

**GOVERNMENT POLYTECHNIC, DHENKANAL**

**LECTURE NOTES**

**ELECTRICAL INSTALLATION AND ESTIMATING**

**6<sup>th</sup> SEMESTER**

**PREPARED BY**

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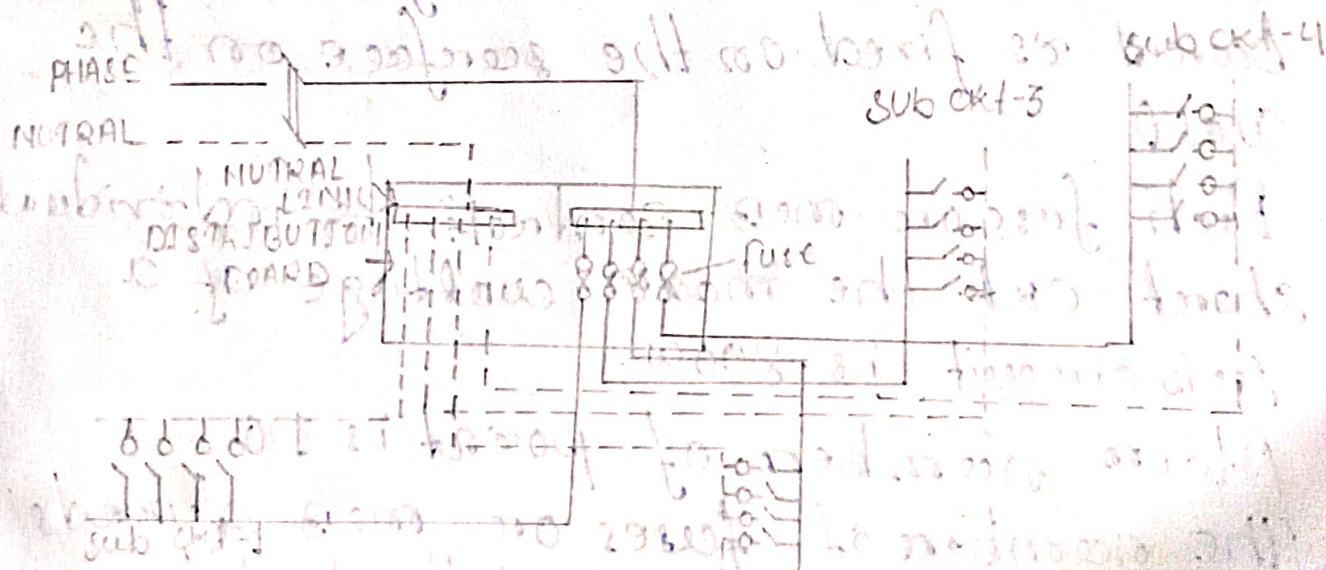
## Wiring System :-

A network of wires connecting various accessories for distribution of electrical energy from the supplying meters board to the numerous electrical energy consuming devices such as lamp, fans and other domestic appliances through controlling and safety devices is known as wiring system.

## System of wiring :-

- (i) Distribution system
- (ii) Tree system.

## (i) Distribution system :-



This system is most commonly adopted for distribution of electrical energy in a building.



In this system the supply is coming from meter board to main switch and then to distribution board.

In the distribution board the fuses of various circuit are grouped together so some times the board is known as fuse board.

In the distribution board to copper strips are fixed on insulating material these strips are known as bus bars. One strip ~~one known~~ works for neutral strips the neutral is passing as short ckt but from phase strip the phases are coming through the different fuses from the short ckt.

- \* The distribution board is made of metal case.
- \* The main distribution board is fixed concealed on the wall and fuse distribution board is fixed on the surface on the wall.
- \* Each fuse or mcb controls its individual short cut the maxm wattage of a sub circuit is 800w.
- \* Maxm number of point is 10.
- \* The number of fuses or mcb depends upon the maximum load of the building.
- \* In the sub circuit switch boards are fixed and power supply is given to



lamp and fans through the controlling switches.

