LECTURE NOTE ON

ELECTRICAL INSTALLATION and ESTIMATING

6th SEM ELECTRICAL

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HOUSE WIRING :-

Before considering a particular type of wiring the following points should be consider.

a) **DURABILITY :-**

Durability means proper specification of life span that the wiring exist i.e how many days it should be continue working giving arised any type of problem.

Ex :- Clear wiring is suitable for temporary purpose. The life span is about 5 years. But for permanent residence we should choose life span is (20-40) years.

b) **SAFETY :-**

During house wiring we should consider the safety of wiring.

Ex :- In factory where a lot of fumes are produces clear. casing capping wiring is not suitable (may destroy). So metal sheath wiring is suitable at that place.

c) **APPEARANCE :-**

It is a most important factor while considering the house wiring in proper place.
so according to place we used the wiring should be of good appearance.

Ex :- In Bangloo we should not choose batten wiring are casing capping wiring rather than concleed conduit wiring.

d) COST :-

Cost is also an important factor while considering a particular type of house wiring.

Ex:- The conduit system of wiring is costlier than other type of wiring so the cost of wiring is suitable for consumer and also effortable by the Customer.

e) ACCESIBILITY :-

It means that there is provision for extension we should select such type of wiring and the wiring material such that future extension may posible in the above wiring.

f) MAINTENANCE :-

(i) We should choose the wiring such that maintenance cost is low.

(ii) We should choose such type of wiring such that inspection can be done regularly so that the maintenance cost is low.

(iii) So inspection box are provided in the regular interval for maintenance.

TYPES OF WIRING :-

There are five types of wiring generally employed.

1) Cleat wiring.
2) Wooden / PVC casing capping wiring.
3) Lead sheathed / metal sheathed wiring.
4) CTS / TRS / Batten wiring.
5) Conduit wiring.
   a) Surface conduit.
   b) Concealed conduit.

(3)

CLEAT WIRING :-

(i) In this system of wiring cables are supported by means of porcelain cleats.

(ii) The porcelain cleats are made on two halfs.

(iii) The main part is base which is grooved to accomodate cable the other part is top or capes which is coven on it after placing the cable in the groove and fixed to base by the help of screw.

(iv) First the base of cleat fixed to the wall by the help of screw and gutties with a interval of (30-60) cm and the screw size of 38 mm for normal supply 240V.

(v) The cable will be placed at 2.5 cm appart from centre to centre. (Two wire shall not be placed in the same groove).

(vi) so for this type of wiring VIR and PVC cables are used.

ADVANTAGES :-

(i) Installation is quick and easy.

(ii) Inspection is easy as cables are visible.

(iii) cost is very low.

(iv) Installation is for ther use after removal from one installation.

(v) Alternation and addition can be made easily.

(vi) This type of wiring can be done unskilled labour.

DISADVANTAGES:

(i) It is not good looking
(ii) It is a temporary purpose wiring.
(iii) It's life span is less about 5 years
(iv) It is subjected to mechanical injury as the wires are exposed.
(v) It is can't be used in damp places. (where fumes and alkaline atmosphere are found.)

WOODEN CASING CAPPING WIRING:-

(i) This system of wiring is very suitable for low voltage specially house and office.
(ii) Here VR or PVC cables are placed in the grooves of wooden casing.
(iii) The casing consist of U-shape grooves, which is two in numbers where wires are laid in such away that wires of opposite polarity are laid in different grooves
(iv) First the casing is installed in the wall by the help of screw and gutties at an interval of (60cm - 64cm) where water shepage and steam is not found.
(v) The screw fixed the casing through porcelain cleat, after laying the cable in the groove then it is covered by capping of same width of wooden with the help of screw of the length (12.7mm)
(vi) casing and cappings are made of teak wood and all sides of casing and capping should be smooth and varnished.

(c)

ADVANTAGES:

(i) It was cheap in cost as compare to conduit system of wiring.

(ii) Inspection of wire is easy which can be done by just opening the capping.

(iii) It is easy to install and rewiring is easy economically.

(iv) As different polarity wires are placed in different grooves chances of short ckt is minimum.

(v) DISADVANTAGES:

(i) There is risk of fire hazards so it is not used where posibility of fire hazards.

(ii) Skilled labours are required for this installation.

(iii) The casing and carring are placed on wall surface it does not good looking.

TRS / CTS / BATTEN WIRING:

(i) It is suitable for low volt installation like residental building or offices.

(ii) It is suitable where acid and alkaline to be present.

(iii) It most economical and commonly used ordinary residental building.

(iv) In this system of wiring the cables are carried on seasoned teak wood perfectly straight and well varnished batten of thickness 13mm.

(v) The width of the batten depends upon the no. of wires to be drawn.

(vi) The wires are fixed to the batten by the help of tinned brass / aluminium link clips :

(vii) The link cleap should be fixed to the batten at an interval of 100m apart by the help of small nails, where as battens are fixed to the wall by the help of guttes and screw.

(viii) The distance between the two conjugative screw should be 75 0m.

(ix) After fixing the wire on the batten the link cleaps are tight such that the wires are equally placed on batten.

(x) During wall crossing on the possibility of fire hazard then the portion of cable is covered by metal sheathed.

ADVANTAGES :-

(i) It is easy to install and caboin charge is less as compare to conduit system.

(ii) It is cheaper then conduit system of wiring.

(iii) It appearance is quite good.

(iv) Fault location and fault removal is easy as the wires are visible.

(v) Replacement of defective wire is also easy.

(vi) It's life span is long about (20-30) years.

DISADVANTAGES :-

(i) It is can't be used in situation where the wiring is exposed to sun and rain

(ii) Good workman ship is required.

(iii) It can't be used where possibility of fire hazards.

CONDUIT SYSTEM OF WIRING :-

(i) In this type of wiring all wires are enclosed in steel pipe known as conduit pipe.

(ii) It is similar to water pipe but metal is annealed to permit easy bending.

(iii) There are two types:
a) Surface conduit.
b) Concreld conduit.

SURFACE CONDUIT SYSTEM OF WIRING :-

(i) The surface conduit wiring is placed on the surface of the wall and held with the help of shadle.

(ii) The system of wiring is applied in industrial domestic and workshop wiring.

(iii) The conduit size is started in terms of its outside diameter.

(iv) The minimum size of conduit is 12.7 mm.

(v) The next size of conduits are 15mm, 20mm and 25mm which are commonly used for house wiring system.

(vi) In this system of wiring the conduits are fixed on the wall by means of shaddles. screw, which are provided at an interval of 1mtr.

(vii) All the outlets (holder, switches, ceilingrose are fitted on the metal box)

CONCEALED CONDUIT WIRING:-

(i) The conduits are embedded along the wall and and ceiling by the plaster at the time of construction.

(ii) The PVC cables are draw in to the conduits after the conduit is placed in the wall by proper embedding in the wall

(iii) During embedding small nails are fixed by the help of hammering in the front of conduit pipe.

(iv) After that proper plastering shaud be done over the conduit pipe.

(v) Junction boxes are provided at a reguar interval for inspection purpose. such that the iron frame plaed inside the wall switch board, MCB board mainswitch baard frames are also plaed inside the wall.

(vi) GI wire of 18 SWG are also move along the conduit for acts as earth wire.

(vii) After wires are draon then MCB frame main switch frame ceiling rose frame, switch boand frame, holden frame are covered with proper size plywood plate.

ADVANTAGES:-

(i) It provide protection against mechanical damage of the due to short ckt.

(ii) Whole system of wiring is water proof.

(iii) It's life span is long about (30-40) years

(iv) It is shock proof as earthing wires Provided throught the conduit.

DISADVANTAGES:-

(i) It is very cosely.
(ii) Experience and highly skill labour are require.
(iii) connection is not so easy it take some more time.
(iv) maintenance is also difficult.

APPLIATION :-

As it is provide protection against. Ime, dampness, mechanical damage so it is recomended for textile industry. saw mills flour mills, workshop lighting, motor wiring factory, varnish factory, chemical industry, oil factory residental and office building and public building.

METAL SHEATHED / LEAD SHEATHED WIRING:

This type of wiring is employ conductor insulated with VIR and is cover with an outer sheath of lead, aluminium alloys containing about 95% lead. This metal sheath gives protection to the cable from mechanical injury, dampness, atmospheric corrosion.

During wiring the cables are run on wooden battens or wooden cleats like TRS/ batten wiring.

It is suitable for low voltage upto 250v. It is also used places are exposed to rain and sun & no joint is provided.

DIFFERENT TYPES OF WIRE & CABLE

VIR - VULCANISE INDIAN RUBBER

(i) In this type of cable conductors are insulated by vulcanised rubber of single braid.

(ii) It just found on available 250/500V grade as well 660/1100V grade.

(iii) Such wires are generally used for ordinary electrical wiring i.e conduit wiring wooden casing capping wiring.

P.V.C - POLY VINYLE CHLORIDE

(i) These wires are available in 250/500V and 660/1100V grade.

(ii) It is used in conduit wiring.

(iii) The conductor have a insulation of polyvinyle which is thermoplastic insulation (soften and flow down due to heat).

(iv) It has not heat absorbing capacity so it is not very suitable for high temperature like heating appliances, pendent holders.

TRS / CTS CABLE :-

TRS :- Tough rubber sheathed.
CTS :- cable tough sheathed.
This cable has a small thickness of tough rubber or it has two type of insulation A thin layer over the conductor or main insulation layer over the thin layer and finaly the two layers is covered by tough rubber.
Inners layers are PVC or VIR insulated while outermost is tough rubber.

It is found of the voltage level 250/500V and 660/1100V grade singee, twin and three core cable.
It is only used for batten wiring.

LEAD SHEATHED WIRE :-

These lead sheathed wire provide complete resistance to the entry of moisture and also provide mechanical protection (high mechanical strength) so it is used for wiring purpose where moisture are present, damped condition industrial wiring, workshop wiring and distribution purpose.

WITH ATHER PROOF CABLE :-

These cable are used for out door wiring also used for underground duty for street light.
It may be singee core, twin core, threecore and thereee and half core.
Insulation around the cable VIR and PVC.
It is found of the voltage level 250/500V, grade and 660/1100V grade

FLEXIBLE WIRE :-

The flexible wires are used as connecting wires for household appearances, TV, fridge, lamp etc.

It is made up of copper conductor of small diameter which is cover with PVC or VIR (SOFT).

WIRING MATERIALS :-

MAIN SWITCH

DPIC MAIN SWITCH :- DOUBLE POLE IRON CLAD

It is used for 1φ AC ckt and DC ckt.

It is found of the rating 6A, 16A, 32A, 48A, 60A, 63A, 100A, 200A of 250 voltage grade.

TPIC :- TRIPLE POLE IRON CLAD MAIN SWITCH :-

It is used for 3φ - 3 wire AC ckt.

It is found of the current rating 16A, 32A 48A, 63A, 100A, 200A. 600 voltage grade.

TMCN :- TRIPLE POLE IRON CLAD MAIN NEUTRAL LINK :-

It is used for 3φ - 4 wire AC ckt.

It is found of rating 32A, 48A, 63A, 100A, 200A 600 voltage grade.

DISTRIBUTION BOARD :-

It is the protection for all the wiring from main switch.

It carries all the fuses of appropriate rating.

The distribution board are two types.

a) MDB :- main distribution board.

b) SDB :- sub distribution board.

FUSE CARRIER & FUSE WIRE (Light :- 6A, Power ckt :- 16A)

It is a protective element.

Generally fuse carrier or without use fuse wire of low resistance high melting point

It is connected series with the ckt to be protected.

Generally coppers are used as fuse wire.

SWITCHES :-

a) one way switch.
b) Two way switch.
c) Two way centre of switch.
d) Double pole main switch.
e) Bad switch..
f) Push button switch.
g) Intermediate switch.

* It is connected in series with the phase in the CKT.
* It is found rating of 6A, 16A, 250v grade.

CEILING ROSE :-

There are two types of ceiling rose:
a) Two plate.
b) Three plate.

It is used for giving power supply to fan, tube light, calling bell etc.

SOCKET OUTLET :-

It is found, two pin, three pin, five pin having 6A, 16A rating up to 250V grade for lighting CKT we used 2-pin & 5-pin 3pin. 16A 250v grade is used for power CKT.

DIFFERENTYPES OF LAMP HOLDERS

LAMP HOLDER :-

The function of lamp holder is hold the lamp and connect it to the supply terminal.
It is made up of brass with porcelain insulation.

It is also made up of bakelite.
It is upto 5- types

1) Batten lamp holder.
2) Angle lamp holder.
3) pendent lamp holder
4) Bracket lamp holder.
5) swivel lamp holder.

CHAPTER-2

INSTALLATION AND ESTIMATING FOR RESIDENTAL BUILDING:-

IE RULES

CONDUIT WIRING:-

1) Balance of 3Φ supply voltage should in wiring for supply.
2) Under no circumference wire upto different phases can be run in one pipe accept incase of wire of all 3- phase with or without neutral combination
3) For incase of wiring required for VIP rooms (Bangalow). The installation of room shall be connected two different phase through change over switch.

