 Amp ; 1 way switch and socket for 1-ϕ motors	2
8.	HG conduit of size 25 mm dia for 3-ϕ motors.	38 mt.
9.	HG conduit of 20 mm dia for 1-ϕ motors.	21 mt.
10.	Conduit accessories of 25 mm dia	
	1. Conduit board	— 12
	2. Junction box.	— 3
	3. Conduit socket [to connect 2 conduit.]	— 13 (appox)
	4. Conduit shaddle.	— 38
11.	Conduit accessories of 20 mm dia	
	1. Conduit band	— 8
	2. Conduit JB	— 2
	3. Conduit socket	— 7 (approx per 3rd)
	4. conduit Shaddle	— 21

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Sl. No.	Description	Quantity
12.	From IM to MB 16 mm², 7/1.70 single Core Al. conductor from 3-φ FEB to TPIC main switch	Exact meter cut (approx)
13.	PVC insulated 1 core, Al conductor of size 6 mm², 1/2.80 mm for 3-φ motors.	119 mt
14.	For 1-φ motor, 1.5 mm², 1/1.40 mm Al conductor for 1-φ motor.	38 mt.
15.	GI Earth wire	— 178 mt
16.	Iron clad Board of ICDB power of size.	— 1
17.	ICDB board for mounting 1-φ main switch and ICDB lighting	— 1
18.	Nut bolt 12 mm dia and 150 mm dia.	— 30 packets
19.	GI thimble	— 14 no. (approx)
20.	Flexible conduit of 25 mm dia 1.5m for each motor + for main board	— 5 mt.
21.	Flexible conduit of 20 mm dia for both 1-φ motor	— 2m (approx)
22.	Flexible conduit attachment with cock nut [ ]	— 14
23.	Flexible conduit cop. Coupler	— 6
24.	Flexible conduit attachment for 1-φ motor	— 4
	Flexible conduit coupler	— 2
	for	— 2

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Sl. No.	Description	Quantity
27.	Dangan plate quantity	1
28.	Sock treatment sokat	1
29.	Earth set complete with GI earth plate, GI pipe earth wire, Cast Iron coken. Cast iron frame, Funnel with wireness, thimble, nut and bolt charcoal, salt, soldering material. Sand Concrete etc	= 2
30.	Civil engineering work	— 1000/-
31.	Transportation cost	— 250/-
32.	Labour charge	— 1500/-
33.	GST	

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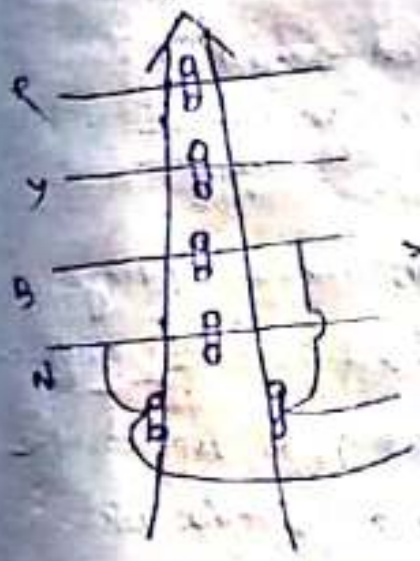
Overhead Transmission and Distribution System

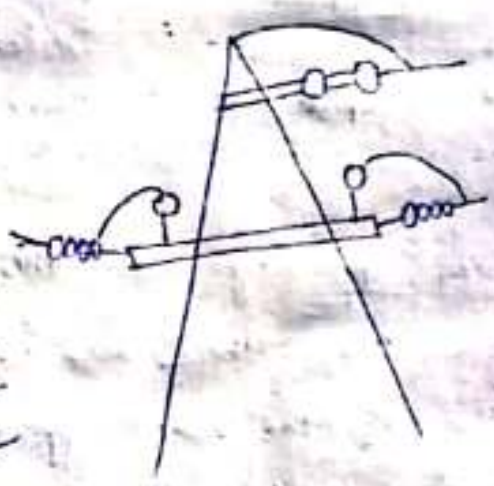
→ The network of wire which is used to transmit the bulk power from the generating station to the load end is called overhead transmission and distribution system.

→ The transmission of power is upto 11kV and Distribution of power is started from 415V.

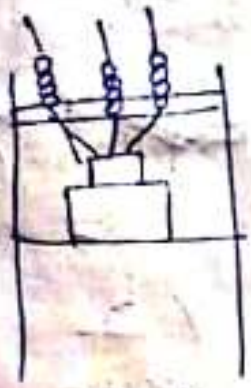
Support



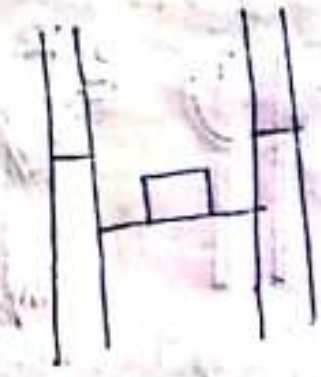
Single wooden pole



A type pole 3-P

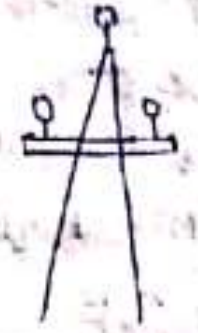


4-pole for transformer.