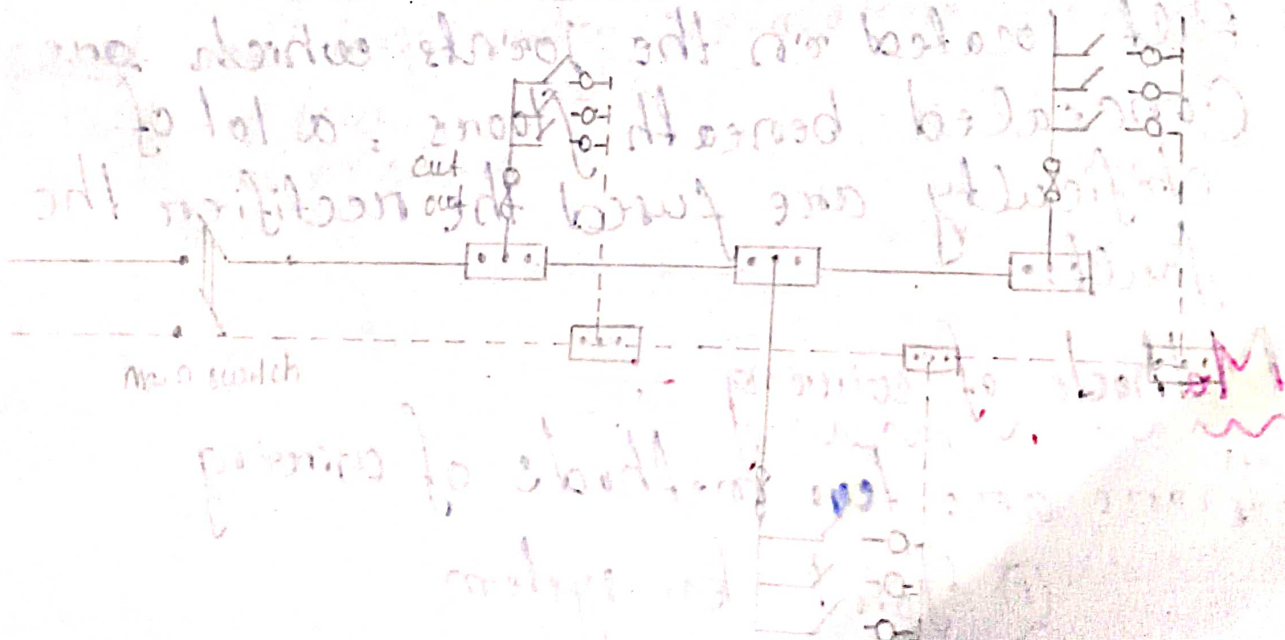
\* In large building there is one main distribution board and there are several sub distribution boards. The supply is coming from main distribution board to sub distribution board.

\* The sub distribution board is fixed near the board.

For determination of load the following rating may be assumed.

- ① Fluorescent lamp  $\rightarrow$  40w
- ② Incandescent lamps, fans and socket out  
lates  $\rightarrow$  60w.
- ③ Power socket out lates  $\rightarrow$  1000 w.
- ④ Exhaust fan  $\rightarrow$  80 watt.

### Tree System :-





(i) In this system of wiring smaller branches are taken from the main branch, as shown in figure.

(ii) The wiring system appears like a tree so the name is like this.

(iii) A fuse is inserted in each branch.

(iv) This system is used in early days.

(v) Now days this system is not used due to following disadvantages.

### Disadvantages :-

(i) The voltage across all the lamps does not remain same.

(ii) The voltage across the lamp in the last branch is minimum. Due to voltage drop in the leading branches.

(iii) A number of joints are involved in every circuit.

(iv) Fuse are in scattered manner.

(v) Fault located in the joints which are concealed beneath floors, a lot of difficulty are faced to rectify the fault.