FOR CABLES:-

(1) The cable should be rated 440V or 1100V.
(2) The minimum size of aluminium conductor shall be 1.5mm² for house wiring but copper conductor has 1mm².
(3) For power wiring the size of aluminium conductor is 6mm² but copper is 4mm²
(4) The minimum size of flexible cable shall be 16/20mm and cable should be copper.

5) Flexible cables are used for calling bell bed switch, table lamp, t.v e.t.c. but it is not used for permanent wiring -

FOR RATINGS OF POINT :-

(i) The light points in a building rated in should be 60 watt.

(ii) ceiling fan, table fan rated at 80watt.

(iii) Exhaust fan rated at 100 watt.

(iv) Power paint socket out let is rated at 1000kw.

(v) For fluroscent lamp
2 Ft = 20W
4 Ft = 40W.

(vi) 5 Amp socket out let (80- 100) watt.

IE RULES FOR HEIGHT LEVEL :-

(i) Light point junction boxes, hanging light from floor level to be (2.5) mtr to (3) mtr or (0.5) m below the ceiling.

(ii) Fan point should be placed at (2.75) mtr from the floor level or (0.3) mtr below the ceiling.

(iii) Light plug, power plug, telephone socket, TV, socket should be at the height of (0.25 mtr) above the floor.

(iv) Bed light point should be at (1 mtr) from the floor level.

(v) minimum height of switch board from the floor level should be (1.5 mtr)

(vi) Power plug in bathrooms should be at a height of (2 mtr) from the floor level.

(vii) Power plug along & without switch to be at (2.5 mtr) from floor and with switch (1.5 mtr)

which is used for AC & fridge.

(viii) calling bell should be at height of 2.5m-3m.

(ix) Pus button switch are provide for calling bell which is at a height of 1.5mtr, above the floor.

(x) The geezer and AC's are required paven ckt for that 16A, 3 pin or 5 pin, sockets should be used.

(xi) The horizontal run is taken 2.5m above the floor or 0.5m below the ceiling.

FOR MAIN SWITCH AND SWITCH BOARD:-

(i) The main switch should be fitted at the close point of entry of supply.

(ii) Energy meter, main distribution board and main switch placed nearby to each other or at 0.5m distance from eachother.

POSITION:-

(i) It should be placed at a height of 1.5m above the floor level.

(ii) Energy meter, MDB and main switch covered by proper size of panel board.

IE RULES FOR SWITCH BOARD:-

(i) There shall be only one row of switch board of any switch board.

(ii) For conduit wiring no separate earth wire is drawn.

(iii) But the conduit shall be earthed at suitable different place (for steel conduit), then PVC conduit earth wire is drawn throught the conduit.

GUIDELINES FOR WIRING:-

(i) The place where service connection is taking most be nearer to the building and it can be taken carefully.

(ii) Energy meter, MDB, main switch are placed closed to eachother and pace nearen to the commencement of the supply.

(iii) The weather proof cable selected for service connection should be proper rating.

(iv) The wires of wiring connection to main switch and MDB shaud be rating based on total load requirement of the building.

(v) The conducton used beyond the distribution board in the whole of building is of same size.

(vi) CTS OR TRS are batten purpose of wiring ~~should be installed~~ VIR insulated top rubber coated conducton are used.

(vii) The socket outlet in the house wiring should be insteaued on the switch board along with other switches bat socket outlet in office building may be insteaued 0.5m above the floor.

(viii) sufficient no. of socket outlet are to be provided at suitable place in all rooms so is to be avoide long length of cable.

(ix) Individual sockets has individual switches for control.

(x) Each lighting CKT (fan, light etc) is contained maximum 10 points and maximum 800W.

(xi) for 15 amp socket outlet provided a separate power CKT.

(xii) The fuse and switches are not to be provided on earthed conducton or earthing lead only placed in phase.

(xiii) In domestic installation for the purpose of earthing we used 8 SWG / 14 SWG.

(xiv) In case of large building we require 4 wire supply because the load is to be distributed equally on all the phases to avoide voltage drop (Extreme voltage)

(xv) The heigh of ceiling in a normal residental building may be taken as 3.5 mtr for estimating purpose and for large hall the ceiling should be 4 mtr.

(xvi) The height of horizontal running should be taken as 2 mtr above the floor 0.5 mtr below the ceiling.

(xvii) Every switch board placed nearer to the point of entry of rooms.

COLOUR MARKING OF WIRES

a) AC SUPPLY :- Red, Yellow & Blue for Phase wire
Black for neutral wire.
Green for earthing

b) DC SUPPLY :- Red for +ve wire
Black for -ve wire. Blue & green also.
for earth

SYSTEM OF WIRING

There are two methods of distribution of electrical energy beyond energy meter in the domestic power wiring.

a) Tree system wiring.
b) Distribution system of wiring.

TREE SYSTEM OF WIRING :-

(i) In this system smaller branches are taken from main branch.

(ii) A fuse is connected at the commencement of each branch, this system of wiring is now not use due to following disabvantages.

a) The voltage across all the lamp doesn't remain same or last branch has heavy voltage drop across them.

b) A no. of joines are involve in the CKT.

c) Here the fuses are not fixed a certain point rather it is scattered.

d) A no. of joines are provided so fault finding location is difficult.

e) Here cost is high but safety is less. (A no. of junction boxes are reqd.)

DISTRIBUTION SYSTEM OF WIRING :-

(i) Generally this type of wiring used in domestic and industrial purpose.

(ii) In this wiring MDB & SDB are used.

(iii) In one SDB maximum point should be 10 or 8000 in case of light wiring and sufficient sub CKTs are used according to load.

(iv) In this system of wiring identification of fault is easy.

(v) All the load have equal voltage drop across it.

(vi) Junction boxes are use less hence it is cheaper

(vii) In this type of wiring the no. of CKTS sub CKT decided on the basis of no of points.

TYPES OF WIRING

a) Series
b) Parallel
c) Series parallel

Generally we used parallel connection. It is up to two types

(i) Joint box system.
(ii) Looping system.

JOINT BOX SYSTEM:

(i) In this system all the points are individually control which are located at different place.

(ii) To identify the fault is difficult since it require more junction box

(iii) cost is also high.

LOOPING SYSTEM :-

(i) It does not require more junction box hence fault identification is easy.

(ii) It cost is less as compare to joint box system.

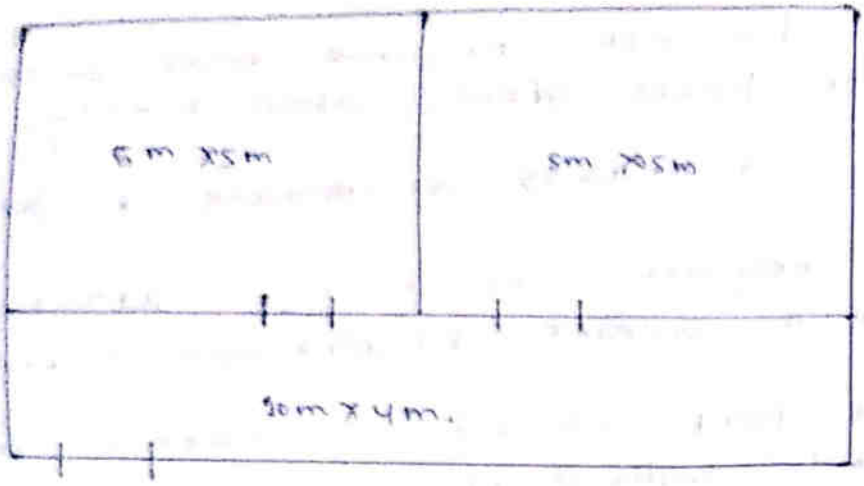
(iii) It require less no of, neutral and phase wire as compare to joint box system.

(iv) All point should be control in a single board individual.

(v) Hence generaly looping system is use.

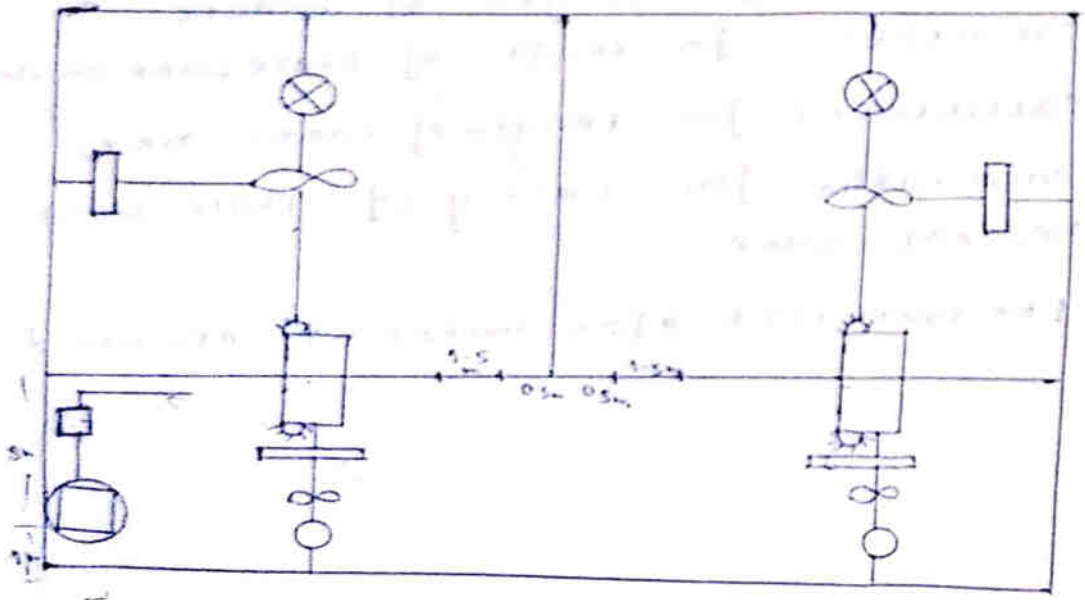
STEP REQUIRE FOR DOMESTIC INSTALLATION :-

1) Draw the installation plan.
2) calculate for total connected load in amp.
3) Assumption.
4) selection and calculation for rating of main switch.
5) selection and rating of MDB.
6) calculation for length of conduit.
7) calculation for length of phase wire, or neutral wire
8) calculation for length of earth wire.
9) calculation for rating of phase wire and neutral wire.
10) Prepare list of for material required.



The plan of the building shown in the above figure required electrical wiring of conduit pipe mark the location of main switch board and electrical point Suitably. Draw the details of wiring diagram and installation plan showing above and prepare material list for this type of wiring.

Installation plan:



Calculation of load current :

1) Lamps : $4 \times 60 = 240W$
2) Fan : $4 \times 80 = 320W$.
3) Tube light : $4 \times 40 \times 160W$.
4) Socket outlet : $4 \times 100 = 400W$.
5) Total : $240 + 320 + 160 + 400 = 1120W$.

Taking pf = 1

$P = VI \cos\phi$

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

$I = \frac{1120 \times 1}{230}$

$I = 4.86A$.

Taking 20% over load = $4.86 \times \frac{120}{100}$

$= 0.972$.

Total current = $4.86 + 0.972 = 5.832A$

$= 6A$ (approx).

Assumption :

Total height of ceiling = 3.5 meter.
Height of horizontal run from floor = 3.0 meter
Height of switch board = 1.5 meter.
Location of energy meter main switch board = 1 meter inside the veranda in commencement of veranda wall crossing should be = 0.3m.

RATING OF MAIN SWITCH:-

As the total load current is 6A.
Hence 16A, 250V grade TPIC main switch is suitable so it is used.

RATING OF MDB:-

There are only 16 electrical points. Hence two way MDB of 15A, 250V grade with neutral link should be used (one for 15A switch board and room-2)

LENGTH OF CONDUIT:-

M.D.B to 2nd switch board of veranda = 1.5 + 2 + 7.5 = 11.0m.

Horizontal run to 1st switch board of veranda = 1.5m

HR to 1st fan of veranda = 0.5 + 2 = 2.5m.

Fan to tube light = 2.5 m

HR run to 2nd switch board of veranda = 1.5m.

HR to 2nd fan of veranda = 0.5 + 2 = 2.5m.

fan to tube light = 2.5m.

1ST ROOM :-

Wall crossing = 0.3m

HR to switch board = 1.5m.

HR to fan = 0.5 + 2.5 = 3m.

Fan to tube light = 3m.

Fan to bulb = 3m.

2ND ROOM :-

Wall crossing = 0.3m

HR to fan = 0.5 + 2.5 = 3m.

Fan to tube light = 3m.

Fan to bulb = 3m.

Total length of conduit = 45.6m.

Take 10% wastage = 4.56m.

Total = 45.6 + 4.56 = 50.16m.

Hence 25mm dia PVC conduit of 51m is reqd.

RATING OF WIRE :-

PVC insulated VIR insulated copper conductor single core having area 1.5mm², 3/0.737 is able to carry 10A current hence it is suitable.

