GOVERNMENT POLYTECHNIC,DHENKANAL

LECTURE NOTES

ELECTRICAL INSTALLATION AND ESTIMATING

6thSEMESTER

PREPAREDBY

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Wiring System :—

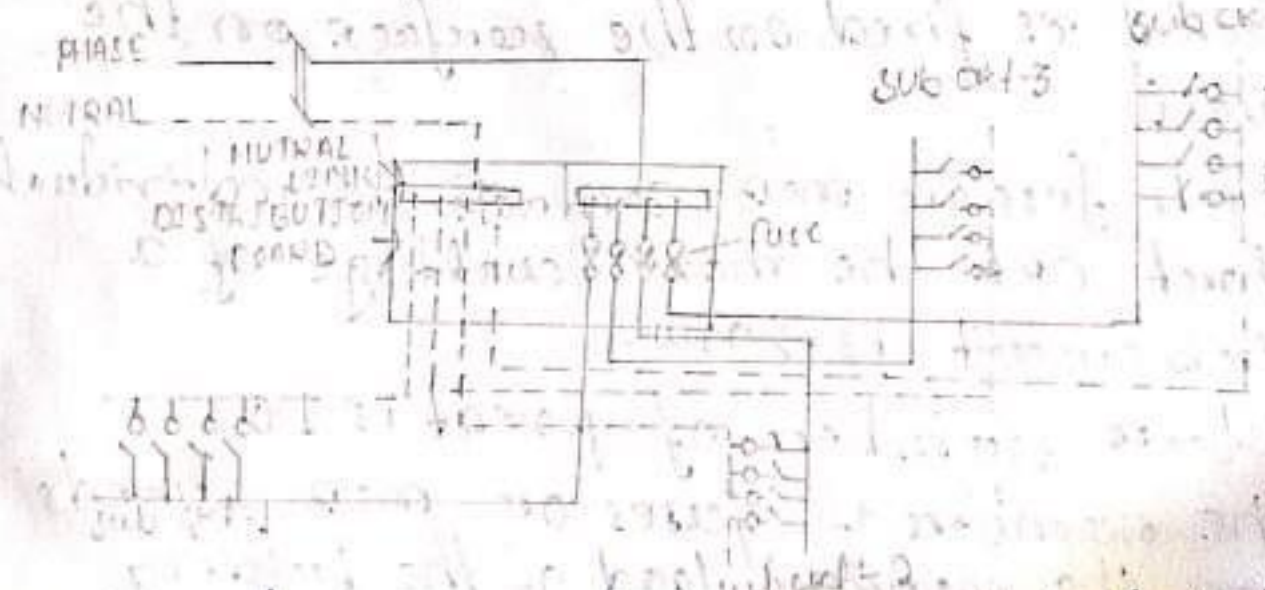
A network of wires connecting varies accessories for distribution of electrical energy from the supplying meter board to the numerous electrical energy consuming devices such as lamp, fans and other domestic appliances through controlling and safty devices is known as wiring system.

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 strip are known as bus bar. One strips ~~are known~~ works for neutral strips the neutral is passing as short ckts but from phase strip the phases are coming through the different fuses from the short ckts;

* The distribution board is made of metal case.
* The mcb distribution board is fixed. Concealed in the wall and fuse distribution board is fixed on the surface on the wall
* Each fuse or mcb controls its individual short ckt the maxm voltage 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

