United International University

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Subject: Electrical Wiring & Drafting

Section: A

Course Code: EEE 2200

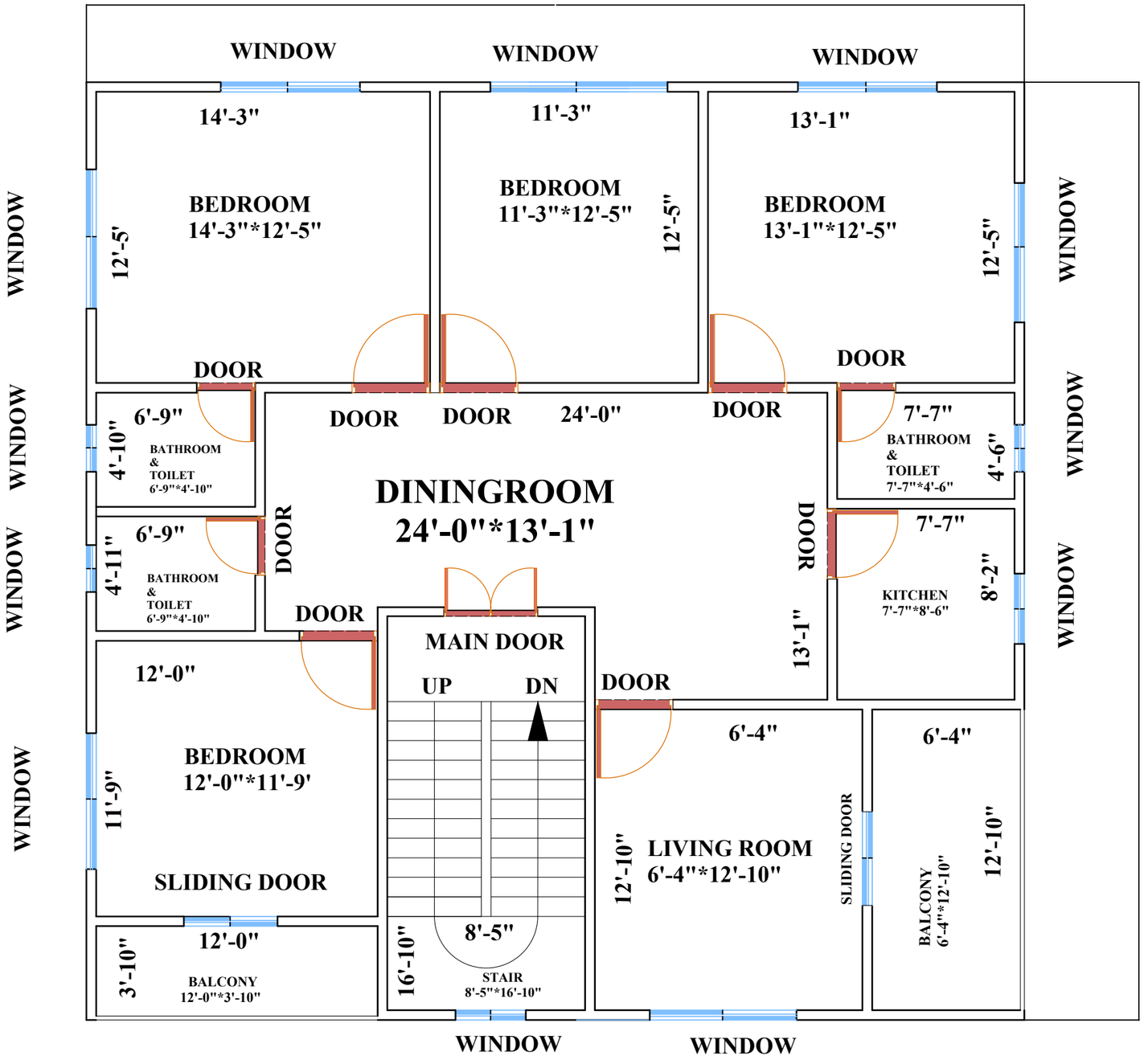
Project

Project

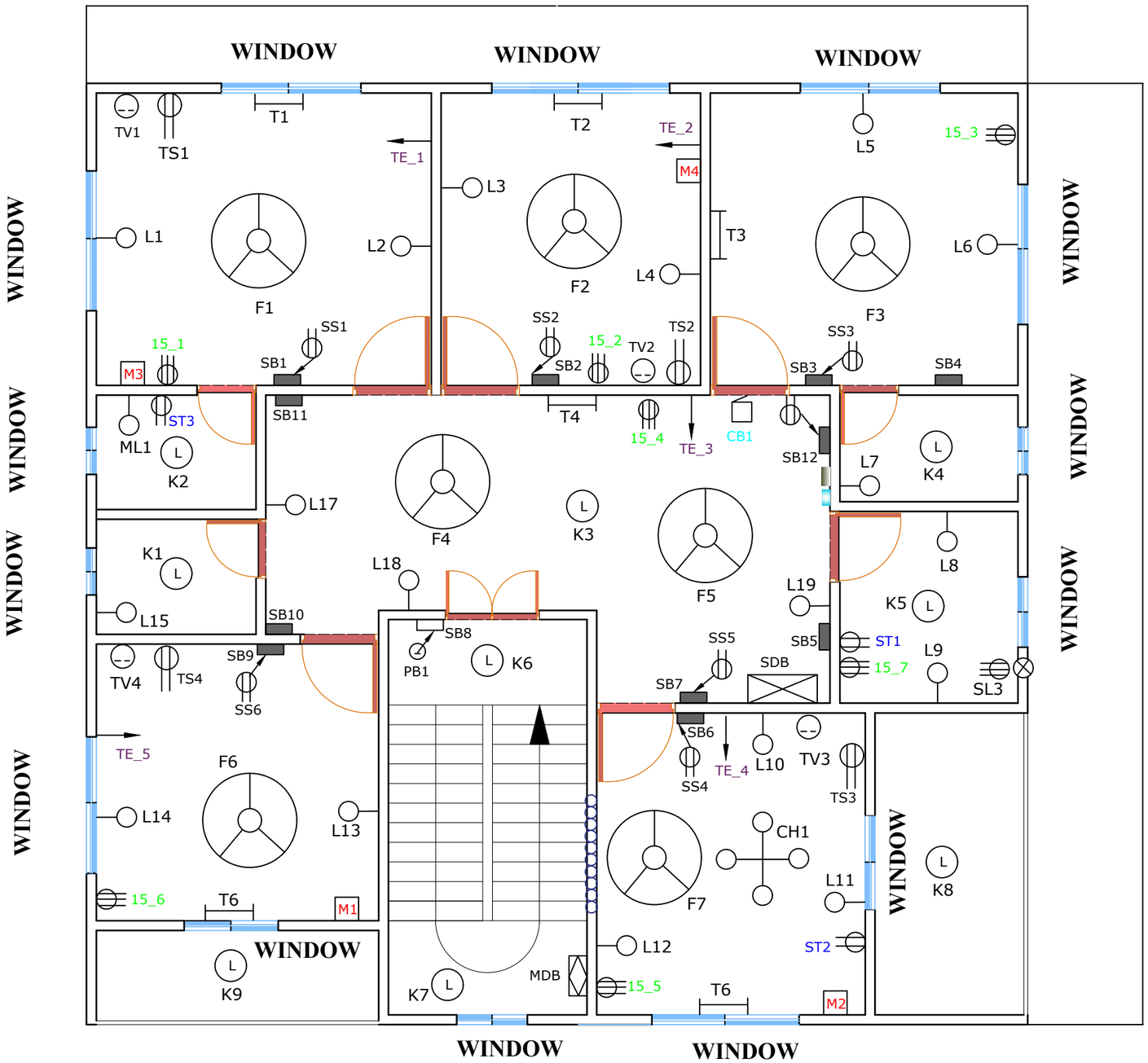
PROJECT SPECIFICATION: 1600+ square ft 10 story building wiring

1. Civil Layout
2. Fitting & Fixture Layout
3. Conduit Layout
4. Light Loads Connection
5. Heavy Loads Connection
6. Switch Board Connection & SDB to MDB Connection
7. Antenna, Telephone Connection
8. Switchboard Calculation
9. Switchboard Connection & Groups
10. SDB & MDB Calculation
11. Breaker Selection for Groups
12. Distribution Board Diagram
13. Main Distribution Board Diagram
14. Calculation of SLD
15. SLD Design
16. Lightning Protection Setup
17. Earthing System
18. Light Calculation for Living Room
19. PV Calculation for 10 Story Building
20. PV System Calculation for 10 Story Building & Battery Sizing
21. Sizing of Solar Charge Controller & PV Inverter
22. Rooftop PV Design & Setup
23. Solar PV System-Model
24. Fire Safety System-Model

