LEARNING MATERIAL OF

ELECTRICAL INSTALLATION & ESTIMATING

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01/

I.E rules & standards — 03/01/201

[I.E-INDIAN ELECTRIC

Estimating :-

DEFⁿ - Estimating is a art of accessment of the quantities of different items required for executing a work before actually carrying out the work

Definitions :-

(1) Ampere → It is the unvarying electric current which, when passed through a solution of nitrate of silver at the rate of 0.00118 of a gram per second

* It is the unit of electric current

(2) Volt → It is the electric pressure which, when steadily (constant) applied to a Conductor, the resistance of which is one ohm, will produce a current of 1 ampere

* It is the unit of emf

(3) Voltage → It is the difference of electrical potential measured in volt betⁿ any two conductor or betⁿ any part of either Conductor and earth as measured

by a suitable voltmeter

It is are of four types.

A. Low voltage
B. Medium voltage
C. High voltage
D. Extra high voltage.

A. Low voltage

* It is the voltage which doesn't exceed 250 volt under normal conditions subject however to the percentage of variation allowed by the I.E Rules

B. Medium voltage.

04/01/2017

* It is the voltage which doesn't exceed 650 volt under normal condit^n subjected to the percentage of variat^n allowed by the IE rule

C. High voltage.

* It is the voltage which doesn't exceed 33,000 volt under normal condition subjected to the percentage of variation allowed by the IE rule

D. Extra High voltage.

* It is the voltage which exceeds 33 KV under normal condit^n subjected to the percentage of variation allowed by the IE rule

(4) Circuit → It is an arrangement of conductors o
Conductors for the purpose of conveying energy
and forming a system or a branch of system

(5) Circuit breaker → It is a device which a capal
of making and breaking the ckt under all condit
and unless other-wise specified so design as to
break the ckt automatically under any
abnormal condit^n

(6) Apparatus → Apparatus means electrical appara
and includes all the m/c fittings, accessories and
appliances in which conductors are used

(7) Conductor → It is an a wire, cable, bar, tube,
rail, or plate used for conducting energy and so arran
as to be electrically connected to a system

(8) Live → It means the system is electrically
charged

(9) Dead → It means the system is disconnected fro
any live/charged system i.e its potential is
equal to the earth potential
* The apparatus seperated from a live conductor
by a spark gap shall not be deemed to be dead

(10) Cable → It means a length of insulated single
core or two or more such conductors each
provided with its poor insulat^n which are laid of
together

(11) Bare → It means the conductor not covered with any insulating material

(12) Cut-out →

05-01-2017

It is an appliance for automatically interrupting the transmission the energy through any conductor when the current raises above a predetermind amount

(13) Conduit → It means regid or flexible metalic tubing or mechanically strong and fire resisting non metalic tubing in which the cables may be drawn for the purpose of affording it

14) system → It means an electrical system in which all the conductors & apparatus are electrically connected to a common source of electric supply

15) Danger :-

It means danger the health or life or any part of body from shock, burn or other injury to life or property or fire explosition attendⁿ up-or the generadⁿ transmissⁿ distributⁿ or use of energy

16) Installation :- It means any Composite electrical unit used for the purpose generating, transmiting, Converting distributing or utilizing energy

17) Earthing system :- It means an electrical system in which all the Conductors are earthed

18) ~~Earthing~~ span :- It means the horizontal distance betⁿ two adjascent supporting poles or an overhead conductor

19) Switch gear :- It shall denote switches, breakers, cutouts and other protective appearaths used for operation regulatn and control of circuits.

20 Electrician:- It means persion over 21 years of age who is competent for the purpose of the rule in which the term is used and who has bein appointed by the owner, agent or manager of any Company

General Conditions Relating to supply and use of Energy. 09/02/2017

Rule 45

* the maxm voltage regulatn for low & medium voltage is ±5% as per I.E. rule
* As per I.E. rule the maxm voltage regulatn for high & extra high voltage ± 12.5 % according as per IE rule

Rule 55:-

* As per IE rule the maxm frequency regulatn is ± 3%

Rule 56:- 17/01/2017

(RCC - Rainforcet Cement Concrit)
(PCC - Pre-stret Cement Concrit)

Short Q.

? what is the max voltage regulation for H.V & E.H.V line as per IE Rule.

Ans The maxm voltage regulatn. for H.V & E.H.V line as per I.E. Rule is ± 12.5%.

? what is the maxm voltage regulatn for low & medium V line as per I.E. rule.

Ans The maxm voltage regulatn for low & medium voltage line as per I.E rule is ±5%.

? Define low voltage, medium voltag, high voltage, extra H.V Ampere, electrician as per I.E rule.

L.V → which voltage can't exceed 250 V under normal condiⁿ subjected to the percentage of variatⁿ allowed by the I.E rule.

M.V → It is a voltage which can't exced 650 V under normal condiⁿ subjected to the variatⁿ allowed by the I.E rules.

H.V → It is the voltage which can't exceed 33 kV under normal condiⁿ objected to the percentage of variation allowed by the I.E rule.

E.H.V → It is the voltage which can exced above 33 kV under normal condiⁿ subjected to the percentage of variatⁿ allowed by the I.E rule.

Ampere → It is a unvarying electric current, when it passed thrugh the solutⁿ of nitrate silver the rate of 0.00118 of a g/sec.

* Also it the unit of current.

Electrician → Electrician means, whose age limit 21 years old, he is appointed by an owner or manager. That man know about all the indian electricity rules

CH-V

OVERHEAD INSTALLATION 20/01/2017

(H.T DISTRIBUTION)

Generally for distributing electrical energy we have two types of system such as :-

(a) High tention (H.T) distribution

(b) low " (L.T) "

* It depends on the voltage to be supplyer so it may be L H or H.T distribut^n but following accessories must be used in over head distribut^n system

1. supports

* usually electric poles or towers are called as supports. The main funct^n is to support the conductors so as to keep the conductors at a suitable level from the ground
* Generally for L.T distribution we used 8 m PCC pole (Prestressed Cement Concrit) or RCC poles and also rail polles of 9 m or 10 m height
* Similarly for H.T distribut^n we use 9 m pcc or rcc pole and joists, rail poles of height 12 mo depending on the voltage to be supply and various regions, we also use the towers in H.T distribut^n

factor covering height of pole

following points are the important factor for which height of the pole is fixed to a certain limit

* The minimum clearance of the caried conductor from the ground
* The no. of conductors to a carried out and minimum vertical clearance betn the conductors & ground
* The length of the pole is to be burried in the ground (Generally 1/6 of the total height must be burried in the ground in normal soil).

Cross-arm

It is cross piece fitted to the pole top at the end portion by means of brackets is known as pole bracket, such cross arms used to hold the insulators

Usally in the distributn line MS channel, angle iron, V-shaped, U-shaped or Zig-zag cross arm are used

In order to prevent arcing betn two conductors the cross arm must be design so as to hold the insulators as per the following applying voltages

Working voltage (KV)	spacing betn Conductors
6.6 KV	96 mm
11 KV	101 mm
33 KV	190 mm

* Generally pole brackets are used to hold the cross-arm with the poles.
* Clamps are made up of flat iron and are used for fixing as well as holding service lines, stay wire shackle insulators, cross arms etc.

3. Insulator :-

The main funct^n of insulator in distribut^n line used to avoide the direct contact betn charged Conductor and earth.

* The Commonly used material for overhead insulator is ~~porcelain~~ Purcelin, glass or seramic

We have following type of insulators are used for distribut^n system

(a) Pintype insulator. —

20-01-17

a) Pin Type Insulator :-

⇒ This type of isulator is used in 220 V, 440 V, 11 KV & 33 KV

b) Disc type Insulator :-

*) Disc insulator is catagorised in two types depending upon its use.

i) If it is Vertically arranged then it is known as suspension insulator.

ii) If it is horizontally arranged then it is called as strain insulator,

* This insulators are used from 11 KV un wards.

for minimum no. of insulator disc required for transmissi line are :-

Voltage in KV	Suspension Assembly (No. of Disc)	Tention or Dead end assembly No. of Disc
11	01	01
33	02	03
66	05	06
132	09	10
220	14	15
400	21	22

c) Shacule type insulator.

This insulator is used only in L.T distribution up to 440 V.

* This insulator are used in the strit light purpose.

d) Egg insulator.

It is Commonly used in stay for H.T as well as L.T lines

* Its shap is like egg.

4. Conductor.

In distribut^n Conducter plays a vital role to transmeet the electrical energy & to circulate the electric current.

Hence the Conductor is a medium of electric supply system. Generally use A.A.C (All aluminium Conductor) & A.C.S.R (Aluminium Conductor still Rain forced) as the over head Conductor in the distribution line.

In real practice Conductors are placed various configuration like horizontal, Vertical & triangular.

while stretching the conductor we most have to maintain a specific clearance among the conductors called as inductor spacing & also betn the ground is called as ground clearance.

A general formula used to get conductor spacing of the allowable minimum conductor

$$\text{spacing} = \sqrt{5} \times \frac{V}{100}$$

where, s = Sag of the Conductor
V = line vale.

The Conductor clearance of the various voltage are written below

Supplied voltage KV	0.4	11	33	66	132	220	400
spacing (m)	0.2	1.2	2	2.5	3.5	6	4.5

Similarly the ground clearance in different locations given below

Supplied voltage (KV)	0.4	11	33	66	132	220	400
Across street (m)	5.8	5.8	6.1	6.1	6.7	7	8.4
Along street (m)	5.5	5.5	5.8	6.1	6.1	7	8.4
other areas (m)	4.6	4.6	5.2	5.5	6.1	7	8.4

5. span Length :-

Depending on the supplied voltage of the distribution as well as transmission line we have following spans for the various types of supports.

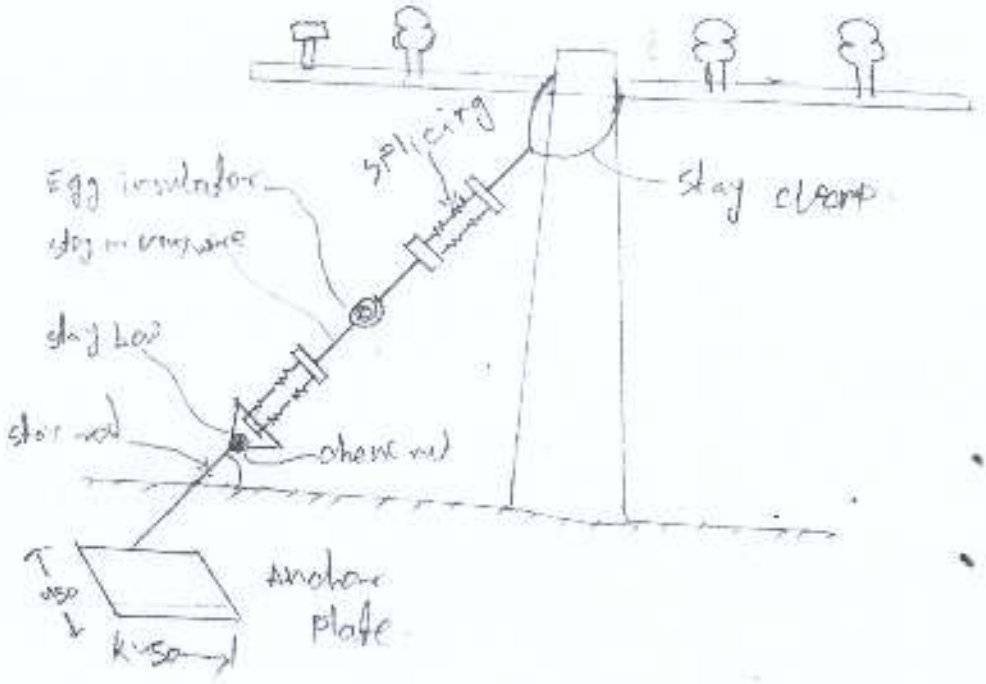
a) for wooden supports span is (40-50) m
b) for Rail poles span is (50-80) m
c) " RCC or P.C.C pole span is (80-200) m
d) for steel tower span is (200-400) m

for rever crossing long span about 800 m may be consider which exceptional.

6. Lightning arrestor :-

It is a device which protects all the electrical equipments from damage due to surge voltage of lightning hence all the over head Conductor are also connected with the lightining arrestor out is substation, grid etc.

7) Stay & Guys:- CEE 21/01/17



stay is basically used to provide supports to the lines pole those are in balanced condition.

* Generally stay is done at an angle 45° or less than 30° for L.T lines.

* for H.T line the stay angle varies from 45° to 60°

* In the stay we use 1 m.s rod of 19 mm dia, stay bow and chain nuts, we also use stay wire either of 7/8 SWG or 7/10 SWG GI. I (galvanised iron) one anchor plate of size 450 mm × 450 mm × 6.1 mm having 4.8 mm hole at the centre.

* usually the depth of stay is approximately 1.67 m keeping a length of 46 cm of the rod projected above the ground level

8) Phase plate.

To identify the colour codes of over head conductor such as red (R), yellow (Y), Blue (B) such phase plates are attached with the supports.

9) Danger plate.

Usually this plate is placed at a height of 2.4 m from the ground or the support.

* This plate contains rating of voltge.
* This plate is used to aware the human being

10) Barbed wire / Anti climbing.

This wire is provided around the poles at a height of 2.5 m from the ground from atleast meter it is used no to climb any ~~unathorised~~ / unauthorised.

11) Bird guird.

* These are the wooden pieces of size about (10x12.5x15) in case metal poles and are fitted under the insulato
* Bird guird are used to avoid short ckt or earth fault due to the shiting of barts which may short ac any two like conductor or and one live conductor to the ear

12) Jumpers

Jumpers are the conductors which are used to continuity supply line from one point to another point by jumpering.

* Jumpers are generally used in D.P (Double Pole) structure and where disconnectn of supply line is existing

13) Guarding wire

It is used to protect the life of human beings as well as wild life.

* These are used in the place or locations of road crossing, over the telephone line, railway crossing, street crossing etc.

a) Electric supply to a factory is to be taken from an 11 kV over head 3-φ line for a distance of 1 km from the existing 11 kV line. If this line meand for 300A load, prepare a list of material required for this purpose. Assume a road crossing in this distribut^n line & take the span length is 80m.

23-01-2017

Calculat^n of no. of poles or supports.