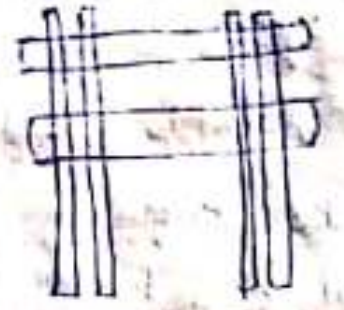


4 member pole

wooden pole with protection



Triangular formation



H-type RS joint pole

Horizontal formation

Tubular pole Rail pole

Rolled steel joists pole

Rolled cement Concrete pole (RCC pole)

Pole or towers depending upon the working voltage and the region where these are used is called supp

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

Cross arms and clamps:-

ms Channel Cross arms

U-shaped Cross arms

V-shaped Cross arms

Zig-zag Cross arms

Pipe bracket

Wooden bracket

Channel bracket

Shackel Clamp

Cross arm bracket

Strain clamp

→ Eye clamp.
[For earthing

* Cross arm and clamps :-

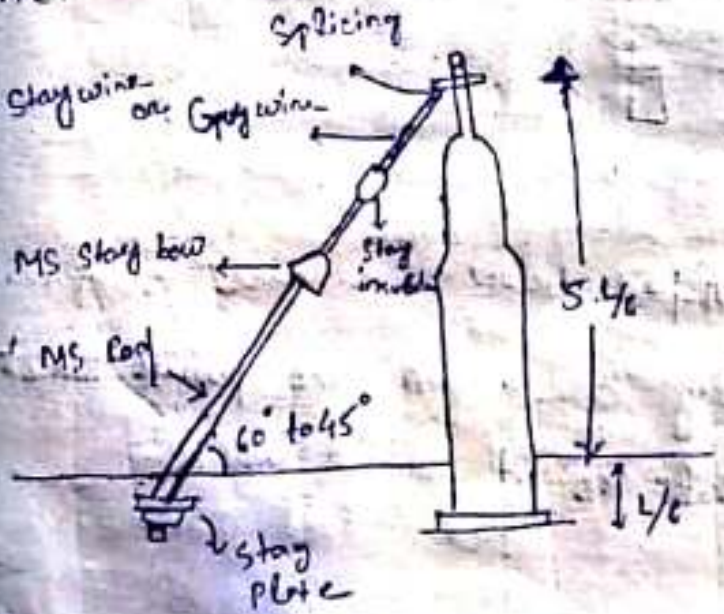
These are either of wooden, steel, steel angle, section and are used on pole structure to support the insulator and conductors.

* Insulators :-

Pin, strain, suspension type, as the case may be for supporting the conductor and taking strain or suspending the conductor respectively.

* Conductors :-

Cu, Al, ACSR (Al. conductor steel Reinforced), AAL (All Al. conductor), or any other composition depending upon the current to be carried and span of the line.



Cables are kept to the pole at the termination or angle poles to resist lateral force.

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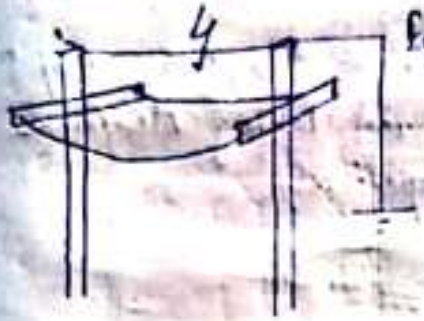
* Lightening arrester :-

To discharge excessive voltage build up to earth due to lightening.

* Fuse and isolation switch :-

To isolate different parts of overhead system.

* Continuous earth wire :-



Earth wire

It runs on the top of the tower to protect the line against lightening discharge.

* Vee - Guard :-

Vee guard provided below the bare overhead line running along or across the public street to make the line safe if it should break.

* Guard wire :-

→ These are provided above or below power lines while crossing telephone or telegraph line.

→ The guard wire and steel structures are solidly connected to earth.

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* Phase plate :-

It is used to distinguish various phases.

* Bird guard :-

- A stick of ebonite or rounded top is fixed near the insulator on the cross arm to prevent flash over due to birds perking on the conductor.

* Danger plate :-

→ It is provided on each pole as a warning measure to indicate the working voltage of the line and the word danger.

→ It is provided at a height 2.5m from the ground.

* Barbed wire :-

Barbed wire is wrapped on pole at a height above 2.5m from the ground for at least 7m.

This prevent climing of unauthorised person.

* Mischallengous item :-

It is such as vibration damped, top hamper bead for jumper.

Imp.

The factors determines the size of conductors are.

(i) Line working voltage.
(ii) Length of the transmission line.
(iii) Power to be carried.
(iv) power factor of the load.
(v) permissible voltage drop.