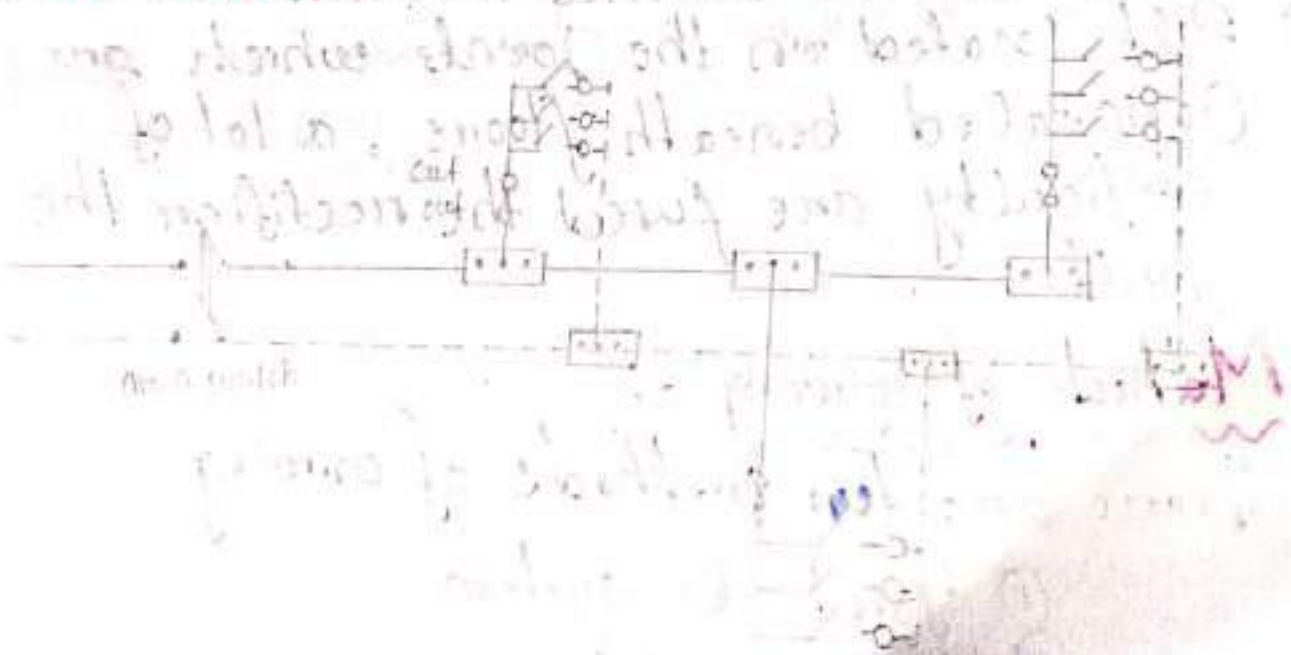
lamp and fans through the controlling switches.

* 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 Florecent lamp → 40w
② Incandecent lamps, fans and sucket out lates → 60w.
③ Power socket out lates → 1000 w.
④ Exhust fan → 80 watt.

Tree System :-



(i) In this system of wiring smaller branches are taken from the main branch are 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 not connected manner.

(v) Fault located on the joints which are concealed beneath floors, a lot of dificulty are fused the rectifier the fault.

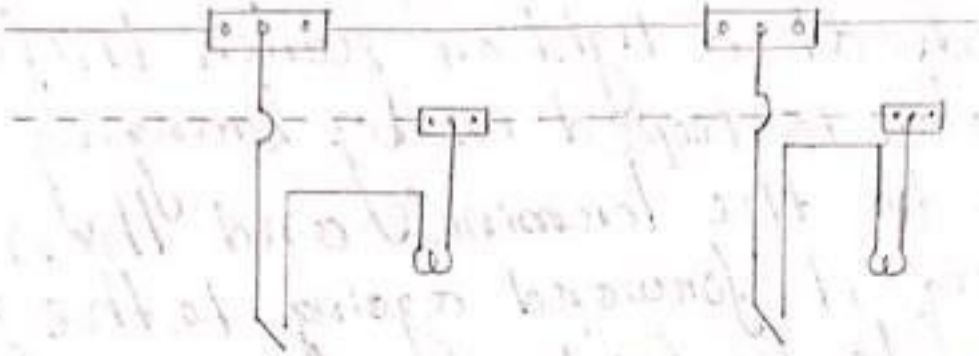
Methods of wiring :-

There are two methods of wiring

(i) Joint box system.

(ii) Loop in system.

