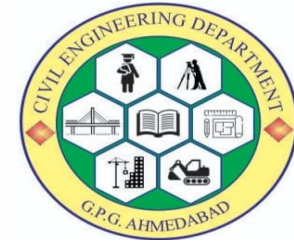




# GOVERNMENT POLYTECHNIC FOR GIRLS



**CIVIL ENGINEERING DEPARTMENT**

**SUBJECT : BUILDING SERVICES ( 3360604 )**

**TOPIC : ELECTRICAL SERVICES AND LAYOUT (PART II)**



**GOVERNMENT POLYTECHNIC FOR GIRLS**

**AHMEDABAD**

**COURSE: BUILDING SERVICES**

**COURSE CODE : 3360604**

**TOPIC: LAYOYT OF ELECTRICAL SERVICES  
(PART II)**

**PREPARED BY : H.S.PATEL LCE**

# INDEX






- Conventional symbols for electrical installations and accessories of wiring
- Electrical accessories
- Types of wire based on insulation
- System of wiring
- Layout of typical house wiring
- Indian standard recommendation for house wiring
- Steps for wiring estimation
- Estimation of house wiring
- Point to be considered in maintenance of electric system in a building

# CONVENTIONAL SYMBOL FOR ELECTRICAL INSTALLATION AND ACCESSORIES OF WIRING

Fig. 2.5 (b) Plate earthing













2.6 વીજ સાધનો અને વાયરીંગ માટેની સહાયક સામગ્રી માટેના સંકેતો (Conventional symbols for electrical installations and accessories of wiring) :

LIST OF STANDARD SYMBOLS : AS PER IS : 2032

(A) Fuse-boards :	
Lighting circuit fuse-boards :	
(a) Main fuse-board without switches	
(b) Main fuse-board with switches	
(c) Distribution fuse-board without switches	
(d) Distribution fuse-board with switches	
Power circuit fuse-boards :	
(a) Main fuse-board without switches	

ઇલેક્ટ્રિકલ સર્વિસીસ અને લે-આઉટ

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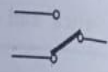
(b) Main fuse-board with switches	
(c) Distribution fuse-board without switches	
(d) Distribution fuse-board with switches	
(B) Switch and Switch outlets :	
(i) One way switch	
(a) Single pole	
(b) Two-pole	
(c) Three-pole	
(ii) Two-way switch (May 2016, Oct. 2016, May 2017) (May 2018)	
(iii) Intermediate switch	
(iv) Push-button or bell-push (May 2015, Oct. 2016)	
(C) Socket outlets :	
(i) Socket outlet, 5A	
(ii) Socket outlet, 15 A (May 2016, 2017, 2019)	
(iii) Combined switch and socket outlet, 5 A	

(D) Switchgear :

(i) Switch-general symbol



(a) Two way



(b) Intermediate



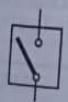
(ii) Three-pole switch, multiline representation



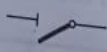
(iii) Three-pole switch, single line representation



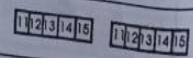
(iv) Circuit breaker (May 2015)



(v) Isolator



(vi) Terminal strip



(vii) Link (May 2017)



(viii) Open link



(ix) Distribution board cubical box



(E) Contacts :

(i) Socket



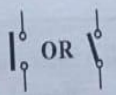
(ii) Plug (May 2019)



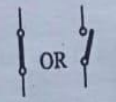
(iii) Plug and socket



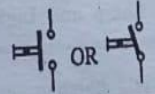
(iv) Relay or contactor contact, normally open (NO)



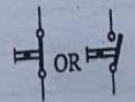
(v) Relay or contactor contact normally closed (NC)



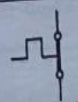
(vi) Push-button with momentary closed contact (normally open contact)



(vii) Push-button with momentary open contact (normally closed contact)



(viii) Thermal overload relay contact



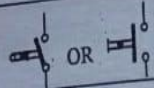
(ix) Time-delay relay contact



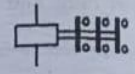
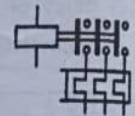






















(x) Limit switch (NC contact)



(xi) Limit switch (NO contact)



(F) Relays and contactors :	
(i) Coil of electro-magnetic relay or contactor	
(ii) Thermal overload relay	
(iii) Electrically operated three-pole contactor	
(iv) Electrically operated three-pole contactor with thermal overload device in all three-pole	
(v) Time delay relay (TDR)	
(G) Lamp and Lighting Apparatus :	
(i) Lamp or outlet for lamp (Oct. 2016, May 2018)	
(ii) Group of three 40 W lamps	3 X 40 W
(iii) Lamp mounted on wall or light bracket	
(iv) Lamp mounted on ceiling	
(v) Fluorescent lamp	
(vi) Group of three 40 W fluorescent lamps	
(H) Fans :	
(i) Ceiling fan (Oct. 2016, May 2017)	

(ii) Bracket fan	
(iii) Exhaust fan (May 2016, Oct. 2016)	
(iv) Fan regulator (May 2015)	
(I) Earthing :	
Earth point (May 2016, Oct. 2016, May 2018)	
(J) Miscellaneous Apparatus :	
(i) Fuse (Oct. 2016)	 OR 
(ii) Signal lamp	
(iii) Indicator	
(iv) Horn	
(v) Bell (May 2017, May 2018)	
(vi) Buzzer	
(vii) Siren (May 2015, Oct. 2016)	
(viii) Electrical appliances (a) General	