CALCULATE FOR PHASE WIRE :-

Calculation for phase wire :-

1/ MDB to SB_1 = 1.5 + 2 + 2.5 + 1.5 = 7.5m.
2/ SB_1 to L_1 = 1.5m = 1.5m.
3/ SB_1 to F_1 = 2 + 2 = 4m.
4/ SB_1 to FL_1 = 2 + 4 + 0.5 = 6.5m.
5/ HR above SB_1 to SB_3 = 0.3 + 1.5 = 1.8m.
6/ SB_3 to F_3 = 1.5 + 0.5 + 2.5 = = 4.5m.
7/ SB_3 to L_3 = 1.5 + 0.5 + 5 + 0.5 = 7.5m.
8/ SB_3 to FL_3 = 1.5 + 2 + 2.5 + 1.5 = 7.5m.
9/ MDB to SB_2 = 1.5 + 2 + 7.5 + 1.5 = 12.5m.
10/ SB_2 to L_2 = 1.5m = 1.5m.
11/ SB_2 to F_2 = 2 + 2 = 4m.
12/ SB_2 to FL_2 = 6.5m = 6.5m.
13/ HR above SB_2 + SB_4 = 0.3 + 1.5 = 1.8m. = 1.8m.
14/ SB_4 - F_4 = 4.5m = 4.5m
15/ SB_4 - L_4 = 7.5m = 7.5m.
16/ SB_4 - FL_4 = 7.5m = 7.5m.

Total = 86.6m.

Calculation for neutral wire.

1/ MDB - HR above SB_2 = 1.8 + 2 + 7.5 = 11m.
2/ HR above SB_1 - SB_1 = 1.5m = 1.5m.
3/ HR above SB_1 - F_1 = 0.5 + 2 = 2.5m.
4/ HR above F_1 - FL_1 = 2 + 0.5 = 2.5m.
5/ HR above SB_2 - SB_2 = 1.5m = 1.5m.
6/ HR above SB_2 - F_2 = 0.5 + 2 = 2.5m.
7/ HR above F_2 - FL_2 = 2 + 0.5 = 2.5m.
8/ Wall crossing = 0.3m = 0.3m.
9/ HR above SB_1 - SB_3 = 0.3 + 1.5 = 1.8m.
10/ HR above SB_3 - F_3 = 0.5 + 2.5 = 3m.
11/ F_3 - FL_3 = 2.5 + 0.5 = 3m
12/ F_3 - L_3 = 2.5 + 0.5 = 3m

13) HR above SB_2 - SB_4 = 0.3 + 1.5 = 1.8m

14) F_4 - L_4 = 2.5 + 0.5 = 3 m.

15) SB_4 - F_4 = 2.5 + 0.5 = 3 m

16) F_4 - FL_4 = 2.5 + 0.5 = 3 m.

Total = 45.6m.

Here total wire required = Phase wire + neutral wire

= 86.6 + 45.6

= 132.2 m.

10% wastage = $\frac{132.2 \times 10}{100}$

= 13.22 m.

Total = 132.2 + 13.22 = 145.42 m.

Calculation for earth wire:-

MDB HR above SB_2 = 1.5 + 7.5 + 2 = 11 m.

HR above SB_1 - SB_1 = 1.5 = 1.5 m.

HR above SB_2 - SB_2 = 1.5 = 1.5 m.

SB_1 - SB_3 = 1.5 (1.5 + 0.3) = 1.8 m.

SB_2 - SB_4 = 0.3 + 1.5 = 1.8 m.

Total = 17.6 m.

10% wastage = 17.6 × 10/100

= 1.76 m.

Total = 17.6 + 1.76

= 19.36 m

≈ 20 m.

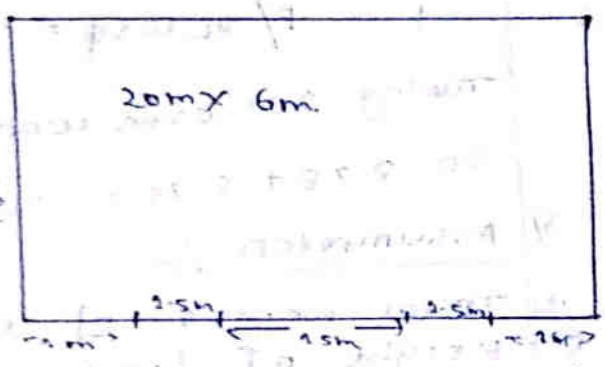
Hence 14 SWG GI wire 20m required for earth

(14 SWG - Domestic
8 SWG - power wiring)

S.No	Specification	Quantity
1/	DPIC main switch 16A · 250V grade	1 NO.
2/	Iron clad DB · 15A · 250V grade	1 NO
3/	Iron clad board for switch board 300mm x 200mm	4 NOS
4/	a) Iron clad 100cm x 50cm for JB1 & JB2 , L1 & L2	2 NOS
	b) 50cm x 1cm	2 NOS.
5/	25mm dia PVC conduit	5m.
6/	PVC/UR insulated conductor single core having size 1.5mm²	247m
7/	14 SWG GI wire	20m.
8/	conduit bend - 25mm dia	24 NOS
9/	ceiling rose - 2 way engine	8 NOS
10/	Holder	4 NOS.
11/	one way flush switch	16 NOS
12/	socket outlet 5 pin 15mm	4 NOS
13/	Indication	4 NOS
14/	Board cover	
	a) 200m x 20 cm	1 NO
15/	b) 100m x 5cm	2 NOS
	c) 50m x 5cm	2 NOS
16/	Screw 25mm	as reqd.
17/	Earthing thimbles	8 NOS

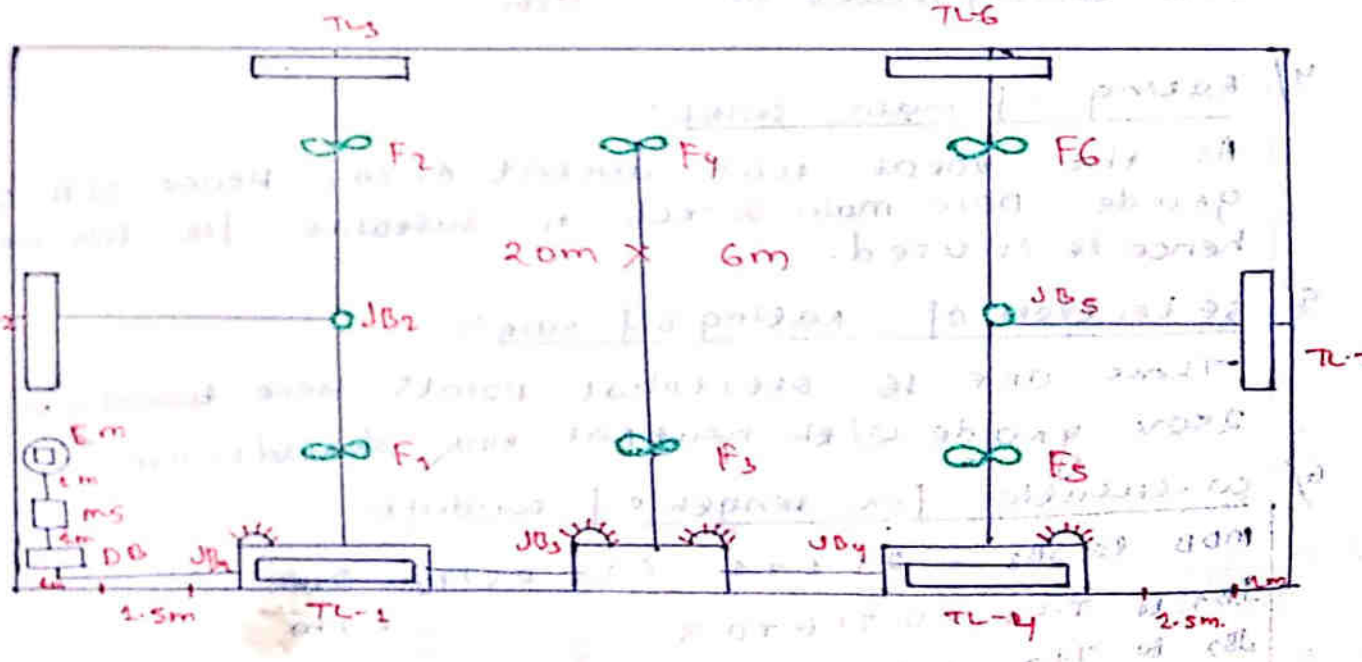
Sl.no	Specification	Quantity
17/	Flexible conduit EM → main switch MS → DB	1mt 2mt.
18/	Flexible wire	2mt.
19/	Nails (small)	as per req.
20/	Labour work	as per req.

(Q.) The above newly build hall required to be wiring by installing energy meter main switch light fan, 5A socket outlets and a 15A socket outlet to be provide in place.



Design the wiring diagram and maxm no. of electrical points to be installed Prepare the material list for above installation.

→ As the maxm current is 15 Amp



2/ Calculation of load

(i) Fluroscent tube = 6 x 40 = 240w

(ii) Fan = 6 x 80 = 480

(iii) Socket outlet ^{5A} = 3 x 100 = 300w

^{15A} = 1 x 1000 = 1000w.

Total = 240 + 480 + 300 + 1000 = 2020w.

Taking PF = 1

I = P / V_L cosφ = 2020 / 230 x 1 = 8.78 amp

Taking 20% over load = 8.78 x 20/100 = 1.75 Amp.

So 8.78 + 1.75 = 10.53 ≈ 11 amp.

3/ Assumption :-

(i) Total height of ceiling = 4m

(ii) Height of floor to HR = 3.5m.

(iii) Height of switch board = 2m.

(iv) Location of energy meter, main switch, DB = 1m.

(v) Wall crossing should be = 0.3m

4/ Rating of main switch :-

As the total load current is 7A. Hence 32 A, 250 V grade DPIC main switch is suitable for this wiring hence it is used.

5/ Selection of rating of MDB :-

There are 16 electrical points. Here two way 30 amp 250V grade with neutral link should be use.

6/ Calculation for length of conduit.

MDB to SB_3 = 2 + 1 + 1.5 (1.5 - 0.5) + 2 = 21m.

JB_1 to $T.L_3$ = 0.5 + 6 + 0.5 = 7m

JB_2 to $T.L_2$ = 0.5 + 1.5 + 1 + 0.5 = 3.5m

JB_3 to $S.B_2$ = 2 = 2m

JB_3 to f_4 = 0.5 + 4 = 4.5 m.

JB_4 to TL_6 = 0.5 + 6 + 0.5 = 7 m.

JB_5 to TL_5 = 0.5 + 2.5 + 0.5 = 3.5 m.

Total = (21 + 7 + 3.5 + 2 + 4.5 + 7 + 3.5) m = 48 m.

10% for wastage & connection = 4.8 m.

Total required conduit = 48 + 4.8 = 52.8 m.

Hence 25 mm dia PVC conduit of 52.8 m ≈ 53 m. is required

calculation of length of wire:-

PVC / VIR insulated copper conductor single core having area 2.5 mm^2. 1/1.80 is able to carry maxm current of 15 amp. Hence it is suitable

→ For power ckt 4 mm^2, 1/2.24 & maxm current of 20 amp is suitable.

FOR PHASE WIRE:-

MDB to SB_1 = 2 + 1 + 1.5 + 0.5 + 2 = 7 m

SB_1 to TL_1 = 2 = 2 m.

SB_1 to f_1 = 2 + 0.5 + 2 = 4.5 m.

SB_1 to f_2 = 2 + 0.5 + 4 = 6.5 m.

SB_1 to TL_2 = 2 + 0.5 + 3 + 3 + 0.5 = 9 m.

SB_1 to TL_3 = 2 + 0.5 + 6 + 0.5 = 9 m.

MDB to SB_2 = 2 + 1 + 1.5 + 7.5 + 2 = 14 m.

SB_2 to f_3 = 2 + 0.5 + 2 = 4.5 m.

SB_2 to f_4 = 2 + 0.5 + 4 = 6.5 m.

MDB to SB_3 = 2 + 1 + 1.5 + (15 − 0.5) + 2 = 20 m.

SB_3 to TL_4 = 2 = 2 m.

SB_3 to f_5 = 2 + 0.5 + 2 = 4.5 m.

SB_3 to f_6 = 2 + 0.5 + 4 = 6.5 m.

SB_3 to TL_6 = 2 + 0.5 + 6 + 0.5 = 9 m.

SB_3 to TL_5 = 2 + 0.5 + 3 + 0.5 = 9 m.

Total = 115 mtrs.

for neutral wire:

MDB to SB_3	= 2+1+1.5+(15-0.5)+2	= 21m
JB_1 to SB_1	= 2	= 2m
JB_1 to TL_3	= 0.5+6+0.5	= 7m.
JB_2 to TL_2	= 3+0.5	= 3.5m.
JB_3 to SB_2	= 2	= 2m
JB_3 to F4	= 0.5+4	= 4.5m.
JB_4 to TL6	= 0.5+6+0.5	= 7m.
JB_5 to TL5	= 3+0.5	= 3.5m.
		Total = 50.5mtrs

Total = 315+50.5 = 365.5mt

10% for wastage & connection = 16.55mt.

