

LECTURER NOTE

SUBJECT-ELECTRICAL INSTALLATION AND ESTIMATING, 6th SEM)

BRANCH-ELECTRICAL ENGINEERING

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Chapter-4 (over head installation)

Important Terms

1. Line Supports. Definition: The different types of structure (poles or towers) used for supporting the overhead lines or wires, such types of structures are called line supports. The line support plays a major role in power transmission.

2. Electrical cross arm. It is an engineered piece of composite equipment used in pole line technology to support power lines and other electric equipment. It is also known as telephone pole cross arm, light pole cross arm or power pole cross arms.

3. A guy-wire, guy-line, or guy-rope, also known as simply a guy, is a tensioned cable designed to add stability to a free-standing structure.

4. SPAN- The horizontal distance between two electrical supports is called the span. If the weight of a conductor is uniformly distributed along the line, then it is assumed that a freely suspended conductor shape is a parabola. The shape of sag increases with the increase in the length of the span.

5. PIN INSULATOR- A pin insulator is a device that isolates a wire from a physical support such as a pin (a wooden or metal dowel of about 3 cm diameter with screw threads) on a telegraph or utility pole. It is a formed, single layer shape that is made out of a non-conducting material, usually porcelain or glass.

6. LIGHTING ARRESTER- it is a device used on electric power systems and telecommunication systems to protect the insulation and conductors of the system from the damaging effects of lightning.

7. DANGER PLATES - These danger plates are as per prevailing industry standards and discourage public access in areas with high voltage.

8. Anti Climbing Device. Anti climbing device is a part of fencing panel system, which is mounted on fencing upright (POLE). These are basically used at sub-station fencing, pole fencing.

9. The term "jumper wire" simply refers to a conducting wire that establishes an electrical connection between two points in a circuit. You can use jumper wires to modify a circuit or to diagnose problems in a circuit.

10. GUARDING OF OVER HEAD LINES - A guarding is provided for the safety of life, installation, and communication circuits. The guarding for 11 KV lines is provided at road crossings, canal crossings, railway crossing, crossing over It lines or communication lines.

L. T. Distribution

1. No of spans

= Length of line ÷ span

What is the span?

Span means horizontal distance between two poles is called span. A number of span means for example in 1000 KM line how many spans is there.

2. No of supports= No of spans + 1 (for tapping pole)

Supports means nothing but poles which give support to the conductors. No support means in 1000 KM line how many supports are there.

3. R.C.C poles are used at starting, deviation points and anchoring points

R.C.C full form is reinforced cement concrete, this pole is constructed using concrete and with some rods. This pole very strong compared to the other pole. R.C.C pole cannot break easily, it can hold heavy weight.

4. P.C.C poles are used at intermediate poles only.

P.C.C pole full form is plain cement concrete, this pole is weak in tension and it is constructed only by using cement concrete.

5.No of cross arms :

No of 4-pin cross-arm = No of support + 1 (tapping pole)

cross-arms which gives support to the insulators and conductors. cross arms are classified into many types; V shape cross arm, horizontal cross arm, U-shaped cross arm, etc.

6. No of pin insulators :

= 4 [Number of supports + no of deviations - (one dead-end + anchoring points)]

Pin insulators that do not allow an electric current to flow through it, pin insulators are used if the voltage is below 33 KV.

7. No of strain insulators :

= [Two (one for each dead end) + 2(number of anchoring points)]

8. Length of the conductors required :

(a). For phases, the ACSR No.2 conductor has required = 3 × lengths of line

(b). For neutral, ACSR No.4 conductor is required = 1 × length of a line

The full form of ACSR conductor is "Aluminium Conductor Steel Reinforced".

9. The number of guy sets

= 2(one for each dead end) + (Anchoring point)2 + deviation points.

10. Whenever guarding is to be provided two numbers of special cross arms with two numbers of guy sets and 15 kg 8 SWG G.I wire are to be used.
A guarding is provided for the safety of life, installation, and communication circuits.

The guarding for 11 KV lines is provided at road crossings, canal crossings, railway crossing, crossing over It lines or communication lines.

Q: A three phases 4 wire 415/230 V LT line has to be extended for a length of 1 KM, for electrification of a factory. Assuming an average span of 60 meters. Prepare the list of materials required for the same.

Solution-

1.number of spans

=length of line/span

= $(1 \times 1000) / 60$

= **16.66 say 17 No's**

(span means distance between two poles)

The number of span in the one-kilometer line is 17 No's.

2. Total number of supports

= Number of spans + 1

= $17 + 1 = 18$ **No's**

The total number of supports required for a one-kilometer line is 18 No's.

3. Number of R.C.C poles

= one for tapping + one for dead end + (at 0.5 KM anchoring) = $1 + 1 + 1 = 3$ **No's**

The total number of reinforced cement concrete pole required is 3 No's.

4. Number of P.C.C poles

= Number of supports - R.C.C poles

= $18 - 3 = 15$ **No's**

The number of plain cement concrete pole required is 15 No's.

5. Number of 4-pin cross arms = 18 No's

How many poles are there that many cross arms are required.

6. Number of 1.1 KV class guy sets

= 1(starting pole) + 1(terminating pole) + 2(at 0.5 KM anchoring pole) = **4 No's**

The number of guy set required is 4 No's.