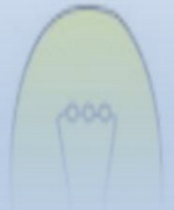
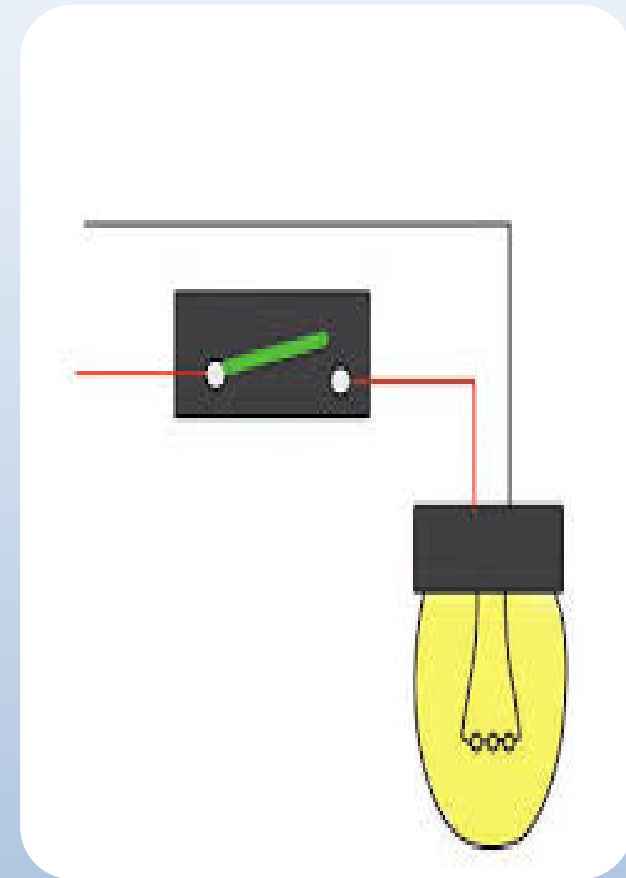
# ELECTRICAL ACCESSORIES

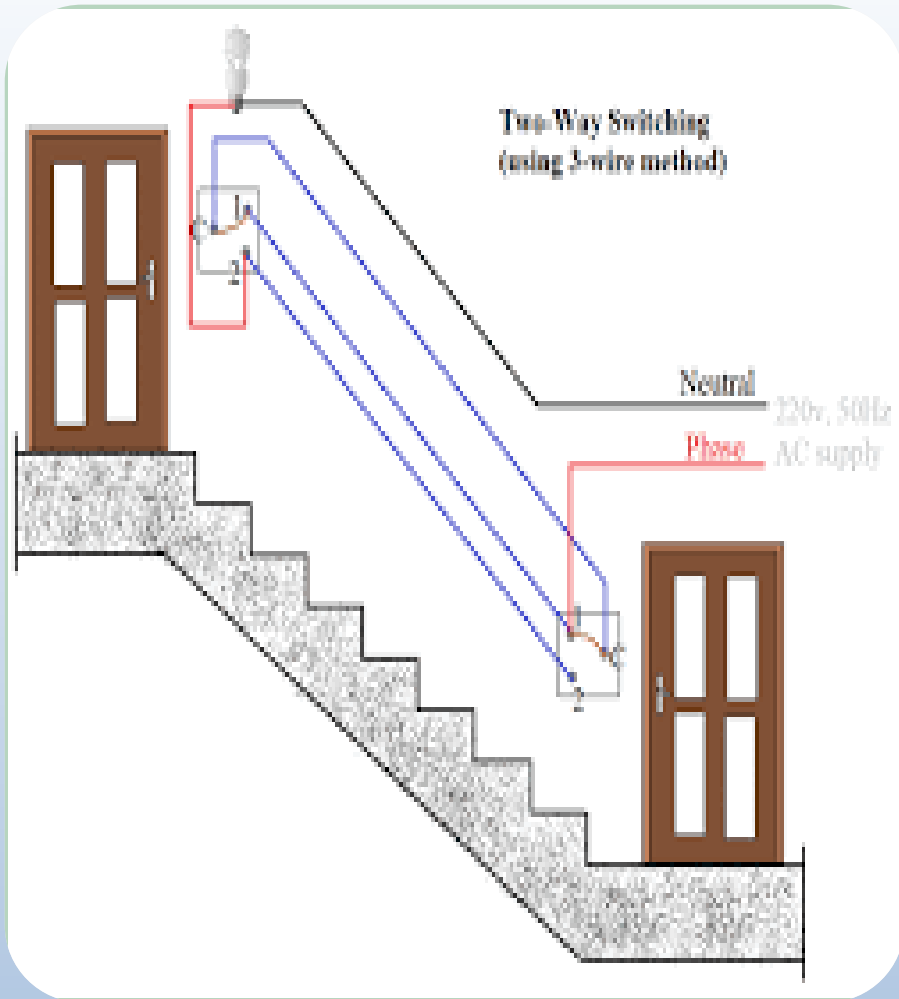
## 1. SWITCH

A switch is a device which is used to either establish a closed circuit or to withdraw it. When the circuit is established then the switch is said to be in 'ON' position. Similarly when the circuit is withdrawn or disconnected then the switch is said to be in 'OFF' position. For domestic lighting switches of 5A and 15A are standardized.

### (i) ONE WAY SWITCH :

in this type, there are two terminals with contact between them. It is operated by a knob. A spring is used for quick operation. This type of switch is predominantly used for controlling most of the electrical appliances, like lamp, fan,t.v.,etc.





## (ii) TWO WAY SWITCH:

Two way switch is used to control an electric device from two different places. Lights at bed rooms and staircases are usually provided with two way switches.

When switch I is operated point A comes in contact with point B and the lamp starts glowing. When switch II is operated point D comes in contact with point C and the lamp start glowing. One way switch and two way switch are surface switches.



### **(iii) PUSH BUTTON SWITCH :**

In this type of switch two contacts connect by a metal ring. Metal ring operated through a button. When pressure is applied by finger on a bottom contact is established. This type of switch is used in doorbell.

### **(iv) PULL SWITCH :**

The pull switch normally work with the strong mechanical action. It is usually operated by a single pull both for 'ON' and 'OFF'. This switch is installed on the ceiling and a chord is made to hang from the top operating.

## **2. LAMP HOLDER :**

Lamp holder is used to hold the lamp at desirable position and locations. Earlier brass holders were used, but due to increase in the cost of brass backalite lamp holders are widely used.

Base on mounting the type of holder are :

**PENDENT HOLDER:** This type of holder is used to hold the lamp when it is required to be suspended from the ceiling.

**BATTEN HOLDER:** This type of holder is normally fixed at the switch board directly. It may be mounted on the squared or round wooden block.