Total line length = 1 km = 1000 m.

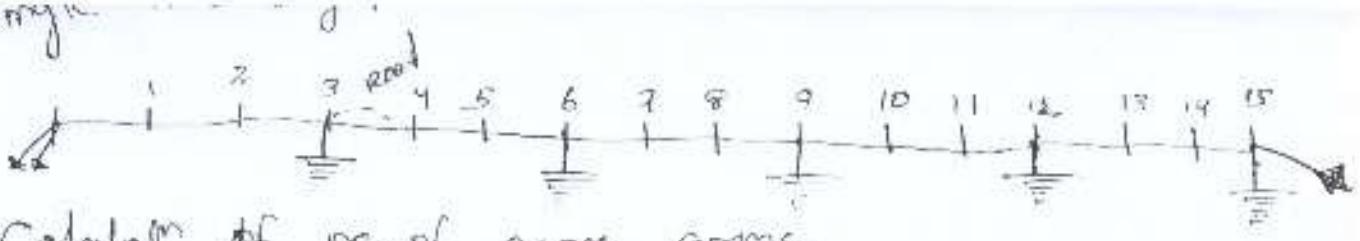
span length = 80 m

No. of span = $\frac{1000}{80} = 12.5 \simeq 13$ (say)

Hence No. of poles required = 13 + 1 = 14

Since Road crossing is there so one pole is required for this purpose

∴ Total no. of poles required = 14 + 1 = 15



Calculation of no. of cross arms.

Let us select angle iron cross arm at the tapping pole as well as dead end pole & rest of the intermediate pole let us select 'V' shape cross arm.

Hence no. of angle iron cross arm required = 2 no.

No. of V shape cross arm required = 13 no.

Calculation

For no. of insulators

According to the above line dig. strain insulators are used at the tapping pole as well as dead end pole and rest at the intermediate poles we use 11 kV pin type insulator.

Hence 11 kV strain (disc) insulator required $2 \times 3 = 6$ no.

no. of 11 kV pin insulators required is equal to $14 \times 3 = 42$ no.s

Calculation for length of overhead Conductor

Net span length = 3% total length + 2% for sag

$3(80 + 2\%) = 240 + 7.20 = 247.20$

3060

Considering 120 m extra for twisting and binding at the tapping zone as well as dead end zone & jumping zone

Gross Length = 3600 + 52 = 3652 m

Selection of over head Conductor

from the Conductor chart for the current rating of 305A at 40°C ACSR, 6/1 X 4.50, Cat type over head Conductor should be selected

Material table -

Sl No	description	specification	quantity
1.	supports	RCC 9m	15 no.
2	cross arms with its Fitting accessories	(a) V cross arm	13
		(b) angle iron cross arm 100mm x 50mm x 5mm x 1.5mm	2
3	Insulator with its Fitting accessories	(a) disc type 11 KV	6
		b) pin type 11 KV	42
4	over head conductor	ACSR 6/1 50 Cat type	3652 m
5	Binding wire at the rate 100 mm per insulator	Aluminium type (single core)	4.2 kg
6	stay with its fitting accessories	for H T line	3 set
7	Earthing with it's fitting accessories	H.T Line pipe earth	5 set
8	Angle iron cross arm to support the grade wire	100 mm x 50 mm x 7.5 mm x 1.5	2 no
9	guard wire	GI 7 types 14 SWG	45 meter
10	anti clamping wire at 8 meter per pole	GI 7 types	15 x 3 = 45 meter

11	Danger Plate	HT 11kV	15
12	Sundries to complete work	- -	as per required

Problem: Prepare and estimate for H.T line for a 24-01-201
a distance of 8 km using ACSR Conductors to transmit
for 800 kw load at 0.85 power factor in 3 phase
11 kV line draw the diagram of structure with cross
arms and insulators. Assume or other necessary da

Calculation the number of pole

Total line length = 8 km = 8000 m.

Assume that span/length = 100

∴ Number of span $\frac{8000}{100}$ = 80 number

Hence number of pole required or support.

= 80 + 1 = 81 number

Calculatn for no. of cross arms

Here 2 types of no. of cross arms are there.

V shap cross arms 80 & angle iron cross arms 1

Calculatn of insulator.

Here disc type insulator are required, 2*3 = 6 no.

Here pin type " " " 3*80 = 240 numbe

Conductor Calculatn for length of over head conductor.

Let span length = 3* 8000 + 24 = 24,480

Consider for twisting & binding aluminium single core wire are required quantity 12 meter

So tal span length = 24,480 + 12 = 24,492

Selection of over head Conductors

given that $P = 800\ kW$

$= 800 \times 10^3$

$V = 11\ kV$

$= 11 \times 10^3\ V$

we know that, $\cos\phi = 0.85$

$P = \sqrt{3}\, V I \cos\phi$

$I = \frac{P}{\sqrt{3} V \cos\phi}$

$= \frac{800 \times 10^3}{\sqrt{3} \times 11 \times 10^3 \times 0.85} = 49.39\ A$

∴ full load current 49.39.

∴ short ckt current $49.39 \times 2 = 98.78\ A$

from the Conductor table for current rating of 188 A of the ACSR

$\frac{6}{1} \times 2.11$ over head Conductor squirrel type should be selected

material table:

Sl No.	Description	specification	quantity
1	support	RCC pcc = 9	81
2	Cross arms with its fitting accessories	V-cross arm	79 number
		angle iron cross arms 100mm x 50mm x 5mm thick	80 numbers
3	Insulator with it's fitting accessories	Disc insulator 11 kV	6 no.
		pin type insulator 11 kV	240 no.
4	over head Conductor	ACSR 6/1-50 cat type	24,492
5	binding wire at the node point on insulator	Aluminium single core	240 kg
6	stay with its fitting accessories	for one pole	3 set
7	[illegible]	[illegible]	2 set

8	guide wire angle wire cross arm	100 mm x 50 mm x 7.5 mm x 1.5 mm	2 nos
9	Danger plate	for 11 KV	80 no.
10	Anticlimbing [illegible] pole	[illegible] type	2.4 kg.

CH-6

Substation

24-1-17

In general practics substat^n are different types depending on their nature of on duity, service operating voltage and it's design.

→ Depending on the design substat^n can be devided in to 2 types

① Indoor substat^n

② out door "

* Again the out door type substation are of 2 types

① pole mounting substat^n (which is feasible 125 KVA at same)

② Plinth " " (which is feasible 250 KVA at same)

Symbols of various types of apparatus used in substat^n

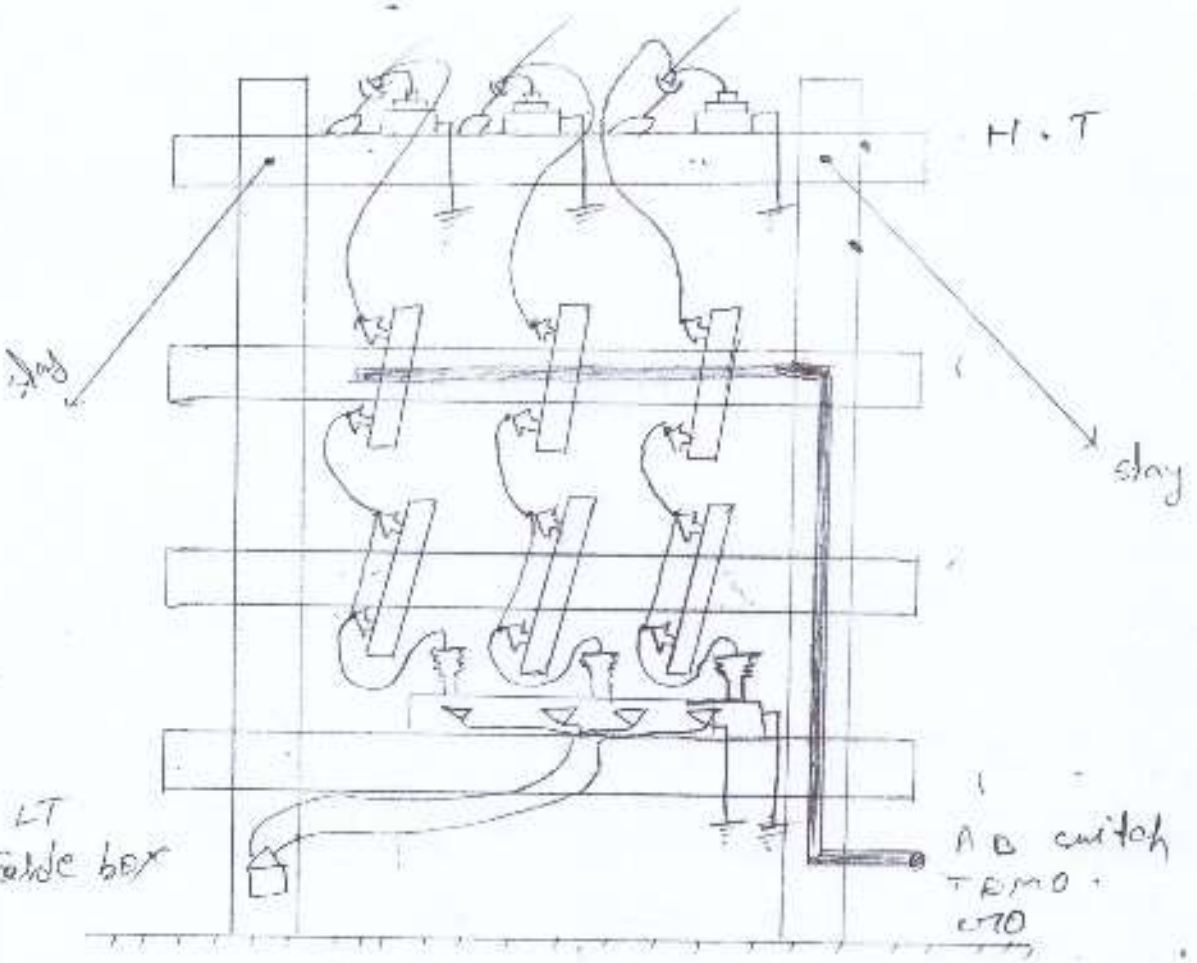
25-1-17

SL NO	Description	symbol
1	Earthing	
2	current T/F	
3	Potential T/F	
4	fuse	
5	Isolator	
6	CW breaker	
7	Bus bar	
8	Lightning arrester	

9) Tendom isolator

Draw a neat sketch of 125 KVA, 50 Hz, 11/0.44 KV substat and prepare list of material required for this purpose. assume ~~that~~ Taking the primary side ACSR conductor of squirrel type & the secondary cable makes as 4 core aluminium conductor/cable

Soln Neat sketch:-



Pole Mounting
Sub-station

Material table

31/01/2016

SL NO.	Description	specification	quantity
A.	for H.T Arrangement		
1	supports	Rail pole . 12 m	2 no.
2	cross arms with its fitting Ass.	MS type, 100mm x 50mm x 7.5mm x 2 m	2 no.
3	strain insul. with its fitting accessories	Disc type, 11 KV	3 no.
4	Lightning arrester with its fitting ass.	for 11 KV	3 no.
5	Earthing with fitting accessories	for 11 KV, pipe earthing	3 set
6	stay with fitting accessories	for H.T	2 set.
B.	for A B switch arrangement.		
7	cross arms with its fitting acces	MS type, 100mm x 50mm x 7.5mm x 2m	2 no.
8	Angle iron cross arms to fix the insul. with fitting accessories	MS type, 100mm x 50mm x 7.5mm x 0.75m	3 no.
9	pin insulator with fitting acc.	for 11 KV	6 no.
10	crang operated (CTO) switch, with 6 m long GI pipe along with its handle lowing arrangement	for 11 KV	1 Set
C.	for drop out arrangement		
11	cross arm with fitg acc.	MS type 100mm x 50mm x 7.5mm x 2 mm	2 no
12	Angle iron cross arm to fix the pin insul. with fitting acc.	MS type 100mm x 50mm x 7.5mm x 0.75m	3 no.