Joint box system :-



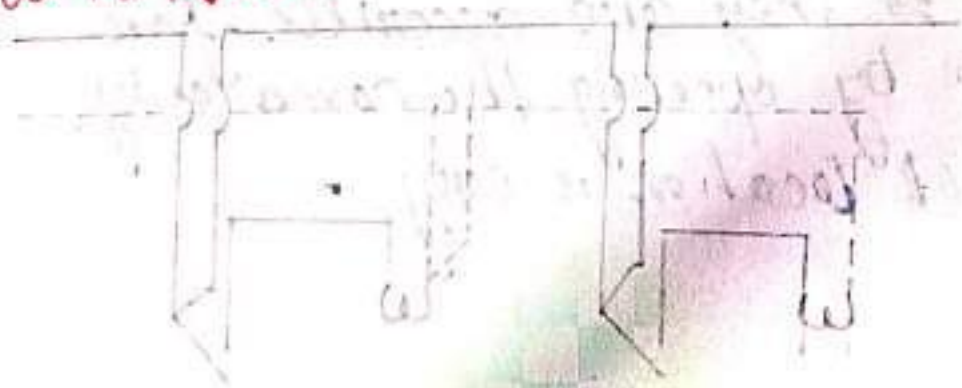
In Joint box system the connection to the lamps are made through joints made on Joint boxes by means of suitable connectors or Joint cut outs.

→ In this system the quantity of wire of 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 installation 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 or shown in figure

→ The phase conductors are looped either in switch board or box and neutrals are looped either 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 concerned beneath floors or roof spaces. The joints are made only at out lets so they are accessible for inispection by opening the cover 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 in switches and lamp holders is usually dificult.

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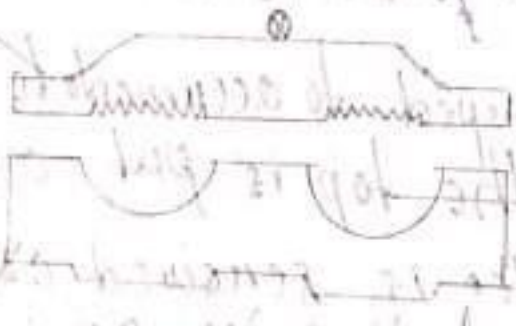
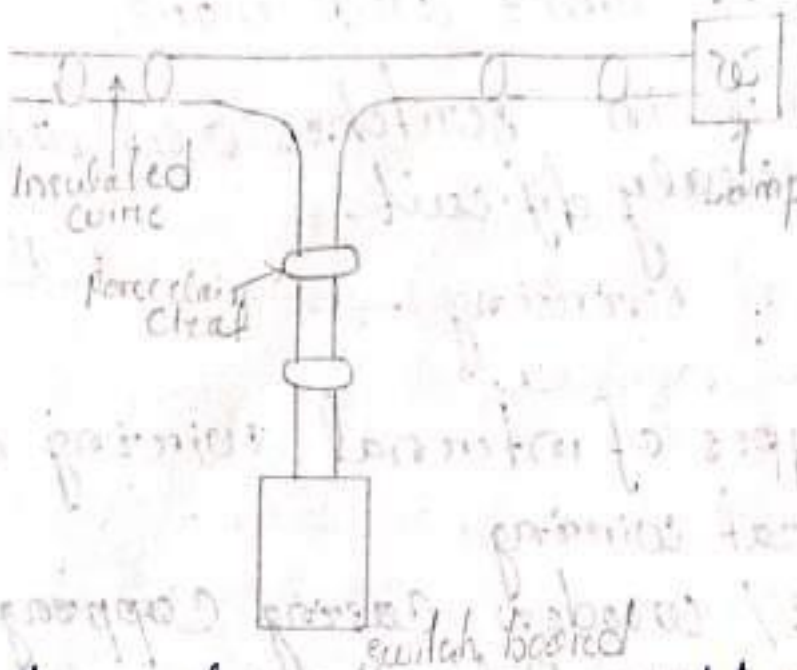
Types of wiring :-