CIVIL LAYOUT

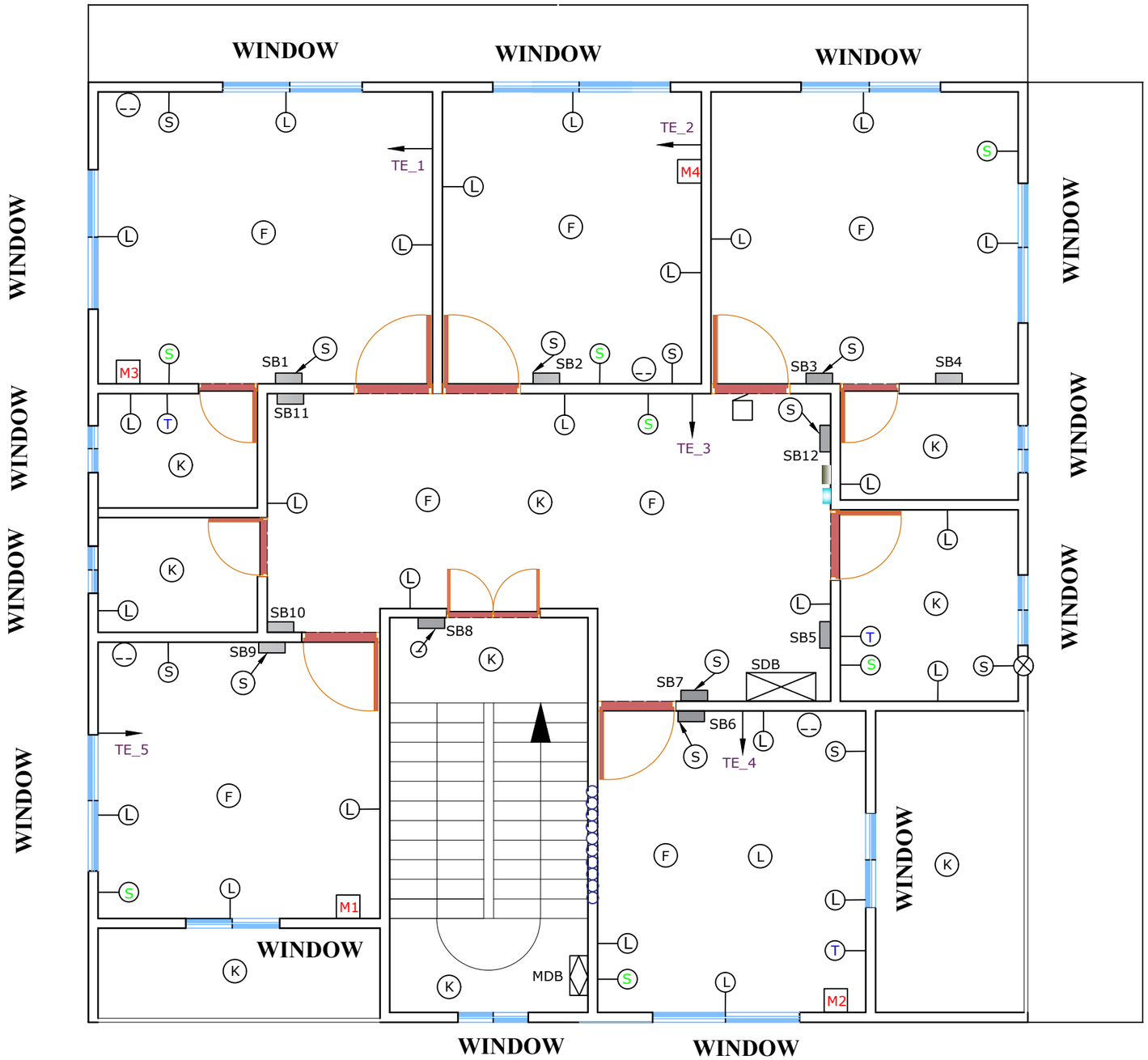


Fitting & Fixture Layout



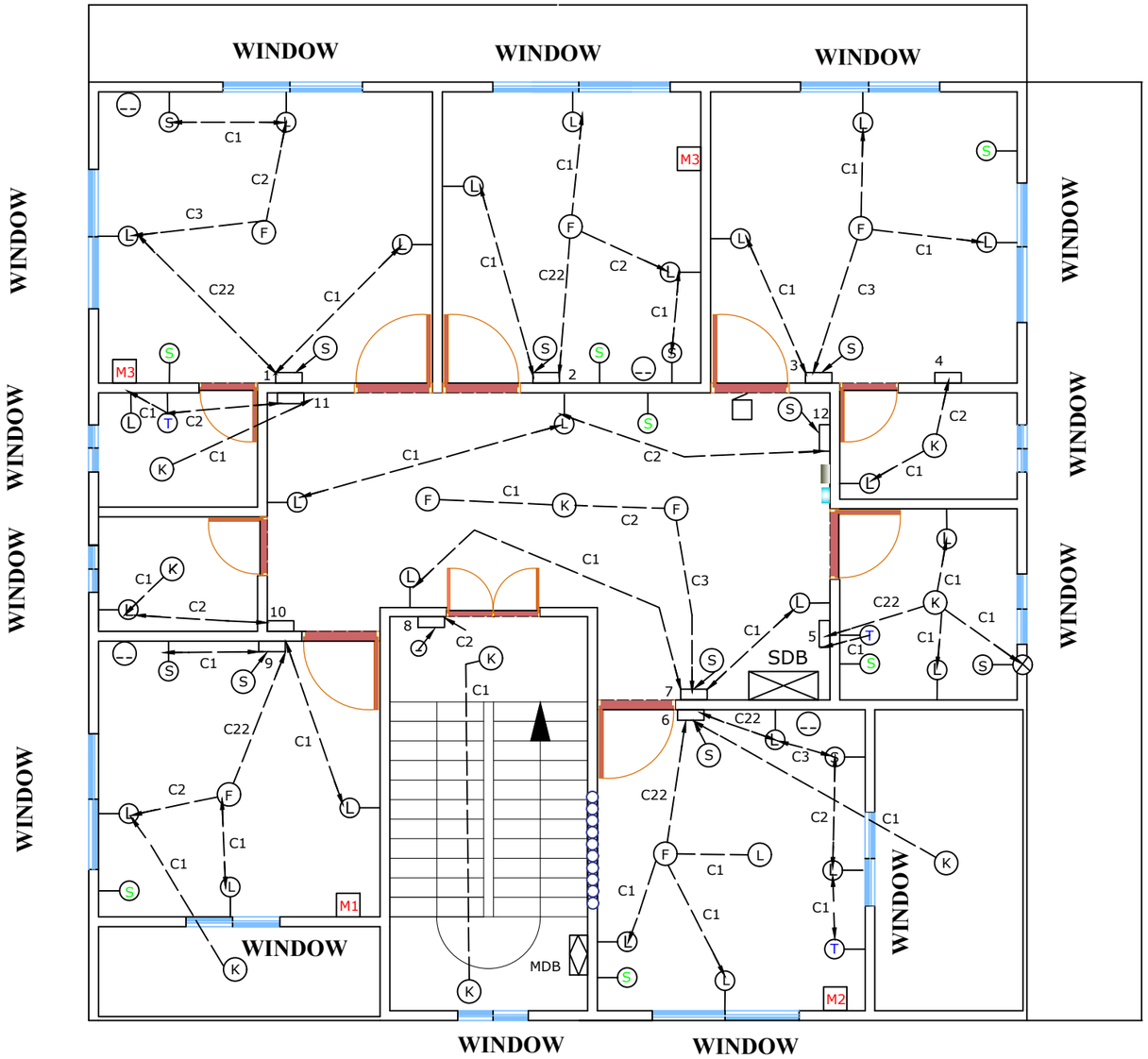
Symbol	Name
	Lintel level light
	Fluresent wall light
	3 pin 15A socket at skirting level
	2 pin 5A socket at skirting level for TV
	3 pin 5A socket at lintel level
	3 pin 5A socket at SB
	Celling Fan
	Calling bell
	K- Type light
	Exhaust
	2 pin TV antena Socket
	AC
	4 point Chandelier light
	Push button
	Telephone Grommet
	Switch Board
	SDB
	MDB
	Antena juncution box
	Telephone juncution box
	Mirror light

Conduit Layout



Symbol	Name
L—	Lintel level light
L—	Fluresent wall light
S—	3 pin 15A socket at skirting level
S—	2 pin 5A socket at skirting level for TV
S—	3 pin 5A socket at lintel level
S—	3 pin 5A socket at SB
F	Celling Fan
	Calling bell
K	K- Type light
	Exhaust
	2 pin TV antena Socket
M	AC
L	4 point Chandelier light
	Push button
→	Telephone Grommet
	Switch Board
	SDB
	MDB
	Antena juncution box
	Telephone juncution box
L—	Mirror light