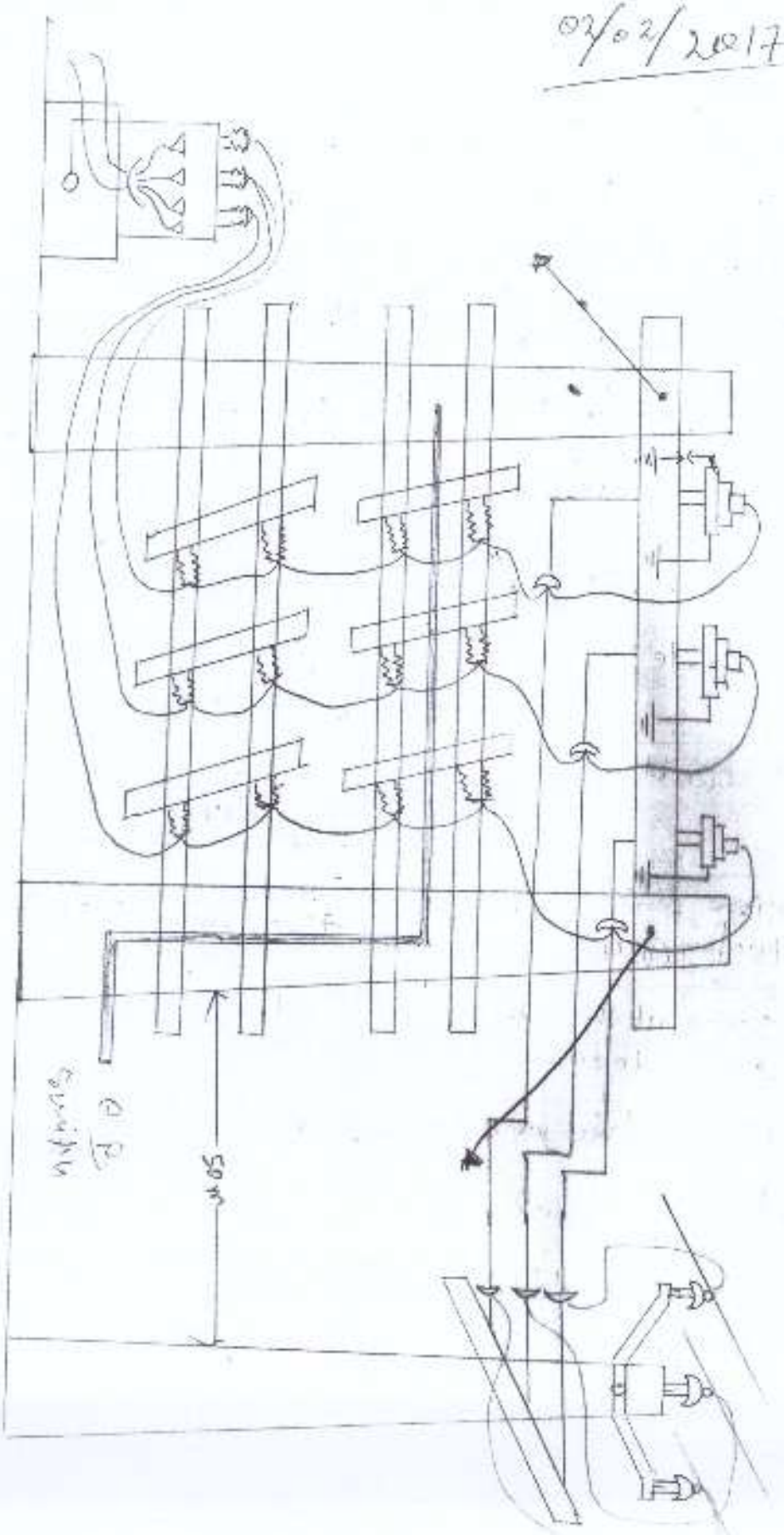
13	pin insulator with fitting accessories	for 11 KV	6 no.
14	splicing red or arcing red to be instand in pin type insulator to support the explosion fuse wire	for 11 KV	6 no.
15	Explosion type fuse wire to be instand in each phase	for 11/0.44 KV subst^{n}	1.5 m
D.	for T/F Installation		
16	cross arms with fitting access.	ms type, 100mm x 50mm x 6mm x 2 m	2 no.
17	angle iron cross arm to be used as base plate of T/F	ms type 100mm x 50mm x 6mm x 0.75 m	2 no.
18	channel cross arm to support the T/F	100 mm x 50mm x 7.5mm x 3m MS type	2 no
19	T/F Transformer	125 KVA, 11/0.44 KV 50 Hz, core type	1 no.
20	Earthing with fitting accessories	for 11 KV, pipe earthing	2 set
21	LT Cable	Aluminium type, 4 Core pvc insulated, 650 grade	5 m
22	LT Cable box	650 grade with rewirable type fuse units, out door type	1 Set
23	Jumper Conductor from HT to T/F bushing @ 4m per phase	ACSR, 6/4.72 mm Squirrel type	12 m
24	Binding wire at the rate 100 gm per pin insulator	single core, Aluminium type	1.2 kg.
25	Danger plate for HV	for 11 KV	2 no.
26	anticlimbing wire	GI type	6 m
27	sundries to complete the whole Job	—	As per actual
	sundries to complete the job		

Prepare the list of material required for single mounting substation of 11/0.44 KV, 50 Hz, 250 KVA T/F. The substation is 50 m away from the existing 11 KV line, uses DP structure for the safety equipment arrangement and draw the neat sketch

Soln

02/02/2017

Neat sketch



Calculation for Length of over head conductor :-

Net length = 3x (Declared + 2% for sag)

= 3x[50+1] = 153 m

Considering 6 m extra for jointing & binding at the tapping pole as well as dedend pole

∴ gross length = 153 + 6 = 159 m

Material table

Sl no	description	specification	quantity
A	For H.T. Arrangement		
1	supports	RCC, 9 m	2 no.
2	cross arms with fit. arrange for tapping pole	MS, 100mm x 50 mm x 7.5 mm x 1 m	1 no.
3	cross arms with fit. acces for supporting strain insul.	MS type 100mm x 50mm x 7.5mm x 2m	2 no
4	lightning arrestor	for 11 KV	3 no set
5	strain insulator with fitting accessories	Disc type, 11 K	6 no.
6	Earthing with fitting acc.	for 11 KV, Pipe earthi	3 set
7	stay with its fitting access	for HT Line.	3 set
8	over head conductor	ACSR, 6/1 x 4.50, cat type	154 m
B	AB switch arrangement		
9	Cross arms with fitng accs	MS type 100mm x 50mm x 1.5mm x 2m	2 no.
10	Angle iron cross arm to fix the pin insulators with fitng acce.	MS type, 100mm x 50mm x 7.5mm x 0.8m	3 no.
11	pin insulators with fitng acc.	for 11 KV	6 no
12	AB switch with G.I earthing pipe along with its fitng acc with handing locking arrang.	for 11 KV	1 set
C	for drop out arrangement.		
13	cross arms with fitg acc.	MS type, 100mm x 50mm x 7.5mm	2 no.
14	Angle iron cross arm to fix the Pin insula with fitng acc.	MS type, 100mm x 50mm x 7.5mm x 0.8m	3 no.
15	pin insulator with fitng	for 11 KV	6 no.

16	Spring ring reinforcing rod to be installed in pintype insel to support the explosion fuse wire	for 11 KV	6 no
17	Explosion type fuse wire	for 11 KV/440 V	1-5 m
	for T/F Installation		
18	Base plate for T/F installation	100 mm x 50 mm x 7.5 mm x 0.5 m	2 no
19	C.C. plinth for T/F installation		—
20	Transformer	250 KVA/ 11 KV/440, 50 Hz Core type	1 no.
21	Earthing with its fixing access	for 11 KV, pipe earthing	2 set.
22	Jumper Conductor at the rate 4m per phase from lightning arrester to T/F installation	ACSR, $\frac{6}{1}$ x 4.50 Coil type	12 ppy
23	Binding wire at the rate 1kg/gram per pin insulator	Aluminium type, single Core	1.2 kg
24	Anti climbing wire	G.I type	6 m.
25	Danger plate, 11 KV	11 KV	2 no.
26	LT Cable	4 Core, aluminium type with pvc insulater, 650 grade	6m
27	LT Cable box	650 grade with reneable type fuse unit, out door type	1 set
28	suntries to Complet the whole job	—	as per req

Short questions

03/02/2017

1.1) where & why GMO switch is used

Ans Gang operated switch is used in different substation as well as D.P structure of H.T lines

* It is used to make & brake the existing line

2) what is TPMO switch & where it is used

Ans TPMO switch means tripple pole manually operated switch.

* It is used in 3p line like, distribution substation to make & breake the supply lines

3) write the various types of out door substn?

Ans outdoor sub-statn are of two types

① pole mounting sub-statn

② plight " "

4) what is the maxm rating of T/F which is installed in pole mounting sub-statn

Ans generally upto 250 KVA rating T/F was used in installed pole mounting sub-statn

5) State any four types of substatn according to their ser

Ans According to service Catagories sub-statn will be Catagories into following groups

1) T/F substatn
2) switching substatn
3) Converting "
4) frequency changing substatn

Long Q: V.V. Imp

1. A 37 KW substatn is to be given to an agriculture fie and 415 V, 3-ϕ, 50Hz the connectn is to given from a 3-ϕ 11 overhead line. this is available at a distance of 10 m. The full load efficiency is 85% & PF=0.8, make a neat sketch showing how will you arrange the supply by a pole mounting sub-statn & estimate the quantity of material required it

2. Prepare the list of material with neat sketch for installatn of a plinth mounted 750KVA, 11KV/433V distributn. The 11 KV line is available 30m away from the proposed side

Overhead Installation :—
(LT distribution)

Q) A 1 km long overhead distribut^{n} line, 440 volt 50 Hz is to be erected along the straight road from the 100 kVA, 11/0.44 kV pole mounting sub-station. The line is to be laid with 6/3 SWG ACSR conductor on RCC poles of 9 m long. Prepare a list of material required. Assume the span length to be 50 m also draw a rough sketch of this line.

Soln

* Calculation the no. of poles

Lover head long 1 km = 1000 m

Suppose span length = 50 m

No. of span = 20

No. of pole req = 20+1 = 21 no.

single line dig.

Calculat^{n} of no. of cross arm angle iron type.

for pole 21 cross arms are 21 & lapping the line from the substat^{n} we have to be used one more cross arm

Hence

Total no. of cross arm required = 21+1 = 22 no.

* for insulator calculat^{n}

There are 3 insulators used for 3 ϕ & other one insulator is used for neutral conductor

Each intermediate poles has four no. of pin type insulator hence total no. of pin insulator required

10 × 4 = 40 no.

at the substation end and at the dedent pole shackle insulator are to be used.

Hence total no. of shackle are required = 2+4+8

* Calculation of length of over head conductor.

total length of conductor = n(declared length + 2 % Sag)

= 4(1000+20) = 4 × 1020 = 4080 m.

* Consider 10 m extra for twisting & binding, gross length = 4080+10 = 4090 m

* We can't use earth wire because it Practically not used now a days 05/04/2017

* Selection of over head conductor & LT cables

As per the given data for overhead conductor ACSR, 6/1×3.00, & for LT Cable we choose 3.5 4 core, 650 grade PVC insulated cable.

* material table

Sl. No	Description	specification	quantity
1	pole	RCC, 9 m	21 no.
2	cross arms with fitng access.	MS, 150mm×75mm×5mm×1.5m	22 no.
3	Insulator with fitng accessories	a) Pin insulator, 440 V	80 no.
		b) Shackle insulator	08 no.
4	overhead conductor	$\frac{6}{1}$ × 3.00 mm, ACSR.	4090 m
5	Binding wire at the rate of 100 gr per insulator	Aluminium type (single core)	8 kg.
6	Stay with fitng accessories	for L.T Line	2 set
7	Earthing with fitng accessories	Pipe earthing, 440 volt	5 set
8	Anticlimbing wire at the rate 3 m per pole	CI type	63 m
9	Danger plate	For 440 V/0.44 kV	21 no.
10	LT Cable	3.5 4 core 650 grade PVC insulated	10 m
11	Sundries to complete the whole job		As per required

Prepare an estimate for a distribut" line with street lighting is to be distributed from a 11 kV, 440 V over a distance of 1 km. Calculate the size of ACSR Conductor to be used also prepare the list of material required for it and sketch the path of distribut" line

10/02/2017

Ans:

Calculat" for no. of support:

To tal Length 1 km = 1000 m.

Assume span length = 50 m

∴ no. of span = $\frac{1000}{50} = 20$

∴ Supports 20 + 1 = 21

Calculation for cross arm.

Here all angle iron Cross iron reqd

for 21 pole 21 no. Cross are required

for tapping 1 cross arm required 21+1 = 22

Calculat" for insulator.

Here two type insulator are required

① pin type insulator - 100 no.

② shackle insulator - 10 no.

* Here street light Conductor is required so we use 3 phase & 5 wire system is occured.

* we use intermideate pole, pin insulator

over head Conductor length calculat"

5 * (1000 + 20) = 5100 m

for Binding the wire I thing 20 m required extra

5100 + 20 = 5120 m

No of street light is row ≠ 1 LED Street light

For 21 poles 21 street light is required 21 LED t

select" for overhead conductor :-

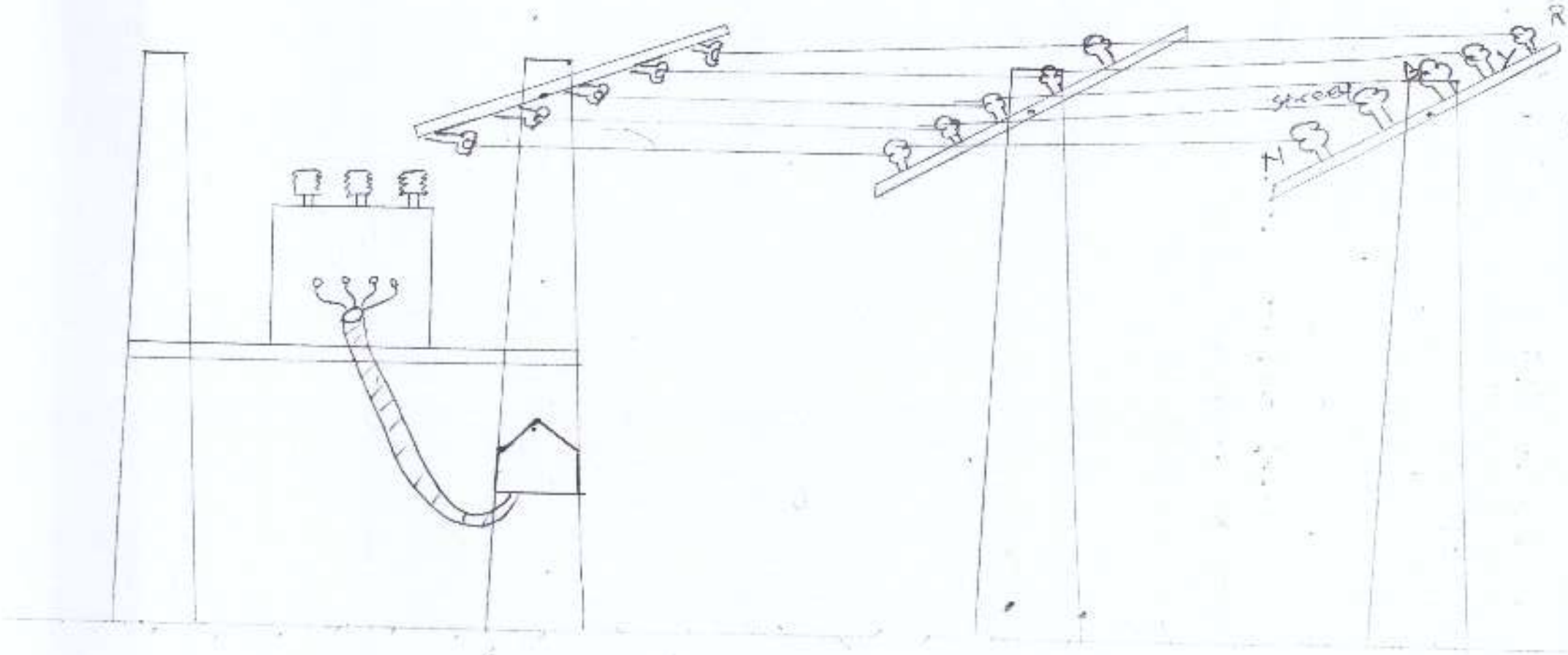
Given = P = 100 kVA = 100×10^3 VA, V = 440V, Cos φ = 0.8

We know $P = \sqrt{3} V_L I_L \Rightarrow I_L = \frac{P}{\sqrt{3} V_L} = \frac{100 \times 10^3}{\sqrt{3} \times 440} = 131.2$ A

short ckt current = $I_{sc} = 2 \times 131.2 = 262.4$ A.