**ANGLE HOLDER:** This holder is fixed to the wall with some angle.

**BRACKET HOLDER:** This type of holder is used in table lamp.

### **3. CELLING ROSE:**

Celling rose is fixed in the ceiling or on the wall. It is used to tap the current for lamp tube light or ceiling fan etc using a flexible wire. It is fixed on the square or round wooden block. Usually a low voltage of less than 250 V is tapped from this device.

### **4. ADAPTOR:**

It is used for small portable electric appliances to tap power temporarily from holder. It is made of bakelite. It has two small pins which fits into the lamp holder. On the upper side there are two terminals.

### **5. CONNECTOR :**

A connector is used to tap power supply from relay , timer, etc. for tube light and fan connection connector may be used.

By connector the connection is obtained without joining wires.

## **6. DISTRIBUTION BOARD (D.B) :**

This is used to distribute the total supply into the required number of subcircuits. The number of point connected to one sub circuit should not exceed 10 and the total connected load should not exceed 800 watts. For each subcircuit a 15 A fuse is provided on the phase wire.

## **7. SOCKET OUTLET:**

Socket out is normally fixed in the switch board with the control of a switch. It consists of a socket base having two or three terminal sleeves.

## **8. PLUG:**

The plug is used to tap power from the socket outlet. This is usually connected with the flexible wire of the portable electrical appliances such as table fan, radio, electric iron, etc. It is of two type; one is of two pin plug and other is a three pin plug.

## **9. MOUNTING BLOCKS:**

Mounting blocks are square or round wooden blocks. It is used as a insulated base on ceiling and walls, for fitting all electrical devices such as ceiling rose, batten lamp holder, surface switches, etc.

## **10. MAIN SWITCH :**

A main switch is fixed near the energy meter in a distribution board and controls the complete electrical system of the building. This is also called as iron clad switch and is available in following types:

- . Double pole iron clad switch (DPIC) - used for controlling single phase connection.
- . Triple pole iron clad switch (TPIC) – used for controlling three phase connection .

# Types of Wires based on insulation

Wires are used for passage of electric current in many ways from generating power plant to various distribution levels like.

1. In overhead transmissions and distribution lines.
2. In giving service connection to various consumers.
3. In winding coils of electrical machines.
4. In house and industrial wiring .
5. In under – ground cables etc.

1. In overhead transmissions line mainly bare conductor of copper or aluminum are used. Now – a-days aluminum conductors are used as it is cheaper than copper conductor.
2. In giving service connection to the different consumers weather proof insulated conductors are used.

3. In electrical machine enamel covered round copper connectors are used as winding wire for small capacity machines while paper or cotton covered copper conductors are used for large capacity machines.
4. In house or domestic wiring insulated copper or aluminum conductors are used.
5. For higher rating machines or in congested area underground cables with copper or aluminum conductors are used.

For conducting of small current, single standard insulated copper conduction used. As per the current rating, the conductors has specific diameter cross – sectional area and level of insulation depends upon voltage rating.

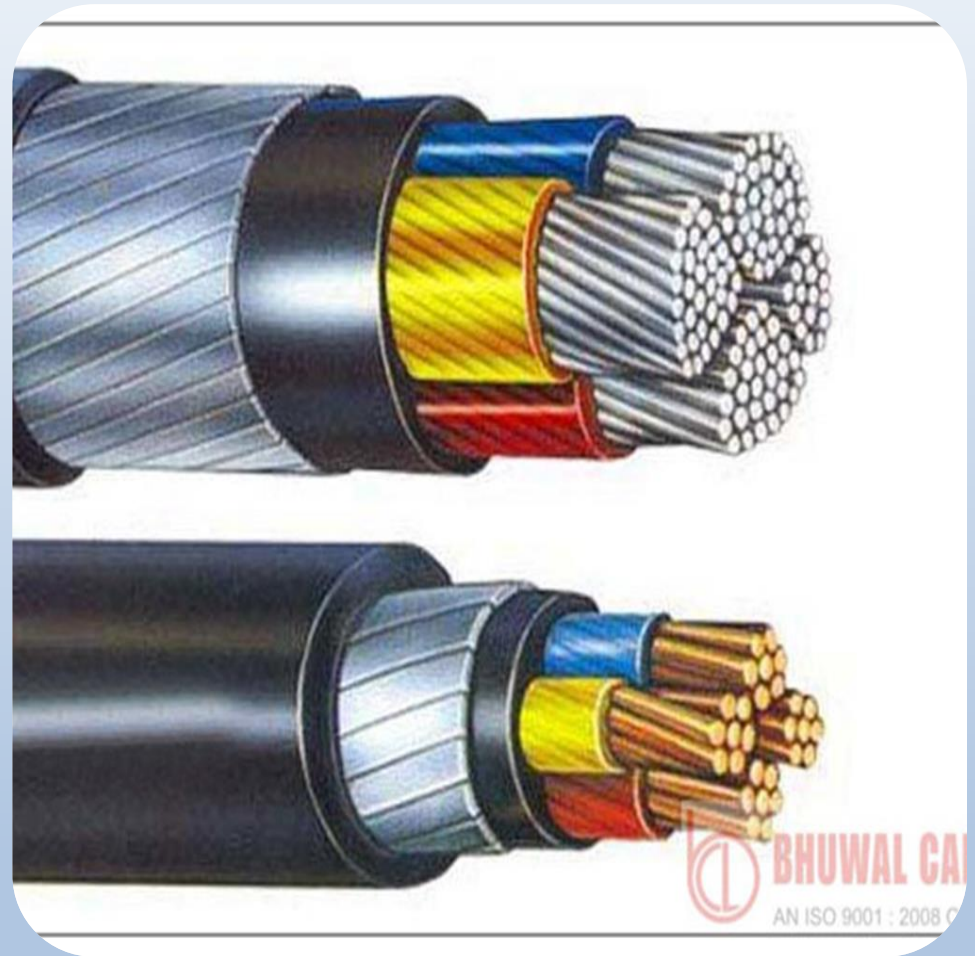
1. V.I.R (vulcanised India Rubber)wire
2. C.T.S or TRS (cab Tyre Sheathed or Tough Rubber Sheathed)wire
3. Weather proof wire
4. L.C.( lead covered)wire
5. MICC (Mineral Insulated Copper Covered)wire
6. PVC (Poly Vinyl Chloride)
7. Flexible wire

## 1.VIR (Vulcanised India Rubber)Wire:

In this type of wires conductors are made up of aluminum or copper. A layer of vulcanized rubber is provide over it.

