Electrical Instalation
&
Estimating

Prepared by

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2.1 Introduction :-

A network of wires connecting various accessories for distribution of electrical energy from the supplier meter board to the necessaries electrical energy consuming devices such as lamps, fans & other domestics apliences through controlling & safety devices is known as wiring system.

2.2 Systems of distribution of electrical energy :-

Since as per indian standard the maxm no of points of lights, Fans and 5A socket outlets that can be connected in one ckt is 10 & the maxm load that can be connected in such a ckt is 800 watts in case more load or points are required to be connected to the supplier, then it is to be done by having more than one ckt.

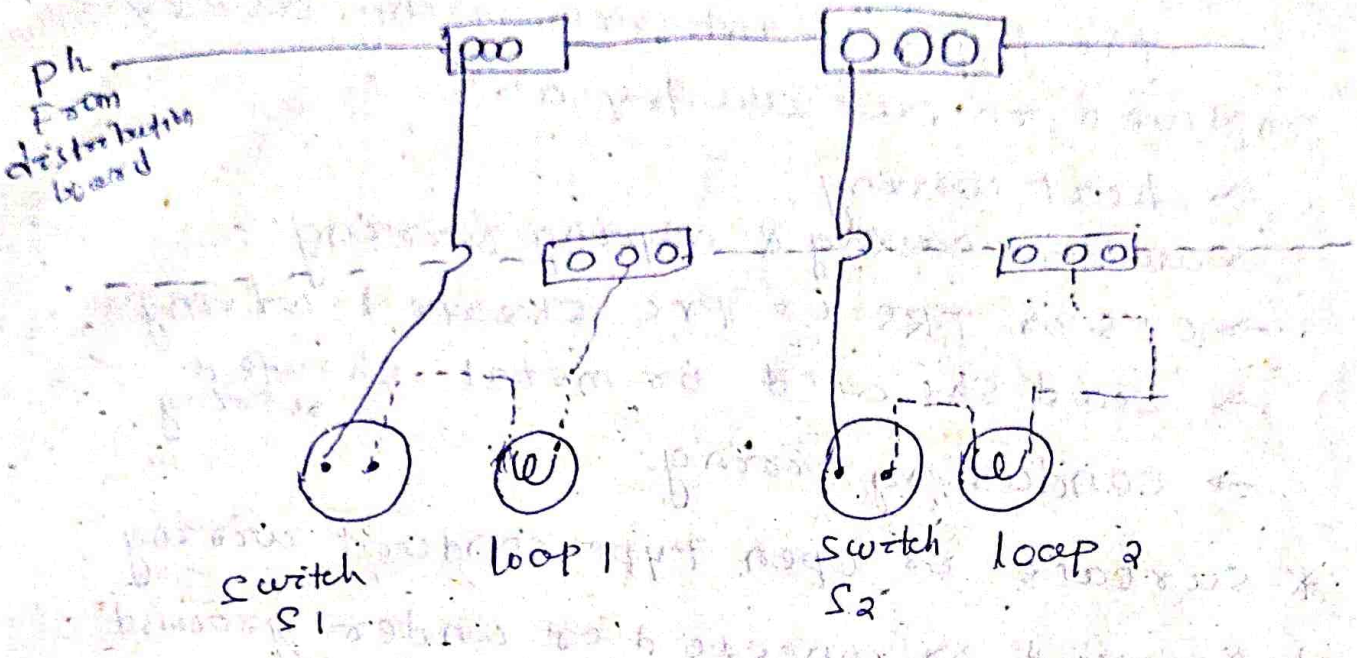
→ Distribution board system (Fuse board system

⇒ Tree system

2.3 method of wiring ; there are 2 methods of wiring known as

* joint box system or (Tee system)
* Loop in system.

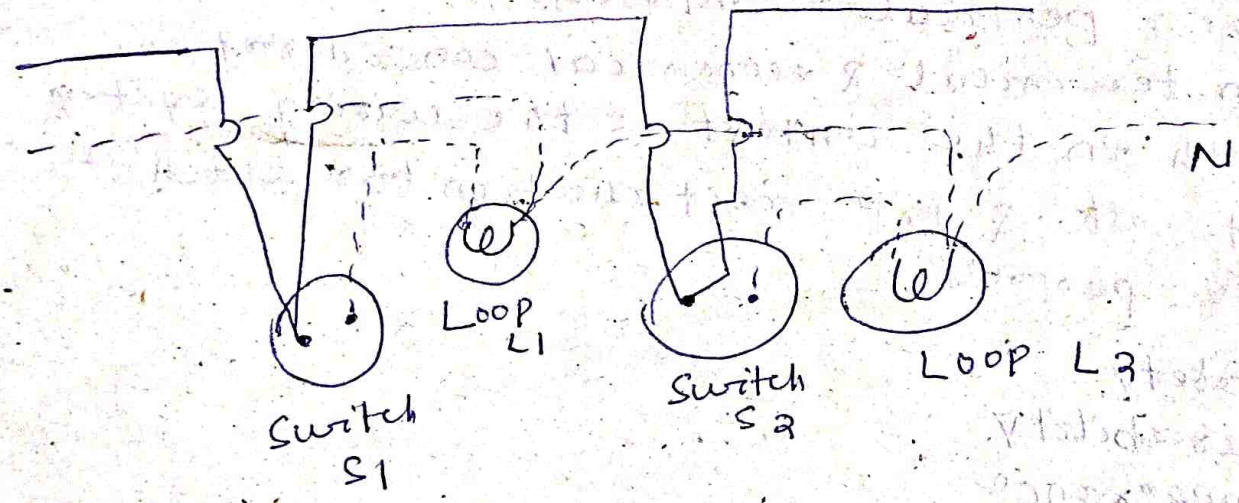
Joint box system or (Tee system) :-



– Live wire / phase wire

– – – – Neutral wire / Return wire

Loop in system :-



Advantages :-

→ Joint box are not required in case of loop in system

Disadvantage

Length of wire or cable required is more & voltage drops & copper losses are therefore more.

2.4 system of wiring :- (VV/P)

The types of internal wiring usually employed in our country are

→ cleat wiring
→ wooden casing & capping wiring
→ CTS or TRS or pre sheated wiring
→ Lead sheated or metal sheeted wiring
→ conducting wiring

* surface or open type conduit wiring
* Recessed or concealed or under ground type conduct wiring.

2.5 choice of wiring system :-

The choice of any wiring system for a particular installation should be based on technical & economical consideration, both in the context of the wiring system itself & the installation for which it is purposed.

→ Safety
→ Durability
→ Appearance
→ Mechanical protection
→ permanency
→ Adaptability
→ initial cost
→ Maintance cost

* which wiring system is emplied in mechanical workshop?

Ans conduct wiring system (surface or concealed wiring system)

→ Energy meter

→ Main switch

→ earth wire

→ Fluroscent lamp

→ switch board

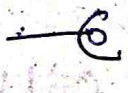
→ Celling Fan

~~→ Outcomes~~

→ ckt run

→ shoket

→ Lamp

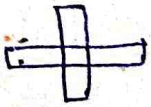


→ motor

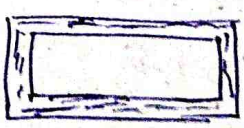
→ water tight

→ plug shoket

→ Earthing set

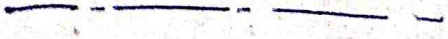


→ BDB (Branch distribution box)