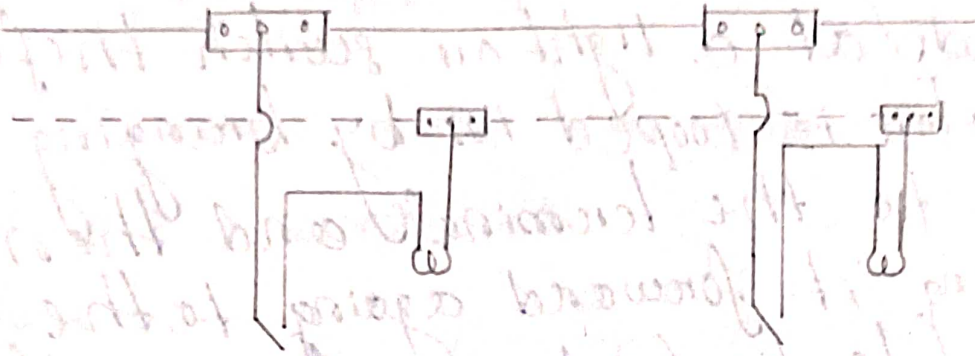
### Methods of wiring :-

There are two methods of wiring

- (i) Joint box system.
- (ii) Loop in system.



## Joint box system :-



In Joint box system the connections to the lamps are made through joints made in Joint boxes by means of suitable connectors are joint cut outs.

→ In this system the quantity of wire or cable used is less but at the same time the number of joint boxes are more.

→ As there are more numbers of joints the wiring system is weak, if it is not properly done.

→ Now days this system is limited and is used in temporary installations because its cost is low.

## Loop in system :-





- This system is universal use for connections of various lamps or other appliances in parallel.
- In this system when a connection is required at a light or switch the feed conductor is looped in by bringing it direct to the terminal and then carrying it forward again to the next point to be fed as shown in figure.
- The phase conductors are looped in on switch board or box and neutrals are looped in on switch board or in light and fan.
- The phase conductor should never be looped from light or fan.

### Advantages :-

- (i) Joint boxes are not required.
- (ii) In loop in system no joints are concealed beneath floors or roop spaces. The joints are made only at out lets so they are accessible for inspection by opening the covers only.
- (iii) The fault location is easy.

## Disadvantages :-

- (i) Length of wire or cable required is more and so voltage drops and copper losses are more.
- (ii) Loop in switches and lamp holders is usually difficult.

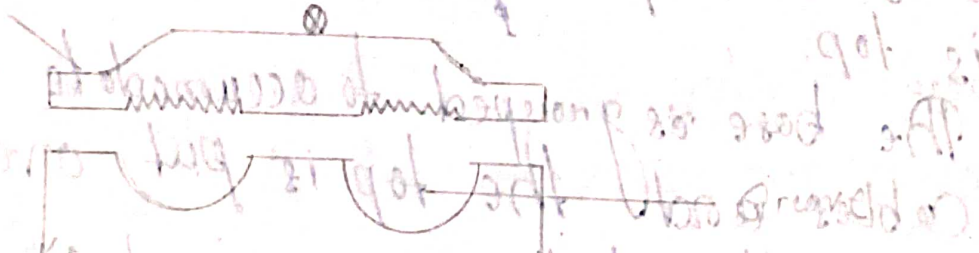
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## Types of wiring :-