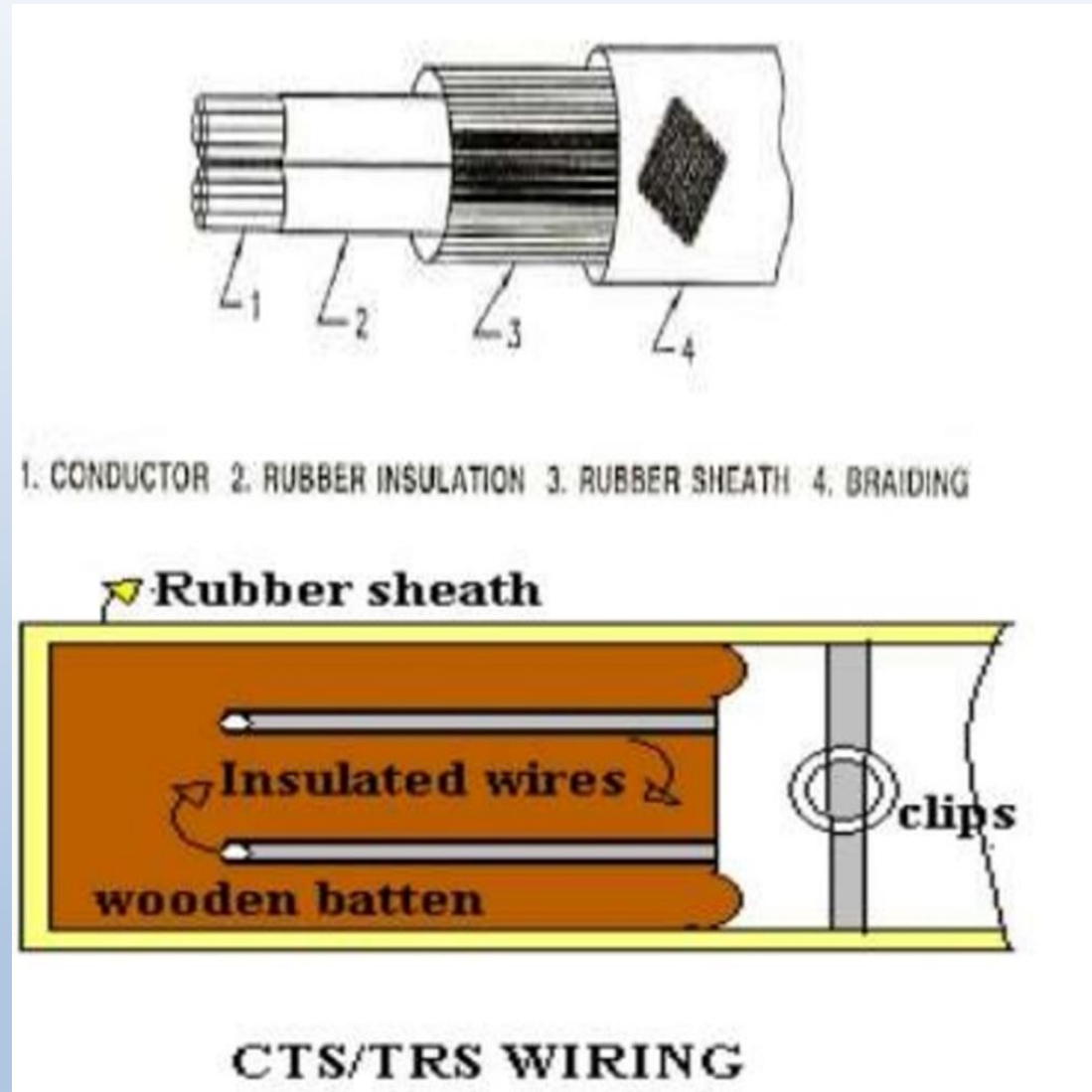
In figure single braided wire and in figure double braided wire is shown.

These types of wires can bear little mechanical stress. These are available in the voltage ratings of 250/440V,650/1100V and in the sizes of 1/1.40,3/1.80,7/1.70 etc.



## 2. CTS or TRS (cab tire sheath or tough rubber sheath) :

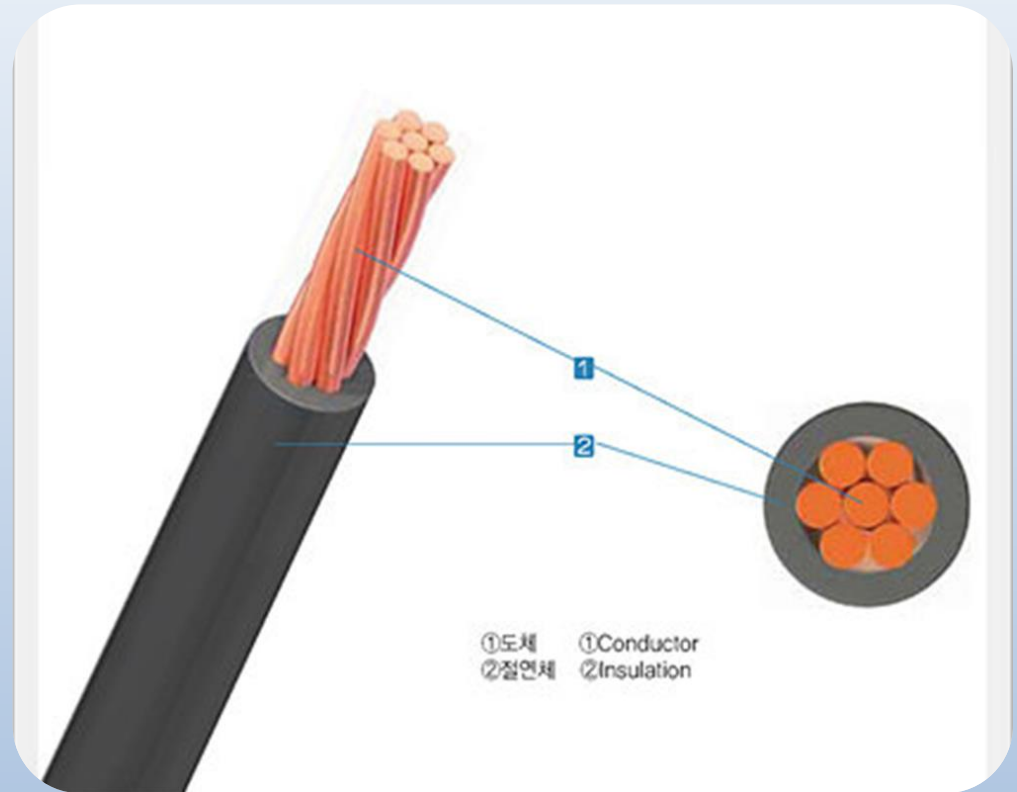
In this type of wire layer of strong and durable rubber is provided over the conductor. Its mechanical strength is more than that of the VIR wire. This type of wire is available in varieties of single core, twin cores and three cores. These wires are available in the voltage ratings of 250/440V and 650/1100V and in the sizes of 1/1.40, 1/1.80, 3/1.80 and 7/1.80.