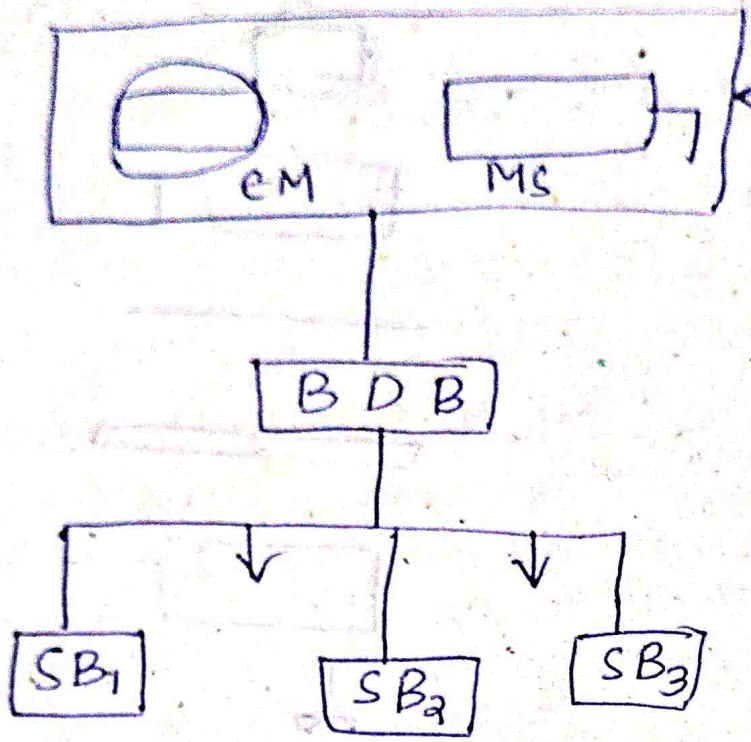
→ branch pannel

→ Natrial line



→ Earth wire

Single line diagram :-



Conductor materials used in cables :-

→ copper at 20°C $\rho = 1.786 \times 10^{-8} \Omega m$

→ Aluminium at 20°C $\rho = 2.87 \times 10^{-8} \Omega m$

→ **silver**

Though silver is the best conductor but due its higher cost it is rarely used.

chapter-1

ESTIMATING :-

→ Estimating is an art by which we can get approx. of the material, investment involved & the time to be taken for the completion of electrification project we are planning to do.

purpose of Estimating AND costing :-

→ It is necessary to know the necessary material & the cost to be incurred on it before starting a new programme. Hence it is very necessary to make a complete project report for the said programme because this project acts as a guide in the successful implementation of our programme.

— it has the following aims

* to ensure that the list of material is completed before starting the job so that there are very sleek chance of shortage of any necessary material after starting the work.
* To ensure that the money is not inisued in the projects under implementation.
* the time is saved i.e the work is completed well in time as planned.

Electrical schedule :-

→ Electrical schedule is that list or plan of the building by which we come to know the no. of points provided in each room of the building under estimation.

Catalogue :- For an upto date estimating & costing, an estimator should always have quotation & a bunch of price list provided by whole sale dealers and manufactures of specific material.

Contingencies :- During completion of the project, there can be certain emergency expenses which can't be calculated while calculating the material, cost & labour expenses for the project.

These additional emergency expenses which may be due to any reason such as increase in cost of material or increasing in labour rates.

Overhead charges :-

In addn to the total estimated expenditure involved on material, labour, for completion, maintenance & proper functioning of the project, there are other expenses which are to be incurred such as govt. taxes, Addn expenses on labour etc. are called overhead charges.

Profits :-

The profits are calculated on the basic of total expenses involved on the project so far upto completion stage & the contract money signed while signing an agreement on tender

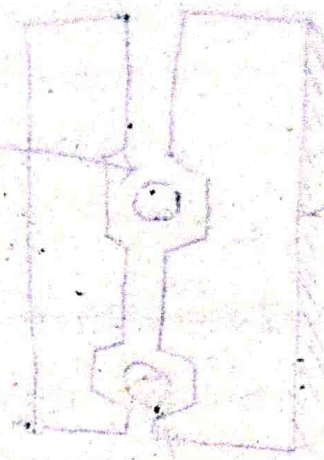
Purchase system :- we know that the purchase department of the PWD Elect. is responsible for making purchase at lowest market rate & make arrangement for storage so that the material required for the project in hand is made available.

Purchase inquiry & selection approx purchase mode :->

State type of internal wiring, their advantages & disadvantages & its application & uses

different types of internal wiring usually employed in our country are-

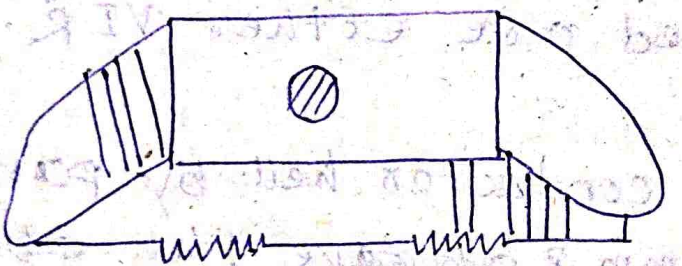
1. cleat wiring
2. wooden casing & capping wiring
3. CTS & TRS wiring
4. Lead sheathed wiring (LS)
5. Conduit wiring
   (a) Surface to open type
   (b) Recessed or concealed



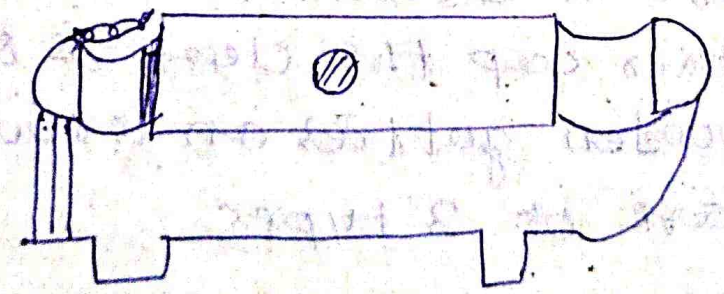
① cleat wiring (PVC or VIR)

PVC - polivinite cloride

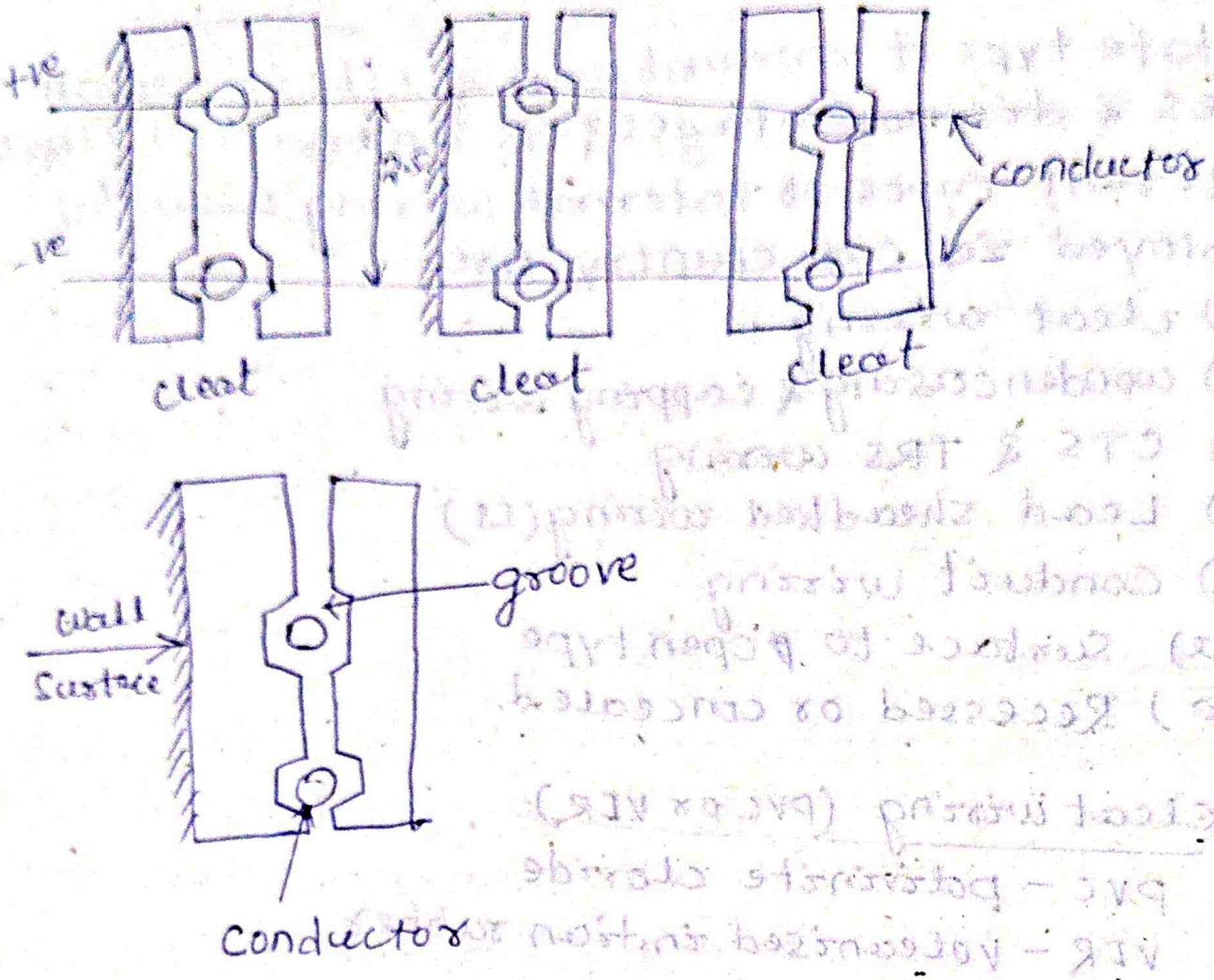
VIR - voleanised indian rubber



cleat (cap)