For 262.4A we selected conductor from the conductor ta Raccoon ACSR 6/1 x 4.09 which max^m Current carrying capacity is 270 A.

Sl no	Description	Specification	Quantity
1	Pole	9m RCC	21
2	Cross arm with fitting accessories	Angular iron 50mm x 50mm x 5mm	21
3	overhead Conductor	ACSR 6/1 x 4.09 mm	5120 m
4	Insulators with fitg accessories	Pin type insulator	100 no.
		Shackle type	10 no.
5	Binding wire per insulator wise	Aluminum (single core)	10 kg.
6	stay with fitg accessories	for LT line	2 set
7	Earth with fitg accessories	pipe earthing for L.T	1 set
8	Anticlimbing wire Procure 2 m	GI type	63 m
9	Danger plate	for 440 V	21
10	Bird guard	10 mm x 12.5mm x 15 mm	110 no.
11	street light with fitg acc.	LED, 90, 230 V	21 nos
12	Flexible wire at the rate of 3m per street light	6A, 230V, copper wire	63 m
13	L.T Cable	3Ø 440 V, 5	10 m
14	Suntriech to Complet the whole job.	- - -	As per requirement


street

Q) An over head distribut^{n} line of 440V, 3-ϕ 50 H_z is 13-02-17
to be erected along a straight road. The length of the line is 300
and the end supports are terminal structure. Its span bet^{n} t
adjacent pole is 50 m. make a neat sketch of the terminal p
showing disposit^{n} of the conductors.

The Conductors of the over head line are as follow
i) phase wire - Hard drawn hair Copper Conductor of number ax
ii) neutral & street wire - Hard drawn hair Cu Conductor of numbers
iii) earth wire — GI S (galvanised steel) wire of no. 8 swg.
Prepare the list of material required for this process

* Calculat^{n} for no. of supports-

Total Length of the distribut^{n} line = 300 m
span length = 50 m.

No. of poles = $\frac{300}{50}$ = 6 no.

Now Total span 6+1 = 7.

Calculat^{n} no. of cross arms :-

since the no. of poles is 7 so 8 cross arms requi

Calculat^{n} for insulator.

According to the rule we use shackle insulator at the tapping pole deadend pole as well as an intermediate pole.

5 insulators are used for 3 ϕ & other two insulator are used for nutral & street light.

pin insulators are used for earth conductor

Hence,

Total no. of shackle insulator are required.

8×5 = 40 no.

Total no. of pin insulator required 8×1 = 8 no.

Calculatⁿ of length over head Conductor.

i) Calculatⁿ for length of phase wire (4 SWG):-

$3 \times (300 + 6) = 918$ m

Take 5m for binding = 923 m

ii) Calculatⁿ for neutral & street wire (8 SWG)

$2 \times (300 + 6) = 612$ m

Take 5m for twisting & binding = 612 + 5 = 617.

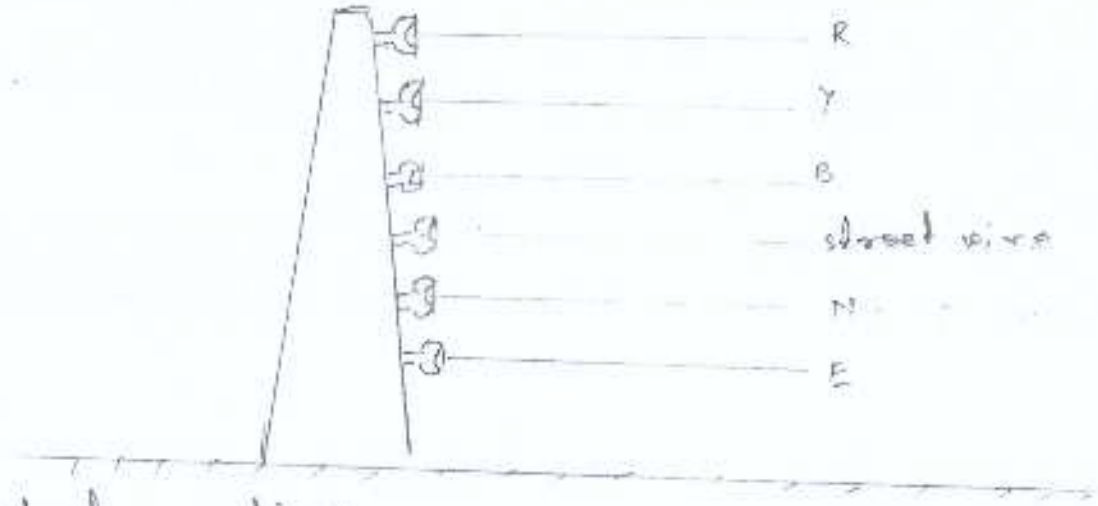
iii) Calculatⁿ for Earth wire (G.I. type 8 SWG):-

$1 \times (300 + 6) = 306$ m.

Take 5m for binding = 306 + 5 = 311 m.

M-Table:

S.No	Description	Specificatⁿ	Quantity
1	Supports	RCC, 9m	7 no.
2	Cross arms with fitting accessories	50mm×25mm×3.5mm×1.5m MS	7 no.
3	Insulator with fitting accessories	Shackle type Pin type	40 no. 8 no.
4	Over head conductor for phase wire	Copper conductor 4 SWG	928 m
5	Over head conductor for neutral & street light wire	Copper conductor 8 SWG	617 m
6	Over head conductor for earth wire	G.I. type, 8 SWG	311 m
7	Binding wire at the rate 100g	Copper type single core	3 kg
8	Stay with it's fitting acc.	For L.T line	2 set
9	Earthing with fitting accessories	For L.T line pipe earthing	5 set
10	Anticlimbing wire 2m per pole	G.I. type	21 m
11	Danger plate	For 440 V	7 no.
12	Street light with its fitting accessories	LED 9W, 230 V	7 set
13	Flexible wire at the rate 3m per street light	6A, 230V, copper cond.	21 m
14	Switches for street light	6A, 230V, 1-ϕ,	7 NO.
15	L.T cable	3-ϕ 440V, 4 core PVC insulated	10 m.
16	Sundries to complete the [illegible]		As per req.



short question:

1 (a) which type of insulator is used in L.T line.

Ans Pin & shackle.

2 (b) what is the permissible angle for the stay installatn of L.T line.

Ans $>30°$ & $<45°$

3 (c) what is the specificatn of stay wire which is used in stay installatn

Ans $\frac{7}{10}$ SWG CI.I wire

(4) what is the ground clearance of L.T distributn line running the street & cross the street?

Ans The ground clearance of the L.T distributn along the street is 5.5 m & across the street is 5.8 m.

(5) where & why stay installatn is required?

Ans The stay installatn is required at the tapping pole, dedend & and deviatn poles to maintain the unbalanced mechanical forces of a particular supports of over head line.

(6) what is the length to be burried in the ground of a pole in the normal soil?

Ans $\frac{1}{6}$.

(7) why the core of service cable service cable is must be selected as Aluminium

Ans The core of service cable is selected as aluminium because the over head Conductor of the service pole is also aluminium Hence to avoide interrupt^n of energy supply.

CH-5

over Head service Connection

14-02-17

1-ø service Connectⁿ

The over head line or cable or under ground cable connecting betⁿ the supplier line & Consumers premises is called as service line or service connectⁿ.

The service Connectⁿ may be two types depending on the phase that are.

i) 1-ø service Connection
ii) 3-ø service Connection

Depending on the field situation it may be of two types.

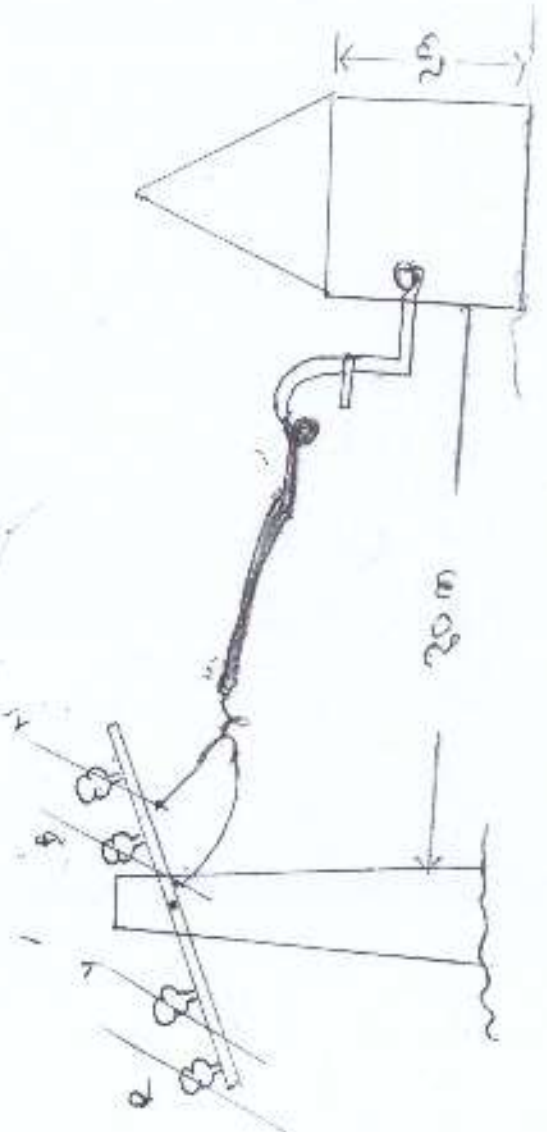
1) over head service Connectⁿ
2) under ground service Connection

Important points to be Remember:-

* If the service pole is situated more than 45 m from the Consumer premises then over head line may be used the pole bracelets.
* If Consumer premises more than 30 m from the service pole then one intermidiate pole may be used.
* If the Consumer load doesn't exceeds to 1 kw then seven hard drawn copper Conductor may be used.
* If the Consumer load doesn't exceeds to 2.5 kw then 8 swg copper conductor or 13.9 mm² A.A.C Conductor may be used.
* If the Consumer load doesn't exceeds to 12 kw then 6 ~~swg~~ swg copper or 19.4 mm² A.A.C Conductors are used.

Q) Prepare the list of material required for providing a service Connectn to a 1-ϕ stained buildi at 240 V 1-ϕ, 50 Hz having light & fan load of 5 kW. The supply is to be given from an over head line 20 away from the building & also draw the rough sketch.

26/02/20



Given - $V = 240\ V$,

$P = 5\ kW = 5 \times 10^3 = 5000\ W$

$F = 50\ Hz$

Calculat^n of short ckt current :-

Given -

$P = 5\ kW = 5000\ W$, $f = 50\ Hz$

$V = 240$

$\cos\phi = 0.8$

We know that,

$P = VI \cos\phi$

$I_L = \frac{P}{V \cos\phi} = \frac{5000}{240 \times 0.8} = 26.04\ A$

∴ Short ckt current

$I_{sc} = 1.5 \times I_{FL} = 1.5 \times 26.04 = 39.06\ A$

Select^n of Service Cable

Though out I_{sc} is 39.06 A but from the Conductor table it is observe that for the current rating of 43 A a PVC insulated two core aluminium Conductor of 7/1.70 mm dia, 16.0 mm^2, 240 V is to be selected

Calculat^n for length of service cable.

Net length = declared length + 3% of sag + 1 mt Coil at the pole + 0.5 mt Coil at the gi pipe + 1.5 mt from the Coil to overhead Conductor + 1 mt curvature + 3 mt along the pipe + 0.3 mt for wall thickness + 0.3 mt for meter clearance = 28.2 m

Considering 10% extra for bending & cutting

∴ Cross length = $28.2 + 2.8 = 31$ m

$= 28.2 + 2.82 = 31.02$ m

Calculation for Length of GI wire 14/02/17

Net length = declared length + Sag 3m + 1m at the pole
+0.5m at the GI pipe = 20 + 0.6 + 1 + 0.5 = 22.1 m

Calculation for Length of aluminium clip.

Let us assume Length of each aluminium clip is equal to
10 cm

Spacing of the clip is

Spacing of the clip is 20 cm.

∴ No. of aluminium clips required = $\frac{20\text{ m}}{20\text{ cm}} = \frac{2000}{20} = 100$ nos

∴ Length of the aluminium clip $100 \times 10 = 1000$ cm
$= 10$ m

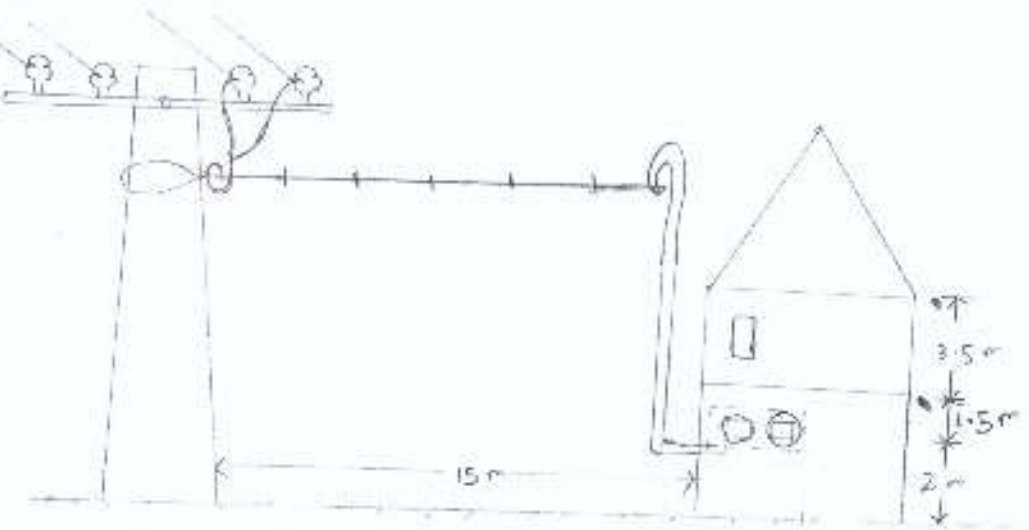
Material Table

Sl no	Description	Specification	Quantity
1	over head cable	$\frac{7}{1.40}$ mm dia, twin core aluminium type, 16.0 mm² 240 volt	31.02 m
2	support wire	14 SWG, GI type	22.1 m
3	Aluminium clip to hold the cable with the support wire	Aluminium type, 38 mm dia	10 m
4	service pipe	GI type, 3m height, 1-Ø	1 no.
5	clamps to support the GI pipe from the wall with fitng-accessories	GI type with appropriate diameter	3 nos
6	cruttics	wooden type	6 no.
7	Energy meter	240 V, 50 Hz, 1-Ø, digital type	1 no
8	Board to fix the energy meter with fitng accessori	45×60 cm with its cover	1 set
9	kit kat fuse	1-Ø, 240 V, 32 A	1 set.
10	sundries to complete the whole job		as per requ.