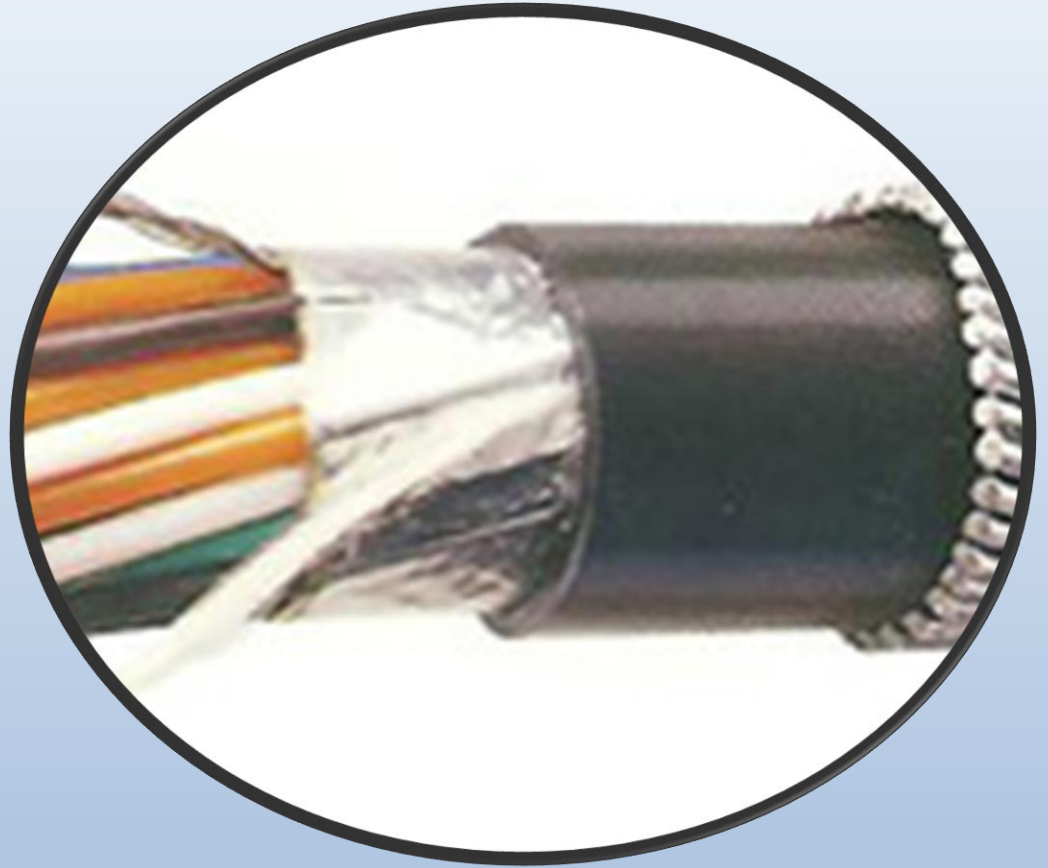
### 3.Weather proof wire:

On this type of wire there is no effect to atmosphere. A layer of rubber is provided on copper conductor. Braiding of cotton is provided on this. It is made waterproof by dipping it into waterproof compound. It is useful in service connections. Its use is now days has become limited.