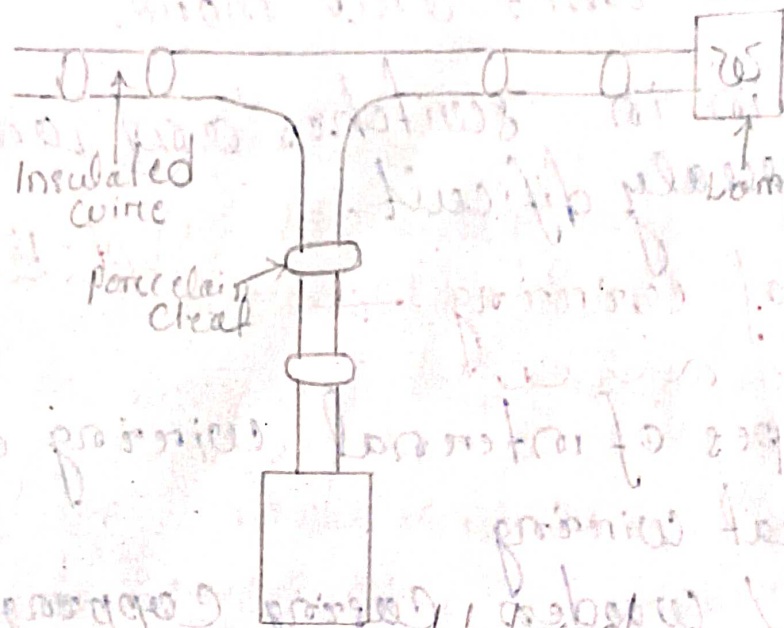
The types of internal wiring are

- (i) Cleat wiring
- (ii) PVC / wooden casing capping.
- (iii) CTS / RPS Batten wiring.
- (iv) ~~Conduit w~~
- (v) Lead sheathed or metal sheathed wiring
- (vi) Conduit wiring
  - (a) surface conduit wiring
  - (b) concealed conduit wiring.

## (i) Cleat Wiring :-







\* In this system of wiring the cables used are either VIR or PVC pipe.

The cables are held by porcelain cleats about 6mm above the wall or ceiling.

The cleats are made into two halves one is base another is top

\* The base is grouped to accommodate the cables and the top is put over it and the top is holes is base another is top.

\* The base is grouped to accommodate the cables and the top is put over it and the holes is screwed on the wooden plugs or gaffers previously cemented into the wall or ceiling.



The cables are firmly stretched between the cleats which are supported on the wall. The screws use one of size 28mm

The cross section of wooden gutties use is 38mm x 38mm at big end and 26mm x 26mm at smaller end.

The length of wooden gutties is about 6.6m. The cleats used are of different sizes and different types in order to accommodate cables of various sizes and different numbers of cables respectively.

The cleats are of 3 types one groups, two groups, and 3 groups to accommodate 1, 2, 1-3 cable respectively.

For low voltage installation (up to 250V) The cleats shall be of such dimensions that the cables should not be less than 2.5cm apart for branch circuits and not less than 4cm for sub mains.

The distance between the cleats used should not be less than 30cm and more than 60cm.



## ADVANTAGES :-

- (i) It is the chiefest system of internal wiring.
- (ii) Its installation and dismountment is easy and quick.
- (iii) Material is recoverable after the dismountment.
- (iv) Inspection, alterations and additions can be easily made.
- (v) Skill, labour, required is very less.

## DISADVANTAGES :-

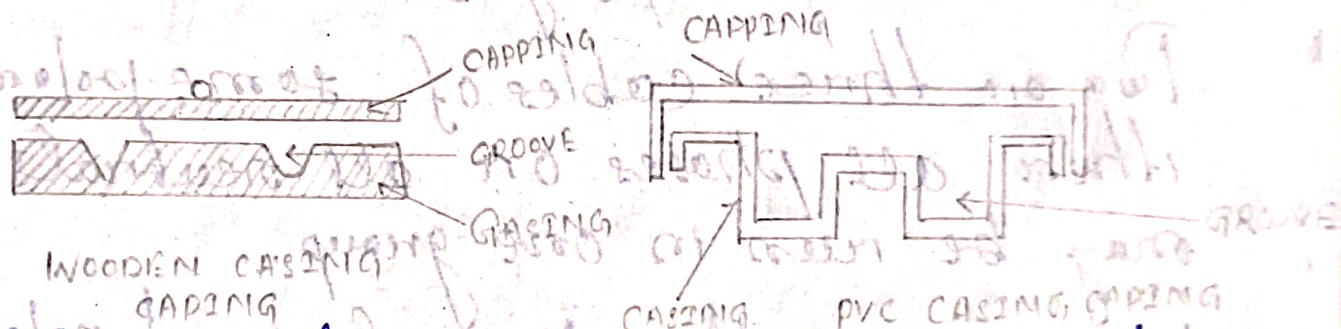
- (i) It is not good looking.
- (ii) It is quit temporary.
- (iii) The wires are exposed to mechanical injury.
- (iv) The insulation catches dampness from the atmosphere and a common salt like substance appears on the insulation which lowest the insulation resistance and causes leakage hence this type of wiring can not be used in damp places unless precautions are taken.
- (v) This type of wiring can not be used in factories because oil and smoke are enjurious to VIR insulation.