G. Total = 365.5+16.55 = 382.05mt.

2// Calculation for earth wire:

MDB to SB_3	= 2+1+1.5+(15-0.5)+2	= 21m
JB_1 to SB_1	= 2	= 2m
JB_3 to SB_2	= 2	= 2m
		= 25m.

10% wastage = 2.5m

G total = 25+2.5 = 27.5mt ≈ 28mt

Hence 14 SWG GI wire of 28mt is selected

MATERIAL LIST

Sl.No	SPECIFICATION	QUANTITY
1/	DPIC main switch 32 Amp, 250V	01 No.
2/	Iron clad MDB 30 amp	01 No
3/	Iron clad board for switch board (30x30) cm	3 Nos.
4/	a) Iron clad (20x5) cm (for JB_1, JB_2, JB_3, JB_4, JB_5, TL_1, TL_4)	3 Nos.

SL NO	SPECIFICATION	QUANTITY
	b) 1 non clad 6X5) c/m	12 NOS.
5/	25mm dia pvc conduit	59 mtr.
6/	PVC /VTR insulated cu conduction single core having size (i) light ckt 2.5mm². 1/1.60 (ii) for power ckt 4mm²1/ 2.24	153 mtr. ~~2.5 mtr~~
7/	14 SWG GI wire	25MTR.
8/	conduit bend 25mm dia	5 NOS.
9/	ceiling nose	12 NOS.
10/	switch 5AMP flush type 15amp	13 NOS 1 NO.
11/	5 amp 3 pin outlet socket	3 NOS.
12/	15 AMP 3 PIN outlet socket	1 NO
13/	indicator	3 NOS.
14/	board cover (30 x30) cm (10 x5) cm (5 x5) cm	12 NOS.
15/	m/c screw 2.5 cm	As reqd.
16/	fanning thimbles	3 NOS.
17/	flexible conduit	2mtr
18/	flexible wire 5AMP	4mtr.
19/	Nails	As reqd.

ESTIMATE FOR POWER CKT IN WORKSHOP:

MOTOR WIRING:-

1/ For starting of squirrel cage induction motor of the capacity up to 1 HP DOL starter is used.

2/ Above 1 H.P and below 15 HP star-delta starter is used.

3/ For above 15 H.P autotransformer starter is used.

4/ For slipring induction motor above 15 H.P rotor resistance starter is used.

Determination of rating of cable

1/ The rating of cable should be equal to two times of the full load current

2/ The range may also be taken as 1.5 - 2 times of full load current.

DETERMINATION OF FUSE RATING:

1/ The fuse is employed for protection of motor against over load and short circuit

2/ So it should be taken as twice the rating of cable.

SELECTION OF RATING OF MAINSWITCH:-

The main switch for power wiring is selected on the basic of total current rating requirement on the workshop including starting current of one highest rating of motor + full load current of remaining motor to be control from it. i.e rating of main switch =

= starting current of one highest rating motor + full load current of remaining motor.

DETERMINATION of MOTOR POWER: (I/P)

1/ Motors are rated in break horse power (BHP) i.e the power which the motor will able to supply at rated voltage and speed.

2/ The motor I/p will be greater than o/p due to internal losses, (Iron loss, mechanical loss).

3/ So for determination of I/p to the motor for wiring calculation, these losses needn't be determine separately.

4/ So we take help of efficiency to determine the I/p of a motor which is the ratio of output to input.

EFFICIENCY:-

1/ For motor below 1HP (0.5 - 0.65).

2/ For motor bet^{n} 1 BHP - 2 BHP = (0.7 - 0.75)

3/ The motor above 2BHP and below 5 BHP = (0.75 - 0.8)

4/ The motor above 5 BHP or large size efficiency = 0.9 (i.e 0.85 - 0.9)

IMPORTANT TERMS ABOUT MOTOR INSTALLATION:

1/ All equipment used in power wiring shall be up iron clad construction and

2/ the wiring shall armoured cable or of conduit type

2/ Looping of conducton and use of Joines shall not be allowed.

3/ Length of flexible conduit use for connection between the terminal box of motor and starter or switches shall not be exceed 1.25 mtr.

4/ Every motor regardless of its size shall be provided with separate main switch placed near it.

5/ All motor should be started with a suitable starter

6/ The conduit use for wiring or enclosing V.I.R or PVC cable, aren't usually run on surface rather than laying them in suitable inches.

7/ All motor shall be earthed at diffrent separate earthing.

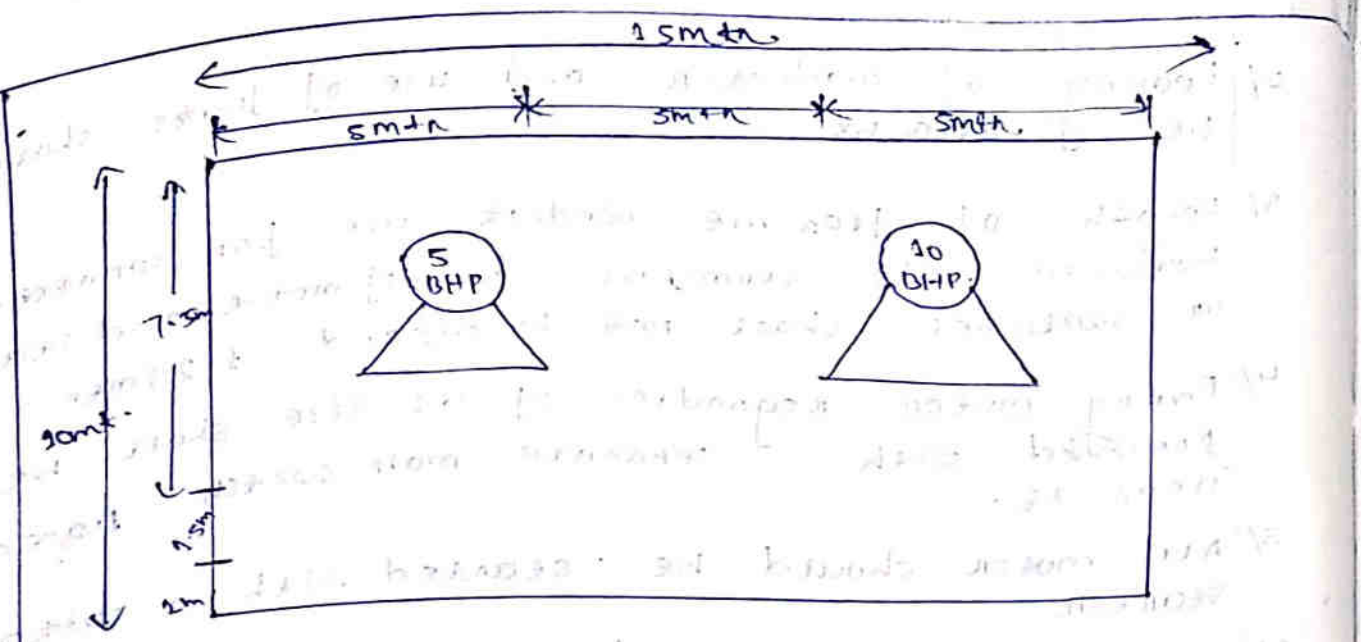
8/ The earth wire should be copper or G.I.

9/ IMPORTANCE REGARDING

Q-1/ It propose to install two motors having 5HP & 10 BHP. The installation should be provide with concled conduit wiring after main switch. The electrical connecton of motors are given below. prepared the complete estimate in the following sequence.

a) Draw installation plan shoing location of machine, main switch, starters, main switch board

b) Prepare the material required for above installaton with proper installation.



ASSUMPTION :- ① Distance beet motor switch to starter 0.25m.
② Starter to condule mount 0.25m.

1/ Let meter board, main main switch, MDB box are placed 1mtr away from commencement of work shop.

2/ The height of energy meter, mm sholder MDB ~~1mtr~~ 1.5mtr above the floor

3/ The height of workstor is 4mtr and HR runis facing a height of 3.5mtr above the floor.

4/ The motor are placed 2mtr away from the wall distance beet wall and faindation.

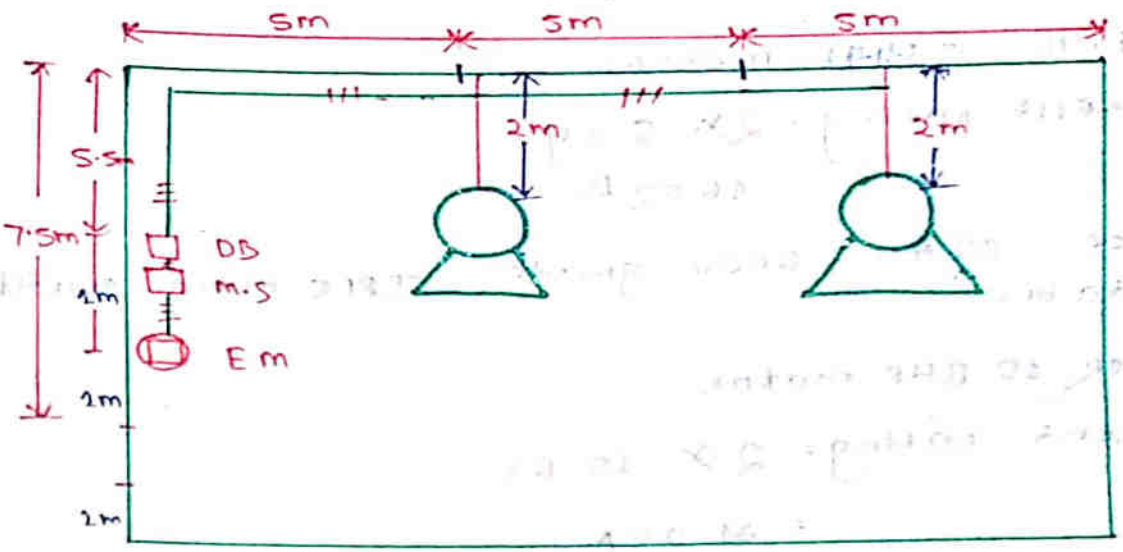
5/ The height of foundation is 0.5mtr above the floor

6/ Distanie beth terminal box to foundation height is 1m.

7/ The ~~depth~~ of wires are taken out a ~~trench~~ depth of 0.5mtr below surface of floor

8/ The power factor should be taken 0.8 for

LAYOUT



CALCULATION OF LOAD CURRENT:

FOR 5 BHP motor = $5 \times 735.5 = 3677.5$ watt.

$\sqrt{3} V_L I_L \cos\phi = 3677.5$ watt.

$\Rightarrow I_L = 3677.5 / \sqrt{3} \times 400 \times 0.8 = 6.635$ AMP.

Hence I/P to the motor = I_L / η

$= 6.635 / 0.8$

$= 8.293$ A.

η = O/P / I/P

∴ I/P = O/P / η

FOR 10BHP motor = $10 \times 735.5 = 7355$ watt.

$\sqrt{3} V_L I_L \cos\phi = 7355$ watt.

$I_L = 7355 / \sqrt{3} \times 400 \times 0.85 = 15.66$ A

~~Hence I/P to the motor~~ = I_L / η

$= 15.6A / 0.85$

$= 18.35$ A

SELECTION OF MAINSWITCH

a) Main main switch.

current rating = Ist of 10 BHP motor + Full load current of 5BHP motor

$= 2 \times 15.61 + 8.29 = 39.51$ A

Hence 63A, 600V grade TPIC main switch is used

b) FOR 5 BHP MOTOR

current rating = 2X 8.29

= 16.52A

Hence 32A, 600V grade TPIC main switch is suitable

c) FOR 10 BHP motor

Current rating = 2X 15.61

= 31.22A.

Hence 40A, 600V grade TPIC main switch is suitable

SELECTION OF RATING OF WIRE

Between EM to DB :-

Total load current = 39.5

16mm², 7/1.68 mm diameter copper conductor single core PVC insulated is able to carry hence it is suitable

FROM DB to 5HP motor :-

Current = 16.52A

4mm², 7/0.85 dia PVC insulated copper single core conductor is able to carry 40A hence it is suitable

FROM DB TO 10 BHP MOTOR :-

current = 31.22A

6mm², 7/1.04 mm dia PVC insulated copper single core conductor is able to carry 32A hence it is suitable.

SELECTION OF MDB :-

As the total current is 39.31 A so 60 A, 600 V grade 6-way with neutral link iron clad DB is suitable

SELECTION OF CONDUIT :-

From EM to MDB = ~~25mm dia~~

Here 25 mm dia PVC conduit is suitable

Total length of 25mm dia conduit = 0.5m + 0.5m = 1m

Taking 20% wastage = 0.2

Grand total of 25mm dia conduit = (1 + 0.2)m

= 1.2 m.

From MDB box to 5HP motor

Here star delta starter is used so 30 mm dia PVC conduit is suitable.