7. Number of pin insulators

$$\begin{aligned} &= (\text{No of intermediate poles} + \text{Anchoring}) \times 4 \\ &= (15 + 1) \times 4 \\ &= 16 \times 4 = \mathbf{64 \text{ No's}} \end{aligned}$$

The number of pin insulator required is 64 No's

8. Number of strain insulators

$$= 4 * [\text{starting pole} + \text{end pole} + 2(\text{Anchoring pole})] = 4(2 + 2) = \mathbf{16 \text{ No's}}$$

9. Length of conductors

(a). A.C.S.R No.2 weasel conductors for 3-phase conductors with 3% sag = $3 \times 1 \text{ KM} \times 1.03 = 3.09 \text{ KM}$

(b). A.C.S.R No.4 squirrel conductor for neutral with 3% sag = $1 \times 1 \text{ KM} \times 1.03 = 1.03 \text{ KM}$

10. Miscellaneous materials such as nuts, bolts, barbed wires, etc

List of Materials for LT line			
Sl.No	List of Materials	Unit	Quantity
01	R.C.C poles 7.5 meter long, 140 Kg working load.	No's	03
02	P.C.C poles 7.5 meter long, 115 kg working load.	No's	15
03	4-pin cross arms with pole clamp nut, bolt and washers.	Set	18
04	1.1 KV class guy set complete	Set	04
05	1.1 KV pin insulators with pin and nuts complete set	Set	64
06	No 8 strain insulator of porcelain	No's	16
07	No 2 A.C.S.R weasel conductor with 3% sag for all line conductors	KM	3.09
08	No A.C.S.R squirrel conductor with 3% sag for neutral conductor.	KM	1.03
09	Miscellaneous materials such as nut, bolts, washers, barbed wire etc	Lump sum	45

H.T. DISTRIBUTION

IMPORTANT TERMS

1. Poles : *Materials used: R.C.C*

length of pole 8 meters or 9 meters, working load 140 Kg.

Cement concrete proportion, 1:2:3 or steel with M.S round.

2. Cross Arm :

Type: H.T Horizontal cross arm or H.T v-cross arm.

Section : L-section (Angle iron)

Length : 0.9 meter

With HT single top support, pole clamp, bolt, nuts, washers complete set.

3. Guy Set :

11 KV class, a stay clamp is fixed at which a turnbuckle with eyebolt is bolted.

15 KV strain insulator, stay wire of 8/11 SWG standard, Anchor plate of MS 300 mm * 300 mm * 3.1 mm, Guy pit is filled with sufficient weight of stones and then fit into the earth, A complete set.

4. Pin Insulator :

Class: 11 KV for H.T

Material: Well glazed porcelain

Size: height 125 mm and dia 178 mm

Complete with insulator pin, nut, and washer.

5. Strain insulator :

Material: Well glazed porcelain

No: 15

Voltage: 15 KV

6. Conductor :

Size: Squirrel, (No.4 A.C.S.R) of 6/1/2.11 mm (6. no of aluminum conductor and one central galvanized steel conductor having a diameter of 2.11 mm each). Weasel, (No. 2 A.C.S.R) of 6/1/2.59 mm. Rabbit (No. 1 A.C.S.R) of 6/1/3.35 mm. Wren (No. 8 A.C.S.R) of 6/1/3.33 mm. Fox (A.C.S.R) of 6/1/2.79 mm. Drake (A.C.S.R) of 30/7/4.27 mm

7. Gang operating switch (G.O.S) :

Operating voltage: 11 KV or 13.2 KV

No of Break: Single or double

Current rating: 200 or 400 Amps

Operating handle with locking arrangement.

8. Spiral earth electrode (SEE) :

Material: 8 SWG G.I wire

Size: 150 mm dia, 450 mm long with 115 turns.

Wound spirally from top of the pole to the ground and buried 1.5 m below the ground at bottom of the pole.

9. Anti-climbing devices :

AC devices such as barbed wire are to be wound on all H.T poles above the height of 1.5 meters so that ignored persons do not climb the pole and meet with an accident.

10. Danger board or Caution board :

Size of plate : 20 * 15 * 1.6 mm thick

Color: Red letters in a white background or white letters on a red background

11. Earth guard stirrup (EGS) :

Material: M.S. flat of size: 25 * 6 mm, length 2.74 meters.

Double inverted V-Shaped flat forming a net of 8 SWG G.I wire for conductors. If the line snaps it will hit earth G.I wire and gets earthed.

12. Double pole structure :

Type of pole: P.C.C or R.C.C

Height of pole: 8 meters or 9 meter with cross arms braces, clamps bolt, nuts, with 2 No. of 8 meter RCC pole a complete set.

13. Bird guards :

Material: MS sheet of 1.6 mm thick.

Size: Saw-type with a suitable arrangement for fixing in to cross arms, etc.

14. Primary cutout :

Type: *Drop out lift-off (DOLO)*

Material: Porcelain

Voltage rating: 8, 11 and 15 KV class

15. Lightning Arr-esters :

Type: Electrolytic multi-gap, oxide film, Thy-rite, etc

Voltage rating : 6, 11, 13.2 KV etc.

Enclosure material: porcelain with suitable top and bottom terminal for connection.



The specifications of materials used in 11 KV HT line are shown in the figure are as follows ;

1. Poles :

Materials used: R.C.C

length of pole 8 meters or 9 meters, working load 140 Kg.

Cement concrete proportion, 1:2:3 or steel with M.S round.

2. Cross Arm :

Type: H.T Horizontal cross arm or H.T v-cross arm.

Section : L-section (Angle iron)

Length : 0.9 meter

With HT single top support, pole clamp, bolt, nuts, washers complete set.

3. Guy Set :

11 KV class, a stay clamp is fixed at which a turnbuckle with eyebolt is bolted.

15 KV strain insulator, stay wire of 8/11 SWG standard, Anchor plate of MS 300 mm * 300 mm * 3.1 mm, Guy pit is filled with sufficient weight of stones and then fit into the earth, A complete set.

4. Pin Insulator :

Class: 11 KV for H.T

Material: Well glazed porcelain

Size: height 125 mm and dia 178 mm

Complete with insulator pin, nut, and washer.

5. Strain insulator :

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Voltage: 15 KV

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Current rating: 200 or 400 Amps

Operating handle with locking arrangement.