Q) Prepare & estimate the quantity of material required for providing a service connection to double storey building with a load of 5.5 kW at 240 V, 50 Hz, seperate meters are to be provided for two floors and the distance bet" the pole & building is 15 m

18/02/2017

Sketch



Calculation of short cut current

$$P = VI \cos\phi$$

where $P = 5.5\ kW = 5.5 \times 10^3\ W$

$V = 240\ V$

Assume $F = 50\ Hz$

$\cos\phi = 0.8$

$$I = \frac{5.5 \times 10^3}{240 \times 0.8} = 28.64\ A$$

∴ short cut current $1.5 \times 28.64 = 42.96\ A$

Selection of service Cable.

From Conductor chart we selected, PVC insulated twin core 7/1.70mm, 43A, 16.0 mm² range cable, for 42.96 ampere

Calculation for length of Cable.

Net length = decrade length + 3m for sage + 1m Coil at the pole + 1m Coil at the gi pipe + 1.5m from Coil to the over head conductor + 1m for Corvature + 3m along of the gi pipe + 0.3m for wall thickness + 0.3m for meter clearance + 1m for second meter

= 24.55, m. Considering 10% extra for twisting & binding

Cross length of conductor = 24.55 + 2.455 = 27.005 m

Calculation for service wire length as support wire.

Declared length + 3% of sag + 1m at pole + 0.5 m

twisting × 16.95 m

Cliping of the pole

Calculation for length of aluminium clip.

20th Feb-17

Spacing between the clamp = 20 cm

∴ No of clip required = $\frac{1500}{20\text{ cm}}$ = 75 no.

∴ Length of GI clip = 75 × 10 = 75 cm = 7.5 m

Material details

Sl no	Description	specification	quantity
1	over head cable	twin core, $\frac{7}{1.70}$ mm, 43A 10.0 mm^2, 240 V	27 m
2	support wire	14 SWG GI pipe	16.95 m
3	Aluminium clip to hold the cable	38 mm dia.	1.5 m
4	service pipe	GI type 3m 1-Φ	2 no
5	clamp to support the GI pipe with fing accessories	appropreate diameter GI type.	3 set
6	Gutties	wooden type	6 no.
7	Energy meter	50 Hz, 240V, 1-Φ, digital type	2 no.
8	Board with fitng accessories to fixed the meter	45×60 cm with it's cover	2 set
9	Kit kat fuse	1-Φ, 240 V, 32 A	2 set
10	sundries to complet whole job	. . .	as per required.

Short questions :-

1) which type of cable is used for service Connection?

Ans Generally for service Connectn we used pvc insulate wheather proffe aluminium cable

2) Differenciate various types of service Connectn?

Ans Generally service Connectn are of two types depending on the field situatn that are

1- overhead service Connectn

2- underground

3) what is the size of aluminium clip used to hold the cable with the support wire in case of service Connectn?

Ans The minium size of aluminium clips used to hold the cable with GI wire is 38 mm

4) why the GI pipe is bend twice in the upper end with opening facing downward for carring the cable in service Connectn?

Ans The GI pipe is used for carring the cable in service Connectn has bein made bend twice to prevent the entry rain water in to the pipe

Long questions

1) Prepare and estimate the materials required for installatn of over head service Connectn to residential building having a 3-ϕ load of 1.3 kw standing a distance of 24 m along the road from the nearest Pole of supplier. Also draw a neat sketch.

2) Estimate the quantity of materials required for providing a service Connectn to a double stayer building with a load of 4 Kw at 240 V, 50 Hz, seperate meters are to be provided for two floors. The distance betn the pole and building is 12 m and the distance betn service bracket & service board 10 m

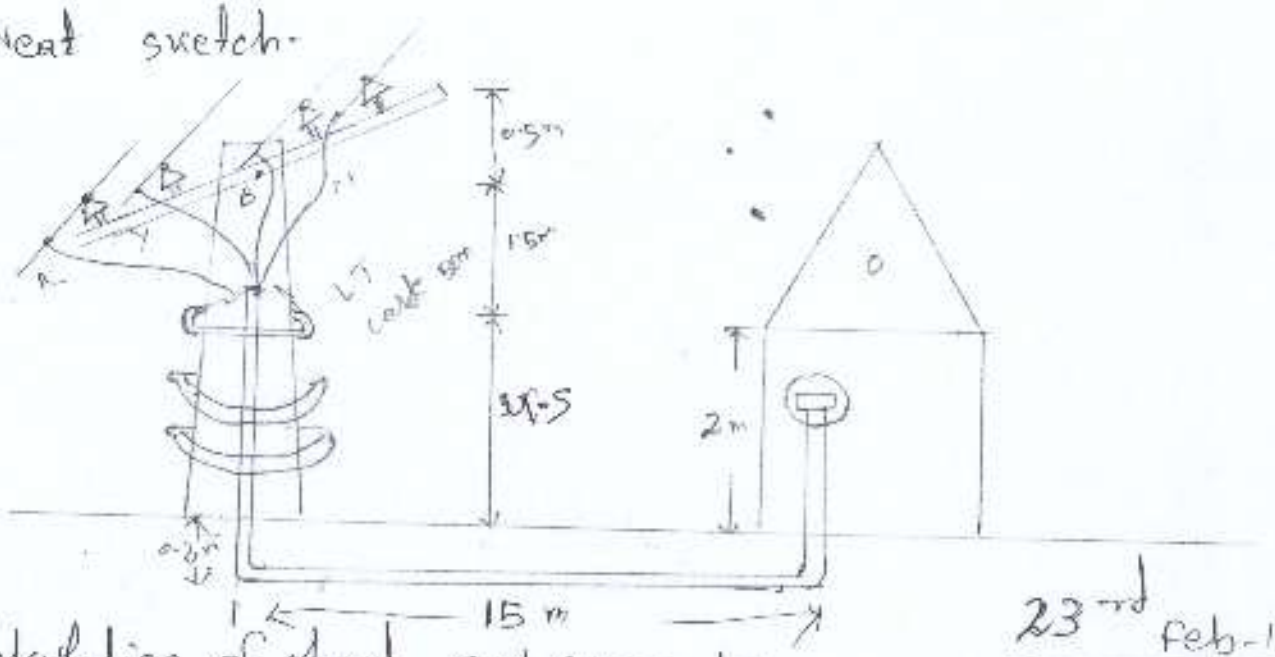
OH-5

22 H Feb

3-ϕ service Connection

Problem: A farmer requires to connect a 37 kW, 440 V, 50 Hz 3-ϕ motor from a 3-ϕ, 4-wire overhead line. The distance of service line from the farmer structure having the motor is 15 m. The motor has an efficiency is 85% & PF of 0.8. Estimate the quantity of materials required for this purpose and also draw the neat sketch.

Neat sketch:



23rd Feb-17

Calculation of short ckt current :→

Given that

output, $P_o = 37$ kW

$V = 440$ V

$F = 50$ Hz

$\cos\phi = 0.8$

$\eta = 85\% = 0.85$

we know that

$$\eta = \frac{P_o}{P_i} \Rightarrow P_i = P_o/\eta = \frac{37}{0.85} = 43.52 \text{ kW}$$

43.52×10^3 W

Again:-

$$P_i = \sqrt{3}\, V_L I_L \cos\phi$$

$$\Rightarrow I_L = \frac{P_i}{\sqrt{3}\, V_L \cos\phi} = \frac{43.52 \times 10^3}{\sqrt{3} \times 440 \times 0.8} = 71.38 \text{ A}$$

Short ckt current $I_{sc} = 2 \times I_{FL}$

Selectn for Service Cable = $2 \times 71.38 = 142.76$ A.

From the Conductor table it observe that for the current rating of 142.76 A a alluminium Conductor paper insulated Lead Cover 1100 volt, 50mm² Wire armor under ground cable should be selected in which the maxm current carrying capacity is 158 A.

Calculation for length of PVC Pipe.

Net length = declared length + length from L.T box of underground + vertical meter clearance

$= 15 + (4.5 + 0.2) + (2 + 0.2) = 21.9 \text{ m} \simeq 22 \text{m}$

Calculatn for length of under ground cable:-

Net Length = vertical distance for overhead conductor to under ground + declared length + meter clearance

$= 4.5 + 1.5 + 0.5 + 15 + 2 + 0.2 = 23.9 \simeq 24 \text{ m}$

Consider 10 % extra for twisting & cutting

$24 + 2.4 = 26.4 \text{ m}$

Calculatn for no of GI-T clamp:-

Assuming the distance betn 2 clamp to be 1 m.

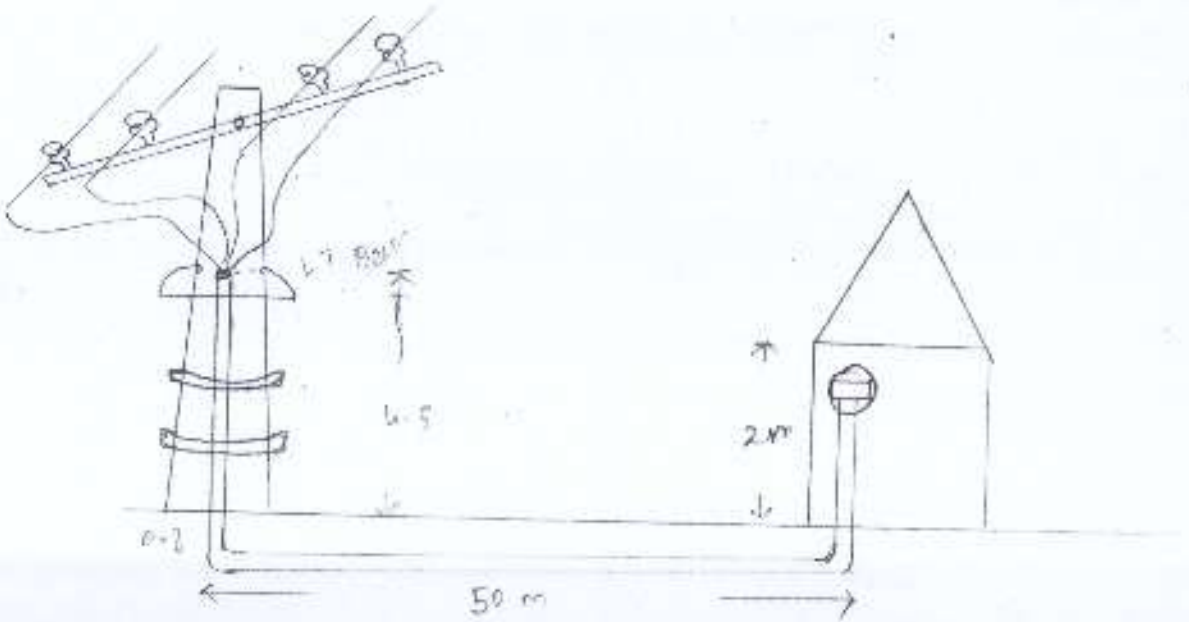
As per dig. we need 6 no. of clamp with its fitng accessories

Material table

Sl No	Description	Specification	Quantity
1	underground cable	aluminium conductor paper insulated, 50 mm^2 4 core armanded cable	26.4 m
2	LT Cable box with it's fitng acc.	CNI outdoor type	1 no.
3	Clamp to hold the cable with pole	CNI type. appropriate diam.	6 no
4	PVC pipe for underground system	PVC appropriate diameter	22 m
5	Energy meter	3ϕ, 440 V, 50 Hz, digital	1 no.
6	Board to fixed energy meter with fitng accessories	45 x 60 cm with its cover	1 no.
7	ICTPN switch with fuse unit (3 no pole triple pole with neutral link	200 A, 440 V, 50 Hz	1 set
8	Sundries to complete the whole job		As per requ.

8) A farmer house wants 3ϕ, 4 wire power connection to his home motor which is situated at a distance of 50 m. from the nearest service pole. make a neat sketch showing the arrangement of supply & estimate the quantity of material required. Assuming the efficiency of motor is 85 %.

1st march-17



Calculation for short cut current

P = 7460 W , 1 HP = 746 W

V = 440 V

η = 85 %, 0.85

F = 50 Hz

Cos θ = 0.8

$$\eta = \frac{P_o}{P_i} = P_i = \frac{7460}{0.85} = 8776 \text{ W}$$

$P_i = \sqrt{3}\, I_L V_L \cos\theta$

$$I_L = \frac{8776}{\sqrt{3} \times 440 \times 0.8} = 14.39 \text{ A}.$$

Short cut current, $I_s = 2 \times 14.39 = 28.78$ A

Selection for service conductor.

From conductor table, we select for the currating of 28.78 A, aluminium conductor, paper insulated lead covered 1100 V, 6 mm², 4 core armoured underground cable should be selected in which the max^m current rating is 48 A.

Calculation for length of PVC pipe.

Net length = declared length + length of the box of underground + vertical clearance = 50 + 4.5 + 0.2 + 0.2 + 2

= 56.9 ≅ 57 m

Calculation for underground service wire

Net length = declared length + vertical length of ~~overground~~ of the overhead conductor to the underground + 0.5

where Clearance = 45 + 4.5 + 0.2 + 2 + 0.2 = 58.9 ≅ 59 m

for twisting we need 10 % extra

~~Correction~~ Gross length = 64.9 ≅ 65 m

Calculation for CTs clamps.