1) MDB to motor main switch = 2 + 5 + 5 + 2 = 14.5 m
2) From starter to motor foundation = ~~1.25 + 0.5 + 0.5 + 0.5~~

= 1.25 + 0.5 + 2 + 0.5 + 0.5

= 4.75 m

From MDB box to 10 BHP motor

1) MDB to motor main switch = 2 + 5 + 5 + 10 + 2 = 19.5 m
2) From starter to motor foundation = 4.75m

Grand Total conduit = 14.5 + 4.75 + 19.5 + 4.75

= 43.5

Taking 10% wastage = $43.5 \times \frac{10}{100}$

= ~~07~~ 4.35

Grand total = 43.5 + 4.35 = 47.85 m

~~2 m~~

Flexible conduit :-

1) motor main switch to starter = $2 \times 0.25 = 0.5$m.
2) Starter to conduit mouth = $2 \times 0.25 = 0.5$m.
3) foundation to terminal box = $2 \times 1 = 2$m.

Total = $0.5 + 0.5 + 2 = 3$m

Take 10% wastage = $3 \times \frac{10}{100}$

$= 0.3$

Grand total = 3.3 mtr

CALCULATION FOR LENGTH OF WIRE/CONDUCTOR

1) E.M to MDB = $3 \times (0.3 + 0.5)$
$= 3 \times 1$
$= 3$m.

10% wastage = 0.3

G total = 3.3m

2) MDB to 5BHP MOTOR = $3(2 + 5.5 + 5 + 2 + 0.25) + 6(1.25 + 0.5 + 2 + 0.5 + 0.5 + 1)$

$= 44.25 + 34.5$

$= 78.75$

10% wastage = 7.875

G total = $78.75 + 7.875$

$= 86.625$

$= 87$ mtr

3) FROM MDB to 10BHP MOTOR:-

= 3(2 + 5.5 + 10 + 2 + 0.25) + 6 (1.25 + 0.5 + 2 + 0.5 + 0.5 + 1)

= 93.75

10% wastage = 93.75 × 10/100

= 9.37

G total = 93.75 + 9.37

= 103.125

= 104 m.

EARTH WIRE:-

For the motor installation double earthing is provided with the help of 8 SWG GI wire so total length of GI wire

= 2(Length of from ~~main~~ MDB to 5BHP + Length from MDB to 10BHP

= 2{(2 + 5.5 + 5 + 2 + 0.25 + 1.25 + 0.5 + 0.3) + (2 + 5.3 + 10 + 3.5 + 0.5 + 2 + 0.5 + 0.5)}

= 92

10% = 92 × 10/100

= 9.2

= 101.2 m

MATERIAL LIST

SL.NO	MTRL & SPECIFICATION	QUANTITY
1	a) TPIC main switch. 63 A, 600V grade	1 No.
2	b) TPIC main switch 32A, 600V grade	1 No.
3	c) 40A, 600V grade TPIC main switch	1 NO.
4	60A, 600V grade 6-way with neutral link iron clad distribution box	1NO.
5	3 ϕ EM with board size 300mm x 300mm	1NO.
6	a) EM to MDB 25mm dia conduit (PVC)	1.2mtr
	b) MDB to 5HP motor 30 mm dia P.V.C conduit	48 mtr
	c) Flexible conduit 30mm	3.5 mtr
7	a) ~~EM to MDB board~~ 15mm^2, 7/1.63 mm dia copper conductor.	1 mtr
	b) 6mm^2, 7/1.06 mm copper conductor	11 mtr
	c) 8mm^2, 7/1.12 mm copper conductor	16 mtr
	d) GI wire 8 SW.G	10.1.2 mtr
8	Iron clad board for mounting main switch 300mm x 300mm	3 Nos.

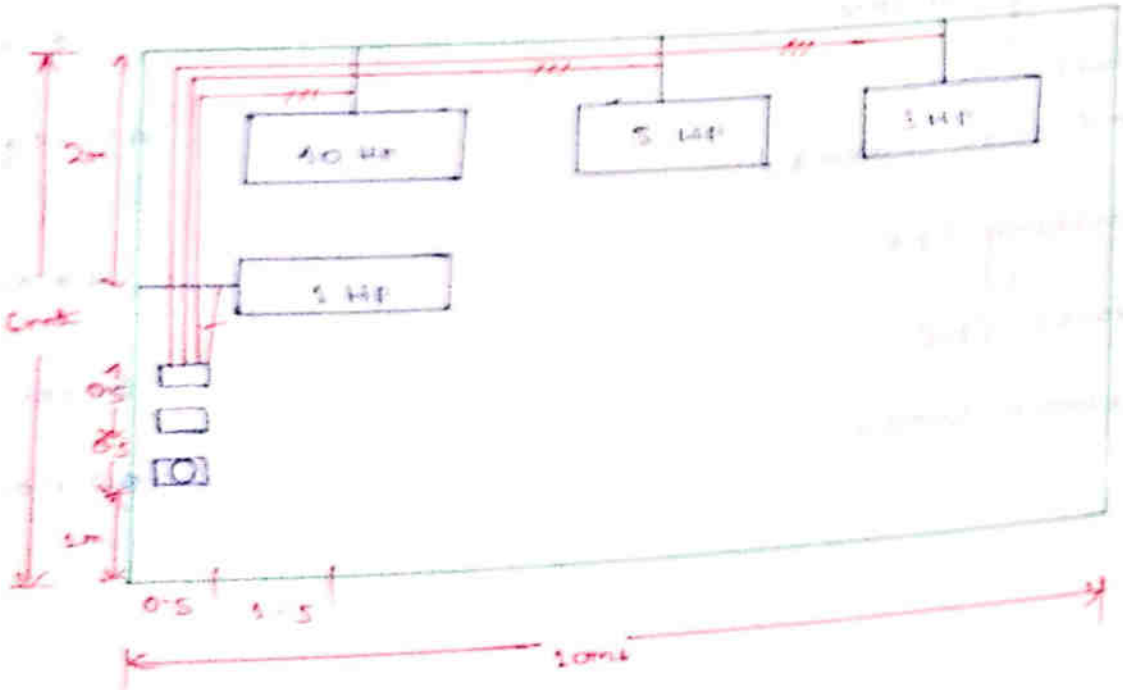
Sl.No	MTRL & SPECIFICATION	QUANTITY
18	Iron clad board for mounting motor starter (60cm x 45cm)	2 Nos.
19	GI thimbles connecting earth wires with main switch, motor switch & other iron parts	16 Nos.
20	Flexible conduit coupler.	12 Nos.
21	Conduit shaddle for holding the conduit inside the wall	as per reqd.
22	Screw 25mm long.	as per reqd.
23	PVC / wooden guttles	as per reqd.
24	~~Dan~~ caution plate showing 440V.	2 Nos.
25	Civil-works. (Sand, chips, cement)	as reqd.
26	Earthing set.	20 Nos.
27	Nails (1.5")	as per reqd.
28	Labour works	as per reqd.

(Q) A small workshop size 10m x 6m x 4m height is required to provide following electrical power connection for motor which are taken along the wall

a) 10 BHP motor for lath.
b) 5 BHP motor for small lath
c) 3 BHP motor for automatic tool manufacturing machine.
d) Grinding machine of 1ϕ induction motor of 1 BHP.

Prepare the complete estimate with the installation lay out showing different location of motor

Solution:



Assumptions:

1) Distance between motor switch to starter = 0.25m.
2) Starter to conduit motor = 0.25m.
3) Meter board, main switch MCB box are placed = 1m long from the work shop.
4) The height of energy meter, mainswitch & MCB box 1.5m above the floor.
5) The motor are placed 1m away from the wall distance between wall and foundation.
6) The height of foundation is 0.2m above the floor.
7) Distance between terminal box motor foundation height is 1m.
8) The wire are take at a trenches depth of 0.2m below surface floor.
9) The power factor should be taken 0.8 for all motor.
10) The roof height of workshop is 4mt.
11) Grinding machine is place 1m above the floor fixed to the wall.

Calculation of load current :

Load current of 10HP motor = $\frac{P}{\sqrt{3} \times V \times \cos\phi \times \eta}$

$= \frac{10 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.85}$

$= 15.61\ A$.

Load current of 5HP motor = $\frac{P}{\sqrt{3} \times V \times \cos\phi \times \eta}$

$= \frac{5 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.85}$

$= 7.80\ A$

Load current of 3HP motor = $\frac{P}{\sqrt{3} \times V \times \cos\phi \times \eta}$

$= \frac{3 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.75}$

$= 5.30\ A$.

Load current of 1HP motor = $\frac{1 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.75}$

$= 1.76\ A$.

$= 5.32\ A$

Selection of mainswitch:-

a) main main switch :-

current rating = starting current of one highest rating motor + full load current of remaining motor

= 2 × 15.6A + 7.80 + 5.30 + 5.32

= 49.64

Hence TPI.CN switch 63A, 600V grade main switch is suitable

b) For 10 BHP motor :-

current rating = 2 × 15.6

= 31.22A

= 32A.

Hence 32A, 600V grade TPIC main switch is suitable

c) for 5BHP motor :-

Current rating = 2 × 7.80

= 15.60A

32A, 600V grade TPIC main switch is suitable.

d) 3 BHP :-

CR = 2 × 5.30

= 10.60

16A, 600V grade TPIC main switch is suitable.

c) 1 BHP

CR = 2 × 5.32

= 10.64 A

16 A, 400 V grade DPIC make switch is suitable.

Selection of conductor:

I_L = 49.64 A

a) Em to DB

20 mm², 19/1.12 mm dia copper conductor single core PVC coated is able to carry 56 amp hence it is suitable

b) From DB to 10 BHP motor:

S.C. = 32 A

Hence 8 mm², 7/1.12 mm dia copper conductor single core PVC coated is able to carry 32 A hence it is suitable.

c) From DB to 5 BHP motor:

S.C = 15.60

Calculation for rating of MDB:-

Hence 63 A 600V grade M.D.B with neutral link is suitable hence it is used. ~~Calculate~~

Calculation of conduit:-

As 3φ supply is given to each motor so 30mm dia PVC conduit is suitable.

From MDB to 10 BHP motor:-

= 2 + 4 + 2 + 2 + 1.25 + 0.25 + 0.5 + 1 + 0.25 + 0.5

= 13.75 mts.

= 13.75 M

= 11.75 mts

From MDB to 5 BHP motor:-

= 2 + 4 + 2 + 3 + 2 + 1.25 + 0.25 + 1 + 0.25 + 0.5 = 16.75 Mts

From MDB to 3 HP motor:-

2 + 4 + 2 + 3 + 2 + 1.25 + 0.25 + 1 + 0.25 + 0.5 = 19.25 M

From MDB to 1 BHP 1φ motor:-

= 2 + 0.25 + 1.25 + 0.25 + 1 + 0.25 + 0.5 = 5.75 mt

= 2.05.

Total = 51.25.

10 % wastage = $51.25 \times \frac{10}{100}$

= 5.125

MDB to 5 BHP:-

= 3 (2 + 4 + 8 + 2 + 0.25) + 6 (1.25 + 0.25 + 1 + 0.25 + 0.5 + 1)

= 65.25mts.

MDB to 3 BHP

= 3 (2 + 4 + 8 + 2 + 0.25) + 6 (1.25 + 0.25 + 1 + 0.25 + 0.5 + 1)

= 74.25 mts.

MDB to grinder 1 BHP motor

= 2 × 2.5

= 5 mts

Em to main mainswitch and mms to MDB

(3 × 0.5) + (3 × 0.5)

= 3mts

Calculation of earth wire

For motor installation double earthing is provided with the help of 8 SWG G.I wire so the length of GI wire.

= 2 { length from MDB to 10BHP + length from MDB to 5 BHP + length from MDB to 3 BHP motor. }

= 2 { 56.25 + 65.25 + 74.25 }

= 319.5m.

Calculation for flexible conduit:

from tim to mms = 0.25 m

mms to MDB = 0.25 m

motor m.s to starter = 3 × 0.25.

= 0.75 m

Starter to conduit mouth: 0.25 × 3

= 0.75m

motor foundation to terminal box: 3 × 1

= 3m

DP fc main switch of 1φ grinder to grinder terminal box = 0.25 m

Total = 0.5 + 0.5 + 0.75 + 0.75 + 3 + 0.25

= 5.75

10% wastage = 5.75 × 10/100

= 0.575.

Total = 5.75 + 0.575.

= 6.325m.

Calculation for plain wire:

MDB to 10BHP

3 (2+4+2+1.5+0.25+1+0.25+0.5+1) + 6 (1.5

= 3 (

= 3 (2+4+2+2+0.25) + 6 (1.25+0.25+1+0.25+0.5+1

= 56.25 m

MDB to 5 BHP:-

= 3 (2 + 4 + 8 + 2 + 0.25) + 6 (1.25 + 0.25 + 1 + 0.25 + 0.5 + 1)

= 65.25 mts.

MDB to 3 BHP

= 3 (2 + 4 + 8 + 2 + 0.25) + 6 (1.25 + 0.25 + 1 + 0.25 + 0.5 + 1)

= 74.25 mts

MDB to grinder 1 BHP motor

= 2 × 2.5

= 5 mts

Em to main mainswitch and mms to MDB

(3 × 0.5) + (3 × 0.5)

= 3 mts.