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Size: 150 mm dia, 450 mm long with 115 turns.

Wound spirally from top of the pole to the ground and buried 1.5 m below the ground at bottom of the pole.

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AC devices such as barbed wire are to be wound on all H.T poles above the height of 1.5 meters so that ignored persons do not climb the pole and meet with an accident.

10. Danger board or Caution board :

Size of plate : 20 * 15 * 1.6 mm thick

Color: Red letters in a white background or white letters on a red background

11. Earth guard stirrup (EGS) :

Material: M.S. flat of size: 25 * 6 mm, length 2.74 meters.

Double inverted V-Shaped flat forming a net of 8 SWG G.I wire for conductors. If the line snaps it will hit earth G.I wire and gets earthed.

12. Double pole structure :

Type of pole: **P.C.C or R.C.C**

Height of pole: 8 meters or 9 meter

with cross arms braces, clamps bolt, nuts, with 2 No. of 8 meter RCC pole a complete set.

13. Bird guards :

Material: MS sheet of 1.6 mm thick.

Size: Saw-type with a suitable arrangement for fixing in to cross arms, etc.

14. Primary cutout :

Type: Drop out lift-off (DOLO)

Material: Porcelain

Voltage rating: 8, 11 and 15 KV class

15. Lightening Arr-esters :

Type: **Electrolytic multi-gap, oxide film, Thy-rite, etc**

Voltage rating : 6, 11, 13.2 KV etc.

Enclosure material: porcelain with suitable top and bottom terminal for connection.

For 11 KV Overhead line Methods of Calculating Materials

Materials required are :

1. No of span

= Length of line / span

2. No of supports

= No of span + 1

3. For 11 KV lines, Double pole structure is to be provided for each run of 1 KM with an additional DP structure required for tapping and deviations if any.

Therefore, No of DP structures = No of KM + (Deviation) 1 + 1 (for tapping)

4. Number of poles i.e., R.C.C poles of 8 meters long

= total no of supports - number of DP structures.

5. No of HT horizontal cross arms

= No of poles + No of additional deviations

= No of top fittings

6. No of pin insulators

=(No of supports + No of additional deviations) * 3

7. No of strain or Disc insulators :

= 3[1 (staring end) + 2(additional anchoring) + 2(intermediate DP) + 1(dead end DP)]

8. No of Guy set required :

= (No of intermediate D.P) * 4 + (No of additional anchoring's) * 2 + No of deviation + (No of guardings) * 2 + No of storm guysets (for each KM two pairs) + 2(dead end DP)

9. Length of A.C.S.R conductor required with 3% sag

= 3*1.03*No of KMS.

10. During stringing of the conductor in order to reduce the sag of the conductor every 6th span pole is anchored is called anchored pole i.e., at a distance of 0.5 KM.

Hence additional anchoring at pole = No of KM, because the anchoring is to be had at each 0.5 KM, and as one anchoring will be done at DP itself, so for each KM there will be only one additional anchoring at the pole.

11. No of anti-climbing devices

= 1 (No of the single pole) + 2 (No of DPS)

12. No of Danger boards = No of supports

13. No of Earth guard stirrups

= [No of poles - Additional anchoring poles]

14. Provision for guarding, Transportation charges, labor charges, inspection charges are to be provided.

Q- : A 11 KV line is to be tapped and extended to a distance of 7 km, rural electrification. Prepare a list of materials required for (a) Tapping (b) Extending an 11 KV line assuming a span of 85 meters.

Solution :

Assuming anchoring at 0.5 KM and D.P for each KM run.

1. No of span = $7000/85$
= 82.3 or say 82

2. No of supports required
= $82 + 1 = 83$ No's

3. No of D.P structure = 7 No's

4. No of 8-meter R.C.C poles

= No of supports - (No of DP + one tapping)
= $83 - 8 = 75$

5. No of Horizontal cross arms with H.T.S.T.S

= No of poles = 75 (No deviations)

6. No of pin insulators with pin and clamps

= 3 (No of cross arms + No of DPS)

$$= 3(75 + 7) = 82 \text{ No's}$$

7. No of disc insulators

$$= 3[1(\text{starting end} + 2 * 6(\text{Intermediate DPS}) + 2 * 7(\text{additional anchoring}) + 1(\text{dead end DP})]$$
$$= 3[1 + 2 * 6 + 2 * 7 + 1] = 28 * 3 = 84 \text{ No's}$$

additional anchoring at the pole for 7 KM length of line apart from DP is 7.

8. No of Guy sets

$$= 4 (\text{No of intermediate DP}) + 2(\text{No of additional anchoring}) + 2 (\text{dead ends})$$
$$= 4 * 6 + 2 * 7 + 2 * 1 = 40 \text{ sets.}$$

9. Length of A.C.S.R No 2 with 3% sag

$$= 7 * 3 * 1.03 = 21.63 \text{ KM}$$

10. No of spiral earth electrodes

$$= \text{No of poles} + \text{No of DPS}$$
$$= 75 + 7 = 82$$

11. No of danger boards = 82

12. Earth guard stirrups

$$= \text{No of poles} - \text{No of anchoring points}$$
$$= 75 - 7 = 68$$

13. No of A.C devices

$$= \text{No of poles} - \text{No of anchoring points}$$
$$= 75 - 7 = 68$$

14. Miscellaneous materials such as bolts and nuts, etc.

Chapter-5 (overhead service lines)

Estimating and Costing of Overhead Service Connection for Single Phase

Q: Prepare a list of material and estimate the cost for providing service connection to a building at 240 V single phase 50 Hz having a light and fan load of 2 KW and heating load of 2 KW. The supply is to be given from an overhead line 20 m. away from the building.