cleat (Base)



① In the system of internal wiring, the cables used are either VIR or PVC types.

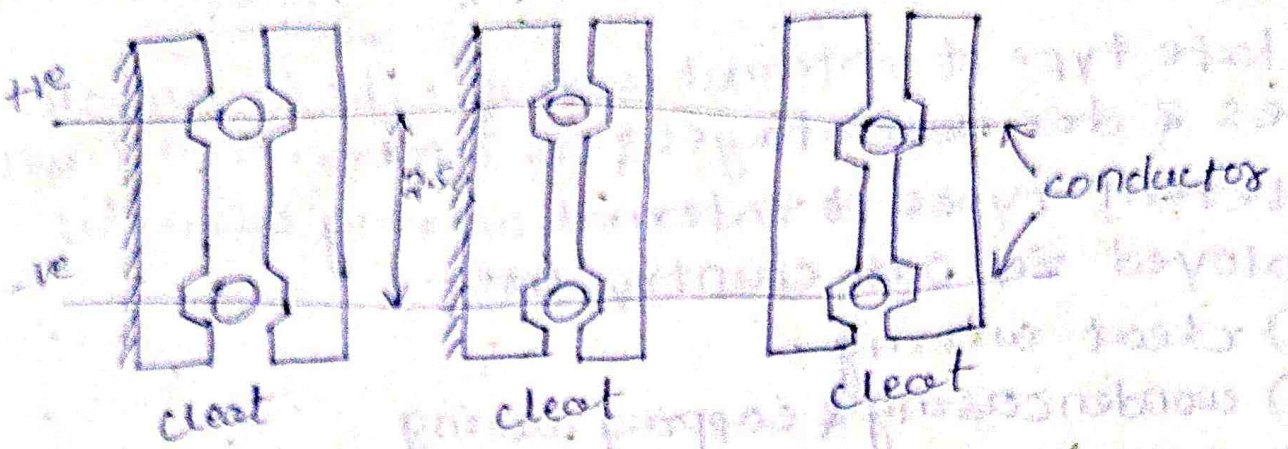
② the cables or conductor held by porcelain chips about 6mm & above the above walls or ceiling.

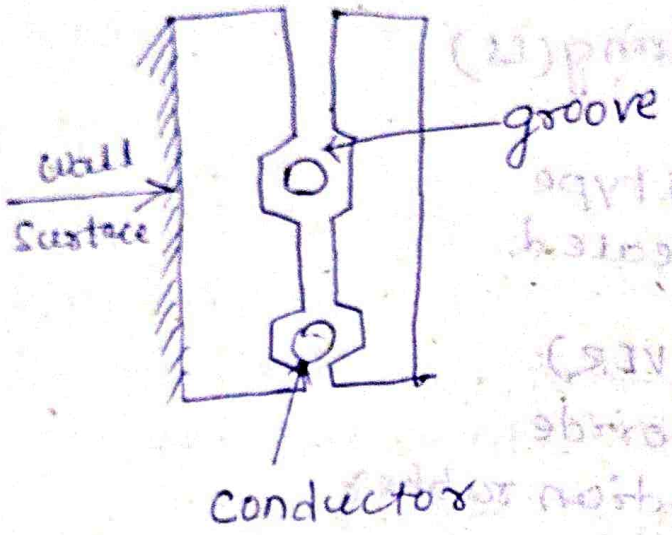
③ the cleats are made in two halves, one base & other cap the cleat is fixed in the wall wooden guttries on screws.

④ the cleats are of 3 types

① one groove
two grooves
& three groove

to acomodate one, two & three cable respectively.





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to acomodate one, two & three cable respectively.

(v) the size of the cleats are such the minimum clearance betn the conductor each 2.5 cm for branch ckt & 4 cm for the sub mainckt.

(vi) the cleat should be used at intervals of 30 cm to 60 cm.

Size of worden gutties

38 mm x 38 mm at big
25mm x 25 mm at small
length about 6.5 mm

advantages:-

(i) it is the cheapest system of internal wiring
(ii) it is easy to install & easy to dismentle
(iii) Material can be reused at the dismentle
(iv) Maintenance inspection, replesment, expansion can be easily made
(v) skilled required is little.

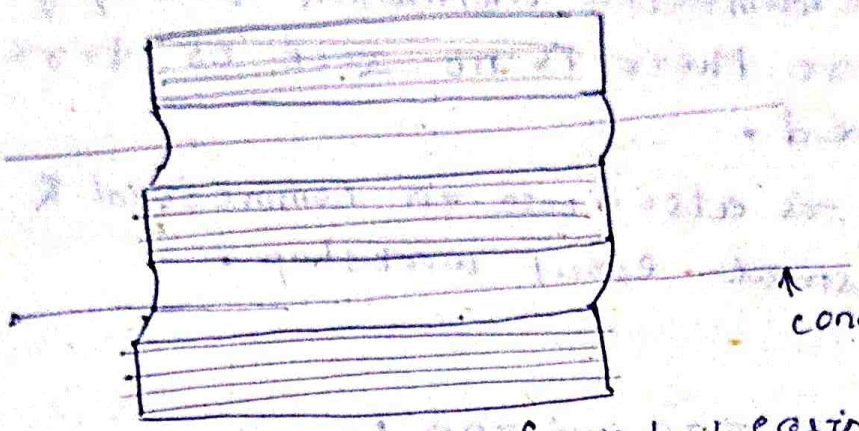
dis adv:-

(i) It is not good looking
(ii) It is not long lasting because it is temperary.
(iii) the wires are exposed to mechanical injury.
(iv) the wires are exposed to atmosphere it may get damaged. due to accumulation of dust, moisture or other chemical substances.
(v) this can't be used in industries where smoke dust, chemical & moisture are plentily avariable.

avalible, varies from 2.5 m to 3 m.

CTS - Cab type sheathed

LS - Lead sheathed



(woodend casing)

:- advantages of wooden casing or capping :-

- It is cheaper than CTS or LS or conduit wiring system
- It is easy to install & rewire & easy to inspect.
- It is ~~bread~~ better insulation to the conductor
- It is not directly in contact with moisture; smoke; dust & other chemicals

disadv of ---

- the cas need to protect with varnish to protect it from insects.
- If the place is excessively damped, such wiring are recomonted.
- their is always a risk of fire hazard
- It required skill labour & work manship.
- this type of wiring can be used only of surface & can't the concealed in plaster.
- It is also temporary winding.