Calculation of earth wire

For motor installation double earthing is provided with the help of 8 SWG G.I wire

So the length of GI wire.

= 2 { Length from MDB to 10 BHP + Length from MDB to 5 BHP + Length from MDB to 3 BHP motor. }

= 2 { 56.25 + 65.25 + 74.25 }

= 319.5 m.

SL NO	MTRL & SPECIFICATION	QTY	UNIT
d)	MDB to 3 BHP motor 30 mm dia conduit PVC.		
e)	MDB to 1 BHP motor 30 mm dia conduit PVC.		
5) a)	25 mm² : 7/1.63 mm dia 1-core copper conductor	1.1	mtr
	b) 6 mm² : 7/1.60		
6)	DP I C switch	1	Nr
7)	GI wire SWG	112	mtr
8)	Iron clad board for mounting motor main switch. a) 300mm x 300mm	4	NOS.
	b) 200mm x 200mm	1	NOS.
9)	Iron clad board for mounting motor starter (60 x 45) cm	3	NOS.
10)	GI thimble with nut & bolts for connecting earth wire to main switch, motor starters, & other iron parts.	16	NOS.
11)	Flexible conduit coupler		as per required.
12)	Conduit shaddle for holding the conduit inside the wall.		as per required.
13)	Screw 25 mm long.		as per
14)	Gluttes.		

10% for wastage = $319.5 \times \frac{10}{100}$

= 31.95

So Grand total = 319.5 + 31.95

= 423.45 mts

ESTIMATING LIST:

SL NO.	MTRL & SPECIFICATION	QUANTITY	UNIT
1// a)	TPICN main switch 63A, 600V grade	1	NO.
b)	TPICN main switch 32A, 600V grade	2	NOS.
c)	TPICN main switch 16A, 600V grade.	1	NO.
d)	DPIC main switch 6A, 230V grade	1	NO.
2//	MDB, 60A, 600V grade 10 way with neutral link	1	NO.
3//	3 ϕ EM with board size 30 cm × 30 cm	1	NO.
4// a)	EM to MDB 30 mm dia conduit PVC	5)	mt.
b)	MDB to 10 BHP motor 30 mm dia conduit PVC		
c)	MDB to 5 BHP motor 30 mm dia conduit PVC		

SL NO	MTRL & SPECIFICATION	QTY	Unit
d)	MDB to 3 BHP motor 30 mm dia conduit PVC		
e)	MDB to 1 BHP motor 30 mm dia conduit PVC.		
5) a)	2.5 mm², 7/1.63 mm dia 1-core copper conductor	1.1	mtr
b)	6 mm², 7/1.60		
6)	DP I E switch	1	Nos
7)	GI wire 8SWG	112	mtr
8)	Iron cuaid board for mounting motor main switch. a) 300 mm x 300 mm	4	Nos.
	b) 200 mm x 200 mm	1	Nos.
9)	Iron cuaid board for mounting motor starter (60 x 45) cm	3	Nos.
10)	GI thimble with nuts & bolts for connecting earth wire in main switch, motor starter, & other iron parts.		
11)	Flexible conduit coupler	16	Nos.
12)	Conduit shadde for holding the conduit inside the wall	as per required	
13)	Screw 25 mm long.	as per required.	
14)	Gutties -	as per	

15) caution plate showing 440V — 3 Nos.

16) Earthing complete set — 2 Nos.

17) Main 1.5" — as per req d.

18) Civil work Sand, cement chips — as per req d.

19) Labour work — as per req d.

SERVICE CONNECTION

SERVICE CONNECTION TO WORK SHOP SMALL INDUSTRY

(i) The from the generating station is transmitted to places for public utility by means of distribution line known as distributor

(ii) The distribution is fed by desribution substation which convert 11 kv 3φ 3wire to 440V 3φ 4-wire system i.e Phase to neutral 230 V.

(iii) For domestic consumer we supply 230V 1φ 2-wire system, where as for industerial consumer generally fed by 3φ - 4wire system.

(iv) For the workshop and industry consumers are supply with power individually from nearest pole in the form of 3φ - 4wire service main cable

(v) so it is divided in to two types;

a) over head service connection.

b) under ground service connection.

OVER HEAD SERVICE CONNECTION:-

(i) This system is prefer for load below 20kw.

(ii) Which may be 1ϕ or 3ϕ overhead service connection should be provided.

(iii) The overhead service connection will vary prevailing condition regarding the consumer premises.

(iv) The overhead service connection will vary depending upon the prevailing condition regarding consumer.

UNDER GROUND SERVICE CONNECTION:-

(i) This system is prefered for above 20kw.

(ii) which is 3ϕ - 4wire system.

(iii) For providing service connection by underground cable a cable box of suitable size is fitted to the service pole. by means of ms channel. of size (66 x 25) mm. by means of bolts & nuts.

(iv) Then the cable is carried from the cable box fitted on the pole to another cable box fitted on service board (maunt in workshop wall).

(v) 1st the cabe is taken along the pole then through a trench. (1mtr depth) to the workshop wall and then lastly vertically along the wall to the second cable box.

(Q) A 3Φ 4 wire underground cable service connection is to be given to a small workshop from an existing 440V, 3Φ, 4 wire, 50 Hz overhead line. The distance of the main board from the service board 15m. The total 1Φ and 3Φ load in the workshop is about is 150 Amps. Estimate the quantity of material for given service connection?

Assumption:

(i) Total height of the pole of supply is 6mt height from the ground level

(ii) The cable box on the pole fitted 0.5mt below the overhead lines.

(iii) Assume all the loads in the w/s shouldnot separate at a time (i.e different units are operate at different times).

(iv) The cable box in the wall fitted 1.5mt above the ground.

(v) Depth of the trench = 0.5 mtr
conduit pipe is provided for the cable 2.5mt above the ground level on the pole.

* **Calculation for length of weather proof underground cable.**

It is given that total 1ϕ & 3ϕ load in the w/s = 150 amp.

Taking diversity factor = 0.6.

Hence total estimate load current;

= 0.6 × 150

= 90 Amp.

Hence 25 mm², 7/2.24 mm dia 3 Q & multicore 1100v grad 'AC' conductor paper insulated impregnated lead coven underground cable having maximum current carrying capacity is 107 amp. Hence it is suitable.

Total length of cable required:
Length of the cable along the pole upto the ground + Length along the trench + vertical run along the wall upto cable box.

= 6 + 0.5 + 15 + 0.5 + 1.5

= 23.5m

alowing 10% wastage = 23.5 x 10/100

= 2.35

Total = 23.5 + 2.35 = 26mtr

Calculation for length of earth wire.

Total length of earth wire = same as that of cable length = 23.5mtr

Taking 1mtr wastage = 24.5mtr.

Calculation for length of conduit pipe:

38 mm GI conduit is used.

Length of conduit pipe = 2.5 + 0.5 + 15 + 0.5 + 1.5

= 20mtr.

Taking 1mtr wastage = 20 + 1

= 21mtr

Material table:

SL NO	SPECIFICATION OF MTRL	QUANTITY	UNIT
1	25mm² 7/2.24 dia 3 1/2 core aluminium conductor paper laminated lead covered 660v grade	26	mtrs.

SL NO	SPECIFICATION OF MTRL	QUANTITY	UNIT
	Earth wire.		
2	8 S.W.G earth wire	24.5	mtrs.
3	38 mm conduit (GI)	21	Mtrs.
4	LT cable bow suitable for above cable	2	NOS.
5	MS channel required of suitable size for cable bow	4	NOS.
6	conduit bend for 38 mm dia pipe.	2	NOS.
7	pole clamp for cable covered with GI pipe	3	NOS.
8	Nut and bolts required for pole clamps.	6	Nos.
9	Rubber bushing	2	NOS.
14	Iron clad fuse 150 AMP capacity which is fitted on service pole	3 (1 set)	NOS
11	Iron clad meter board (30 x 45) cm	1	NO.
12	Nut and bolts for fitting LT cable bow on meter board (15mm dia x 50mm long)	4	NOS.
13	Shades	3	NOS.
14	Industrial gutles	3	NOS.
15	Nails	as per reqd.	
16	civil work	as per reqd.	
17	Labour charge	as per reqd.	

Q// A 3φ, 4-wire underground cable service connection is to be given to a newly constructed laboratory block of the polytechnic from an existing 400/230V 3φ, 4-wire 50Hz overhead lines. The distance of the main board from service pole is 15 mtrs. Total 1φ & 3φ load in the laboratory is about 250 Amp. Estimate the approximate cost of the material for giving service connection.

ASSUMPTION:

(i) Total height of the pole of supply is 6mtrs height from the ground level

(ii) The cable box is fitted 0.5mt below the overhead lines.

(iii) Assume all the loads w/s should not separate at a time (i.e different units are operate different times)

(iv) The cable box on the wall fitted 1.5mt above the ground.

(v) Depth of the trench = 0.5mt.
conduit pipes provided for the cable 2.5mt above the ground level on the pole

Taking diversity factor = 60%
= 0.6

The actual current used at a time = 250 × 0.6
= 150 AMP

SELECTION OF CABLE:-

~~50mm², 19/2.24 mm dia multicore 1100V grade AC conductor.~~

50mm², 19/1.8 mm dia aluminium conducton paper insulated mass impregnated, lead coven under-ground cable having maxm current capacity is 158 Amp. Hence it is suitable

Total length of cable required =

Length of the cable along the pole up to the ground + Length along the trench + vertical run along the wall up to cable box =

= 6 + 0.5 + 15 + 0.5 + 0.15

= 23.5 mt

Taking 10% wastage = 2.35.

Grand total = 23.5 + 2.35 = 25.85.

CALCULATIONS FOR LENGTH OF EARTH WIRE:-

Total length of earth wire = same as that of cable length = 23 mt.

= 24.5 mt.

CALCULATION FOR LENGTH OF CONDUIT PIPE :-

Here 38 mm GI conduit is used.

Length of conduit pipe = 2.5 + 0.5 + 1.5 + 0.5 + 1.5

= 20 mtr.

Taking 1 mtr wastage = 20 + 1

= 21 mtr.

MATERIAL TABLE :-

OVERHEAD SERVICE CONNECTION TO DOMESTIC BUILDING

Overhead service connection may be divided into two types

a) angle iron method.

b) G.I pipe method.

Angle iron method :-

i) In this method an angle iron fitted to the wall or GI pole mounted on roof of house.

ii) The overhead lines should be taken from the nearest pole to the angle iron by the help of GI wire which fitted by the help of pin type shackle type insulator.

iii) Now the service connection is taken in to the house by the help of wheather proof cable towards the energy meter.

Problem :

A newly constructed single stayer building is to be provided 1Φ, 230V, 50Hz, having a load of 5KW the supply is to be given from over head line 20m away from the building. Prepare the list of material for giving service connection. A GI pipe laid along the roof to receive bare conductor on its cross arm fitted with insulation

Assumption :-

The height of the ground floor is 3.5m service connection received at the height of 6m from the floor. Electrical loads, 5-sub ckt of 1000 each a 15A socket of two = 5kW

Calculation :-

selection & rating of wheather proof cable

Total load = 5kW

voltage = 230V

Power factor = 1.

$$I = \frac{5 \times 10^3}{230} = 21.73A.$$

Taking diversity factor 60%

so total load current = 21.76 × 0.6

= 13.056 A.

Hence wheather proof cable of size 1/1.5mm dia 1.5mm² PVC insulated two in core is able to carry 24A (12.2) KW hence it is suitable.

To meet the present load requirement and provision for future requirement in the event of expansion of building and any other electrical point.

Existing building therefore used higher rating wheather proof cable (50% extra)

13.056 + 50%.

= 19.584 ≅ 20 A.

Hence 3 4 A current rating is used

Length of bare conductor:

3 wires (earth, phase, neutral) comes from nearest pole to GI pipe

= 20 x 3

= 60 + 3 m (extra) for binding

= 63 m

Length of weather proof cable:

GI pipe is at a distance 6m above the floor.

EM is at a distance of 1.5m above the floor.

So the vertical distance bet^n GI pipe and EM = 4.5 m.

The EM is placed at a distance of 1m inside the verandha.

Wall crossing 0.3 m.

Thus distance bet^n shaded insulation and neck of GI pipe = 5 m.

So weather proof cable required

= 4.5 + 1 + 0.3 + 0.5 = 6.3 m

Taking 10% wastage = 0.63.