Solution: Materials used for service connection :

To calculate the size of the wire first you need to calculate the total connected load in the house and then calculate the load current of the house using proper formula.

$$\begin{aligned}\text{Connected load} &= \text{lighting load} + \text{heating load} \\ &= 2 \text{ KW} + 2 \text{ KW} = 4000 \text{ W}\end{aligned}$$

See a total load of house is 4000 W, multiply it by a factor of safety, the factor of safety means we should consider future load, now itself I will consider future load double of the present, so I will multiply by 2.

Keeping in view the future additional demand (say 100%) lets the future load be twice of the present load (i.e. a factor of safety of 2). i.e. $2 \times 4000 \text{ W} = 8000 \text{ W}$.

Load current in amperes = Load in watts/Rated voltage

$$\begin{aligned}&= 8000/240 \\ &= 33 \text{ Amps.}\end{aligned}$$

The load current of the house is 33 Amps, now by see the wire table you can find the size of the wire. Watch my video how to find the size of the wire - [Click Here](#)

The size of the aluminum cable is 10 sq mm from the wire table.

(a) The length of cable required

$$\begin{aligned}&= (20 + 6 + 3 + 4) \times 2 \\ &= 66 \text{ m}\end{aligned}$$

We should calculate the length of cable from low tensions lines to the consumer meter board, below I will provide formulas on how to calculate the length of cable.

Note: Length of the cable = Horizontal length (20 m) + Looseness and meter board

connection (6 m) + Service pipe length (3 m) + Pole side connection (4 m)

Horizontal length - Length of cable from a pothead up to service pipe.

Looseness and meter board connection - length of cable from the end of the service pipe to the meter board.

Service Pipe - The cables are drawn inside the service pipe, so we should consider that length also.

Pole side connection - The cables used to connect low tension lines to pothead that length also we should consider.

(b) No of Break Insulators = 2 Nos

The number of break insulators required is 2 No. Only two break insulators are used in overhead service mains. one insulator at the pole side and another insulator at the meter board side. Break insulators are used to isolate messenger wire from the pole and also to give support for messenger wires.

(c) No of Reel Insulators = $2(20 + 6) = 52$ Nos

The number of reel insulators required is 52 No. The purpose of reel insulators is to provide some distance between two conductors and it will also avoid short circuits between two conductors if both the conductor's insulation has been damaged.

(d) 10 SWG G.I wire for messenging = 22m = 2 kg.

The purpose of messenger wire is to give support to the reel insulators and also to the service cables.

(e) 30 mm PVC pipe of 2 m and bends of 3 Nos.

(f) 40 mm G.I pipe of 3 mm thick 1.8 m for supporting.

(g) 500 mm × 500 mm × 45 mm WVTWB - 1 No.

(h) 40 mm G.I pipe 2.5m and 1 kg 8 SWG G.I. wire for earthing.

(i) 30 A fuse of 2 Nos and Miscellaneous materials.

Miscellaneous materials means nut, bolt etc.

These are the Materials required.



Sl. No.	Particulars	Unit	Quantity	Rate Rs. Ps.	Amount Rs. Ps.
✓1.	10 sq. mm aluminium cable of 1. kV voltage grade, double sheathed	100 M (coil)	80 M	1800.00	1440.00
✓2.	1.1 KV porcelain break insulators	Nos.	2	10.00	20.00
✓3.	Porcelain reel insulators	Nos.	52	2.00	104.00
✓4.	10 SWG G.I messanging wire	Kg	2	100.00	200.00

✓5.	30 mm PVC pipe of 2 mm thick, for servicing	3M	2	65.00	130.00
✓6.	PVC bends for 30 mm PVC pipe	Nos	3	10.00	30.00
✓7.	50 mm G.I pipe 3 mm thick 1.8M for supporting	M	1.8	495.00	891.00
✓8.	500 × 500 × 45 mm WVTWB	No	1	600.00	600.00
✓9.	30 A porcelain fuse unit 500 Vg	No	3	100.00	300.00
✓10.	40 mm G.I. pipe 3 mm thick	M	2.5	375.00	937.00
✓11.	8 SWG G.I. wire for earthing	Kg	1	150.00	150.00
12.	12.5 mm dia 300 mm eye bolt nuts of M.S	No	2	50.00	100.00
✓13.	Miscellaneous materials such as binding wire Nuts, bolts, cement, Salt, coal etc.,	Lump sum			298.00
✓14.	Labour charges :				
	(a) For earthing				300.00
	(b) for servicing				700.00
✓15.	Contingencies and unforeseen things @ 5% on above amount				260.00
www.shidlingelectricals.com				Grand Total in Rs.	5460.00

Estimating and Costing of Overhead Service Connection for Three Phase
(Service connection to factory)

Q: Three phases overhead service connection: select the size and prepare an estimate for overhead service connection to feed power supply to a factory of 10 HP load for a distance of 10 meters.

Solution: Materials used for service connection.

Assuming a supply voltage of 400 V, p.f = 0.8 and the efficiency of the load is 80%.

$$\text{Current} = (10 \times 735.5) \div (0.8 \times 0.8 \times 400 \times \sqrt{3}) = 16.6 \text{ Amps}$$

Keeping view the future additional demand says 100% let the future load be twice of present load or factor of safety as 2, the current rating is 33A.

The size of the aluminum cable required is 10 sq mm.

(a) Length of the cable = $10 + 3 + 3 + 4 = 20 \times 4 = 80 \text{ m}$.

Note: Length of the cable = Horizontal length (10 m) + Looseness and meter board connection (3 m) + Service pipe length (3 m) + Pole side connection (4 m).

(b) G.I Messenging wire = $10 + 1 = 11\text{m} = 1\text{kg}$.

(c) No of Break Insulators = 2 Nos.

(d) No of Reel Insulators = $(10+3)4 = 13 \times 4 = 52 \text{ Nos}$.