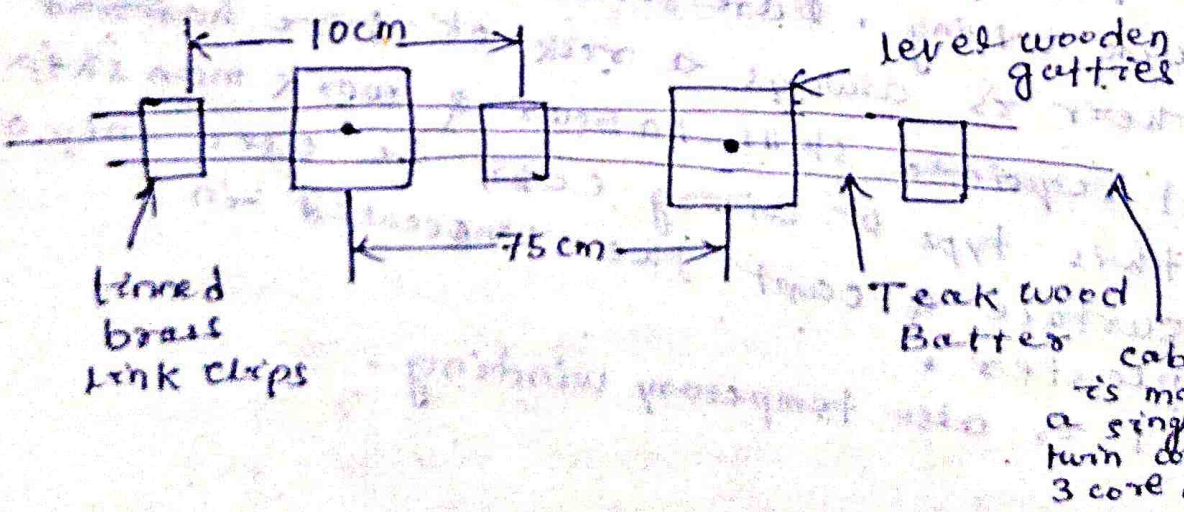
Uses or applications :-

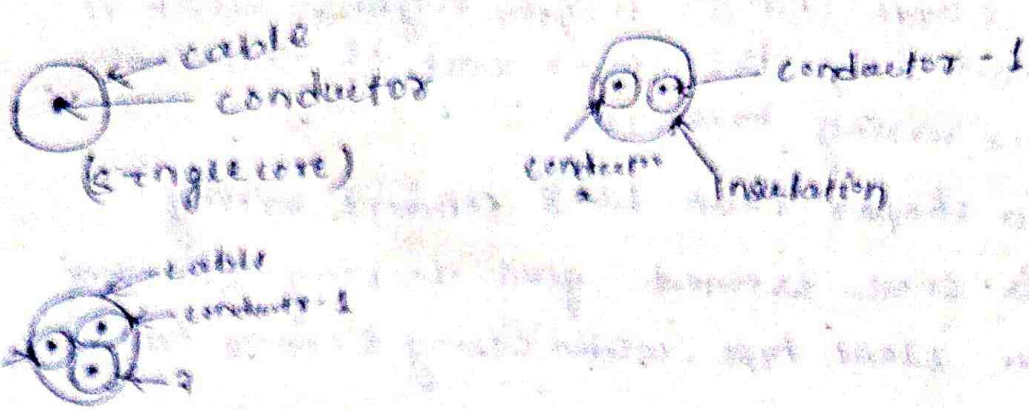
- This type of winding is suitable for low voltage domestic installation in dry places & where there is no risk of fire hazard.
- This is also use in commercial & industrial expert workshop.

(3) CTS or TRS wiring :-
(Batten wiring)

CTS - cab type sheathed
TRS - Tough Rubber sheated

- TPS cables are run on well seasoned, perfectly straight & well varnished (on all 4 size)
- teak or batten of thickness 10 mm, ~~to~~ mi atleast
- In this type of wiring the cables may be used may be single core two wire core or 3 cores TPS with a circular sheth.
- usually single core cables are preferred to this wiring





① The width of the batten depends upon the number & size of the cable to be carried by.
- the batten are available in width of 13, 19, 25, 31, 38, 44, 50, 56, 63, 69, & 75 mm.

13 mm

→ Space bet^n to clips 10 cm in case of horizontal run & of 15 cm of vertical run

② the min^m size of batten - use for this wiring is 10 mm in thickness.
the width of is of valid dimension such as 13, 19, 25, 31, 38, 44, 50, 55, 56, 69 & 75

→ the batten are fixed on the wall with help of teak wood gatties is num of m approx & by using screw.
- then the conductor is run of the batten with help of aluminium link & clips fixed on the batten with help of brass nails.
- the cleop is fixed on the wooden batten at 10cm interval.

adv
(i) easy installation
(ii) it life is long
(iii) saves labour charges
(iv) time saving
(v) the cable is in some enamel & fixed proved & cabable of width standing the action of most chemicals

- hence cable cost is slightly higher which is compensated by the lower cost of installations & other wiring materials.
- It is a cheaper than CC & conduit wiring
- It is some extened good looking (batten than cleat type, wooden casing & capping type)

dis adv

(i) it needs skill labour & workmanship to this wiring is not suitable for open places due to scem & the insulation may be affected

(ii) when putting the wiring on wall, the certain precaution are required like treatment of wood of batten against turbine attacked

(uses)

uses

(i) the TPS wiring is suitable for low voltage
250 V to 400 V

(ii) low voltage installation & extentivly use for lighting purpuses every where that is domestic i.e commercial or industrial building expect works where it is reable to mech injury.

Table

Number of cables of size 3/0.736 mm copper condition or 1/1.40 mm aluminium conductor single core that can be laid	Size of batten required	Number & size of link clips required
2	13 x 13 mm	1 x 38 mm
3	19 x 13 mm	1 x 50 mm
4	25 x 13 mm	2 x 38 mm

3/0.736 ← diameter of each strand. (3 wire)

(4) Lead sheathed wiring (LS wiring)

(i) This type of wiring employes conducts insulated with VIR & each covered with & outer sheat & lead aluminium alloy. containing about 95% lead.

Lead
Pb - 95%
White
95% lead sheathed : 95% of Pb + 5% Al

(ii) the metal sheath give protection to the cable for mechanical injury, dampness & atmospheric corrosion.

- the cables are run on wooden batten & fixed by means of clip as in TRS wiring.

- wiring with twin core cable makes the neatest job.

advantage

- it provides protection against mechanical injury better than that of TRS wiring
- It is easy to fix & looks nice.
- it's life is long if proper & if proper earth continuety is maintained throughout.
- it can be used in situations exposed to rain & sun provided no joint is exposed.

disadv

(i) it is costlier than TRS wiring.
(ii) it is not suitable for places chemical corrosion may occur.
(iii) skill labour & proper supervision are required.

uses or application

(i) this wiring system is suitable for low voltage installation
(ii) it may be used in places exposed to sun & rain provided no joint is exposed.
(iii) it may also be used in damp places with a suitable protection covered.

conduit wiring

their are two types of conduit wiring i.e.
(a) open or surface conduit wiring
(b) of hidden or concealed conduit

- For both cases in this system of wiring still to be known as conduits & installed on or fixed or on the surface on the wall by means of saddle clamps.

this saddle ~~clamps~~ clamps fixed by screws & the screw is fixed by wooden guttes.

- VIR or PVC cables are put or with (wen) inside the conduit.
- In damp situations the conduit can be spaced from the walls spaced by means of small wooden blaks fixed betw the pipes at regular interval.
- the conduit shoud be electrically & mechanically continues & connected to earth at sum suitable point.
- the conduit used for this perpose is of two types namely
  (i) light gauge (or split type) conduit
  (ii) heavy gauge (or screw type conduit)

- Light conduit is used for cheap work
- heavy gauge conduit is used for all medium voltage i.e. (250 to 600 V) ckt.

(vi) conduit size with terms of outer diameter
the smallest size is 2 mm
next size is 16 mm
19 mm

after which it rises a in size in 16 mm steps to 31 mm & next standard sizes are 38 mm & 50 mm.

The largest standard size 63 mm, but this not much is used.

advantage of conduit

(i) the biggest adv is that it give protection against mechanical injury

(ii) it is also secured against fire moisture, dirt & dust & chemicals.

(iii) the life is quite long lasting

(iv) it is quite good looking

(v) the whole system is water prove

dis adv

(i) it is the costliest wiring

(ii) the instalation is difficult & time taking

(iii) it require skill work man ship & more labour.