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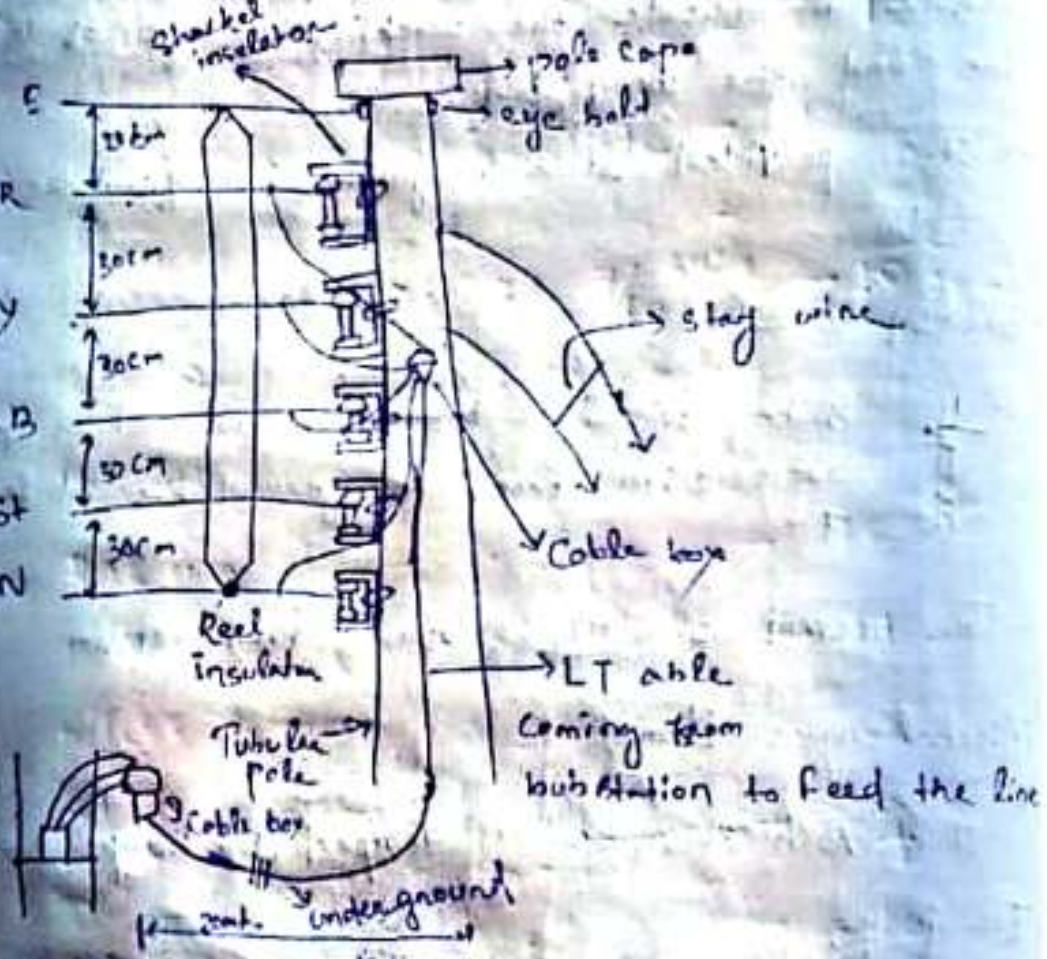
Q1. In a city of locality an overhead distribution l... 400V, 3φ, 50 Hz, is to be ~~erected~~ rated along a ... line on a steel tubular pole. The length of line 500m and the line terminates at one end. The span of pole is 50m. The street light conductor are also supported on the same pole. Make neat sketch of 2 to 3 poles and estimate the quantity of material required. [6 / 1×2.11 sqinch]



No. of pole = 500/50 + 1 = 10 + 1 = 11 poles

(Not given existing pole)

Length of wire = (5×500) + 2% Sag (6 / 1×2.11 sqinch required)

= 2500 + 2500 × 2/100

= 2550 mt.

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Earth wire = (1×500) + 2% sag

= 500 + 10 = 510 mt.

Table :-

Sl. No.	Description	Quantity
1.	LT underground Cable Connection from 11/0.4 KV substation.	
ii)	LT, 4 core 600V grade mass impregnated paper insulated lead cover cable of size 7/2.50mm, 35 mm²	— 20 mt (approximate)
2.	LT, outdoor cable box, suitable for above cable.	— 2
3.	Cable clamps (For holding the cable along the pole and double pole structure.	— 6 (approx.)
4.	Cable box fitting, MS channel iron 75 mm a/x 40 mm x 3mm x 0.3 mt long	— 2
5.	Steel tubular pole of 9mt long ISI quality	— 11
6.	ACSR conductor squirrel 6/1x2.11	— 2550mt.
7.	Earth conductor of 8 SWG. GI. wire	— 510 mt.
8.	14 SWG, Galvanised steel wire as binding wire.	— 5 kg. (approx)
9.	Insulator with D strap medium size Shackel insulator.	— 55

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Sl no.	Description	Quantity
10.	Nut and bolt 15mm dia 200 mm long with washer for fixing D-strap with pole. (1 for each strap)	— 55
11.	Earth wire clamp on terminal pole for isolating the earth wire	— 2
12.	Eye bolt, 15 mm dia 200mm long for holding each wire for an intermediate pole	— 9
13.	Guard wire of size 7/16 for guarding at approximately 15 places.	— 15
14.	Reel insulator	— 30 ml
15.	pole cap for steel tubular pole	— 11
16.	Stay wire set complete 2 set of each terminal pole	— 4
17.	Earthing set complete for 2 terminal pole and 1 intermediate pole	— 3
18.	Street light fitting complete with tube and clamps.	— 11
19.	pole foundation for each pole of 0.5 cubic	— 11