(e) 30 mm PVC pipe of 2 m and of 3 bends.

(f) 50 mm G.I pipe of 3 mm thick 1.8 m for supporting.

(g) $500 \times 500 \times 65 \text{ m WVTWB} - 1 \text{ No}$.

(h) 40 mm G.I pipe 2.5 m and 1 kg 8 SWG GI wire for earthing.

(i) 30 A fuse unit - 3 Nos.

(j) M.S. clamps with nuts and bolts - 2 sets and miscellaneous materials.



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✓5.	30 mm PVC pipe of 2 mm thick, for servicing	3M	2	65.00	130.00
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✓7.	50 mm G.I pipe 3 mm thick 1.8M for supporting	M	1.8	495.00	891.00
✓8.	500 × 500 × 45 mm WVTWB	No	1	600.00	600.00
✓9.	30 A porcelain fuse unit 500 Vg	No	3	100.00	300.00
✓10.	40 mm G.I. pipe 3 mm thick	M	2.5	375.00	937.00
✓11.	8 SWG G.I. wire for earthing	Kg	1	150.00	150.00
12.	12.5 mm dia 300 mm eye bolt nuts of M.S	No	2	50.00	100.00
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CHAPTER- 3 (INTERNAL WIRING)

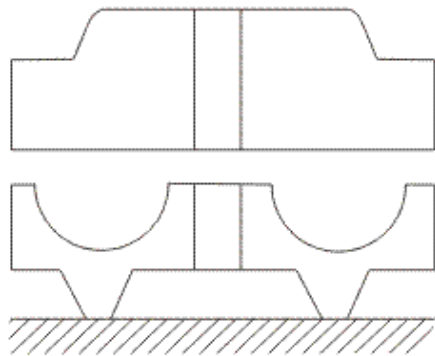
What is Electrical Wiring?

Electrical wiring is the electrical power distribution through the wires in a perfect manner for economic use of wiring conductors inside a room or building with better load control.

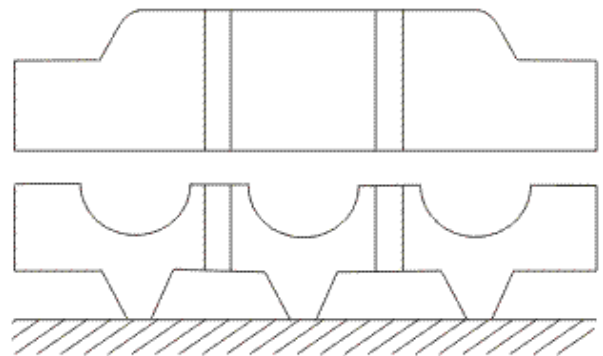
CLEAT WIRING

Material Used in Cleat Wiring

- VIR or PVC insulated wires
- Weather proof cables
- Porcelain cleats or plastic cleats (two or three grooves)
- Screws



Cleat with two grooves



Cleat with three grooves

Procedure of Cleat Wiring

In this wiring VIR or PVC insulated wires are braided and compounded on walls or ceiling with the help of porcelain cleats.

The wires can be weather proof. Simple wire laying is done in this scheme of wiring. In present days, this kind of wiring scheme is not recommended for house or building. Only in temporary army campus or festival related pandels this wiring is used.

Advantages of Cleat Wiring

- Cheap and easy wiring
- Easy to fault detection
- Easy to repair
- Alteration and addition is easy.

Disadvantages of Cleat Wiring

- Bad appearance
- Exposed to weather to be affected by humidity, rain, smoke, sunlight etc
- Chances for shock or fire
- Used in only 220V in low ambient temperature.
- Not long lasting
- Sag happens

Batten Wiring

Material Used in Batten Wiring

- CTS or TRS cable
- Straight teak wooden batten (at 10 mm thick)
- Tinned brass link clip (buckle clip)
- Brass pins

Procedure of Batten Wiring

Group of Single or double or three core cables are used to be laid on straight teak wooden batten. The cables are hold with help of tinned brass link clip or buckle clip. Brass pins are used to fix the buckle clips on the wooden batten. Buckle clips is fixed with brass pin on the wooden batten at an interval 10 cm for horizontal runs and 15 cm for vertical runs.



Advantages of Batten Wiring

The advantages of this kind of wiring are given below.

- Easy installation
- Cheap in material cost
- Appearance is better.
- Customization is easy
- Less chance of leakage current

Disadvantages of Batten Wiring

- Not suitable for outdoor wiring
- Humidity, smoke, steam etc directly affect on wires.
- Heavy wires are not recommended for this wiring scheme.
- Only suitable for below 250 V.
- High risk of fire.

Casing Capping Wiring

Material Used in Casing Wiring

- VIR or PVC insulated wires
- Casing Enclosure (made of wood or plastic)
- Capping (made of wood or plastic)
- Casing and capping joints.

Procedure of Casing Wiring

This kind of winding is very old fashioned. Generally PVC or VIR insulated wires are carried through the casing enclosure and capping is used to cover the casing.

Advantages of this kind of wiring scheme are

- Cheap and easy to install

- Strong and durable wiring
- Customization can be done easily
- Safe from smoke, dust, rain and steam etc.
- Due to casing and capping no risk of shock.

Disadvantages of Casing Wiring

There are some disadvantages in casing wiring; they are

- Very costly
- Not suitable for weather with high humidity and acidic conditions.
- Insect like termites or ants can damage wooden casing and capping.
- High risk of fire.

Lead Sheathed Wiring

The type of wiring employs conductors that are insulated with VIR and covered with an outer sheath of lead aluminum alloy containing about 95% of lead. The metal sheath given protection to cables from mechanical damage, moisture and atmospheric corrosion.