## Uses :-

- ① These wiring is very suitable for temporary installation in dry places. This used where appearance is not so important but cost is the main consideration.
- ② These system is not suitable in domestic buildings.
- ③ This is mostly used in army camp, Naval camp etc.

## ② Wooden / PVC Casing Capping wiring



In this type of wiring the cables used are either V.T.R or P.V.C or any other approved insulated cables the cables are carried through p.v.c or wooden casing enclosures.

\* The wooden casing consist of V shape groups and pvc casing consist of U shape groups.

Initially the casing is fixed on the wall with the help of wooden screws or wooden gables. Then the cables are carried through.



the groups or casing. Then the casing is covered and is screwed to the casing by means of 13mm x 4mm wooden screws. These wooden screws are fixed at 15cm apart.

\* The cables of opposite polarity are carried in different groups.

\* To protect the wooden casing against the white ants, first class seasoned teak wood varnished by chellack varnish is employed.

\* Two or three cables of same polarity i.e. all phases or all neutrals may be run in one group.

\* In no case the cables of opposite polarity should be run in same group.

\* In damp situation the casing is usually placed 3.20mm apart from the wall or ceiling by means of porcelain.

\* The thickness of porcelain should not be less than 6.60mm in order to keep the casing dry at the back.

\* The wooden gutters on which the



Cassing is screwed by means of 32mm x 8mm wooden screws one fitted in to walls or ceiling. The distance between the wooden screws should not exceed 900mm for sizes of Cassing Capping up to 64mm and not exceeding 800mm for sizes more than 64mm.

\* The sizes of Cassing Capping depends upon the number and size of the cable to be carried.

\* The length of the Cassing Capping available varies from 2.6m to 3m.

### ADVANTAGES :-

- (i) It is cheap in cost as compared to leads pipe and conduit wiring system.
- (ii) It is easy to installed and rewired.
- (iii) It provides good insulation as conductors are kept at a good insulation distance apart.
- (iv) It is free from trouble of Condensation which is present in steel Conduit wiring.
- (v) It is easy to inspect by opening the Capping.



## DISADVANTAGES :-

- (i) This type of wiring can not be used in damp places unless precaution is taken.
- (ii) It can not be used in places where there possibility of fire.
- (iii) Since it requires better workmanship. The labour cost is higher.
- (iv) This type of wiring can be used only on surface and can not be concealed in plaster.
- (v) The wooden coving coving wiring is costly system because it needs costly wood.