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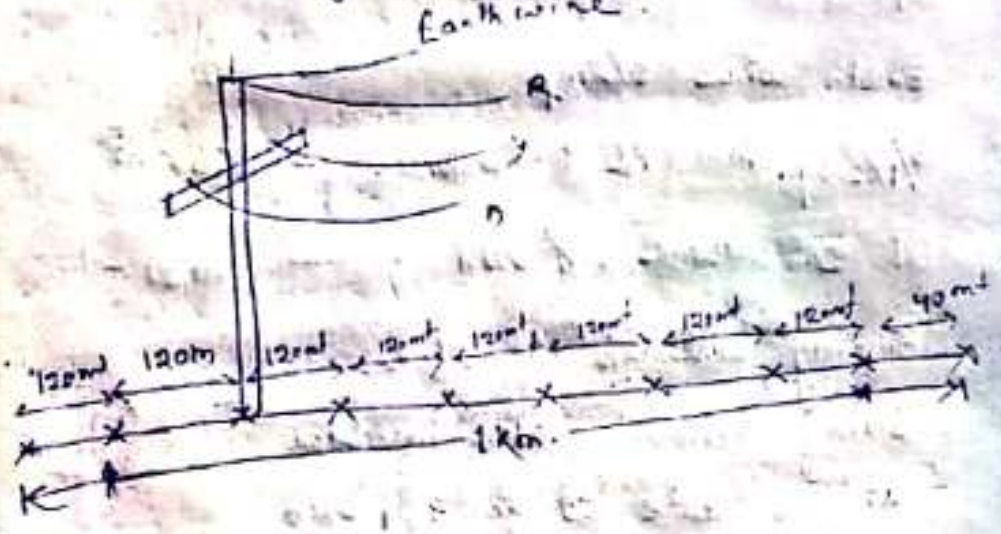
Sl No.	Description	Quantity
20.	No. plate with clamp	— 11
21.	Extra material like, Cement, Sand, thimble paint, Long rump (L.S)	— as per requirement

Q. Estimate the quantity of material required for 11kv overhead, 11kV, 50Hz line using steel pole of 11 m height and ACSR of conductor of 6/1x2.59 mm with an average span of 120 mt.

Ans



Length = 1 Km.

height of the pole = 11 mt

Conductor size = 6/1x2.59 mm

Span = 120 mt.

no. of pole = $\frac{1000}{120}$ = 8.33 ≈ 10

Length of the conductor = (3 x 1000) + 2% sag

= 3000 + $\frac{2}{100}$ x 3000

= 3000 + 60 = 3060 mt.

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Length of earth wire : $1000 + \frac{2}{100} \times 1000$

$= 1020$ mt.

Material required :-

Sl no.	Description	Quantity
1.	Steel pole of 11mt long	— 10
2.	Cross arm 100mm x 100mm x 1.5 mt ~~Long~~ Long	— 10
3.	Top insulator on pin insulator	— 30
4.	Earth wire clamp	— 10
5.	6/1x2.59 mm ACSR Conductor	— 2060 mt
6.	GI earth wire, 8 SWG	— 1020 mt.
7.	Binding wire of Al. for fixing conductor over insulator at the rate 200 gm for each insulator.	— 6 kg
8.	11 KV Lightening Arrestor	— 1 set.
9.	Earthing set Complete	— 3 set.
10.	Danger plate 11 KV with clamps.	— 10
11.	Barbed wire (to prevent climbing the unauthorised person)	— 20 kg Copper
12.	Pole foundation	— 10
13.	Guard wire 4 places (approximate)	— 5 kg (copper

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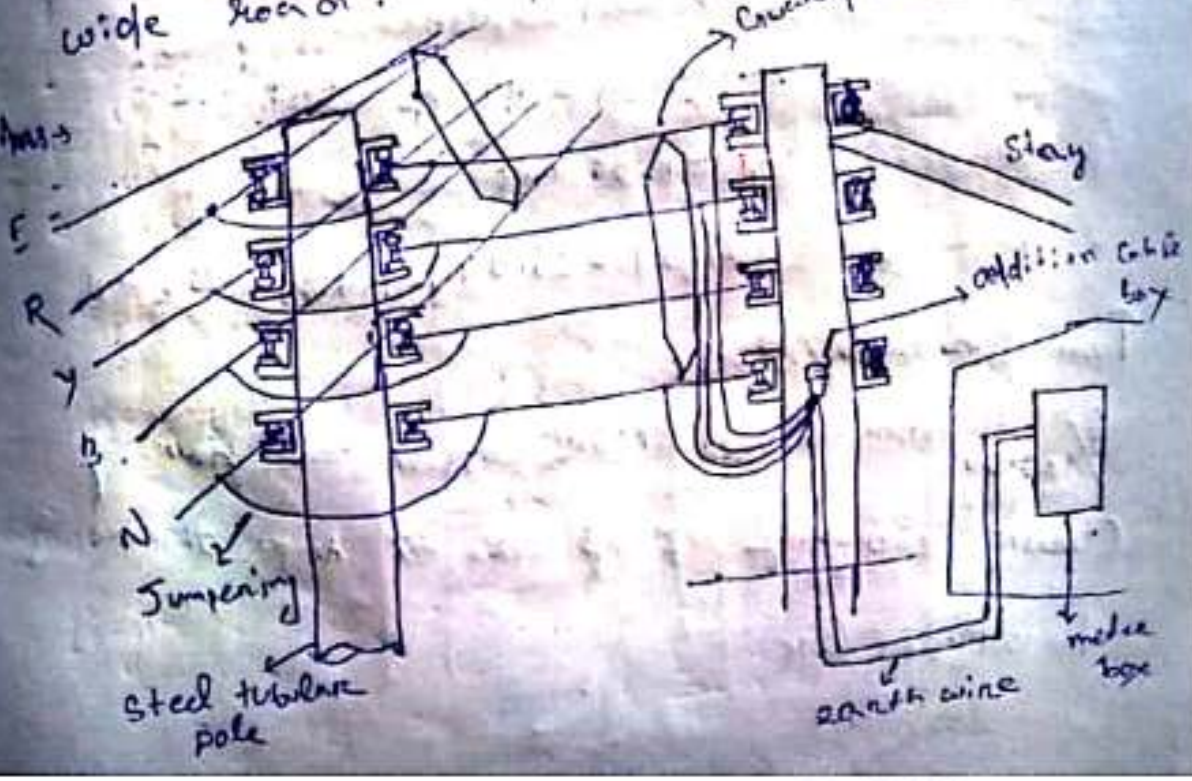
Sl. No.	Description		Quantity
14.	Stay set complete	—	2 Set
15.	Extra material like nut bolt, washer, thimble, painting of iron binds, soldering etc.	—	As per requirement