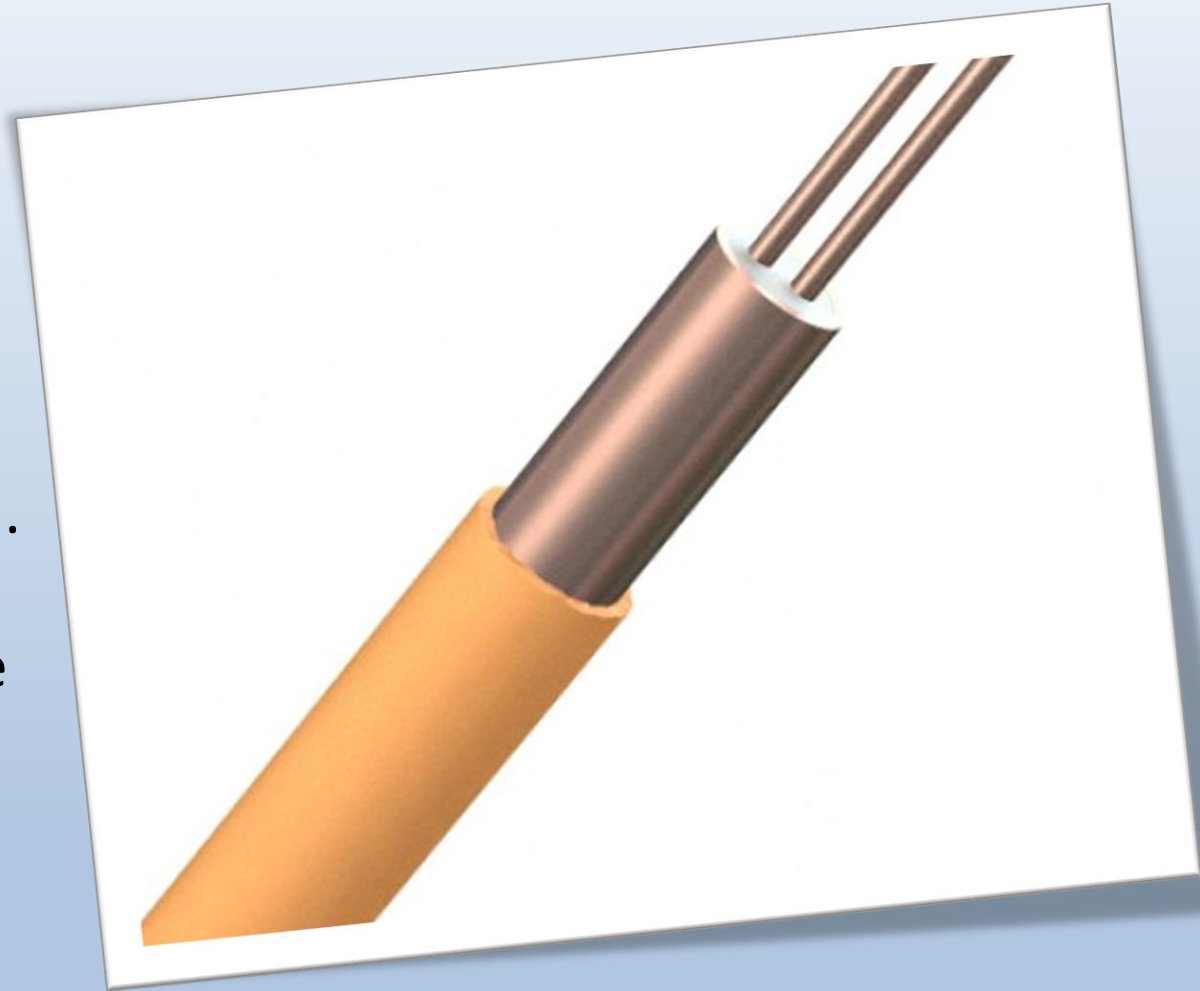
## 4. LC ( lead covered) wire:

In this type of wire coating of insulated rubber is provided on the conductor. A tube made of lead is kept over it . As lead is soft, it is easily affect by mechanical stresses. This wire can be used directly on wooden batten.



## 5. MICC (Minerals Insulated copper covered)

In this type of wire coating of magnesium oxide is provided as insulation on the copper conductor. Over this copper sheath is provided. When this wire has to be used in moist atmosphere a serving made of PVC is provided over this. This type of wire is used in wiring in mines, factories, refineries, furnace, boilers, rolling mills etc.



## 6. PVC (Poly vinyl chloride)wire:

In this type of wire insulation made of poly vinyl chloride is provided over copper or aluminum conductor. The following Advantages can be obtained by using PVC as insulation.

1. Its dielectric strength is more.
2. Its mechanical strength is more.
3. There is good protection against moisture.
4. Its life is long.
5. It provides protection against oil, alkali, acid etc.
6. It provides protection against insect and termites.
7. There is no ill effect of vibrations etc.



## 7. Flexible wire:

In this type of wire instead of using thick conductor many thin copper conductors of 36 gauge are used. This is called stranding. These wires are available in this sizes of 14/36, 23/36, 40/36 etc. This type of wire is used in giving connections to table lamp fan, tube light etc.



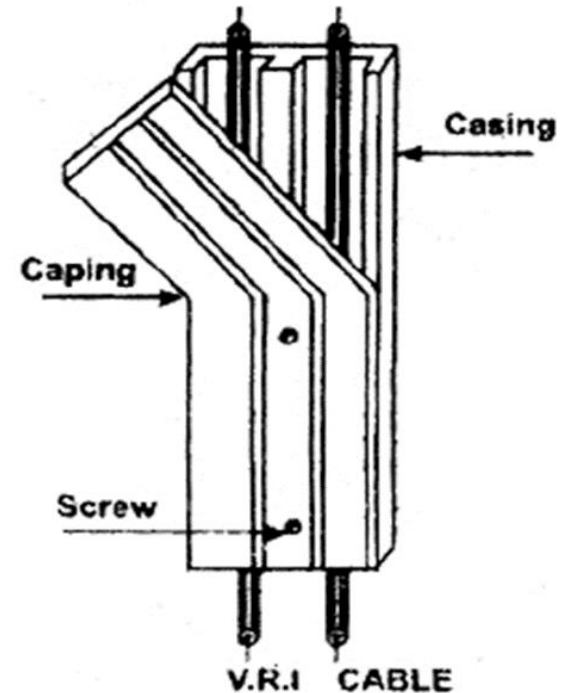
# Systems of wiring:

The main system of wiring are :

1. Wooden casing - capping wiring
2. Coating wiring
3. CTS or TRS wiring
4. Conduit wiring

## 1. **Wooden casing-capping wiring:**

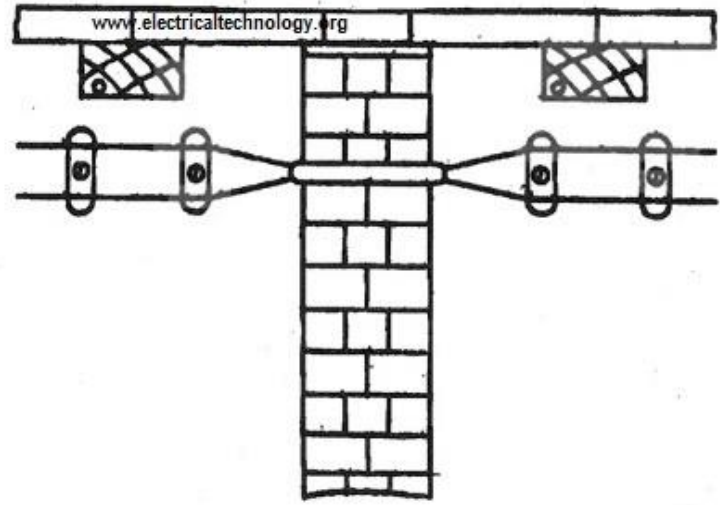
In this type of wiring teak wood casing and capping is used. The casing is a long wooden strip with two grooves which is fixed to the wall. This type of wiring system is widely used for domestic purposes even through it is a little costlier.