## APPLICATION :-

This type of wiring is suitable for low voltages in domestic.

where there is no risk of fire hazard.

cable type specified

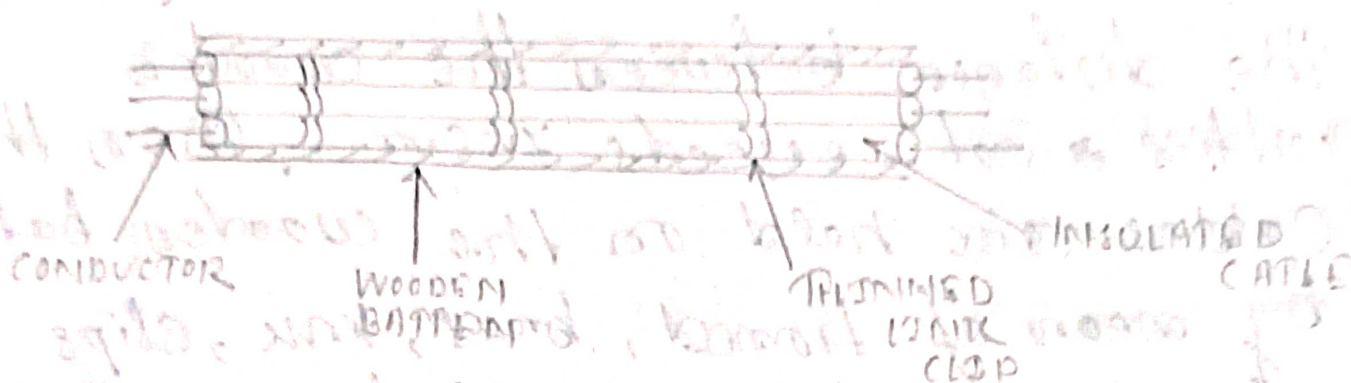
→ T.P., Ring & Sleeve.

## CPS / PPS Better Wiring :-

In this type of wiring the cables used may be single core, twin core or three core CPS or PPS cables with



a circular or oval shape.



In this type of wiring the cables used may be single core.

Usually single core cables are preferred.

These cables are sufficiently chemical proof, water proof and steam proof but are slightly affected by lubricating oils.

- \* Initially well seasoned, perfectly straight and well barked till wood batten are thick on the wall with the help of wooden screws and wooden gables.
- \* Then the cables are run on the batten. The width of batten depends upon the number and size of cable to be carried on it.
- \* The battens are available in widths of 13, 19, 25, 31, 38, 44, 50, 56, 63, 69 & 75 mm.
- \* The number of cables to be carried



on different sizes of batten are given in the table.

\* The distance between the wooden battens should not exceed 750 mm. Then the cables are held on the wooden batten by means of turned, brass, link, clips already fixed on the batten on the brass pins.

\* The interval between turned linked clip is 100 mm in case of horizontal runs and 150 mm in case of vertical runs.

\* After installation the wiring is liberally painted in two courses of oil less non creacking paint as specified in IS 732 rule.

No' of cables of size 7/10 <sup>2</sup> 36 mm <sup>2</sup> Copper conductor or 1/1.40 mm aluminium conductors single core to be run	size of batten
2	18 mm x 13 mm
3	19 mm x 13 mm
4	25 mm x 13 mm
5	25 mm x 18 mm
6	25 mm x 25 mm



7

44 mm x 13 mm

8

50 mm x 13 mm

9

56 mm x 13 mm

10

63 mm x 13 mm

12

75 mm x 13 mm

### ADVANTAGES :-

- (i) Its installation is easy and quick and saving in labour largely. Compensate for the extra cost of cable.
- (ii) Its life is sufficiently long.
- (iii) Within shorter limits it is fireproof.
- (iv) Withstand the action of most chemical such as acid and alkalies.
- (v) It is cheaper than types of wiring except clip wiring.
- (vi) It gives nice appearance if the job is carried out with care.

### DISADVANTAGES :-

- (i) Good workman is required to make a sound judgment in this wiring.
- (ii) This type of wiring is not recommended in situations open to sun and rain unless preventive steps are taken.



## APPLICATIONS →

① This wiring is suitable for low voltage installation and is extensively used for lighting purposes everywhere such as in domestic, commercial and industrial building except work shop.

② It can not be used in damp places.

## Lead sheathed / Metal sheathed wiring →

→ In this system of wiring the cables used are insulated wires, P.R.s / PVC with an outer covering of sheath of lead Al alloy.