Q. A factory has 75 Hp power load for a motor & at 10 KW light and fan load. The supply is to be given from a near by 3-Φ, 4 wire distribution line which is at a distance of 200 mt from the factory. Separate energy meter for power and light load is to be provided in the factory main board. Prepare the list of material requirement for giving service connection to the factory. The line is to cross 10mt wide road.



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Given Data

Power load : 75HP

Light load : 10KW

V = 400V

Length = 200 mt.

Power load

$I_L = \frac{P_{o/p}}{\sqrt{3} V_L \cos\phi \times \eta}$ assumption $\eta = 0.8$, $\cos\phi = 0.75$

$= \frac{75 \times 746}{\sqrt{3} \times 0.8 \times 0.75 \times 400}$

$= 134.59$ Amps

Light load:

$I_L = \frac{P_{o/p}}{V_L \times \cos\phi \times \eta}$

$= \frac{10 \times 10^3}{230 \times 0.8 \times 0.75}$

$= 43.47$ Amp. (For single phase)

For 3 ϕ : $\frac{43.47}{\sqrt{3}} = 25.09$

Total Current : I Power + I Light.

$= 134.59 + 25.09 = 159.68 = 160$ Amp

From table 10.4

6/1×3.00 mm, Rabbit ACSR Conductor having Current carrying capacity of 168 Amp. overhead transmission line.

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table
From 11.1

70 mm², 19/2.14 mm Underground cable having Current Carrying Capacity of 192 Amp will be used.

Sl. No	Description	Quantity
1.	Material required for existing pole and terminal pole.	
	(i) LT shackel insulator with D. shaap	→ no of kg
	D. shaap with nut and	
	(ii) Pin insulator	→ 12
	(iii) Clamp with bolt and nut for earth wire in two terminal pole [terminal pole]	→ 2
	(iv). Stay set complete [at thimbling circle]	→ 2
	(v) Rail pole of 10mt long	→ 4
	(vi) Pole cap welded for holding the top pin type insulator	→ 3 (For pin type insulator)
	(vii) Cross arm of size 75mm × 40mm × 3mm × 0.75mm	→ 3
	(viii) binding wire Al. 14 SWG 200 gm/per insulator	→ 8.4 kg
	(ix) No. plate with clamp	→ 5
	(x) Eye bolt 15 mm dia, 150 mm long for holding the earth wire in intermediate pole	→ 3
	(xi) ACSR Conductor of size	→ 612 mt. (R, Y, B)

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(xii) 7/16 Φ-GS [Galvanized steel] for neutral and earth wire → 2

(xiii) UG cable 70 mm², 19/2.14 mm → 15m

(xiv) Cable Clamp for holding the cable with the pole → 4

(xv) Kit Kat Switch, 200 Amp → 1
Rating for the power load (3 ph)

(xvi) 50 Amp Rating for the light load → 1

(xvii) 3-Φ energy meter → 1

(xviii) 1-Φ energy meter → 1

(xix) Earthing set complete → 1

(xx) Extra material → As per required.

Q3. Estimates the quantity of material required for the construction 1 km overhead line. The line is tapped from a 11kV line to feed a particular locality the particular of material used are as follows