Assume the distance bet^n 2 clamps to be 1m As per dig we need 6 no. of clamps.

Table:

Sl No	Description	specification	quantity
1	under ground cable	aluminium conductor paper insulated 1100V, 6mm^2 4 core armoured type	65 m
2	LT cable box with ftrg accs	CTI out door type	1 no.
3	Clamp to hold the cable with fixe	CRI type appropriate diam	6 nos.
4	PVC pipe for underground syste	PVC type appropriate diameter	57 m
5	Energy meter	3-f, 440 V, 50 Hz digital type	1 no.
6	Board to fit the meter with trgs	45 x 60 cm its covers	1 no.
7	3 CT PH switch with fuse unit	440 V, 50 Hz	1 set
8	sundridge to Complt the job.		As per required

Electrical Installation (Concealed wiring)

Wiring system :-

It is defined as a network of wires connecting with various electrical loads from supplier meter boards through the safety & controlling devices.

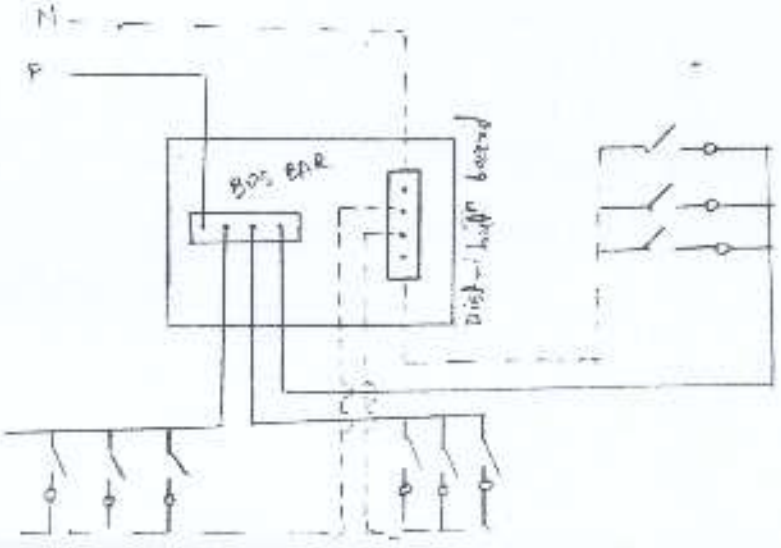
Various system adopted for distribution of Electrical Energy.

In our country basically following two types of system's are adopted for distributing energy.

1. Distribution board system
2. Tree system.

3rd marks

1- Distribution board system.



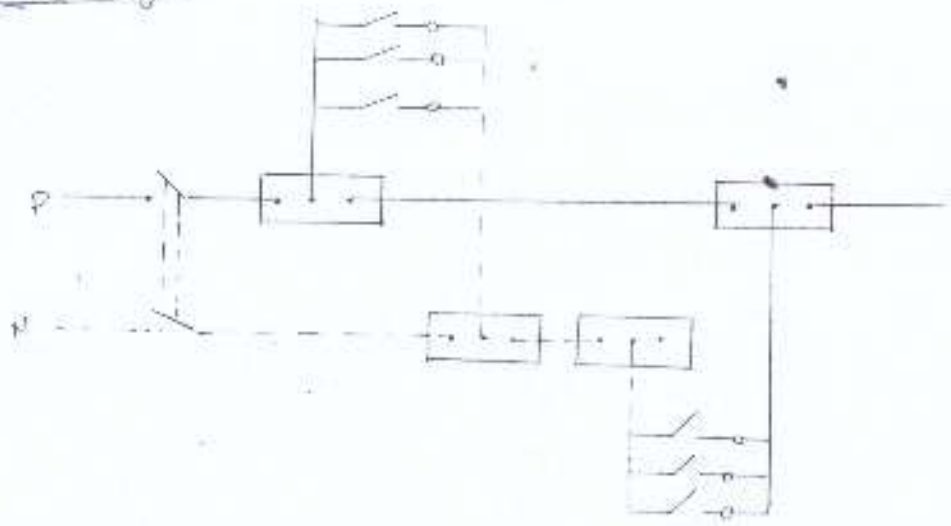
This is one of widly used energy distribut" system in our country;

* This system has an iron clad on each ckt, one ckt out must have to be installed on the iron clad or board, So this board is some time called as fuse board or distribut" board.

* For every ckt phase & nutral wires must be taken from the respectives bus bars which is also fitted on the distribut" bo

* In this system each ckt must contain 100 to 200 watts

2. Tree system



* This system is not used frequently due to the following regions -

1. The extrim of last end load can't get the declending voltage due to resistance drop

2. The fuses are scattered which causes more expensive

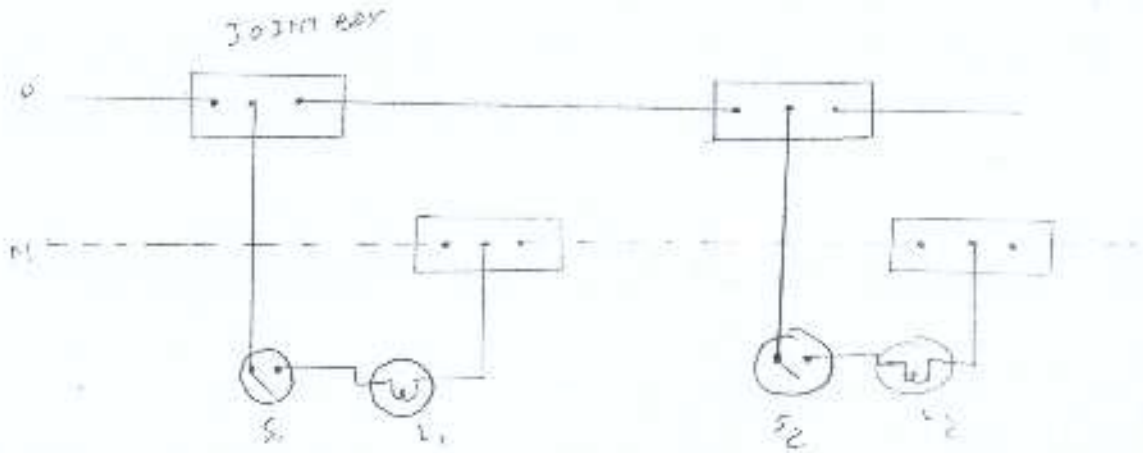
3. For each ckt phase & nutral wires are drawn from the Connectors and nutral links as shown in above figure.

Methods of wiring -

Generally we have two types of methods for wiring that are

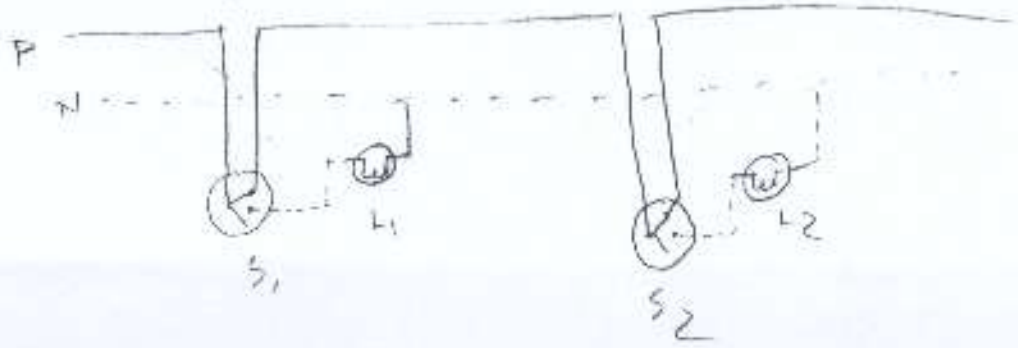
1. Joint box system
2. Loopin system

1. Joint box system



* It is also known as Tee system
* In this system phase & neutral wires are connected with the joint box as shown in above figure
* Each electrical load phase wire is to be taken from the joint box through the switch & neutral wires from the joint box directly to the load by this way for each number of electrical loads are connected
* Joint boxes are used accordingly switches are used
* This method is a costlyer method because large number of joint box is used
hence this method is not adopted now a days.

2. Loop in system



In this system phase wire is to controlled by the switch and the same phase is to be connected to a particular load as shown in above figure.

* The neutral wire is directly connected to the each load by not through the switch

These system of wiring is widly used now a days

Wiring materials and accessories :-

a) Conductor

Generally conductor is a medium through which electric current can easily flow.

following are the important materials that are used for the conductor

1. Copper

* Copper material is used as a best material for conductor
* It's conductivity compairatively very high
* At 20°C of temp the resistivity of copper is 1.796×10^{-8} Ω m.
* The specific weight of copper is 8900 kg/m³
* It has high resistance to corrosion, oxydation & pitting

2. Aluminium

* In the electrical field basically in transmission, distribution, utilization it dominates the copper material
* It is the next immideate choice of material for the conductor
* It's resistivity is 2.8×10^{-8} Ω m
* This material is less cost and used in different cables as well as over head bair conductors
* It is also affected by oxydation

3. Silver (Ag)

* Even though this material has high conductivity as compare to copper but due to its heavy cost it is not used frequently.

b) Wires & Cables :-

The term wire is very much familiar in wiring system which meaning is a strip of bair conductor with negligible thickness.

* Similarly the term cable is also a popular word used in wiring system. It's meaning is a wire covered with the insulating material.

* A cable may be single core, double core or more core.

c) Types of insulating material :-

following are the important insulating material that are used in various electrical fields

1. Rubber
2. VIR (vorganized indian rubber)
3. Impregnated paper
4. PVC (Polyvinaly chloride)
5. Silk & Cotton

d) properties of Insulating material :-

The purpose of insulating materials used in cable or covered with the bair conductor is to prevent linkage current from the conductor or core.

following's are the important properties of insulating material —

1- High resistivity

2. High dielectric strength
3. High flexibility
4. Not flamable
5. High resistance to moisture, acids & alkalic.

* Cables of withstanding high temp
* Cables of withstanding high withstanding voltage

8th mar - 17

e) Mechanical protector:

Generally a cable should be design in such a manner that it can help mechanical stability.

* Usually in power cables to protect against mechanical injury two layer of still steep are used or now a days aluminum sheathing is introduc

f) Types of Cable used in Internal wiring

8th mar - 17

* Generally cables are catagories based on Conductor used
1- number of Cores
2- Amount of voltage supply
3. Types of insulation

Hence following's are the importantes cables used in internal wiring

1) VIR Insulating Cable (240 v/440 v & 650 v/1100 v)
2) TRS or CTS Cables (240 v, 440 v & 650 v, 1100 v)
(Tough rubber sheath) (Cabe tyre sheath)
3) Lead sheathed cable (240 v/440 v)
4) PVC cable (240 v / 440 v & 650 v / 1100 v)

5) wheather proof cable (240V/440V & 650V/1100V)

6) XLPE cable - such cable's are build of the insulation's are made up of Polymers. Polymers are the substances which consisting of long macro molecule. Such cable's are used in high voltage supply purpose

7) General specificat^n of cables

while purchasing or estimating the cable must emphasize

1 size of cable
2 types of conductor used (aluminium or copper
3 number of core (1 core, double core, three core etc
4 voltage grade (240/440V or 650V/1100V etc)

4) main switch & distribut^n core.

Acoording to IE rule 50 a suitable linked switch has to be provided immediately after to the meter board

following are the important specificat^n of mainswitch according to there applicatio^n.

1) 240V, 16A, TPIC switch for two wire DC ckt or 1-p AC.

2) ~~500V DPIC (double pole iron clad)~~ 440V 63A, 32A or 62A or 100A TPIC switch for 3-p DC ckt

3) 440V, 32A or 64A or 100A TPIC switch with neutral Links for 3-p AC ckt

Similarly for distribut" boards we have main specificat" has 2 ways, 3 ways, 4 ways etc.

i) Conduit

Generally in house hold wiring we use following type of Conduit's

1) Light gauge steel Conduit
2) Heavy gauge steel Conduit
3) Flexible Conduit
4) pvc Conduit

J) Conduit accessories and fittings :-

15th march-17

In the wiring system basically for Conduit wiring following accessories are frequently used.

1. Bend Conduit
2. Bushing or Coupler
3. Clips & Saddles
4. Conduit boxes (2-way, 3-way etc)

K. Lighting accessories & Fittings :-

* For lighting purpose we used following accessories & Fittings.

1. switches :-

Various types of switches are used in house hold & wiring that are-

1. 1-way switch, 2. 2-way switch, 3. 2-way centre of switch

4. Double pole main switch
5. push button switch
6. Table lamp switch
7. Dumble or surface switch

ii. Ceiling rose switch

Ceiling rose may be of 2 plates or three plates,

* Three plate ceiling rose is basically used in Ceiling fan

iii. Socket outlet

Depending on the field applicat^n a socket may be 2-Pin, 3-Pin, 5-Pin & 6pin of 250 V, 6A, 16A, 32A etc

iv. Lamp holder

We have following types of Lamp holder

1. Batten holder
2. Pendante holder
3. angle holder
4. slanting holder
5. Bracket holder
6. Water tright bracket holder
7. miniature lamp holder

for the above holder the specificat^n may be 5A, 250V. Bayelight holder of any lamp

1. Fuse :

Fuse is defined as a small safety device which is used for interrupting an electrical cut under excessive of current or short cut current

(i) Element of material used for the fuse :

Generally tean, lead, silver, Copper, Zinc, aluminium & alloy of lead & tean are used as the material's for fuses. But commonly an alloy of lead & tean with a ~~proper~~ of Conbine of 37% & 63% is used ~~for~~ in fuse for the small current rating Purpose (up to 16 A).

* Beyond 16 A or excesseve of current normally we uses Copper as the fuse material even though the Cost of silver is very high still than for heavy current (more than 100 A) this material is used for fuse

(ii) Types of fuse :

Depending on the use of fuses it classified in to following types

(1) supply main fuse → This fuse is provided by the supplier & engencies

* It is fixed just after the service meter board

(2) Consumer main fuse → This fused is placed just after the Consumers main switch.

* The Current of this fuse is Compairatively < that of the supply main fuse.

(ii) Sub ckt fuse :-

As we know the total wiring system is divided in to no. of short ckt so for each sub ckt we connect or fix a fuse which is called as subckt fuse

(iii) Point fuse :-

For good quality of wiring the individual load point such as- Lamp, Fan, washing m/c etc containing fuses called as point fuse.