(iv) while instalation it sum moisture inside the conduit. This will affect the life the insulation by the long run.

(v) Its erection is not so easy & requires fie.

cases
In given

(i) as the system of wiring provid protection against fire, mechanical damage & damp ness so this is the only approved system of wiring for.

(a) places where considerable dust or Fluff is present such as in textile mills; saw mills, Flour mills,

(b) damp situations

(c) In workshop for lighting & motor wiring

(d) places where possibility of fire hazzerd such as oil mills, varnished factories

(e) places where imp. document are kept such as a record room.

(f) residential & public building where the appearance is the prime fixed.

Om Sai R

Internal wiring or house wiring :-
CTS / PVC casing & capping wiring system :-

- prepare one estimate of materials required for CTS wiring for small domestic installation of one room ; one varandah within 25 m² with given ~~fitting~~ light, fan, & plug points.

problem

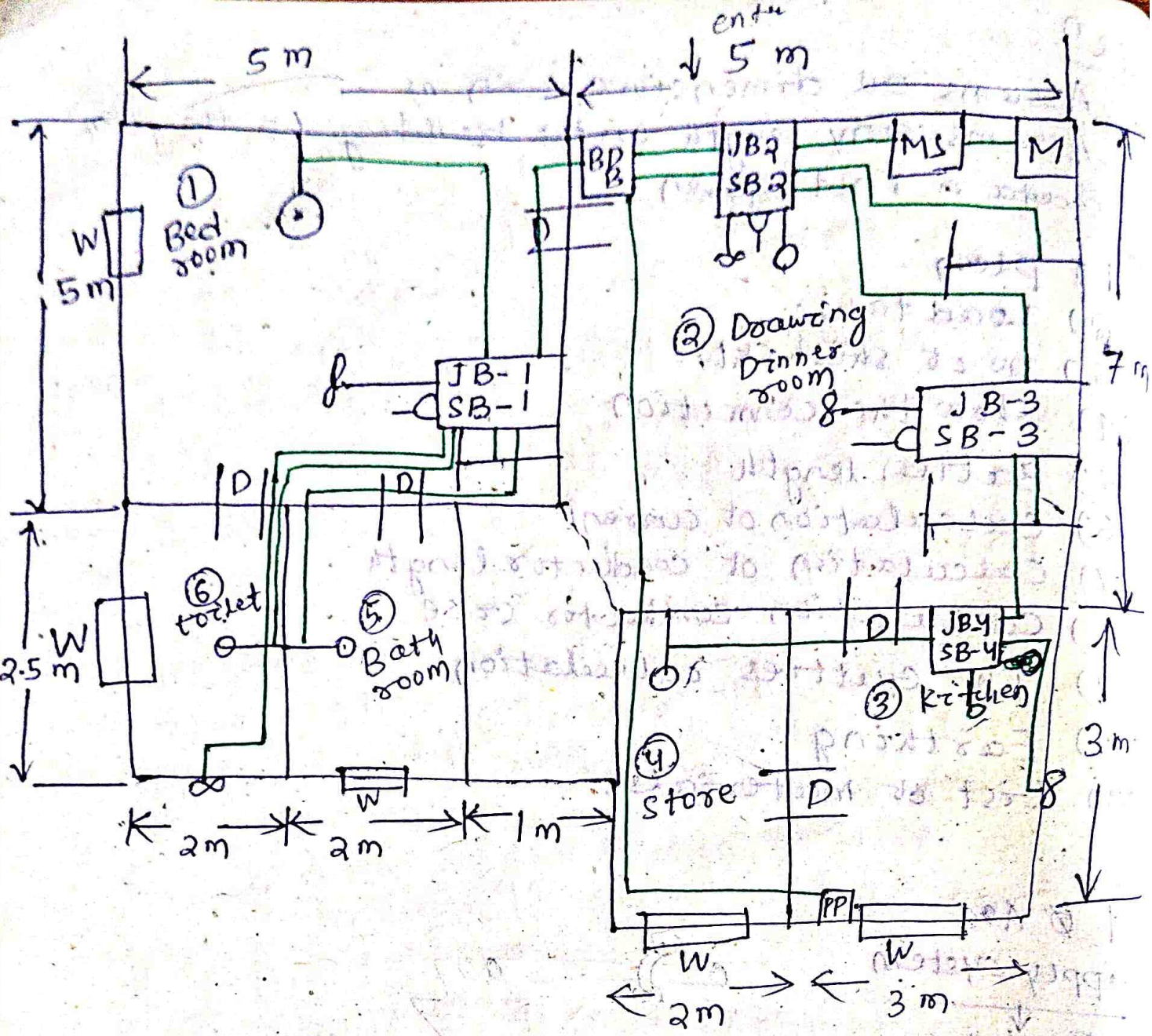
Estimate the material required for internal wiring of a house with CTS wiring. the house consists of :-

1 - Bedroom
1 - drawing cum Dining
1 - kitchen
1 - store room
1 - toilet &
1 - Bathroom

the light loads of the house should not exits 1500 watt. give power - plug connection for 1000 watt.
Draw a neat sketch & give the items least.

Hints

this is a CTS wiring system or PVC casing, capping system



① PLAN

symbols

D — power socket

— Incandesent bulb

— Tube light

— ceiling Fan

— Exhaust Fan

D — Door

w — window

hints

All dimension are in meters

CKt ① - BDB - (JB-1) —

CKt ② - BDB - (JB-B2) - (JB-3) JB-4

CK ③ BDB - PP

~~CKt ④~~

PP - power point

JB - Junction Board

SB - Switch board

M - Energy meter

(2) Load table :-

Sl no	Room	Light L	Fan F	Tube T	Light plug	power plug	Watts
01	Bed room	1	1	1	1	—	300
02	Drawing cum dining room	1	2	2	2		500
03	Kitchen	1	1 (exhaust)	—	—	1	160+1000
04	Store	1	—	—	—	—	100
05	Bath room	1	—	—	—	—	100
06	Toilet	1	1 (exhaust)	—	—	—	160

total = (1320+1000) watts

Hints

Fan = 60 w

Light = 100 w

Light plug = 100 w

Tube light = 40 w

(3) No of ~~Ghost~~ scab ckt :-

$$= \frac{\text{total watts}}{800}$$

$$= 1320 / 800$$

$$= 1.65$$

$$\simeq 2$$

(a) Light Load scab skts = 2

(b) power scab skt = $\frac{1}{3}$

Calculation of load :-

Sub ckt ①

Bedroom + Bathroom + Toilet

Load on SB_1 = Light (100) + Fan (60) + light power plug (100) + Tube light 40 + 100 light + 100 light + 60 w Exhaust

= 560 watts

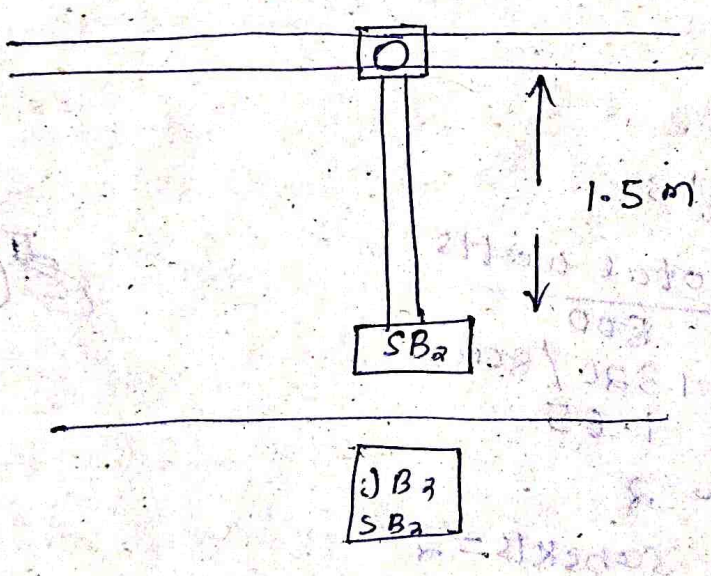
Sub ckt ① = total load

= 560 watt

Sub ckt ②

Drawing cum dining room + store + kitchen

Load on SB_2



SB_2 = one light point + one light plug + one ceiling fan + one tube light

= 100 + 100 + 60 + 40

= 300 watt

Load on SB_3 = one light plug + one Fan + One tube light
= 100 + 60 + 40
= 200 watts