(i) ACSR 6/1 x 2.59 mm

(ii) Tubular pole support of 8m height

(iii) Earth wire of GS SWG

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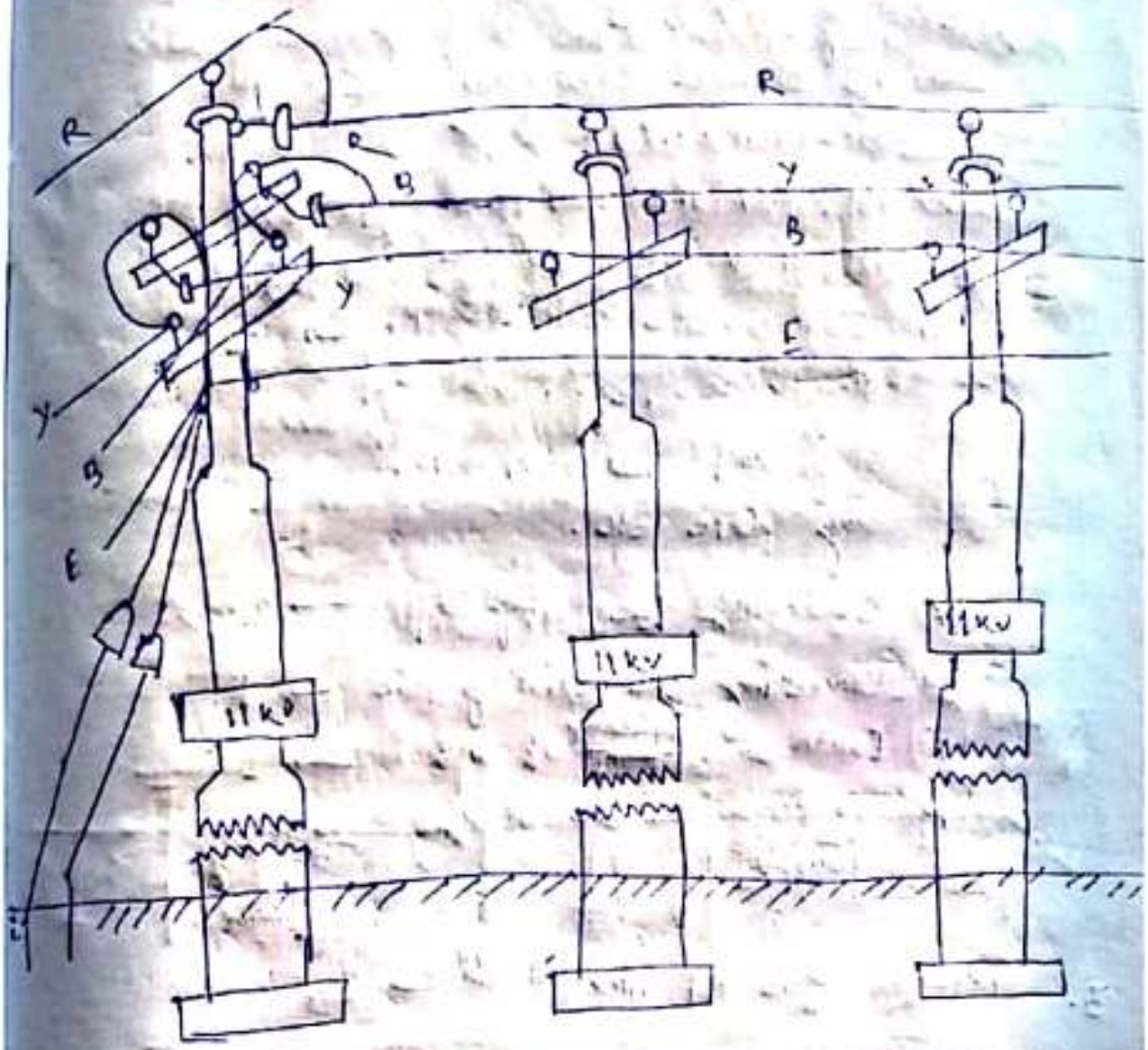
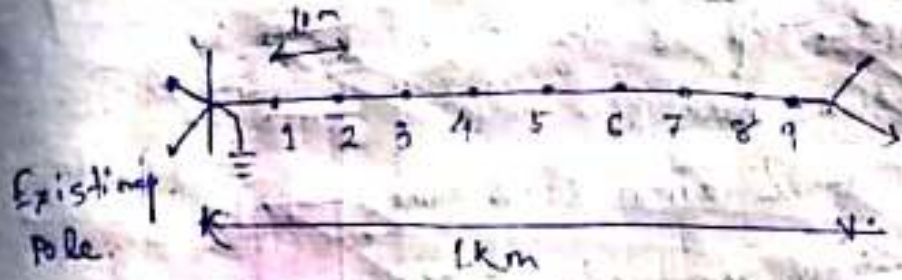
Ans L = 1km = 1000 mt

Span = 100

no. of pole = $\frac{1000}{100}$ = 10





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Sl. No.	Description	Quantity
1.	Tubular 11 mt long	→ 10
2.	Material required for the existing 11kV line	
	(i) MS channel cross arms 10cm x 5cm x 1.5 mt long	→ 1
	(ii) HT. 11 kV shackle insulator	→ 3
	(iii) HT. 11 kV pin insulator	→ 2
	(iv) Stay complete with clamp, stay wire, egg insulator, stay rod, bolt bow, nuts, stay plate, etc.	→ 2
	(v) Concreting for stay rod	→ 2 nos.
	(vi) Concreting for existing pole	→ 1
	(vii) Earth wire ~~clamp~~ Clamp of MS	→ 1
	(viii) binding wire for AI from jumper	→ 1 kg (approx)
3.	Fittings for HT straight line support	
	(i) pole cap of MS	→ 10
	(ii) Stone base for pole	→ 10
	(iii) Angle of iron cross arm	→ 10
	(iv) Cross arm clamp	→ 10
	(v) 11 kV pin insulator	→ 30
	(vi) No. plate	→ 10
	(vii) Danger plate	→ 10
	(viii) Earth wire clamp	→ 10,
	(ix) Barbed wire	→ 10 kg (approx)

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Sl No. | Description | Quantity

(x) binding wire of AL. 200 gm per pole → 6 kg (approx)

(xi) ACSR conductor of size 6/1x2.25 mm → 1000 x 3 = 3000 + 1% sag = 3030 mt.