(iii) Fusing factor :-

It is defined as minimum fusing current to the current rating of fuse elemen.

$$F.f = \frac{\text{minimum fusing current}}{\text{Current rating of fuse elemen.}}$$

iv) Breaking Capacity.

It is defined as the rating of a fuse corresponding to RMS value of the respective current and the system voltage

(v) Fuse unit :-

A fuse unit consist of metal fuse element or link set of the fuse.

* Depending on the field applicat

fuse units are of following types.

1. round type fuse unit.
2. Kitkat or rewirable fuse unit
3. Cartridge type fuse unit
4. High rupturing capacitive fuse unit (HRC)

M. Protective devices used in domestic as well as industrial wiring

Generally for overloading or any type of abnormal condition or any types of short cut we use some protective devices such as -

1. fuses
2. Relays
3. MCB
4. Earth Link cut breaker (ELCB)

N. Earthing system

We know that earthing is defined as a Connect^{n} of the neutral point of the supply system & not current carring parts of electrical apparatus such as - metalic frame work, metalic Covering of Cables, earth terminal of the socket out let & stay wire's etc to the general mesh of the earth so as to discharge the electrical energy immediately to the earth without any danger

1) Resistance of earth

According to IE rule the earth resistance should be low enough to cause the flow of electric current quicly.

* The earth resistance is not equay in all places because it depends on the moisture Contains of soil & types of the soil etc.

* There are following important value of the earth resistance that can be permited

1. In large power station (0.5 Ω)
2. major power stat^n (1 Ω)
3. Small substat^n (2 Ω)
4. In all other cases (5 Ω)

* The resistance from the earth plate to any point in the installat^n should be one Ω ~~ampere~~.

The size of earth Continuity Conductor normally

14 SWG or 16 SWG or 18 SWG GI or Copper wire

3* In general the distance of earc electrode from the building should not be less than 1.5 m

4) Methods of earthing

following methods are addopted for earthi

1.

1. strip or wire earthing —

For copper wire dimant^n is 25 mm × 1.6 mm ⌀

for GI wire diamend^n is 25 mm × 4 mm

2. Rod or spike earthing —

Various rod are available in market for earthing that are -

i. 12.5 mm solid rod copper of 2.5 m long

ii. 16 mm solid rod of GI of 1.5 about 2.5 m long

we also used 25 mm GI of 2.5 m long

3. Pipe earthing — The pipes are available in different size are 40 mm width 2.5 m long GI. And 19 mm GI ⌀ 1.5 m long.

4. plate earthing.

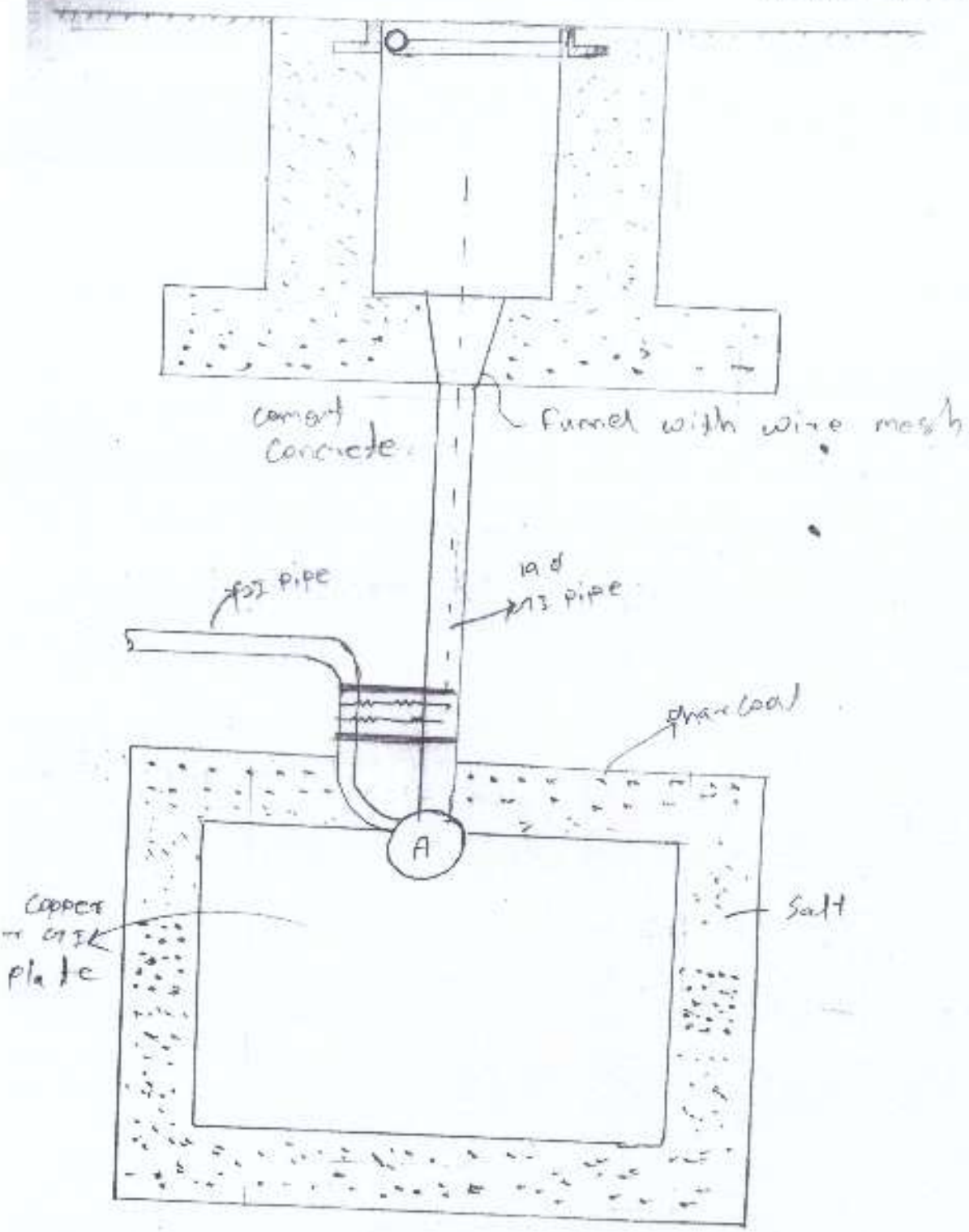
Different size of plate's are available for plate earthing are -

for Copper — 160 cm × 60 cm × 3 mm

for GI — 60 cm × 60 cm × 6 mm

Plate Earthing :-

ground level.

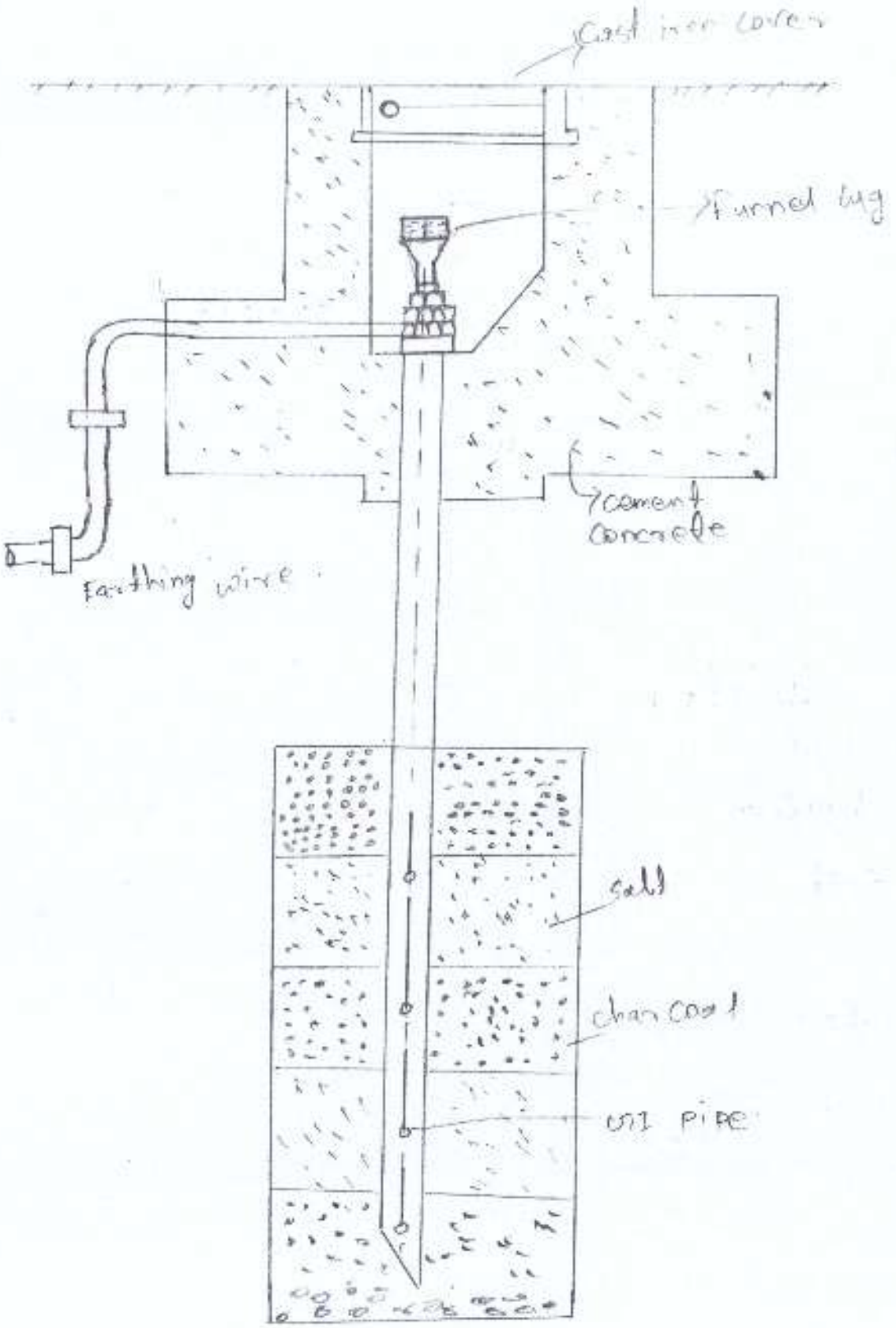


MATERIAL TABLE

plate earth 3

Sl No	Description	specification	Quantity
1.	Earthing plate	Copper type, 60cm x 60cm x 3.8 cm	1 No.
2	pipe	GI type 19 mm ϕ	2.5 m
3	pipe for earth wire with it's fitting accessories	GI type 12.7 ϕ	3 m
4	wire	GI type 16 gwm	1.5 kg.
5	Lugs	for 6swm wire	2nO
6	Nut & bolts	10 mm GI bolt	5 nO.
7	GI frame 60x	30 cm x 30 cm	1 No.
8	Cast iron Cover	30x30 cm	1no.
9	Funnel with wire mesh with it's fitting accessories	—	1 set.
10	Charcoal	—	10 kg
11	Salt	—	10 kg
12	Sundries to Complet the whole job.	—	As per requ.

Pipe Earthing



material table

Sl no.	Description	specification	quantity
1	CI pipe in under ground	38 mm dia	2.5m
2	CI pipe for watering	19 mm dia	1.5 m
3	CI Regulating Bucket with it's Fitting accessories	(38×19) mm	1 set
4	CI pipe for incoming of earthing wire	13 mm dia	4 m
5	CI wire for earthing	6 SWG	12m
6	CI bolt & nut with fitng. acces.	(10×33) mm	2 NO
7	CI bend for incoming CI Pipe	13 mm dia	1 NO.
8	Cast. iron frame	30 cm^2	1 NO.
9	Cast iron cover	30 cm^2	1 NO.
10	Funnel with wire mesh	—	1 NO.
11	charcoal	—	10 kg.
12	Salt	—	10 kg
13	Cement Concrete	1:4:8	0.15 m^3
14	Sundries to complet the whole job	—	As per required.

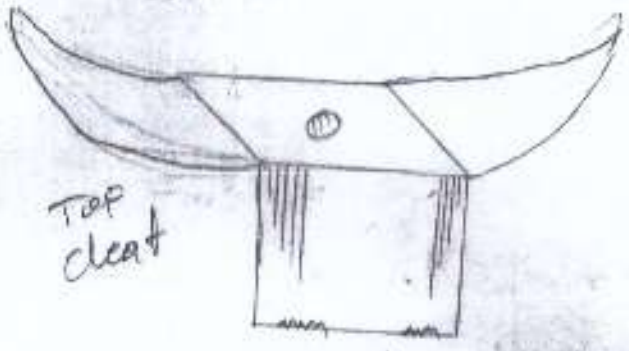
System of wiring :

16th mar-19

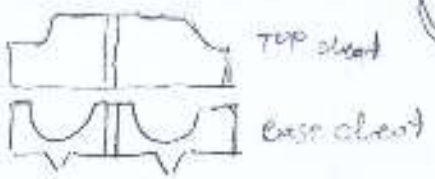
In the wiring system (may be domestic or industrial) following important wirings are adopted

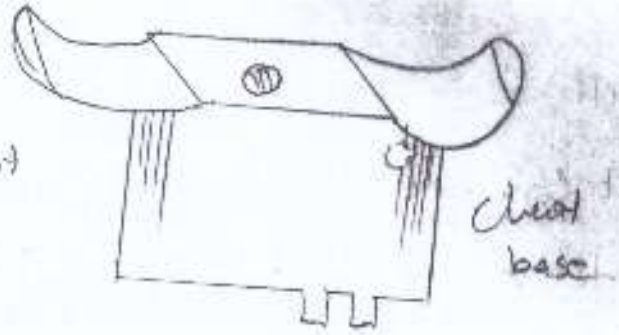
a. Cleat wiring
b. Wooden Casing & Capping wiring
c. CTS or TRS or Lead sheath wiring
d. Conduit wiring

Cleat wiring



(a)





(b)

* At first in this wiring system demarcation is wall surface using hand drill's holes are made along the demarcation at 30 cm to 60 cm apart, Then wooden guddies (plugs) of size 38 mm x 38 mm of 6.5 cm long are placed in the drilling holes.