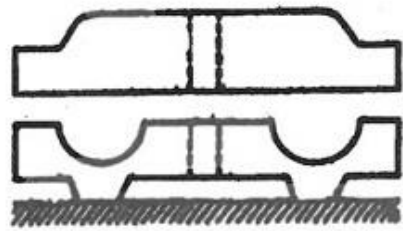
**Wooden Casing & Capping  
Wiring System**

# 2. Cleat wiring:

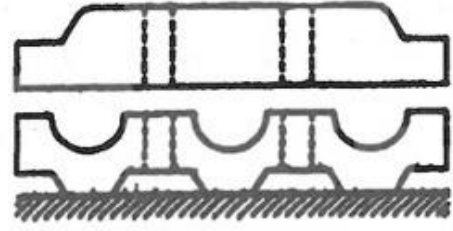
In this type of wiring a chinaware cleat is used. It has two parts in the lower part there are two to three slots and a hole for fixing screw. As the wires remain open there are chances of dust moisture and mechanical damage to the wires.



Use of Wall tube, wires are drawn from one room into the other through partition wall.



i. Cleat with two grooves



ii. Cleat with three grooves



Cleat Wiring

# 3. CTS or TRS

## wiring:

This is one of the oldest type of wiring system and is also called as batten wiring system. Teak wood battens are used in this system with clips fixed at 6 cm to 15 cm intervals.





# Conduit wiring:

In this type of wiring conduits made of either G.I or PVC are used .It is fixed to the wall with the help of saddles and gutties. The conduit wiring are two types:

1. Surface Conduit wiring.
2. Concealed conduit wiring.

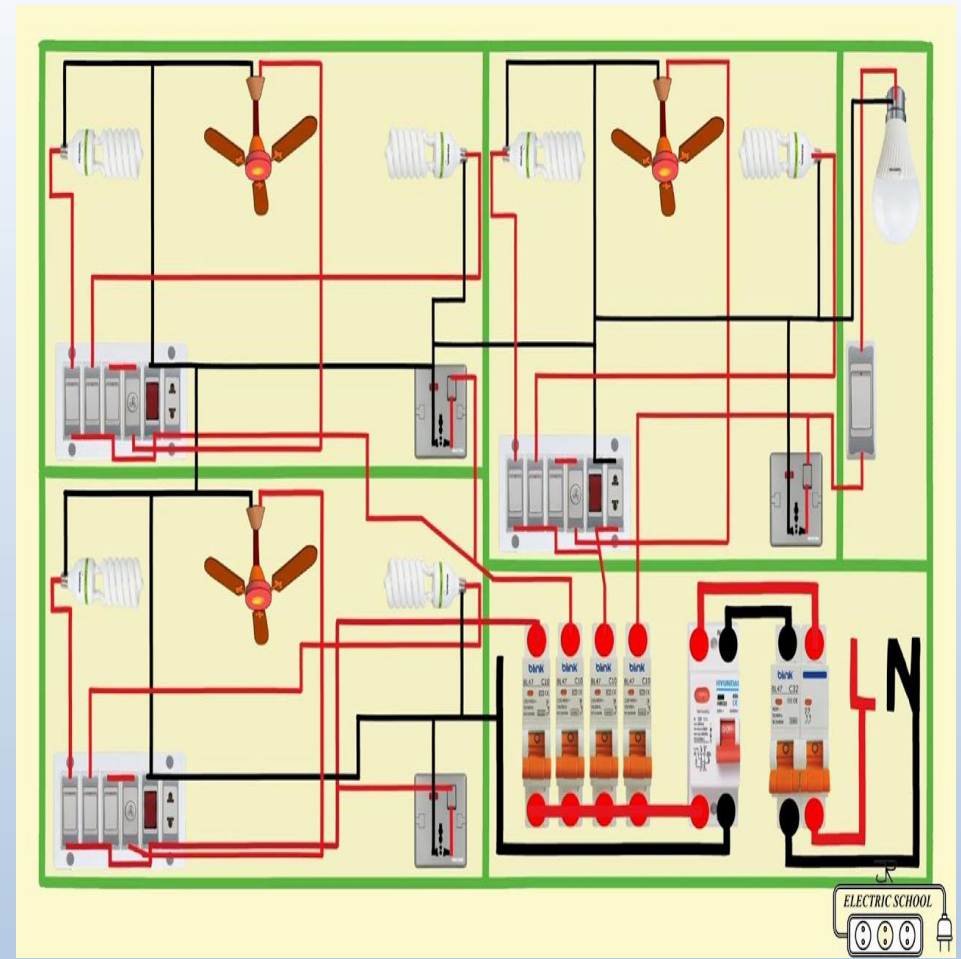


# Layout Of A Typical House Wiring

- The supply wires such as phase and neutral are made to made to feed into the energy meter after connecting it through supply authority's cut out fuse.
- Then the wires are connected to the main switch before connecting it to the D.B. in the D.B., the phase and neutral are branched out into required number of terminals.
- The phase and neutral leading from each respective terminal is called as subcircuit and each subcircuit will be independent of other subcircuit.

**While designing the subcircuits the following points should be considered**

- i. Number of fan and light points in one sub circuit should not exceed 10.
- ii. The total load connected to one sub-circuit should not exceed 800 watts.
- iii. The switches used for fans and lighting should be of 5A rating.
- iv. Socket outlet used should also be of 5A rating.



# Indian standard Recommendation for house wiring

1. Construction , installation, protection, operation, and maintenance of electric supply lines.
2. Service lines and devices in consumer area.
3. Cut out in consumer's permises.
4. Identification of earthed wire and earthed neutral and position of switch and cut out in it .
5. Earth terminal in consumer premises.
6. Accessibility of open conductor.
7. Handing of electric supply line and devices.
8. Testing the consumer's installation.
9. Safety against leakage before giving supply.
10. Supply of energy and use.
11. Seal of meter and cut out.