→ This alloy contains 95% lead & 5% aluminium. This metal sheath gives protection to the cable from mechanical injury, dampness & atmospheric corrosion.

→ The whole lead covering is made electrically continuous & is connected to earth at the point of entry to prevent from leakage current.

→ Initially the battens are fixed on the wall with the help of wooden screws & wooden gutties.

→ The batten should be perfectly straight well seasoned teak wood having



Thickness not less than 10mm.

↳ The cables are run on this batten & are held by means of link clips.

↳ The batten should be well varnished with 2 coats of paint & is painted in front side in the colour which match the surrounding.

↳ The width of batten is varied according to the no. of wires to be carried on it.



The batten shall be run being wall, stone wall or plaster walls and ceiling walls, steel joints or any structural steel wall. wires.

\* The wooden gutties should be of standard size and be placed at a distance 75 cm. The wooden screws shall be used for fixing the batten.

\* Two core flat cable is employed for this purpose, some times three core flat cable is also used with a sheath of lead alloy.

### ADVANTAGES

It provide protection against mechanical injury better than that of CRB or TRB batten wiring.

(ii) It is easy to fix and looks nice as it can be run in buildings without damaging decoration and can be painted to suit the colour of surrounding.

(iii) Its life is long if proper earth continuity is maintained through



out the wiring.

(iv) It can be used in damp situation provided protection against moisture effect on the ends of the cables is given.

(v) It can be used in situations exposed to rain and sun provided no joint is exposed.

### DISADVANTAGES

(i) It is costly than CTS or PPS better wiring.

(ii) It is not suitable for places where chemical corrosion may occur.

(iii) In case of damage of insulation the metal sheath becomes alive and gives ~~soft~~ shock. So it provides safety against electrical shock. It is necessary that the sheath is properly earthed an earth wire is run side by side with each and all pieces are properly jointed together.



(iv) skill labour and proper supervision is required.

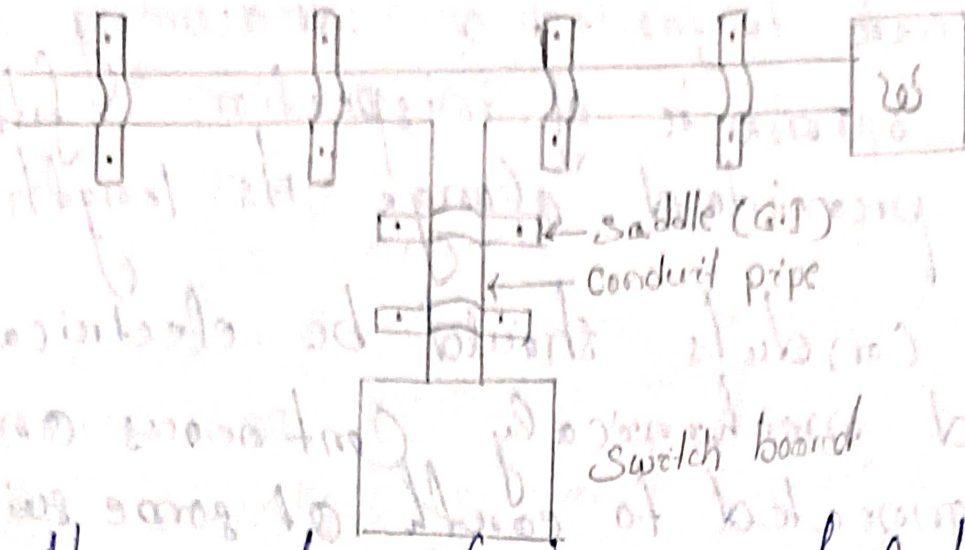
## APPLICATION

- (i) This wiring system is suitable for low voltage upto 220V installation.
- (ii) This can be used in places exposed to sun and rain provided no joint is exposed.
- (iii) It can be used in damp places with protection against dampness.
- (iv) It should not be used in places where acids and alkalis are present.
- (v) The most common application is for laying for submains from pole or bracket to the electric meters laid by the supplier.