The types of internal wiring are

(i) Cleat wiring
(ii) PVC / wooden casing capping.
(iii) CTS / TRS Batten wiring.
(iv) ~~Conduct w~~
(iv) Lead sheated or metal sheated wiring
(v) Conduct wiring
  (a) surface Conduct wiring
  (b) Concealed Conduct 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 celling.
The cleats are made into two halves one is base anathere is top
* The base is grouped to accomodate the cables and the top is put over it and the ~~top is~~ holes is base anathere is top.
* The base is grouped to accumodate the cables and the top is put over it and the holes is screwed on the wooden plugs or getties priviously cemented into the wall or celling

The cables are firmly streched between the cleats which are supported on the wall. The screw use are of size 38 mm

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

The length of wooden gullies is about 6.5 m. The cleats used are of different sizes and different types in order to accomodate cables of various sizes and different numbers of cables respectibly.

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

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

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

ADVANTAGES :-

(I) It is the Chiefest system of internal wiring
(II) It is installation and dismentalment is easy and quick.
(III) Material is recoverable after the dismentalment.
(IV) Inspection, alterations and additions can be easyly 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 ensurey.
(IV) The insulation catches dampness from the atmosphere and a common guilt 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 ~~and~~ are injurious to VIR insulation.

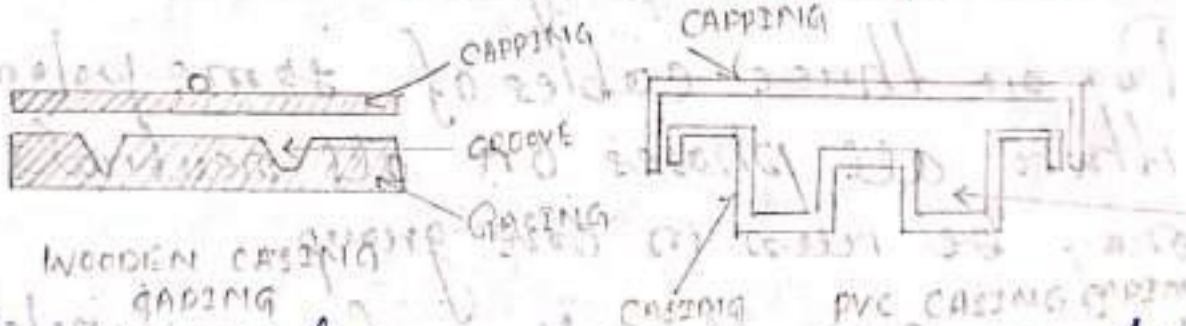
Uses :-

(i) 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.

(ii) These system is not suitable in domestic buildings.

(iii) 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.I.R or P.V.I or any other approved insulated cables the cables are carried through p.v.c or wooden casing enclosers.

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

Initialy the casing is fixed on the wall with the help of wooden screwes or wooden goubties.

Then the cables are carried through

the groups or casing. Then the capping 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 opposit polarity are carried in different groups.
* To protect the wooden casing against the whites ants, first class seasoned teak wood varnished by shellack varnish is employed.
* Two or three cables of same polarity either all phases or all neutrals may be run in one group.
* In no case the cables of opposit polarity should be run in same group.
* In damp situation the casing is usualy placed 3.2mm apart from the wall or ceiling by means of porcelin.
* The thickness of porcelin should not be less than 6.6mm in order to keep the casing dry at the back.
* The wooden guttres on which the

Cassing is screwed by means of 32mm x 8mm wooden screws are fitted in to walls or celling. The distance between the wooden screws should not exceed 90cm for sizes of cassing capping up to 64mm and not exceeding 60cm for sizes more than 64mm.

* The sizes of cassing coping depends upon the number and size of the cable to be carried
* The length of the casing capping available varies from 2.4m to 3m.

ADVANTAGES :-

(i) It is chief in cost as compaired to leads ~~sitct~~ and conduit wiring system
(ii) It is easy to installed and rewire
(iii) It provides good insulations as conductors good ~~insulations~~ distance apart.
(iv) It is free from trouble of condensation which is present in steal conduit wiring.
(v) It is easy to inspect by opening the coping.

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 work manship. The labour cost is highere

(iv) This type of wiring can be used only on surface and can not be concieled in plaster.