# Steps For Wiring Estimation

- Decide the location of electric pole from where service line for power supply will be available accordingly decide the location of energy meter.
- Decide the location of light points and power points required in kitchen, bathroom, etc. and mark these on the building plan.
- Calculate light –fan load and power load required for each room separately.
- Divide the entire wiring in sub circuits.
- Show the route of sub circuit wires in the plan.
- Draw wiring diagram for each sub circuit.
- Decide the size of wire according to circuit load.
- Decide the height of wire, switch board, etc. calculated the length of batten, conduit, casting-capping. Also calculate the length of wires required.
- Decide the size of main switch and D.B.

- Prepare estimating sheet. Accessories are calculated room wise and total material cost is calculated.
- Based on type of wiring and number of points, labour cost is calculated.
- Cost of wiring per point is calculated.

**Example-2** : for a building plan shown in fig. 2.24, calculate total electric points and electric load of a building.

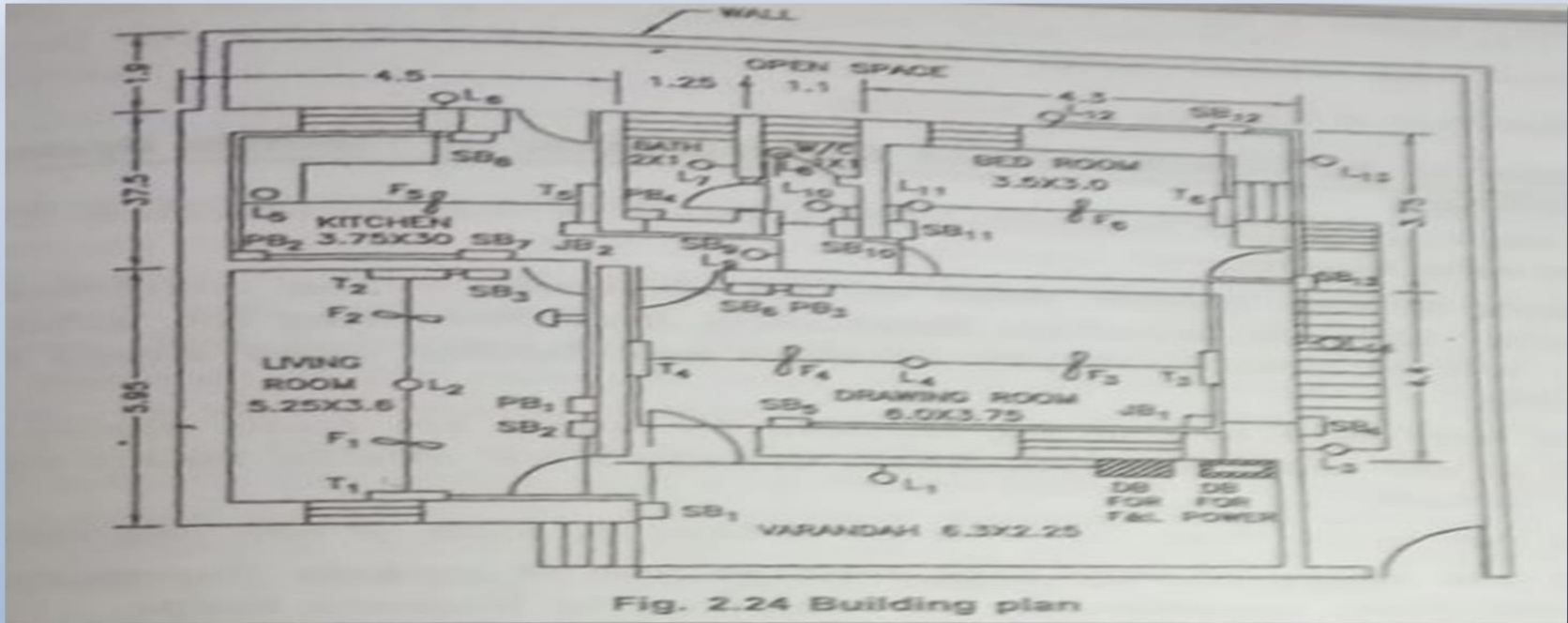


Fig. 2.24 Building plan

Fig. 2.24 Building plan

Room	Light point	Tube light	Fan Point	Plug Point	Bell Point	Total Point	Load(watts)
Drawing Rom	1	2	2	4	-	9	60+120+120+400=700
Living room	1	2	2	4	1	10	60+120+120+400+40=740
Kitchen	1	1	1	2	-	5	60+60+60+200=380
Bed room	1	1	1	2	-	5	60+60+60+200=380
Bathroom	1	-	-	-	-	1	60
W.C.	1	-	-	-	-	1	60
Passage	2	-	-	1	-	3	120+100=220
Veranda	1	-	-	-	-	1	60
Open space	5	-	-	-	-	5	300
Total	14	6	6	13	01	40	3000 Watt



- Total points = 40  
Total load = 3000 Watts  
Therefore 4 circuits are required.

# \* Points to be considered in maintenance of electric system in a building.

The following points should be considered in the maintenance of electric system in a building.

1. Use good quality copper wires for all electrical wiring aluminum wires and other cheaper materials deteriorate fast renewing the wiring in the future will be costly, as the material and Labour costs always increase with time.
2. Do not over load any of the circuits by using too many appliances one circuit. In the residential buildings usually 3kw electric load is connected to one circuit.
- 3 Do not use more than 13A to 15A fuse in each of the Ring circuits.
- 4 Do not use lamps of very high wattage use of modern fluorescent lamps saves electricity considerably as compared to filament lamps.

The brightness (lumens) of 40w filament lamp and 5w fluorescent lamp is same.

5 ELCB should be used in a circuit, so that current is switched off, if there is any leakage in the circuit.

6 Avoid moisture from all the places near the path of the electric wiring and near electric boards.

7 Do not use damaged or worn-out extension cords.

8 Avoid coiling of extension cords of appliances to prevent overheating.

9 Replace extension cords if there is trace of wear and tear.

10 Do not place extension cords under furniture and carpets.

11 Avoid use of many extension cords in one circuit to avoid over loading of the circuit.

12 The repair of any electrical appliance should be carried out through experienced electrician.

13. Use star rated A.C., Refrigerators to reduce the consumption of electricity.
14. Carry out maintenance of A.C. before each summer. It is also advisable to run the A.C. for sometime (say half an hour) each month even if not required.

**THANK YOU**

Courtesy : Dr R.P.Rethaliya

Atul Prakashan