The base cleat having two groups, three groups etc are to be fixed on the gutties. Then VIR cables are drawn through the groups of the base cleat & immidiately after it the top cleat is screwed over the base cleat. Now the cables are gripped or placed in the cleat's

Advantages

* It is the easyest method or way of installat".
* Fault finding is very easy and repairing also requires very less time.
* Dismentaling is easy & quick in this method.
* No skilled person will required.

Disadvantages

This is a temporary wiring system.

* It is not good looking
* Since the cable is exposed to air so it may be chemicall affected which causes damage to the insulat" and
* The wires or cable are exposed to mechanical injury

Applicat"

This wiring system is basically used in undamped places and also where a temporary wiring system is needed.

(c) CTS or TRS (wall) Seath wiring

In this wiring system demarkat" is given on the wall surface using hand drills holes are made along the demarkat" at 75 cm apparts. Then wooden gutties or plugs of size 38mm x 8mm of 6.5 cm long are placed in the drilled holes. Then for the holding the cable clips are made with the tinned brash are fixed on the batten with an interval of 10 cm in case of horizontal & 15 cm in case of vertical. Then tick wood batten of different size as applicable such as (13x13)mm, (19x13)mm, (25x13)mm, (31x13)mm etc. are fixed over the gutties by means of screws or wood'n plugs with appropriate size. Then CTS or TRS cable's are laid over the nail pins and after it the nail pins are twisted, so as to hold the cables permanently

For providing the number of cables & pin's the different size of batten's are mention below

Batten size	no. & size of Link clip	No. of single core cable to be carried out (1/1.44mm c_u)
13 mm x 13 mm	1 x 38 mm	02
19 mm x 13 mm	1 x 50 mm	03
25 mm x 13 mm	2 x 38 mm	04
31 mm x 13 mm	1x38 mm & 1x50 mm	05

Advantages

* It is highly durable
* It can withstand the action of acid's & alcalies
* It is good looking as Compare to wooden coshings keeping wiring.
* It's installath is easy
* Fault finding & maintainam is easy.

Dis advantages

This system is very costlyer now a days
* Skilled lavour is required for making the smooth batten
* There is a risk of fire

Application

This type's of wiring is used for installath in domestric, Commercial or industrial axcept workshop

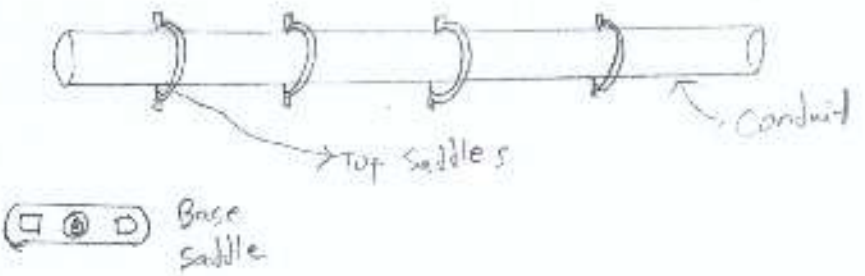
J. Conduit wiring

surface wiring:

In this wiring demargation is given on the wall surface using hand drill m/c's the holes are made along the demargath at 75 cm apprext. Then wooden gutties of size 32mm x 8mm of 6.5 cm long are placed in the drilled holes. Then the based saddle is ~~the finder~~ is fixed on the gutties in proppper manner the PVC & CI pipes are Lade over this base and immideately the saddles are fixed on the screwed its eighter ends

This is the procedure for surface wiring.

17th mar-17



* In Case of Concealed wiring the wall surface is to be burried along the demargation then PVC or GI Pipe are placed inside the plaster by means of Crampet's. I
* It may be surface or Concealed Conduit for drawing the Cables through the pipe. If GI pipe is used.
* This wiring system is frequently used now a days
* The size of Conduit or pipe that available in market are 12mm, 16mm, 20mm, 25mm, 31mm, 38mm, 50mm but large size according to our out side diameter is 63mm is also used

Advantages

* It is free from electric shock
* The whole system is water proof
* It is highly durable
* It give protection against fire
* It is protected from mechanical damage

Disadvantages

* It's installat^n is not easy
* fault finding is very difficult
* Repairing is also very difficult.

b) Wooden Casing & Capping wiring

In this wiring demargeat^n is given at the wall surface at a height of 3m from the ground using the hand drill holes are created along this demarga line with in 15 cm apart. The wooden gutti or plug of size 32 mm x 8 mm about 6.5 cm long are inshorted in the drilling hole. Then wooden casing (may be 2 groups, 3 groups etc) is fixed on the gutties by means of screws the length of such wood gutties about 2.5m to 3m. After it PVC or VIR cable are drown through the groups of the Casing then to cover named as capping is now screwed over the casing

Advantages

* To some extend it is easy to instal
* Even though installat^n cables are damaged but no short cut with takes place in the casing because phase & neutral wire are placed seperat groups
* In this system fault finding is easy
* Repairing is also easyes than conshild wiring.

Disadvantages

* It is very high cost now a days
* It is not used in damped place
* It has risk from fire / hazard.

Applicat^{n}

This wiring system basically used in low voltage (250 v) domestric wiring normally in dry place where not have firing risk.

short Q.

1) Define fusing factor

Ans- It is defined as the minimum fusing current to the current rating of the fuse element.

math. f.f = $\frac{\text{minimum fusing current}}{\text{current rating of fuse element.}}$

2) write the various types of insulating materials which are used in cable.

Various type of insulating material are.

1) PVC insulating material
2) VIR " "
3) Impregnated paper insulating material
4) Rubber insulating material
5) cotton & ~~synthetic~~ silk

3) write the various properties of a insulating materials which is used in useful in cable.

Various properties are.

1) High dielectric strength
2) High resistivity
3) High flexible, high resistance to moisture

4) which type of material used in fuse for small current rating purpose:

Alloy of lead & tin fuse element used in small current rating purpose

5) write the types of system of wiring.

System of wiring are various types such as—

1) cleat wiring
2) wooden casing & capping wiring.
3) CTC or TRS or lead seath wiring
4) Conduit wiring.

Long a:

1) write the various types of system of wiring and describe any two methods of system of wiring and also write advantages & disadvantages

Switches

CMO - Clang operated S.
TPMO - Tripple pole manual operated S.
TPIC - " " iron clate S.
DPIC - Double " " " S.

Push pull switch

Dumble or surface switch

Double pole main switch
1- Way switch
2- Way switch
2-way Centre of switch

D/S advantages:-

* This is a risk of hazard.
* It is not used in damped place.
* It is very costly in now a days

Application

This wiring systems basically used in low voltage (250 V) domestic wiring, normally in dry places where there is no fire risk

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CH-3

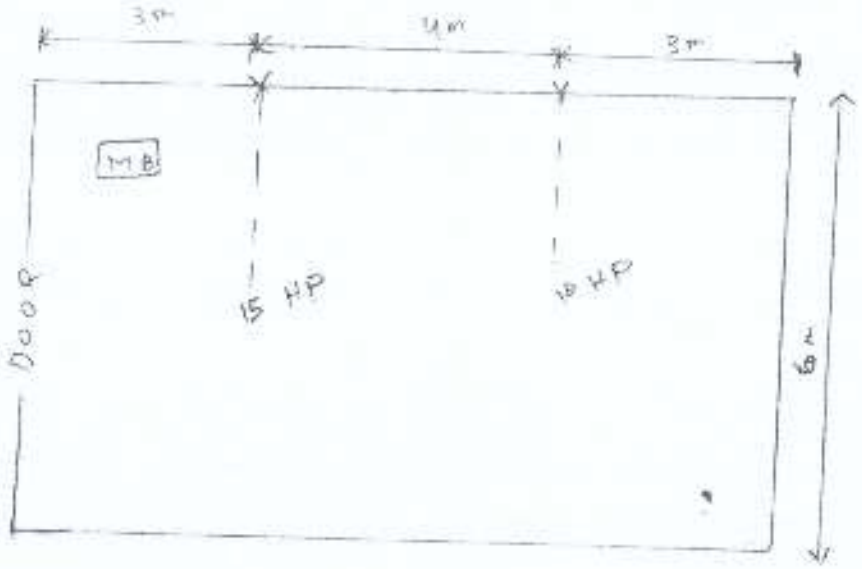
Electrical installation

18th mar 17

Problem:-

Two 3ϕ 415 V, 50 Hz squirrel cage motor are to be installed in a workshop, the rated op of the motors and their locat^n are shown in given below, Y Δ starter supplied with each motor are to be installed on the wall. The supply company meter will be located at the posit^n mark. The wiring of the m/c's is to be carried out according to the IE rule. Make a neat sketch of this wiring with the help of single line dig. indicating the no. & size of cables used. Also prepare a list of material required for the wiring including necessary earthing with GI plates of 600mm x 600mm x 6mm

Neat sketch



Symbol's used

SL NO	Description	symbol
1	Energy meter	
2	main switch	
3	Switch board with switches	
4	Distribution board	
5	Socket out let	
6	phase wire	
7	Neutral wire	
8	Earth wire	
9	fuse	
10	starter	

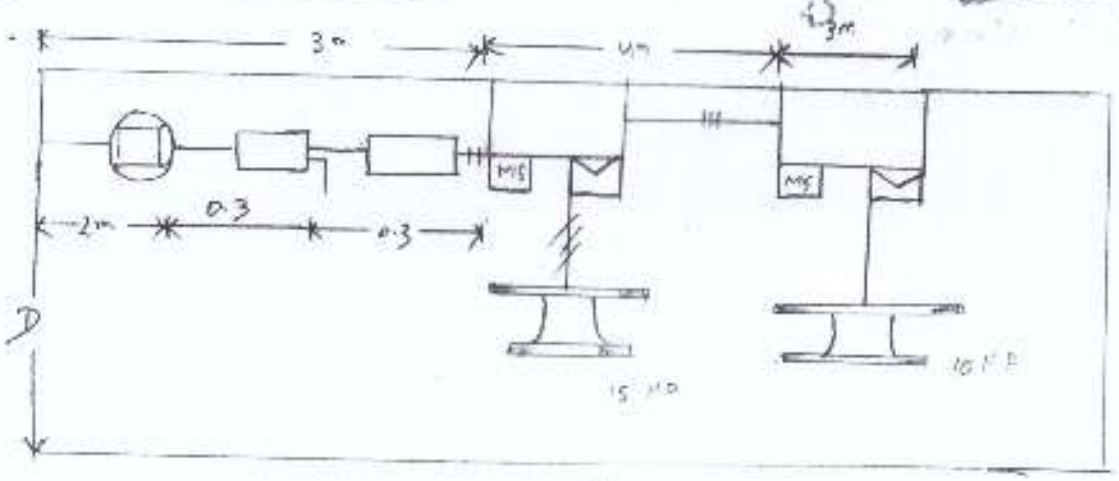
Assumption

For Industrial wiring installation following assumpt" must be consider

* Height of H R (horizontal run up) from the ground is 3m
* Hight of the main switch (MS) and distribut" board is 2m to 2.5m
* Height of the motor switch starter & switch board is 1.5m from the ground
* Height of the plinth for placing electrical m/c is 0.2 meters Visible
* The depth of the trench is 0.2 m
* The wall clearance shouldn't be < 1m
* There shouldn't be wood work in the wiring installat".
* Looping on the cable must be avoided
* Jointing of the cable must not be allowed
* The cable shouldn't be turned with 90° or more.
* Two seperated earthing must be provided to each electrical m/c

Wiring Plan

20th mar 17



4. Calculation for short ckt current :-

Let us assume input voltage or supplied voltage,

$V_L = 415\ V$

$F = 50\ Hz$

$\eta = 85\% \Rightarrow 0.85$

$\cos\phi = 0.8$ lagging.

For 15 HP motor :-

o/p power, $P_o = 15\ Hp = 15 \times 746 = 11190\ w$,

$11.19\ kw$.

we know that $\eta = \frac{P_o}{P_i}$

$$P_i = \frac{P_o}{\eta} = \frac{11190}{0.85} = 13164.7\ w$$

short ckt current (I_{sc_1})

Here $P = V_L I_L \cos\phi \sqrt{3}$

$$I_L \Rightarrow \frac{P}{V_L \cos\phi \sqrt{3}} = \frac{13164.7}{415 \times 0.8 \sqrt{3}} = 22.89\ A.$$

$I_{sc_1} = 22.89 \times 2 = 45.78\ A.$

For 10 HP motor :-

P_o = o/p power = $10\ Hp = 10 \times 746 = 7.46\ kw$

we know that $\eta = \frac{P_o}{P_i} \Rightarrow P_i = \frac{P_o}{\eta} = \frac{7.46}{0.85} = 8776.47\ w$

short ckt current I_{sc_2}

Here $P = \sqrt{3} V_L I_L \cos\phi$

$$I_L = \frac{P}{\sqrt{3} V_L \cos\phi} = \frac{8776.47}{\sqrt{3} \times 415 \times 0.8} = 15.26$$

Hence $I_{SC_2} = 15.826 \times 2 = 30.57$

Total short ckt current both the motor, $I_{sc} = I_{sc_1} + I_{sc_2}$

$I_{sc} = 45.78 + 30.57 = 76.35\ A$

5 selection of Cable :

1) Since total Isc for both the motor is 76.35 A so from the Conductor it is observe that for 3 Core Copper Conductor through rubber sealth Cable of 19/1.80 mm, 3.0 mm², 650 V grade, for 88 A Cable should be selected

2) Since the Isc current for 15 Hp motor is 45.8 A so from the Conductor table we select for the max^m current rating of 52 A, 19/1.40 mm, 25.0 mm², 650 V grade Cable. 25 is to be selected with through rubber sheathed

3) Since the Isc for 10 Hp motor is 30.57 A so we uses 30 A wire because 30 < 30.57 A
4/4.01 mm, 1.0 mm², 650 V grade Cable is to be selected with through rubber sheathed

6 - select^n of main switch :-

Since the Isc of entair load is 76.3 A so we should select TPIC (Triple pole iron clade), 415 V, 100 A with porcelin material is to be selected

7. select^n of distribut^n board :-

Since in this cabe there are two electrical m/c so two way 415 volt grade ironclade with covering system and different grade of fuse or cut out is to be fixed as per the Isc of 15 HP & 10 HP motor

8. Calculation for length of cable for 15 HP motor (25.0