(v) The wooden casing capping wiring is costly system because it needs costly wood.

APPLICATION :-

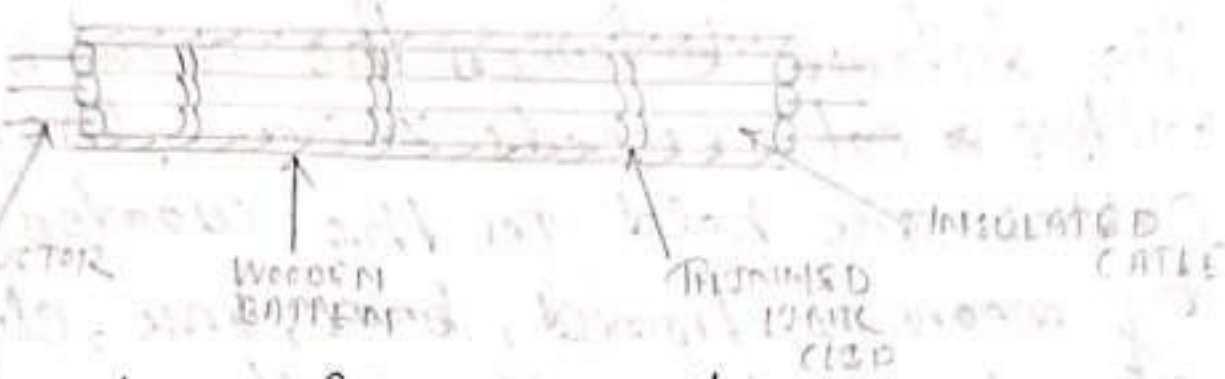
This type of wiring is suitable for low voltages in domestic. and where there is no risk of fire hazard.

cable tyre sheathed → Tip, Ring & Sleeve.

CTS / TRS Batten Wiring :-

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

a circular or oval shape.



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

Usually single core cables are preffered. These cables are sufficiently chemical proof, water proof and steam proof but are slightly effected by lubricating oils.

* Initialy well seasoned perfectly straingth and well barnished till wood battens are thicks on the wall with the help of wooden screws and wooden gauties.
* Then the cables are run on the batten. The width of batten depends upon the number and size of cable to be carried out.
* 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 gaitties not exceeds 75cm. Then the cables are held on the wooden batt by means of tinned, brass, link, clips already fixed on the batten on the brackets.
* The interval between tinned linked. Clip is 10cm in case of horizontal runs and 15 cm in case of vertical runs
* After connection the wiring is linkedly painted in two coarse of oil less non cracking paint as specified in IS 732 rule

No' of cables of size 7/0736 sq mm Copper conductor or 7/1.40 mm aluminium conductors single core to be run	size of Cond batten
2	18 mm x 13 mm
3	19 mm x 13 mm
4	26 mm x 13 mm
5	32 mm x 13 mm
6	38 mm x 13 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 charges. 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 executed out with care.

DISADVANTAGES :-

(i) Good workmanship is required to make a sound jurged in this wiring.

(ii) This type of wiring is not recommended in situations open to sun and rain unless preventive steps are taken

Applications :-

(i) This wiring is suitable for low voltage installation and is extensibly used for lighting purposes every where such as in domestic commercial and industrial building except work shop.

(ii) It can not be used in damp places.

Lead sheated / Metal sheted wiring :-

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

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

↳ The whole lead covering is made electrically continious & 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 sisoned to 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 surrou-nding.

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

The batten shall be run bring wall, ston wall or plaster walls and celling walls, steel joists or any structural steel ~~work~~ works.

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

* Twin core flat cable is employed for this purpose. some times three core flat cable is also used. with a sheath of lead aloy.

ADVANTAGES

Its provide protection against mechanical injury better than that of CTS or TRS 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 ~~shoot~~ suit the colours of surrounding.

(III) Its life is long if proper earth continuity is maintain through

out the wiring.

(iv) It can be used in dense 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 TRS beten wiring.

(ii) It is not suitable for places wire Chemical Corosion may occeres.