The whole lead covering is made electrically continuous and is connected to earth at the point of entry to protect against electrolytic action due to leaking current and to provide safety in case the sheath becomes alive. The cables are run on wooden batten and fixed by means of link clips just as in TRS wiring.

Conduit Wiring

Conduit Wiring

There are two additional types of conduit wiring according to pipe installation

1. **Surface Conduit Wiring**
2. **Concealed Conduit Wiring**

Surface Conduit Wiring

If conduits installed on roof or wall, It is known as surface conduit wiring. in this wiring method, they make holes on the surface of wall on equal distances and conduit is installed then with the help of rawal plugs.

Concealed Conduit wiring

If the conduits is hidden inside the wall slots with the help of plastering, it is called concealed conduit wiring. In other words, the electrical wiring system inside wall, roof or floor with the help of plastic or metallic piping is called concealed conduit wiring. obviously, It is the **most popular, beautiful, stronger and common electrical wiring system** nowadays.

In conduit wiring, steel tubes known as conduits are installed on the surface of walls by means of pipe hooks (surface conduit wiring) or buried in walls under plaster and VIR or PVC cables are afterwards drawn by means of a GI wire of size if about 18SWG.

In Conduit wiring system, The conduits should be electrically continuous and connected to earth at some suitable points in case of steel conduit. Conduit wiring is a professional way of wiring a building. Mostly PVC conduits are used in domestic wiring.

The conduit protects the cables from being damaged by rodents (when rodents bites the cables it will cause short circuit) that is why circuit breakers are in place though but hey! Prevention is better than cure. Lead conduits are used in factories or when the building is prone to fire accident. Trunking is more of like surface conduit wiring. It's gaining popularity too.

It is done by screwing a PVC trunking pipe to a wall then passing the cables through the pipe. The cables in conduit should not be too tight. Space factor have to be put into consideration.

Types of Conduit

Following conduits are used in the conduit wiring systems (both concealed and surface conduit wiring) which are shown in the above image.

- **Metallic Conduit**
- **Non-metallic conduit**

Metallic Conduit:

Metallic conduits are made of steel which are very strong but costly as well.

There are two types of metallic conduits.

- Class A Conduit: Low gauge conduit (Thin layer steel sheet conduit)
- Class B Conduit: High gauge conduit (Thick sheet of steel conduit)

Non-metallic Conduit:

A solid PVC conduit is used as non-metallic conduit now a days, which is flexible and easy to bend.

Size of Conduit:

The common conduit pipes are available in different sizes genially, 13, 16.2, 18.75, 20, 25, 37, 50, and 63 mm (diameter) or 1/2, 5/8, 3/4, 1, 1.25, 1.5, and 2 inch in diameter.

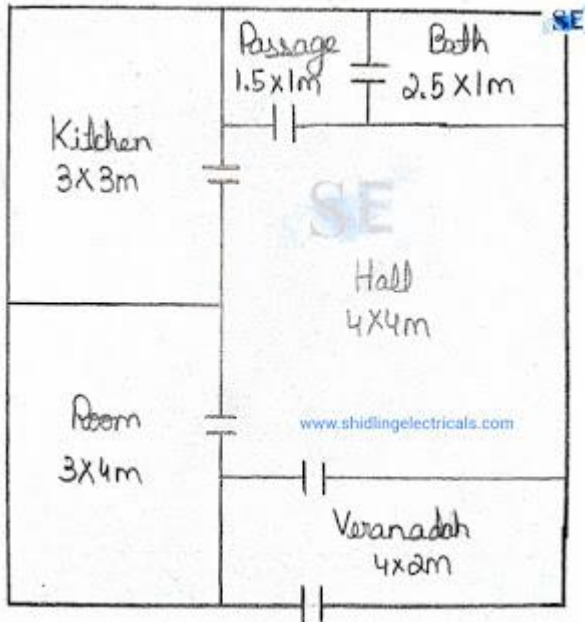
Advantage of Conduit Wiring Systems

- Appearance is very beautiful (in case of concealed conduit wiring)
- No risk of mechanical wear & tear and fire in case of metallic pipes.
- Customization can be easily done according to the future needs.
- Repairing and maintenance is easy.
- There is no risk of damage the cables insulation.
- it is safe from corrosion (in case of PVC conduit) and risk of fire.
- It can be used even in humidity , chemical effect and smoky areas.
- No risk of electric shock (In case of proper earthing and grounding of metallic pipes).
- It is reliable and popular wiring system.
- sustainable and long-lasting wiring system. It is the safest wiring system (Concealed conduit wiring)

Disadvantages of Conduit Wiring Systems

- It is expensive wiring system (Due to PVC and Metallic pipes, Additional earthing for metallic pipes Tee(s) and elbows etc.
- Very hard to find the defects in the wiring.
- installation is not easy and simple.
- Risk of Electric shock (In case of metallic pipes without proper earthing system)
- Very complicated to manage additional connection in the future

Q - Prepare an estimate of materials required for conduit wiring for domestic installation of the following plan. Assume the datas when ever required.



Solution

Step-01

Sl.NO	Location	Area(meter square)	Wattage (10W/m sq)	No of lights	of fans	points socket	Types of fitting
01	Verandah	8	80	1x60	-	-	Pendent
02	Room	12	120	1x40(FL) 1x60(IL)	1x80	1x60	Pendent & batten
03	Hall	16	160	2x40 1x60	1x80	1x60	Pendent & batten
04	Kitchen	9	90	1x40 1x60	-	PS=2000	Pendent & batten
05	Passage	1.5	15	1x60	-	PS=1000	Pendent
06	Bath room	2.5	2.5	1x60	-		Pendent
			Total load =	480w	160w	120w	

HomeElectrical Wiring Estimating and Costing of materials required for House Wiring or residential plan

Estimating and Costing of materials required for House Wiring or residential plan

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Estimating and Costing Interior Wiring

Note - Before reading this article set your phone display on the Desktop site.