Load on SB_4 = two light point + one exhaust Fan
= 2 × 100 + 60
= 260 watts

sub ckt 2 -
= total panel load
= 760 watts

sub ckt 3
kitchen room
load on BDB
= power point
= 1000 watts

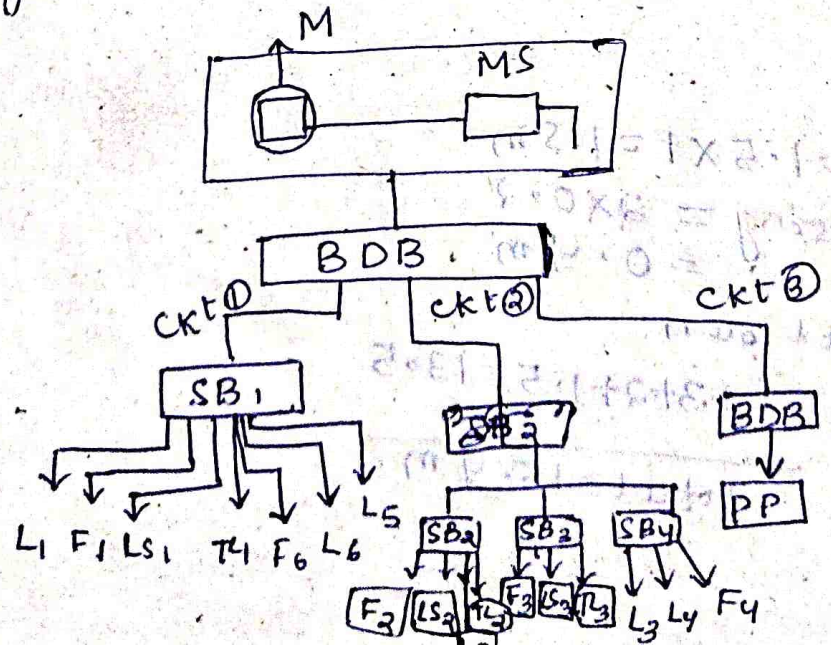
(4) Show the connections :-

sub ckt ① → Bedroom + Bathroom + Toilet
= 560 W

sub ckt ② - Drawing cum dinning room + kitchen + store
= 760 watts

sub ckt ③ ⇒ power point

Single line diagram :-



(5) Batten length :-

Ckt ①

Switch board (SB) drop = 1 × 1.5 m

Light point drop = 4 × 0.5 = 2 m

Vertical run to

ceiling = 2 × 0.5 = 1 m

wall crossing = 3 × 0.2 = 0.6 m

Horizontal run = 5 + 2.5 + 3 + 2.5 + 1

= 14.0 m

=

celing run = 2.5 m

total = 21.6 m

Ckt ②

SB drop = 3 × 1.5 = 4.5 m

light point drop = 5 × 0.5 = 2.5 m

vertical run to ceiling = 3 × 0.5 = 1.5 m

Wall ~~ceiling~~ crossing = 2 × 0.2 = 0.4 m

Horizontal run = 5 + 7 + 3 + 1 + 1.5

= 17.5 m

ceiling run = 2.5 + 1.75 = 4.25 m

total = 30.65 m

Ckt (3)

SB drop = 1.5 × 1 = 1.5 m

Wall crossing = 2 × 0.2

= 0.4 m

Horizontal run

= 7 + 3 + 2 + 1.5 = 13.5

total = 15.4 m

Scab main

Horizontal run = 5 m

BDB drop = 0.2 m

total = 5.2 m

Batten Abstract :-

(a) ckt.1 + ckt.2 = (21.6 + 30.65) m

= 52.25 m

Additional 10% ext = 5.225 m

total = 57.475 m

(b) ckt (3)

length of ckt ③ = 15.4

additional 10% extra = 1.54 m

total = 16.94 m

(c) scab main = 5.2 m

add 10% extra = 0.52 m

5.72 m

→ grand total of batten = 57.475 m + 16.94 m + 5.72

= 80.135 m

total num of wall crossing = 7 No.

(PVC / porecelain pipes tube used for wall crossing)

20-01-14

In this case we assuming P.F = 0.9 &
supply voltage = 230 V & P.F =

short ckt conductor; $I_{sc_1} = 1.5\ I_1$

$= 1.5 \times 2.17$

$= 4.05\ A$

For sub ckt ② = $I_2 = \frac{760}{230 \times 0.9} = 3.67$ amp

$I_{RSC} = 1.5\ I_2 = 1.5 \times 3.67$

$= 5.5\ A$

For sub ckt ③ : $I_3 = \frac{1000}{230 \times 0.9}$

$= 4.83\ A$

$I_{RSC} = 1.5\ I_3$

$= 1.5 \times 4.83$

$= 7.24$ amp

AC supply $PF = \cos\phi = P/Z = \frac{\text{Active power}}{\text{apparent power}}$

$PF = \cos\phi = R/Z = \frac{VI\cos\phi}{VI}$

$= 0.101$

DC $PF = 1$

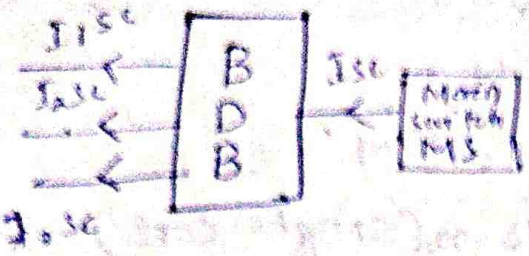
$\cos\phi = \frac{R}{Z} = R/R = 1$

$Z = R + jX = R + j(X_L - X_C)$

$X_L = 0, X_C \Rightarrow \phi = 0$

$X_L = \omega L = 2\pi f L$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$



Submain current

$I_{sc} = I_{1sc} + I_2 sc + I_3 sc$

$= 4.05 + 5.5 + 7.14$

$= 16.79\ A$

7) Calculation of conductor length :- (imp)

For ckt ①

→ Batten length × 3

$= 21.6 \times 3 = 64.8\ m$

Add 20% extra $= 12.96\ m$

total $= 77.76\ m$ (single core)

For ckt ②

Batten length × 3 $= 30.65 \times 3 = 91.95\ m$

Add 20% extra $= 18.39\ m$

total $= 110.34\ m$

For ckt ③

Batten length × 2

$= 15.4 \times 2 = 30.8\ m$

Add 20% extra $= 6.16\ m$

total $= 36.96\ m$ supply arc

Ex- 5.2

Plan of a small house of big. The house is to be electrified by using concealed conduit wiring system. A 100 w plug point is also to be provided in each room or case. Ceiling height may be assumed as 3.5 m.

(a) Draw installation plan & determine number of circuit.