(xii) Earth wire GI of size 8 SWG → 1000 + 10 = 1010 mt.

4. Material for 3 set of earthing

(i) Earth plate of size 60cm x 60cm x 6.35mm. → 3

(ii) GS earth wire of 8 SWG at the rate 10 mt for each set → 30 mt.

(iii) GI pipe for watering 10 mt per 1 set → 30 mt.

(iv) Extra material such as nut bolt, salt, charcoal, thimble, funnel with wire mesh etc → as per requirement.

(v) Painting for poles → 10 nos.

(vi) Transportation cost → 5000

(vii) Labour Charge → 1000

(viii) Tax (GST) → 3 %

(ix) Concreting of pole → 10 no.

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Estimate the materials for construction of overhead line. The line is tapped from overhead line. Assuming that the line is passing telegraph line and railway line.

Given Data

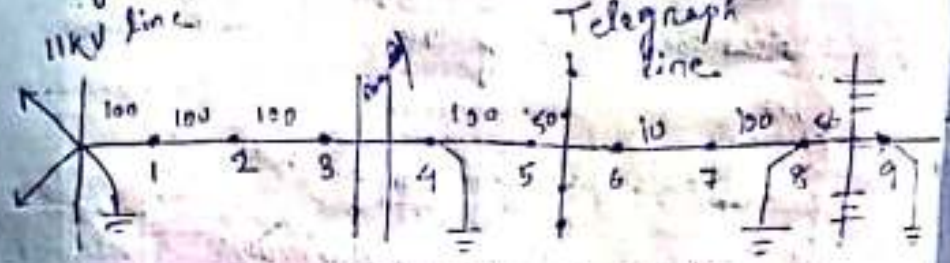
Size of conductor → ACSR, 6/1x2.36 mm

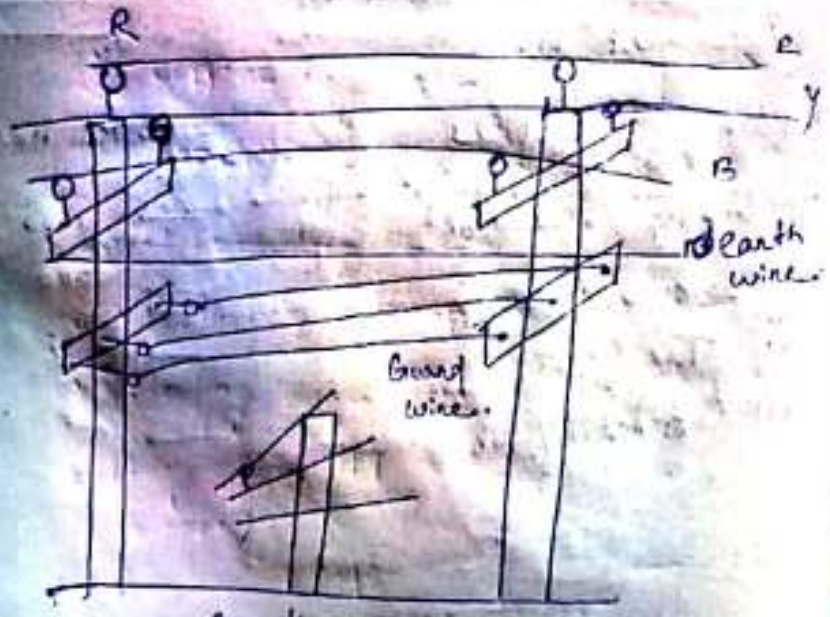
of pole, RS joist pole of 10 m and 11.5 m long.

Size of earth wire → Galvanised steel conductor 7/16 SWG

type of cross arm → Made of angle iron cross arm.

type of earthing = plate earthing.





Connecting for telegraph line.

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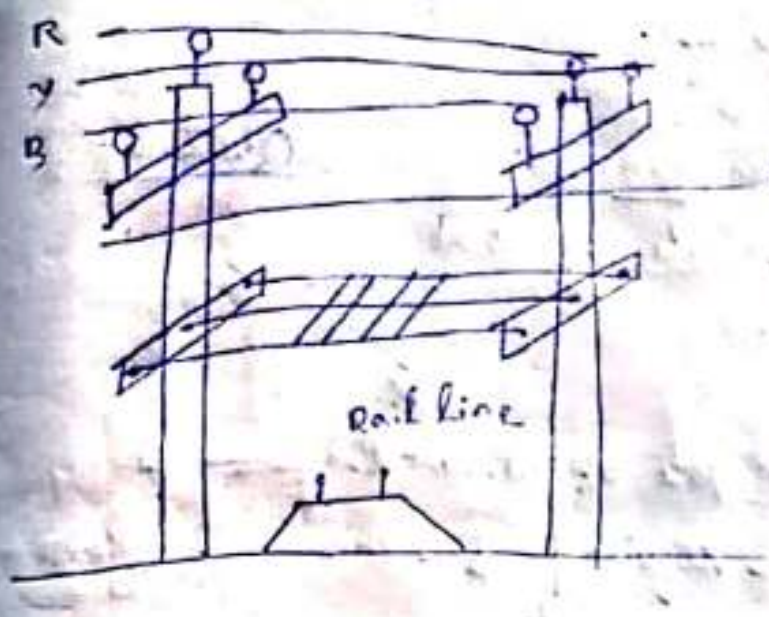