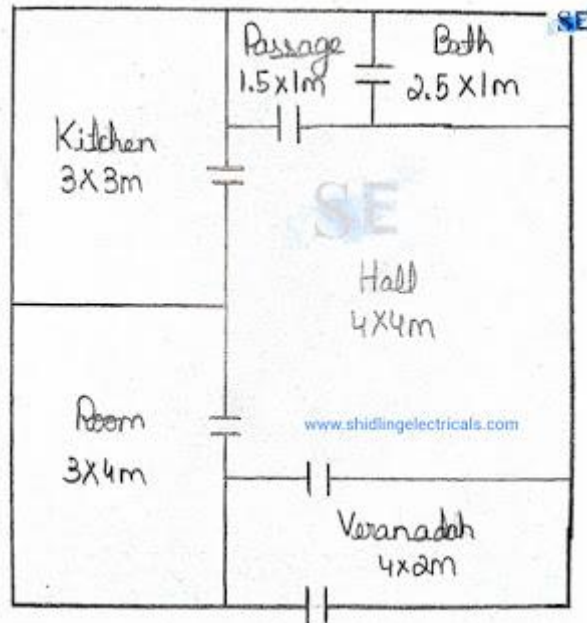
Hello everyone, in this article I will discuss the estimation and cost of the lighting circuit and heating circuit for house wiring or residential plan.

Before starting the article if you want to watch a video related to electrical estimation and costing, you can watch my YouTube videos - [Click Here](#)

Given data: Consider the given residential plan.

This is the plan where we should calculate everything i.e., what are the materials required for the plan and make a chat of materials with costing.





All dimensions are in a meter

The following assumptions are made :

- The height of the meter board, distribution board from the floor level = 2 meters.
- Height of horizontal run and lighting fitting from floor level = 3 meters.
- Height of switchboard from floor level = 1.5 meters.

Step-01

Total lighting load and number of circuits

Sl.NO	Location	Area(meter square)	Wattage (10W/m sq)	No of lights	of fans	points socket	Types of fitting
01	Verandah	8	80	1x60	-	-	Pendent
02	Room	12	120	1x40(FL)	1x80	1x60	Pendent

				1×60(IL)			batten
03	Hall	16	160	2×40	1×80	1×60	Pendent
				1×60			& batten
04	Kitchen	9	90	1×40	-	PS=2000	Pendent
				1×60			& batten
05	Passage	1.5	15	1×60	-	PS=1000	Pendent
06	Bath roon	2.5	2.5	1×60	-		Pendent
			Total load =	480w	160w	120w	

Total lighting circuit load = 480 + 160 + 120 = 760 watts

Total heating circuit load = 3000 watts

Total load of Installation = 760 + 3000 = 3760 watts

No of the lighting circuit

$$= \text{Total lighting circuit load}/800$$

$$= 760/800 = 0.95$$

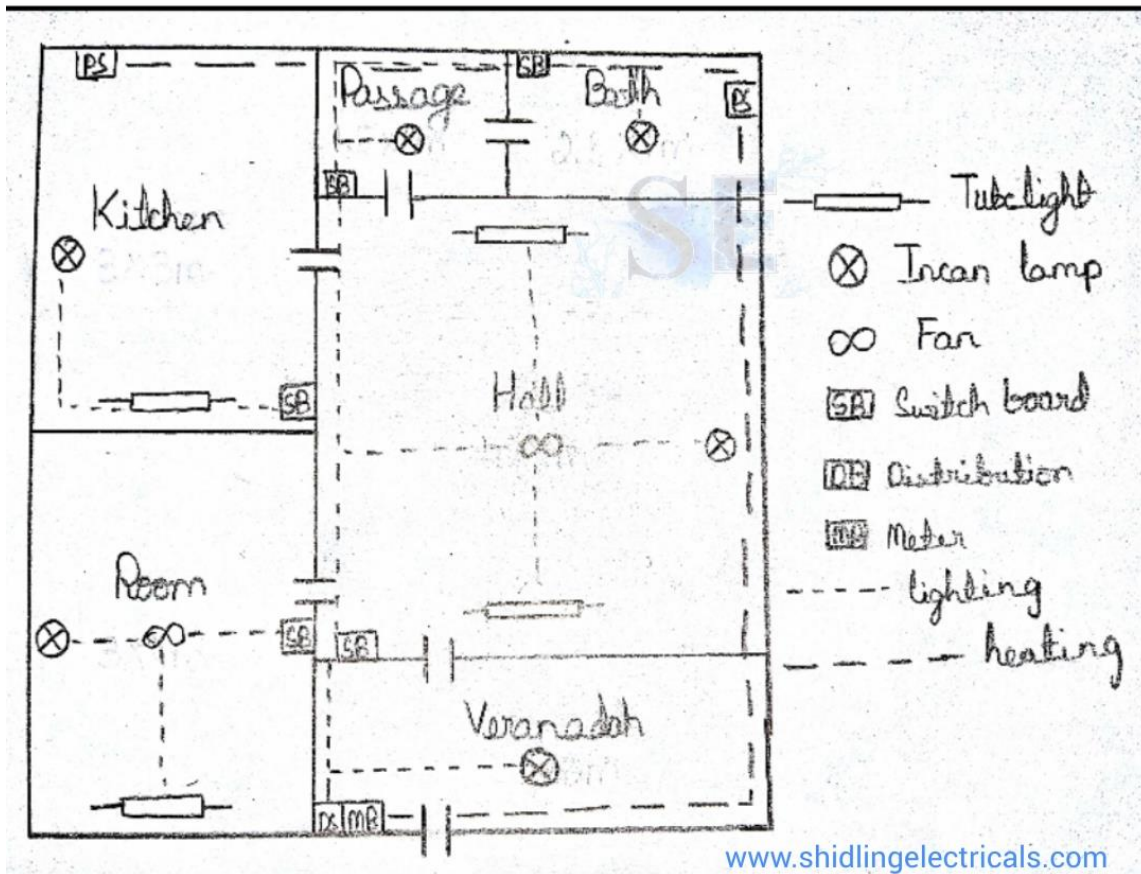
If the total lighting circuit load exceeds 800 watts then two circuits must be provided, but here total lighting circuit load is less than 800 watts.