(b) Draw electric circuit diagram

(c) Calculate

(i) the size of wire required

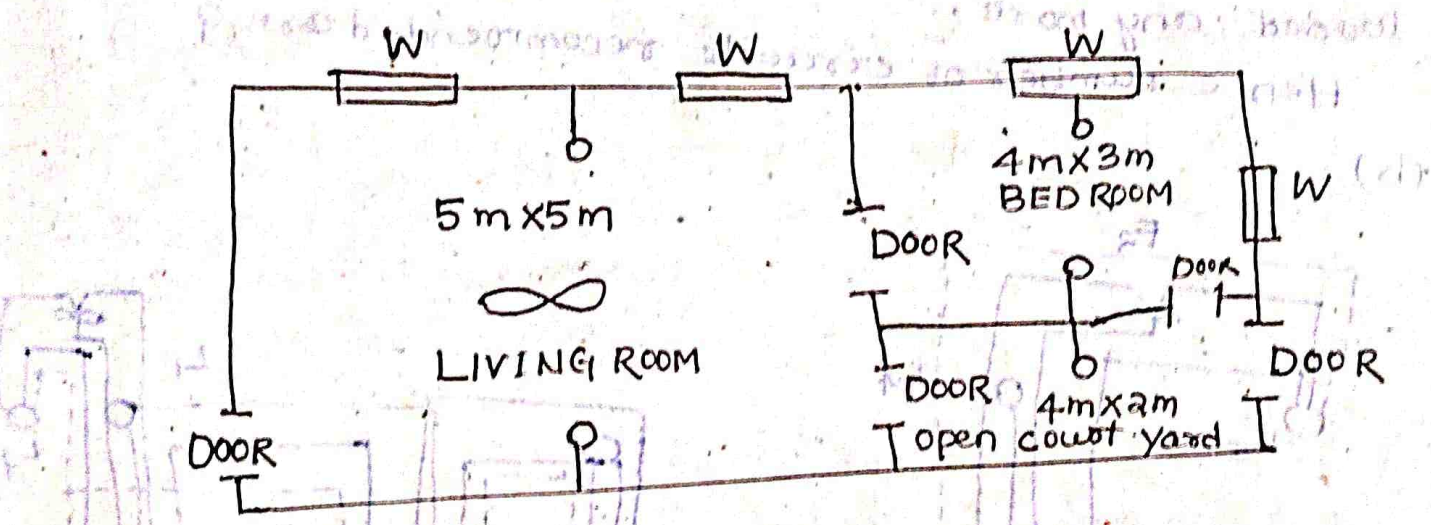
(ii) the size of the main switch

(iii) the length of conduit required

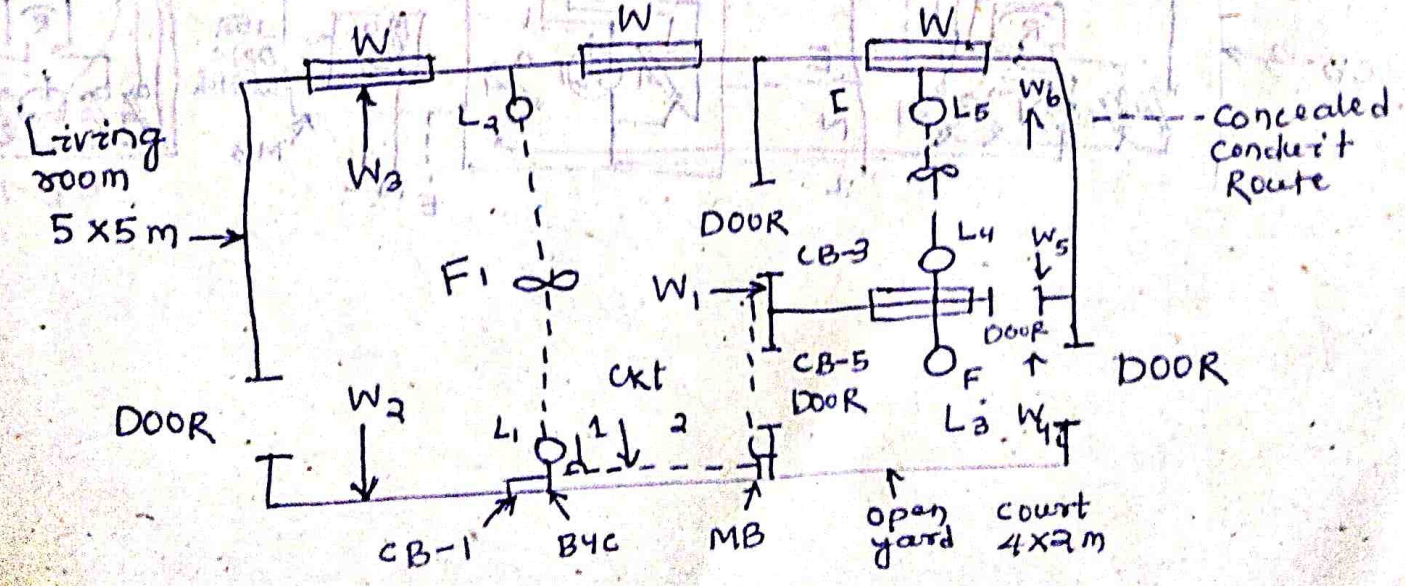
(iv) the length of PVC wire required

(v) the length of earth wire required.

(d) prepare the complete list of material required.



Solution :-



Calculation of number of circuits; Assuming.

(i) each tinght point of 60W.

(ii) Fan point of 100 W

(iii) plug point each of 100 W (as given)

Hence (i) total tight points load $5 \times 60 = 300$ W

(ii) Fan points load, $2 \times 100 = 200$ W

(iii) plug points load, $3 \times 100 = 300$ W

So total points = 10 & load = 800 W

As per IE Rule maximum number of points on one circuit are 10 & loading in watts is 800 W.

∴ number of circuit required,

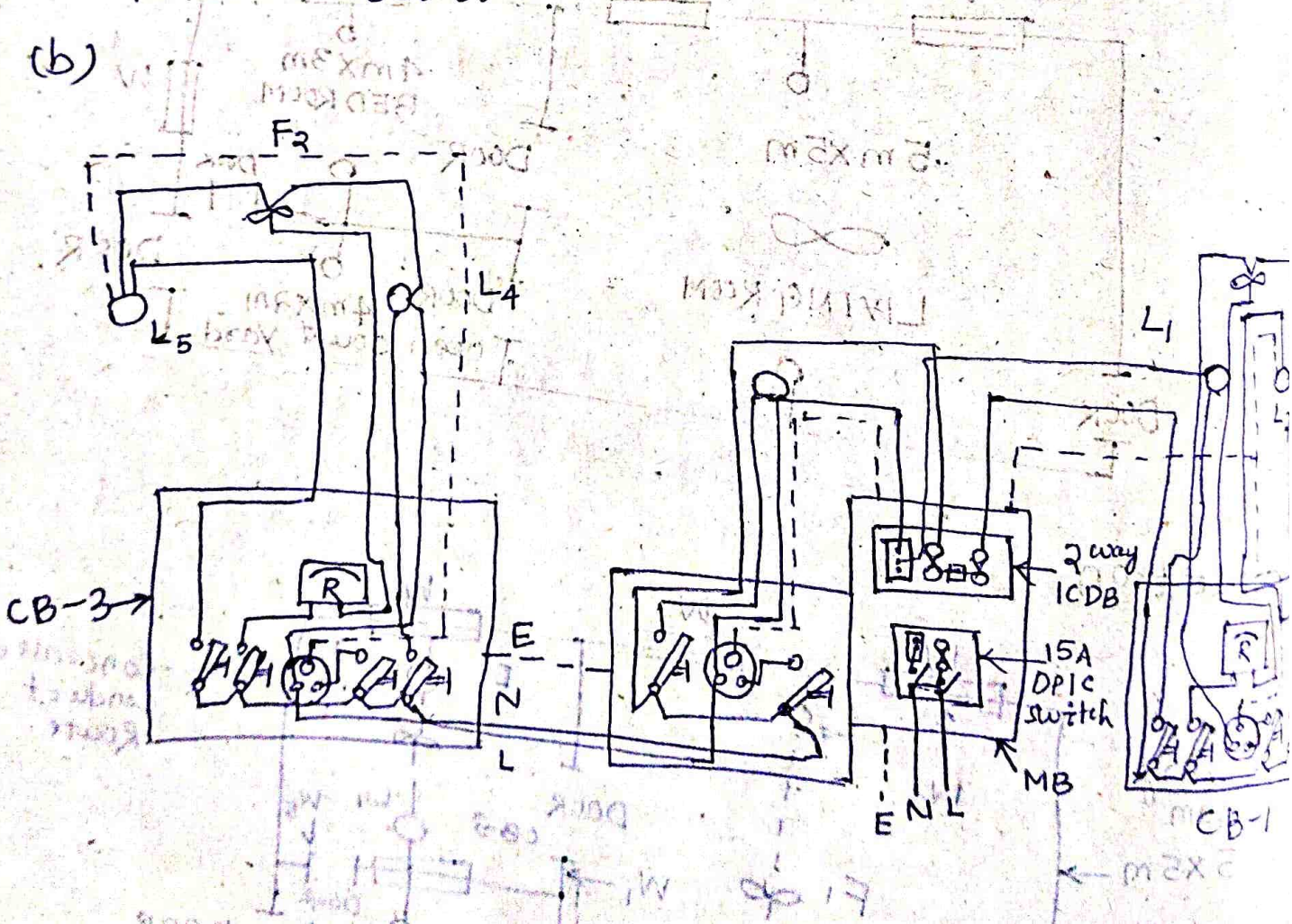
(i) on point basis 10/10 = 1 and

(ii) on loading basis, 800/800 = 1.