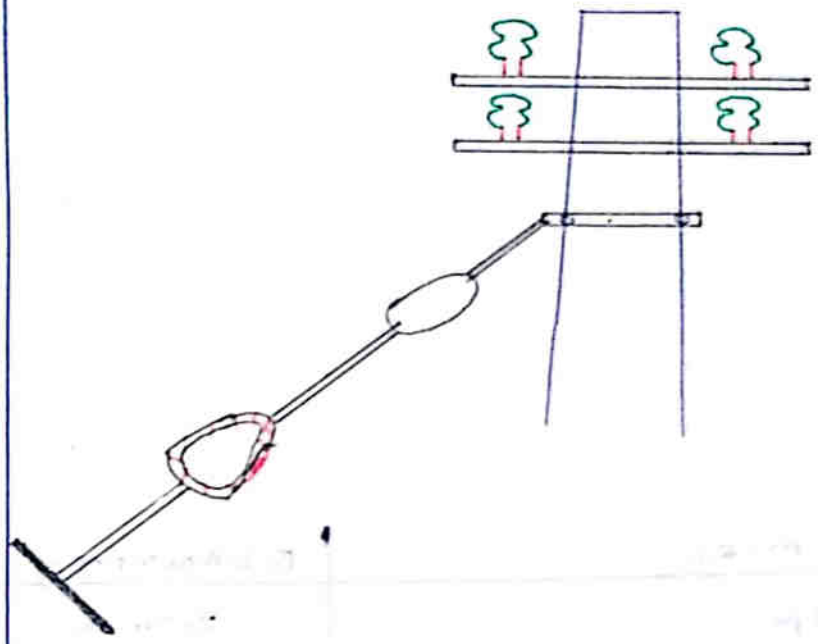
So total cable = 6.3 + 0.63 = 6.93 m ≃ 7m

Estimate chart

SL NO	SPECIFICATION & MATERIAL	QUANTITY & UNIT
1)	8 SWG GI wire for bare conductor up to GI pipe	63m.
2)	Weatherproof cable 1/3.55mm dia 10mm² aluminium core PVC insulated weather proof cable	7m.
3)	Earth wire of 8 SWG GI wire running along the GI pipe upto 6m	7m.
4)	GI pipe 20mm dia	6m.
5)	GI pipe clamp for 20mm dia to fix the stay wire and earth wire	2nos.
6)	GI pipe shaddle for 20mm dia to fix on the wall	4nos.
7)	Nut & bolts for above shaddles	2nos.
8)	For shackel insulator U clamps nut & bolts and other fitting	2nos
9)	Angle iron service bracket size (50mm x 50mm x 6mm & 60cm)	1no.
10)	Nut & bolts to fixed angle iron on GI pipe	2no
11)	Iron clad MB with 4No of bolts (25 x 30)	1no.
12)	Conduit bushing for GI pipe	2nos.
13)	Stay set complete fittings	1set
14)	Civil work	as reqd.
15)	Labour charge	L.S.
16)	Earthing set complete	1no.

A pole for overhead H.T on 11 KV, 50 Hz, 3φ line is to be required earthed make a neat sketch and showing how it should be done prepare a complete list of material required and also estimate the material required for stay wire arrangement?

STAY WIRE:-



SLNO	SPECIFICATION OF MTRL	QUANTITY
1)	MS Anchor plate (300mm x 300mm x 6.5mm)	1 NO.
2)	Thick stay plate.	
2)	MS stay rod (Galvanised) (2.5m long) (15mm dia)	1 NO.
3)	Stay boo.	1 NO.
4)	Stay wire (8 SWG GI wire) (Guy wire)	8 mm.
5)	Stay insulator (egg insulator)	1 NO.
6)	Stay clamp.	1 NO.
7)	Check nut (hexagonal nut)	1 NO.
8)	M.S thimble.	

9)	stay clam nuts bolts	2 NO.
a)	concrete of stay with cement, sand chips of ratio 1:2:4	as per reqd.

POLE EARTHING :-

SL NO	SPECIFICATION OF MTRL	QUANTITY
1)	25mm dia GI Pipe.	2.5mtr
2)	19 mm dia GI pipe for watering.	1.5mtr
3)	G.I wire (6SWG).	3mtr
4)	GI lug.	2NOS.
5)	10mm dia (32mm long) GI nuts & bolts for fixing cable lug with earth pipe.	2NOS.
6)	16 mm dia (40mm long) GI nuts & bolts for fixing thimble with pole.	1NO.
7)	(30cm x 30cm) cast iron cover.	1NO.
8)	(60cm x 60cm x 3.18mm) copper plate or (60cm x 60cm x 6.38mm) GI Plate.	1NO.

9) (30cm x 30cm) cast iron frame — 1 NO.

10) GI bend 19mm dia — 2 NOS.

11) Charcoal. — 10kg.

12) Salt. — 10kg.

13) Civil work and concrete — as per reqd.

14) Labour works. — as per reqd.

DISTRIBUTION SYSTEM :-

Estimate in a city or locality an overhead distribution line of 400V, 3φ, 50Hz is to be erected along a road on steel tubular poles. The length of line is 1000 mts / 1 km and the line terminate at the ends. The span between adjacent pole is 50m. The street light conductors are supported on the same pole make a neat sketch on the last pole and estimate quantity of material required for installing the distribution line with full specification of each item other details of lines are suggested at under

→ ACSR conductor for phase, neutral, street light conductor of size 6/1 x 2.11 sq conductor.

→ Earth wire 8 SWG galvanised steel is used

Fig - 22.2 (page)

ASSUMPTION :-

(i) The connection is taken for the line from an existing substation i.e on 11/0.4 kV grade.

(ii) Since we use to choose steel tubular poles hence shackle insulator will be prefer

(iii) Assume that the total distance in a straight path.

:- CALCULATION FOR NO. OF POLES :-

(i) It is given that total length of the line is 1km or 1000mtr. and the span is 50 mtr.

(ii) So no. of pole required = Distance / span + 1

$$= \frac{1000}{50} + 1$$

= 21 NOS.

i.e 19 NOS of intermediate pole and two end poles.

:- CALCULATION FOR LENGTH OF ACSR CONDUCTOR :-

Length of ACSR conductor of size 6/1x2.11.

= 1000x5 + 2% sag

$= 5000 + 5000 \times \frac{2}{100}$

= 5100 mtr

= 5.1 km.

From the table size of ACSR conductor 6/~~1X11~~. 6/1 X2.11 mm dia. The weight of conductor is 85 kg/km.

So ~~total~~ weight of ACSR conductor

⇒ 5.1 X 85 =

⇒ 433.5 say

= 434 kg.

CALCULATION FOR LENGTH OF EARTH WIRE

Length of 8.SWG GI wire = 1km + 2% say

$= 1000m + \frac{2}{100} \times 1000$

$= 1020m$

Length of 8.SWG GI wire = 10m/kg.

Total weight = 1020/10

= 102kg.

ESTIMATING CHART

SLNO	SPECIFICATION & MTRL	QUANTITY & UNIT
1)	L.T underground cable connection is done from 11/0.4 kv substation.	As per required.
2)	L.T cable box suitable for above cable	1 NO.
3)	~~Tap changer~~ cable clamp for holding cable box along pole.	2 NOS.
4)	Nut and bolts for above clamp	4 NOS.
5)	Steel tubular pole (9mts) long of	2 NOS.
6)	I.S.I quality ACSR conductor squirrel type Size 6/1 X 2.11	5100 mts 433 kg.

7) 8 SWG earthed wire — 10 20mtr, 102 kg

8) Shackle insulator — 3 each pole, Total = 105 nos.

9) 14 SWG GI wire (for binding) wire — 20 kg

10) Nut and bolts (15mm dia 200mtr long) with washers for fixing shackle insulator — 105 nos

11) Earth wire clamp on terminal pole and middle pole for holding earth wire — 2 nos

12) Eye bolt (15mm dia 200mm long) for holding earth wire on intermediate poles. — 1 nos

13) Cross arm :-
angle iron size (100mm × 50mm × 1.5mtr) — 2 nos.

14) pole cap of mild steel — 2 nos.

15) Earthy set (Every three pole one earth is constructed) — 7 nos

16) Stay set. — 2 nos.

17) Stone paid. — 2 nos.

18) Street light fitting (Complete with tubes and clamps — 2 nos

19) Civil work

20) Labour work

but for bulk consumer where substation is specially erected.

(v) The capacity of pole mounted substation is limited i.e upto 125 KVA, but above that we mounted the transformer on concrete plinth.

OUTDOOR SUBSTATION:

(i) In this type of substation the transformers are also mainted on concrete foundation.

(ii) This type of substation require single pole or double pole structure closed to transformer for providing supply and also taking supply.

(iii) CKT breaker as well as TPNO switch provided on both L.T as well as HT side.

(iv) The CKT breaker is provided on both side having transformer rating upto 500 KVA.

INDOOR TYPE SUBSTATION

(i) In this type substation transformer as well as switch gear equipment are installed inside the building.

(ii) We provide TPNO, CKT breaker & HT fuse on primary side which may be pole mounted.

(iii) If the supply is under ground cable it may be fitted inside the room on HT pannel board.

(iv) The LT pannel board also mainted inside the room consisting of LT fuse and CKT breaker.

SUBSTATION :-

(i) For transmission and distribution of electrical energy in urban area for supplying factory, bulk consumer in rural area for agricultural tubewell and bulk consumer and 11 KV line is popularly installed and terminated at 11/0.4 kV substation.

(ii) From a 11/0.4 kV substation the 3φ - 4 wire supply is commence and distributed to different load centre through distribution pole having span 100 mtrs but while crossing a road, rail, & bridge the span varies to 50 - 60 mtrs.

(iii) For distribution purpose we used pin type insulator for straight path, but if there diversion we used disk type insulator.

(iv) 11/0.4 KV substations are used in India;

a) Pole mounted substation.
b) Out door type
c) Indoor type

POLE MOUNTED SUBSTATION :-

(i) The transformer is mounted on (2 or 4) poles (R.S. JOIST).

(ii) It is cheapest and most economically mounting on the point of the view.

(iii) Here the transformer as well as the controlling element (TPMO switch, ST fuse, LT fuse box etc) are locate out side.

(iv) Here the 3φ - 4 wire directly runs from same pole where transformer is placed and no under ground cable connection is required.

but for bulk consumer where substation is specially erected.

(v) The capacity of pole mounted substation is limited i.e upto 125 KVA, but above that we mounted the transformer on concrete plinth.

OUT DOOR SUBSTATION:

(i) In this type of substation the transformers are also mounted on concrete foundation.

(ii) This type of substation require single pole or double pole structure closed to transformer for providing supply and also taking supply.

(iii) CKT breaker as well as TPMO switch provided on both L.T as well as HT side.

(iv) The CKT breaker is provided on both side having transformer rating upto 500 KVA.

INDOOR TYPE SUBSTATION

(i) In this type substation transformer as well as switch gear equipment are installed inside the building.

(ii) we provide TPMO, CKT breaker & HT fuse on primary side which may be pole mounted.

(iii) If the supply is under ground cable it may be feeed inside the room on HT panner board.

(iv) The LT panner board also mainted inside the room consisting of LT fuse and CKT breaker.

Q// A tube-well owner wants 3φ - 4 wire supply of power connection to 10 BHP motor from an overhead double pole structure having transformer rating 25 KV A, 11/0.4 kv. The double pole structure is 300 mtr away from tubewell estimate the quantity of material required for erecting a line and for giving service connection to tube-well motor also draw the neat sketch of diagram.?

SOLN

ASSUMPTION :-

(i) Power factor of the motor is (0.8) lagging

(ii) Efficiency of the machine. is (0.9).

(iii) The 3φ - 4 wire service connection taken nearer to the motor by overhead ACSR conductor and from the pole to EM we take 3 1/2 core wheater proof cable

current required = $\frac{10 \times 735}{\sqrt{3} \times V \times \cos\phi \times \eta}$

$= \frac{10 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.9}$

$= 14.74\ A.$

So ACSR conducton of sq. wage 6/1 X 2.11..

As the starting current is 1.5 time, of full load current is i.e 22.11 A.

So PVC coated 'AL' conducton 3, half core multicore 6mm², 1/2.8mm dia able to carry 24 amp hence it is suitable.

The length of this cable is 30mt as is used from T/F L.T side to pole & pole to Em. & Em to motor

→ Lengthe of A.C.S.R conducton required

= 300X4

= 1200mtrs.

→ 2% sag = $\frac{1200 \times 2}{100}$

= 24 mts

Total = 1224 mts

→ In the substation there are 5 Numbers of jumpers & each jumper requires 2meter (each Jumper - 2mts)

5 X 3 X 2m = 30mts.

Total ACSR = 1224 + 30

= 1254 mts

ESTIMATE CHART

SLNO	SPECIFICATION & MTRL	QUANTITY & UNIT
1)	LT 3 & half core, 6mm² 1/2.0mm dia.	50 mtrs.
2)	ACSR conductor 6/1x2.11.	1254 mtrs.
3)	Concrete poles 9mtrs long	2 NOS.
4)	Earth conductor of 8SWG GI wire	200 + 2% sag + 10m up to Em = 300 + 6 + 10 = 316m.
5)	14 SWG GI binding wire.	3kg.
6)	L.T shackle insulator	12 NOS.
9)	Nut and bolts. 15mm dia, 125 mm long for fixing shackle insulator	12 NOS.
10)	Eye bolt is 4mm dia 200mm long. for supporting cast wire	3NOS.
11)	Stay wire set complete	1set.
12)	Earthing set complet for earthing terminal pole	1NO.
13)	Stone raid	2NOS
14)	Reel insulator	3NOS.
15)	Anial fuse 30 A rating on last pole.	3NOS
16)	3φ, kit kat 32A rating 660V grade	3NOS.