Therefore, only one circuit is used.

Hence from the Meter board, one lighting and one heating circuit are taken.

Step-02

Wiring diagram for the given plan:



MB - Meter Board

DB - Distribution Board

SB - Switch Board contains switches & sockets

Step-03 :

Size of the wire

To calculate any size of the wire, first we should calculate load current and by using a wire table size of the wire can be calculated.

Load current = Total lighting circuit load/Voltage

$$= 760/230 = 3.30 \text{ Amps}$$

let, a factor of safety be 2(for future demands or load)

$$\begin{aligned}\text{Current rating} &= \text{load current} * 2 \\ &= 3.30 * 2 = 6.6 \text{ Amps}\end{aligned}$$

Therefore, for lighting circuit 3/22 SWG copper wire is selected from the wire table

Step-04:

Length of Conduit required, use concealed conduit system of wiring.

SI.NO	Location	Horizontal run	Vertical drop to switch	Vertical rise pipe line to ceiling fan	Wall crossing	Total
01	Verandah	4+2	-	0.5		6.5
02	Room	3+2	1	0.5		6.5
03	Kitchen	3+1.5	1	0.5		6
04	Hall	4+4+4	1	0.5	0.33 * 5 = 1.65 (overall)	12
05	Passage	1+1.5+0.75	1	0.5		3.25
06	Bath	1.25	1	0.5		2.75
	Total				1.65	37

$$\begin{aligned}\text{Total} &= 37 + 1,65(\text{ wall crossing }) \\ &= 38.65 = 39 \text{ (say)}\end{aligned}$$

$$\begin{aligned}\text{Total PVC conduit} &= 39 + 5\% \text{ wastage} \\ &= 40.95 = 41 \text{ meter (say)}\end{aligned}$$

Step-05:

The total length of wire required

$$\begin{aligned}\text{length of wire(3/22 copper wire)} &= 41 * 3 \\ &= 123 \text{ meter}\end{aligned}$$

Step-06:

Wood screws(assorted size) = 4(No of MB+SB)

$$= 4(1 + 4)$$

$$= 20 + 5\% \text{ wastage}$$

$$= 21.95 \text{ Nos}$$

Step-07:

The number of wood plugs required is 22 Nos as same as wood screws.

Step-08:

Other accessories required

01. ICDP Switch

$$\text{load current} = 3.30 * 2 = 6.6 \text{ Amps}$$

A 15A ICDP switch is selected or 15A MCB is used.

02. Switches = No of lamps + fans + sockets

$$= 12 + 2$$

$$= 14 \text{ Nos}$$

A 250 V, 5 A switches = 14Nos

03. A 250 volts, 5 A, 3-Pin socket = 2 Nos

04. No of fan regulators = 2 Nos

05. No of Pendant holder = 6 Nos

06. No of Angle holder = 4 Nos

07. No of ceiling roses = No of fan + No of pendant

$$= 2 + 6 = 8 \text{ Nos}$$

08. Fluorescent fitting, 230 V, 5 A = 4 set

09. Ceiling fans, 230 V = 2 set

10. Incandescent fitting = 6 set

11. No of Tees = 4 Nos

12. Meter Board = 1 Nos

13. Switch Board = 4 Nos

Step-09:

Labor Charge

The labor charge depends upon the number of points

No of point

$$= (\text{lights} + \text{fan} + \text{sockets}) * 0.5 + \text{MB} + \text{DB}$$

$$= (10 + 2 + 2) * 0.5 + 1 + 1$$

$$= 15 \text{ Nos}$$

Labor Cost = Cost per point * No of points

$$= 195 * 15 = \text{Rs } 2970.00$$

Step-10:

Cost of Materials

01. For heating load

load current = Total heating circuit load / Voltage

$$= 3000 / 230 = 13.04 \text{ Amps}$$

Current rating = load current * Factor of safety

$$= 13.04 * 2 = 26.08 \text{ Amps}$$

Therefore, 7/20 SWG copper wire is selected.

02. PVC Conduit required

Horizontal run = 4+2+4+1+2.5+1.5+3

$$= 18 \text{ meter}$$

Vertical drop = 1+1 = 2 meter

Wall crossing = 0.33 * 4 = 1.32 meter

Total PVC Conduit = 21.32 = 22 (25mm, 2mm thick)

Therefore, Total PVC conduit = 22 + 10% wastage

$$= 24.2 = 25 \text{ meter}$$

03. Length of wire required

Length of wire = 3 * length of PVC conduit

$$= 3 * 25$$

$$= 75 \text{ meter}$$

04. Wood screws (assorted size) = 4 * 2

$$= 8 \text{ No} + 5\%$$

$$= 8.4 = 9 \text{ No's}$$

05. Wood Plugs = 9 No's

06. Other accessories required

(a) ICDP Switch

Load current = 13.04, FOS = 3

Current rating = 13.04 * 3 = 39.13 Amps

A 250 V, 50 Amps selected

(b) Switches - A 250 V, 15 A switches = 2 No's

(c) 3-Pin socket = 2 No's

(d) No of elbows = 2 No's

(e) Switch board (200*250*45 mm) = 2 No's

07. Labor Cost

No of point = 2

labor cost = 195 * 2 = 390

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