So, minimum number of circuit required is 1. However keeping in mind the future requirements one spare circuit is also suggested, because present circuit can not be loaded any more.

Hence number of circuits recommended are 2

(b)



(C)(i) Total load = 800 W

taking supply voltage as 230 V & assuming power factor as unity,

$800 = 230 \times I$

or $I = 800/230 \simeq 3.5$ A

short circuit current: 3.5×1.05

short ckt current is taken 1.5 times that of full load current) i.e. 5.25 A Say 6A.

size of PVC wire required = 1/1.2 cu, 250 V.

(i.e. minimum size of wire as per IE Rule)

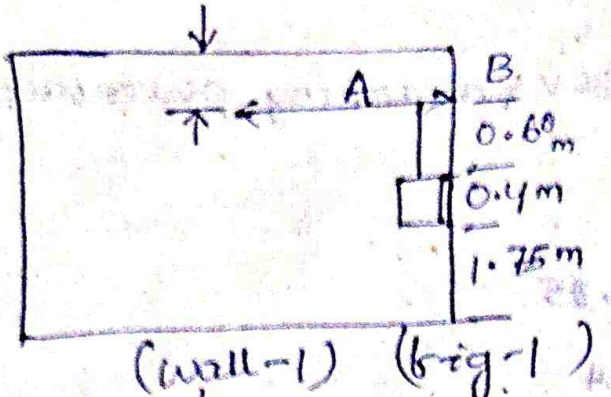
(ii) the size of the main switch is 16 amp, 250 V; DPIC switch (min^m size) (or 16 amp MCB i.e. miniature circuit breaker)

(iii) and (iv) assuming,

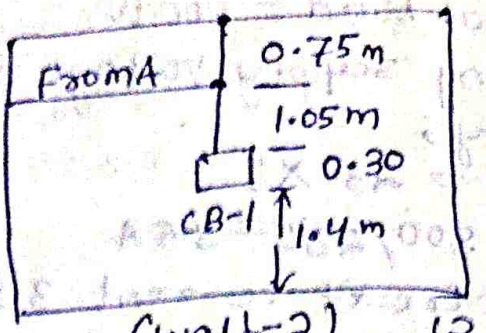
1. the main Board of the house has been installed at 1.75 m above the Floor level.
2. Route of the wiring is 0.75 m below the ceiling
3. Board for controlling switches have been installed at 1.4 m from the floor level.
4. Plug points have been provided in the controlling boards of each room or use.
5. Light points will be installed at 0.75 m below the ceiling.
6. All points of living room are on circuit no. 1 & the remaining points of the house are on circuit no. 2.

For calculation of length of conduit & PVC wire proceed as follows.

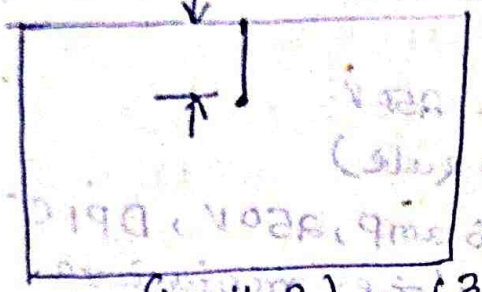
Sl no.	Location	Length of conduit in m	Length of PVC wire in m
01	MB to point A (Fig 5.5)	0.60	$0.6 \times 2 = 1.20$
02	A to B i.e. L_1 (" 5.6)	2.70 (0.2+2.5)	$2.7 \times 2 = 5.40$
03	B to CB-1 (" 5.6)	1.05	$1.05 \times 5 = 5.25$
04	B to C (ceiling) (Fig 5.6)	0.75	$0.75 \times 3 = 2.25$
05	C to F_1	2.50	$2.5 \times 3 = 7.50$
06	F_1 to D	2.50	$2.5 \times 2 = 5.00$
07	D to L_2 (Fig 5.7)	0.75	$0.75 \times 2 = 1.50$
		10.85	28.10



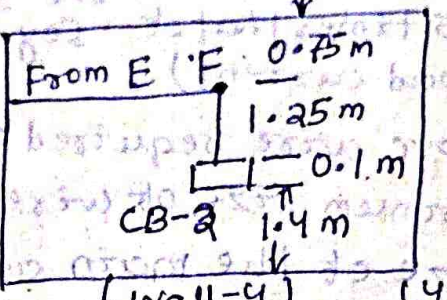
(Wall-1) (fig-1)



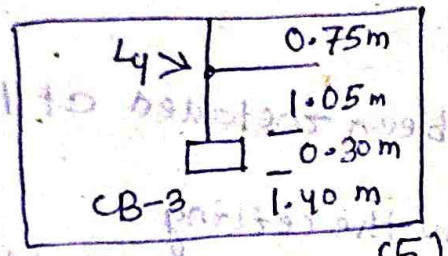
(Wall-2) (2)



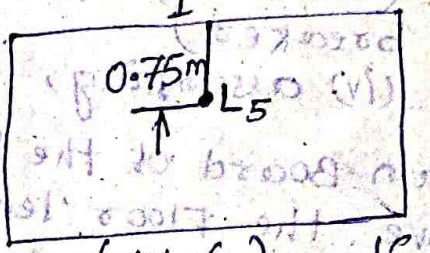
(Wall-3) (3)



(Wall-4) (4)



(5)



(W-6) (6)

Circuit No.02

Sl no.	Location	Length of conduit in m	Length pvc wire in m
01	MB to point A (fig-5)	Same conduit for both ckt - 1.80	0.6 x 2 = 1.20
02	A to E (fig 5)		1.80 x 2 = 3.60
03	E to F i.e L_3	2.25 including 0.25m of wall	2.25 x 2 = 4.50
04	F to CB-2 (fig 4)	1.25	1.25 x 3 = 3.75
05	CB-2 to CB-3 (crossing on wall)	0.25	0.25 x 2 = 0.50
06	CB-3 to G i.e. L_4 (fig 5)	1.05	1.05 x 4 = 4.20
07	G to H (fig 5)	0.75	0.75 x 3 = 2.25
08	H to F_2	1.50	1.50 x 3 = 4.50
09	F_2 to I	1.50	1.50 x 2 = 3.00
10	I to L_5 (fig 6)	0.75	0.75 x 2 = 1.50
	total	11.10	29.00

Total of both the circuits	21.95	57.10
say	22.00	58.00
& 5% wastage	1.10	2.90
total	23.10	60.90
say	24 m	61 m

∴ total (i) length of conduit required = 24 m
and (ii) length of PVC wire required = 61 m

And 10% more, which includes wire required for making connection of switches & sockets etc. in the various boards & other out lets as (the above calculation are upto the entry of each board & outlets) = 6.10

So, total length of PVC wire required = 67.10
say 68 m.

The above calculation shows that the length of the wire is approximately three times the length of the conduit.

(v) Length of earth wire

Length of earth wire will be equal to the length of conduit 24 m m
plus 5% earth wire required for connecting it in the boards etc 1.20 m
total = 25.20 m
say 26 m

(d) List of the material is given below in the tabular form.

Sl no.	Items with specification	Qny	Remarks
1	IC board complete with locking arrangement (40 m x 30 m)	1 no.	
2	DPIC switch (or MCB), 16 A, 250 V	1 no.	
3	ICDB, 2-way, 16 A/way, 250 V	1 no.	
4	16 gauge conduit pipe; 19 mm dia	24 m	
5.	Conduit junction boxes for 19 mm dia conduit		
	(i) one way (also known as terminal box)	2 nos.	
	(ii) two ways	3 no's	
	(iii) three ways	3 nos.	