(iii) In case of damage of Insulation the metal sheath becomes alive and gives ~~shoft~~ shock. So it provide safty 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 requirre.

APPLICATION

(i) These wiring system is suitable for low voltage upto 220v installation.

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

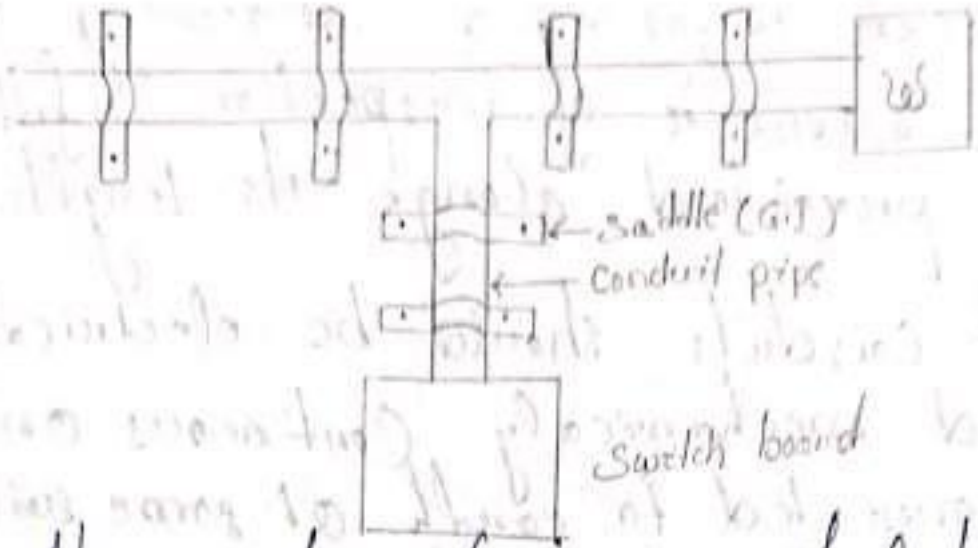
(iii) It can be used in damp places with protection against dampness.

(iv) It should not be used in placeses wire acids and alkalies are present.

(v) The most common application is for laying ~~for~~ submains from pole or bracket to the electric meter laid by the supplier.

Conduct Wiring :-

(a) Surface Conduct wiring :-



* In this system of wiring elect. tubes or pipes are used as conduit pipes this is also known as conduits. Initialy the saddels 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 VIR or PVC cable are drawn through the conduit pipe by means of a GI 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 and regular inter vals.

In order to facilated drawing of wire number of inspection fitting are provided alongs its length.

* The conduts should be electricaly and mechanicaly continous and connected to earth at some suitable points.

* The conduts used for this perepuse is of two types these are

(I) Light gauge (split type) conduit

(II) Heavy gauge (screwed type) condu

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

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

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

* 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 surrounding.
* 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 pvc 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 draw back of pvc conduit is its movement due to variation in temperature

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

Concealed Conduit wiring :-

In this system of wiring steel Conduit or PVC Conduit or lead inside the wall or roof in new building at the time of roof casting the ~~times~~ pipes are lead in the roof at the time of rod windring.

* The opening of pipes are left at the place of wall.
* After wall Joenting the Conduit pipe are fixed in the grooves made on the wall. pt-7-1-16
* It is fixed with the help of steel hooks fixed on the top of piepe.
* The after plastering of wall the PVC or VIR wires are drawn inside the piepe with the help of 18 SWG GI coine.

* 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 VIR wire earth wire is also drawn inside the piepe.
* 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 exicuted.
* This wiring is ~~shof~~ shock proof if earthing and binding of earth wire ~~is prop~~ with pipe is properly down.

DISADVANTAGES

* It is very costly system of wiring
* Its inspection is not easy and requires

time.

* Expressed high skilled labour is required for carrying out the job.
* Internal condensation of moisture may caused damadge to the insulation of wire unless the system out lates are properly drained and ventilated.

APPLICATIONS :-

* As this system of wiring provide protection against fire, mechanical damadge 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 posibility of fired hazzared.