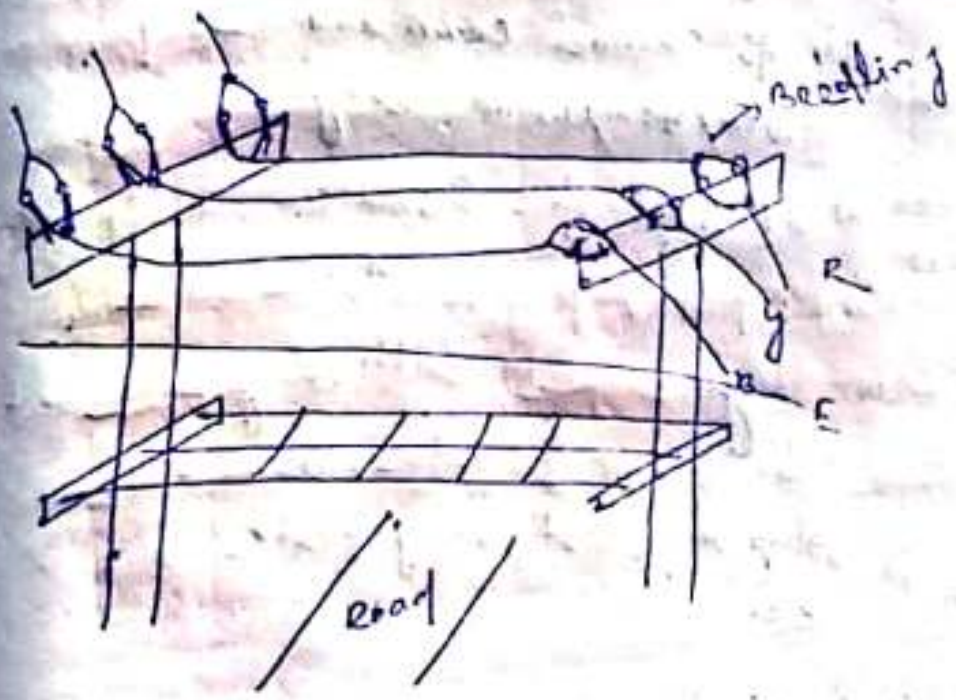

taking normal span = 100 mt

@ the span of 50 mt for railway crossing Road & crossing, telegraph line crossing.

* Every 4th pole will be earth and 2 pole of railway crossing will be earth.

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Material required.

Sl. No.	Description	Quantity
1.	RS joist pole of 10 mt long.	6 Nos
2.	RS joist pole of 11.5 mt long.	6
3.	Materials required for the existing 11 KV line.	
	(i) MS Channel cross arm 100mm x 50mm x 1.5 mt long	1
	(ii) HT 11 KV. olice insulator	3
	(iii) HT 11 KV pin insulator	2
	(iv) Stay complete with Stay clamp, stay insulator, bow, stay rod, nut, stay plate etc.	2 set
	(v) Concreting for stay rod	2 nos.
	(vi) Concreting for existing pole	1
	~~(vii) Concreting for e~~	
	(vii) Earth wire clamp of MS	1
	(viii) binding wire for AL for jumper	1 kg approx
4.	Fitting for HT straight line support.	
	(i) Pole cap of MS	12
	(ii) ditto cross arm (100mm x 50mm x 1.5mt)	12
	(iii) Stone base for pole RS joist pole	12

Sl no. Description

(iv) Cross arm Clamp — 12
(v) 11 kV pin insulator — 42
(vi) No plate with clamp — 12
(vii) Danger plate — 12
(viii) Earth wire clamp — 12
(ix) Binding wire of Al. — 3.4 kg.
at the rate 200 gm per insulator
(x) Barbed wire 1 kg per pole = 15 kg.
(xi) Extra material for the
pole for road crossing
(a) Bracing cross arms — 2
(b) Cross arm clamp — 2
(c) duplicate conductor wire — 10 kg
of size 8 SWG (approx)
(xii) Extra material for telegraph
line.
(a) Angle iron cross arm of size — 2
7.5 cm x 7.5 cm x 1 cm x 2.5 mt
long
(b) Cross arm clamp — 2
(c) GI wire of 8 SWG as — 20 kg.
duplicate conductor of guard (approx)
wire
(d) Eye bolt for holding the guard — 6
wire
(xiii) Extra material for railway cross
(a) Angle iron cross arm of size — 2
7.5 cm x 7.5 cm x 1 cm x 2.5 mt long
(b) cross arm clamp — 2

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(c) GI earth wire of 8 SWG — 40 kg

(d) Eye bolt for holding the — 6
Guard wire

5. ACSR Grapher Conductor of size — for 100 m
5/1×2.36 mm, 2030 m
Cu 1% sag

6. GI, 8 SWG earth wire ——→ 1000 + 1% L
= 1010 m

7. Painting of 12 pole ——→ 12 no.

8. Earthing complete ——→ 4 set

9. Transportation charge ——→ 2000 ₹

10. Labour charge — 2000

11. Connecting of 12 pole — 12

12. Tax — 5 %

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