15) concreting of poles — as per reqd.

16) TPMO switch — 1 NO.

17) Fuse set — 3 NOS.

18) Transformer 25 KVA, 11/0.4 KV — 1 NO.

19) L.T cable box with TPICN main switch off 100 A · 600 V grade — 1 NO.

20) MS channel of size 20cm × 10cm × 1.6 cm × 2.5 mtr long (for mounting transformer) — 2 NO.

21) Lightning arrester. — 3 NOS.

22) Labour charge & civil work — as reqd.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having T/F rating 11/0.4 KV. The HT line is available 50 mtr away from proper site. also make a ~~pole~~ needs sketch of pole mounted substation.)

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50 \text{ KVA}$

15) concreting of poles — as per requ.

16) TPMO scotch — 1 NO.

17) Fuse set — 3 NOS.

18) Transformer 25 KVA, 11/0.4 KV — 1 NO.

19) L.T cable bom with TPICN main switch off 100 A · 600 V grade — 1 NO.

20) ms channel of size 20cm × 10cm × 1.6 cm × 2.5 mtr long (for mounting transformer) — 2 NO.

21) Lightning arrester — 3 NOS.

22) Labour charges & civil work — as required.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having TIF rating 11/0.4 KV. The HT line is available some where from proper site. also make a pole mounted substation. neat sketch of pole

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50$ KVA

15) concreting of poles — as per need.

16) TPMO switch — 1 NO.

17) Fuse set — 3 NOS.

18) Transformer 25 KVA, 11/0.4 KV — 1 NO.

19) L.T cable bow with TPICN main switch of 100 A · 600 V grade — 1 NO.

20) ms channel of size 20cm × 10cm × 1.6 cm × 2.5 mtr long (for mounting transformer) — 2 NO. } 3 NOS.

21) Lightning arrester.

22) Labour charges & civil work — as required.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having TIF rating 11/0.4 KV. The HT line is available 50 mtr away from proper site. also make a rough neat sketch of pole mained substation.

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50 \text{ KVA}$

15) concreting of poles — as per need.

16) TPMO switch — 1 NO.

17) Fuse set — 3 NOS.

18) Transformer 25 KVA, 11/0.4 KV — 1 NO.

19) L.T cable bom with TPICN main switch of 100 A · 600 V grade — 1 NO.

20) MS channel of size 20cm × 10cm × 1.6 cm × 2.5 mtr long (for mounting transformer) — 2 NO.

21) Lightning arrester. — 3 NOS.

22) Labour charges & civil work — as required.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having T/F rating 11/0.4 KV. The HT line is available 50 mtr away from proper side. also make a pole mounted substation needs sketch of pole

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50 \text{ KVA}$

15) concreting of poles — as per need.

16) TPMO switch — 1 NO.

17) Fuse set — 3 NOS.

18) Transformer 25 KVA, 11/0.4 kV — 1 NO.

19) L.T cable bow with TPICN main switch of 100 A · 600 V grade — 1 NO.

20) ms channel of size 20cm × 10cm × 1.6 cm × 2.5 mtr long (for mounting transformer) — 2 NO.

21) Lightning arrester. — 3 NOS.

22) Labour charges & civil work — as required.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having T/F rating 11/0.4 KV. The HT line is available 50 mtr (any) from proper site. also make a ~~pole m~~ needs sketch of pole mainted substation.)

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50$ KVA

15) concreting of poles — as per need.

16) TPMO switch — 1 No.

17) Fuse set — 3 Nos.

18) Transformer 25 KVA, 11/0.4 kV — 1 No.

19) L.T cable box with TPICN main switch of 100A, 600V grade — 1 No.

20) MS channel of size 20cm × 10cm × 1.6cm × 2.5m long (for mounting transformer) — 2 No.

21) Lightning arrester — 3 Nos.

22) Labour charges & civil work — as required.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having T/F rating 11/0.4 KV. The HT line is available some away from proper site. Also make a pole m neat sketch of pole mounted substation?

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50$ KVA

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SLNO	SPECIFICATION & MTRL	QUANTITY
17)	Kitkat 16A rating 250V grade for 1φ supply.	2NOS
18)	3φ wire Rm : 25A	
19)	Concrete of pole foundation.	as per reqd.

FOR SUBSTATION

1)	R.S. JOIST 175mm x 100mm x 5cm.	2NOS.
2)	stone paide.	2NOS.
3)	substation plate.	1NO.
4)	ms channel 100cm x 5cm x 0.5cm x 20Sm long	1NOS.
5)	Eye bolts.	3 NOS
6)	11KV disk insulator with fittings	3NOS
7)	Dropper angle iron 75mm x 75mm x 8mm x 2m.	2NOS.
8)	11KV pin type insulation with fittings	6NOS.
9)	stay set complete	2NOS.
10)	Binding wire aluminium	2kg
11)	Danger plate with clamp	1NO.
12)	Barged wire.	1Kg
13)	Earthing complete set	1NO.
14)	Nut & bolts of size required for fittings of ms channel, dropper angle iron	18NOS.

15) concreting of poles — as per reqd.

16) TPMO switch — 1 NO.

17) fuse set — 3 NOS.

18) Transformer 25 KVA, 11/0.4 kV — 1 NO.

19) L.T cable bom with TPICN main switch of 100 A · 600 V grade — 1 NO.

20) MS channel of size 20cm × 10cm × 1.6 cm × 2.5 mtr long (for mounting transformer) — 2 NO.

21) Lightning arrester. — 3 NOS.

22) Labour charges & civil work — as required.

Q) Estimate the cost of a pole mounted substation capacity 50 KVA having T/F rating 11/0.4 KV. The HT line is available 50 mtr away from proper site. also make a pole m neat sketch of pole mained substation.?

$\cos\phi = 1$

$\sqrt{3} V_L I_L = 50 \text{ KVA}$

Assumption

Power factor of the system is = 1

⇒ Calculation of load current = $P / \sqrt{3} V_L \cos\phi$

$= \frac{50 \times 10^3}{\sqrt{3} \times 11 \times 10^3 \times 1}$

$= 2.624$ Amp.

⇒ So A.C.S.R conductor of sq. cage 6/1 x 2.11 mm dia conductor is used.

⇒ Secondary side current = $P / \sqrt{3} V_{L2} \cos\phi$

$= \frac{50 \times 10^3}{\sqrt{3} \times 0.4 \times 10^3 \times 1}$

$= 72.168$ Amp.

Total
Length of A.C.S.R conductor:-

= 50x3 + 3x5x2 + 2% sag of 150m

= 150 + 30 + 2% sag

= 150 + 30 + 3

= 183 mtrs.

In the secondary side we use underground cable up to pole

Size of underground cable

a) 95mm², ~~19/1.40~~ 7/3.00 PVC coated 3 or more core. AU conductor is suitable for taking 72.166 Amp max C.C.C is 82 Amp.

b) Length of underground cable is = 20 mtrs (approximately)

(If the T/F rating is above 125 KVA then it is required to plinth mounted sub-station so the A.C.S.R conductor is choosen as per the T/F rating and the last (5th) jumpers length increases to (5mtrs) i.e from pin-type insulator to bushing.)

ESTIMATING CHART

SL NO	SPECIFICATION & MTRL	QUANTITY & UNITS
a)	MTRL FOR H.T CONNECTION WITH MAIN LINE	
1)	MS channel (100mm x 50mm x 1.5m Long.)	1 No.
2)	HT 11kV disk insulator with fittings	3 NOS.
3)	11kV pin type insulator with fittings.	3 NOS.
4)	Stay set complete.	2 NOS.
5)	concreting of pole (pad).	1 NO.
6)	Earth wire clamp	1 NO.
7)	Binding wire 'AL' including Jumping.	1kg.
b)		
1)	A.C.S.R conductor 6/1 x 2.11 mm dia. size.	18 3 mtrs
2)	Galvanised steel wire of 8 S.W.G as a earth wire	50m + 2% say 50 + 1 = 51m
3)	R.S JOIST. (175mm x 100mm x 10 mtr Long)	2 NOS
8)	FITTING ON DOUBLE POLE STRUCTURE FOR POLE MOUNTED SUBSTATION.	
1)	Stone pad.	2 NOS
2)	Substation plate. (11/0.4kV) sharp	1 NO.
3)	Danger plate	1 NO.
4)	MS channel (100mm x 50mm x 0.8cm x 2.5mt Long)	1 No
5)	Eye bolt	3 NOS.
6)	11kV DISK insulator with fittings	3 NOS.

7) 11 kv pin type insulator — 6 NOS.

8) Stay set — 2 NOS.

9) LA — 2 NOS.

10) Binding wire 'AL' — 2kg

11) Proper angle iron (75mm x 75m x 8mm x 2m long) — 2NOS.

12) Barbed wire — 10kg.

13) Earthing complete set for pole — 1 set.

14) Nut and bolts of size as per reqd — 2 NOS.

15) Concreting of pole — 2NOS.

16) TPMB switch — 1 set

17) fuse set — 3NOS.

18) fabrication of some part such as clamp etc — as reqd.

D) T/F 50KVA 11/0.4kv — 1 No

E) TPICN mains switch of 100A of rating 600V grade — 1 No.

F) Earthing of T/F — 2 set

G) MS channel for T/P mounting (200mm x 100mm x 1.6 cm x 2.5 mtr long) — 2 NOS.

H) NUT and BOLTS for fixing MS channel on R.S Joist — 8 NOS.

I) Labour charges — as [illegible] or [illegible]

L) L.T cable box — 2NOS.

M) underground cable 50mm², 7/3.00 — 20MT.

N) Clamp (pole) — 6NOS.

O) Fuse links with neutral link. — 6NOS.

Estimating chart

SL NO:	MTRL & SPECIFICATION	QUANTITY	UNIT
1/	**Material for HT connection with main line.** :-		
a)	MS channel 10cm x 5cm. x 1.5 mt. long.	4	NOS.
b)	HT 11 kV disc insulator with fittings	3	NOS.
c)	R.C.C pole 9mtr longs	3	NOS.
d)	Pin insulator (11kV)	12	NOS.
e)	~~Pin type~~ stay set complete	3	NOS.
f)	Earth wire clamp	3	NOS.
g)	'T' clamp for MS channel.	4	NOS.
h)	Bonding wire including Jumper.	4	kg.
i)	Concreting of existing pole.	3	NOS.
2/	**ACSR conductor**		
a)	Squirrel cage ACSR conductor 6/1 x 2.11.	663	mtrs.
3/	GI wire for earthing Jumper	204	mtrs.
4)	RS JOIST 175mm x 100mm x 10m	2	NOS.
5/	**Fittings on HT double pole structure**		
a)	Stone pad	2	NOS.
b)	Substation plate	2	NOS.
c)	MS channel 100mm x 50mm x 1.5mt long	1.0	No.
d)	Eye bolt	3	NOS.

e) L.T cable bom — 2 Nos.

f) Fuse cut-out set 200 Amp — 6 Nos.

g) cable cundery round. 37/2.24, 50 mm² — 20 mtrs

h) Labour charges — one reqd.

i) civil work — one reqd.

(x) Estimate, neat sketch the use of material required for 20kw squirrel cage induction motor 3φ, 400v, 50Hz for use as irrigation pump from existing pole mounted substation of 50 kVA which is located 200 m away from propos side?

> The supply should be taken by A.C.S.R conductor up to propose side then by underground cable up to pump.

e) 11 kV disc insulator with fittings — 3 NOS.

f) 11 kV pin type insulator with fittings — 9 NOS.

g) L A — 3 NOS.

h) Caution plate — 1 NOS.

i) Stay set complete — 2 NOS.

j) Dropper angle iron
75x75mmx8mmx2mt. long — 2 NOS.

k) Bonding wire aluminium — 3 kg.

l) Barged wire

m) Earthy complete set — 1 SET.

n) Nut and bolt for
ms channel and dropper
angle iron. — 12 NOS.

o) T.P.M.O Switch — 1 NO.

p) Fuse set — 3 NOS.

q) Febrication of some
parts. (Clamps, etc) — as reqd

6// Transformer

a) ~~200 kV~~ 11kV / 0.4kV. — 1 NO

b) Plinth for above table size
for above T/F — 2 NOS

c) Earthy set complete. — 1 NO.

d) TPICN main switch of
400 Amp -

e) L.T cable boom — 2 Nos.

f) Fuse cut-out set 200 Amp — 6 Nos.

g) cable (underground) 37/2.24, 50 mm² — 20 mtrs

h) Labour charges — one reqd.

i) civil work — one reqd.

(x) Estimate, neat sketch the list of material required for 20Hp squirrel cage induction motor 3φ, 400V, 50Hz, for use as irrigation pump from existing pole mounted substation of 50 kVA which is located 200 m away from propose side?

> The supply should be taken by A.C.S.R conductor up to propose side then by underground cable up to pump.