## Conduit Wiring

(a) Surface Conduit Wiring





\* In this system of wiring steel tubes or pipes are used as conduit pipes. This is also known as conduits. Initially the saddles are fixed on the wall by means of wooden screws and wooden gutties. Then pipes are laid on the base of saddles. Then the top of saddle is fixed on the pipe so that the conduit pipes are firmly held on the wall.

\* Then VTR or PVC cable are drawn through the conduit pipe by means of a AP wire of size 18 SWG in damp situations the conduits can be spaced from the walls by means of small wooden blocks, fixed below the pipes at regular intervals.



In order to facilitate drawing of wire number of inspection fittings are provided along its length.

\* The conduits should be electrically and mechanically continuous and connected to earth at some suitable points.

\* The conduits used for this purpose is of two types these are

(i) Light gauge (split type) conduit

(ii) Heavy gauge (screwed type) conduit

\* Light gauge or split conduit is used for cheap work.

\* It is not water tight or damp proof. and each not permitted on medium voltage (higher than 250V)

\* Screwed conduit is used for medium voltage 250V to 600V circuit and in places where good mechanical protection and protection and moisture is required.



\* Generally the conduit pipe is black enamelled on both inside and out side. Therefore after wiring the conduit should be painted with aluminium white paint or with a paint to match the surroundings.

\* The diameters of conduit used are 12 mm / 19 mm / 20 mm / 25 mm / 31 mm / 38 mm and 50 mm.

\* The largest size of conduit pipe is 63 mm which is rarely used.

\* Now a days pre conduit pipe is also used in place of still conduit pipes.

\* PVC conduit pipes are cheaper and labour cost is also less than the steel conduit pipes.

\* PVC conduit pipes are also resistance to acid, alkalies, oil and moisture etc. They can be buried in lime or cement plaster with out ill effect.

\* The main drawback of PVC conduit is its movement due to variation in temperature.



PVC conduit is not suitable in locations where there is possibility of fire.

## Concealed Conduit wiring →

In this system of wiring steel conduit or PVC conduit or lead is laid inside the wall or roof in new building at the time of roof casting. The frames pipes are laid in the roof at the time of rod winding.

- \* The opening of pipes are left at the place of wall.
- \* After wall locating the conduit pipes are fixed in the grooves made in the wall. pt-7-1-16
- \* It is fixed with the help of steel hooks fixed on the top of pipe.
- \* After plastering of wall the PVC or VIK wires are drawn inside the pipe with the help of 18 SWG GI wire.



\* Then switch board covers and Junction box covers which is made of bakelite, with switches and sockets are fixed on the appropriate place

\* Addition to pvc or VTR wire earl wire is also drawn inside the pipe.

\* In concealed wiring, solid bends are used at the corners of roof.

### ADVANTAGES :-

\* It provide protection against mechanical damage.

\* It provide protection against fire due to short circuit and other causes.

\* This type of wiring is water proof

\* If life is run if the work is properly executed.

\* This wiring is shock proof if earthing and bonding of earth wire is ~~prop~~ with pipe is properly down.

### DISADVANTAGES

\* It is very costly system of wiring

\* Its installation is not easy and requires



time.

- \* Exposed high skill labour is required for carrying out the job.
- \* Internal condensation of moisture may cause damage to the insulation of wire unless the system out let are properly drained and ventilated.

### APPLICATIONS :-

- \* As this system of wiring provide protection against fine mechanical damage and dampness so this wiring of is used in following places.
- (i) places where considerable dust or fluff is present such as textile mills, saw mills, flour mills etc.
- (ii) In damp situation.
- (iii) In workshops for lighting and motor wirings.
- (iv) places where there is possibility of fire hazard.