Light Load Connections



Wire Colour	Connection
— — — —	Light Load

C1 - 2*1.5mm^2

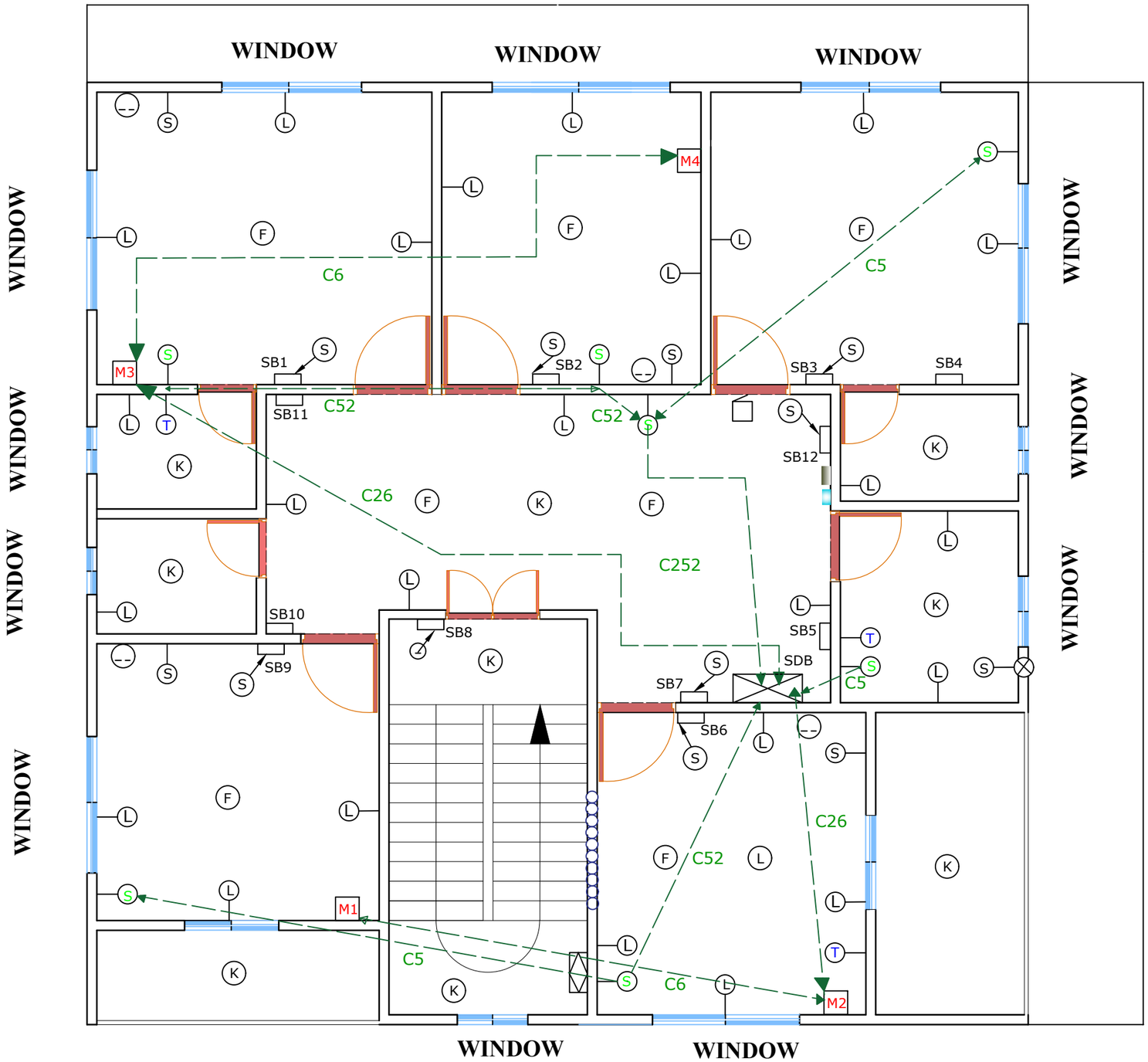
C2 - 4*1.5mm^2

C22 - 2*(4*1.5mm^2)

C3 - 6*1.5mm^2

Symbol	Name
(L)—	Lintel level light
(L)—	Fluresent wall light
(S)—	3 pin 15A socket at skirting level
(S)—	2 pin 5A socket at skirting level for TV
(S)—	3 pin 5A socket at lintel level
(S)—	3 pin 5A socket at SB
(F)	Celling Fan
◻	Calling bell
(K)	K- Type light
⊗	Exhaust
⊖	2 pin TV antena Socket
M	AC
(L)	4 point Chandelier light
⊖	Push button
→	Telephone Grommet
▭	Switch Board
◇	MDB
⊠	SDB
▮	Antena juncution box
▮	Telephone juncution box
(L)—	Mirror light

Heavy Load Connection



Wire colour	Connection
— — — —	Heavy Load

Symbol	Name
S	3 pin 15A socket at skirting level
M	20A MSB at skirting level

C5 - 2*4mm^2,ECC (15A)

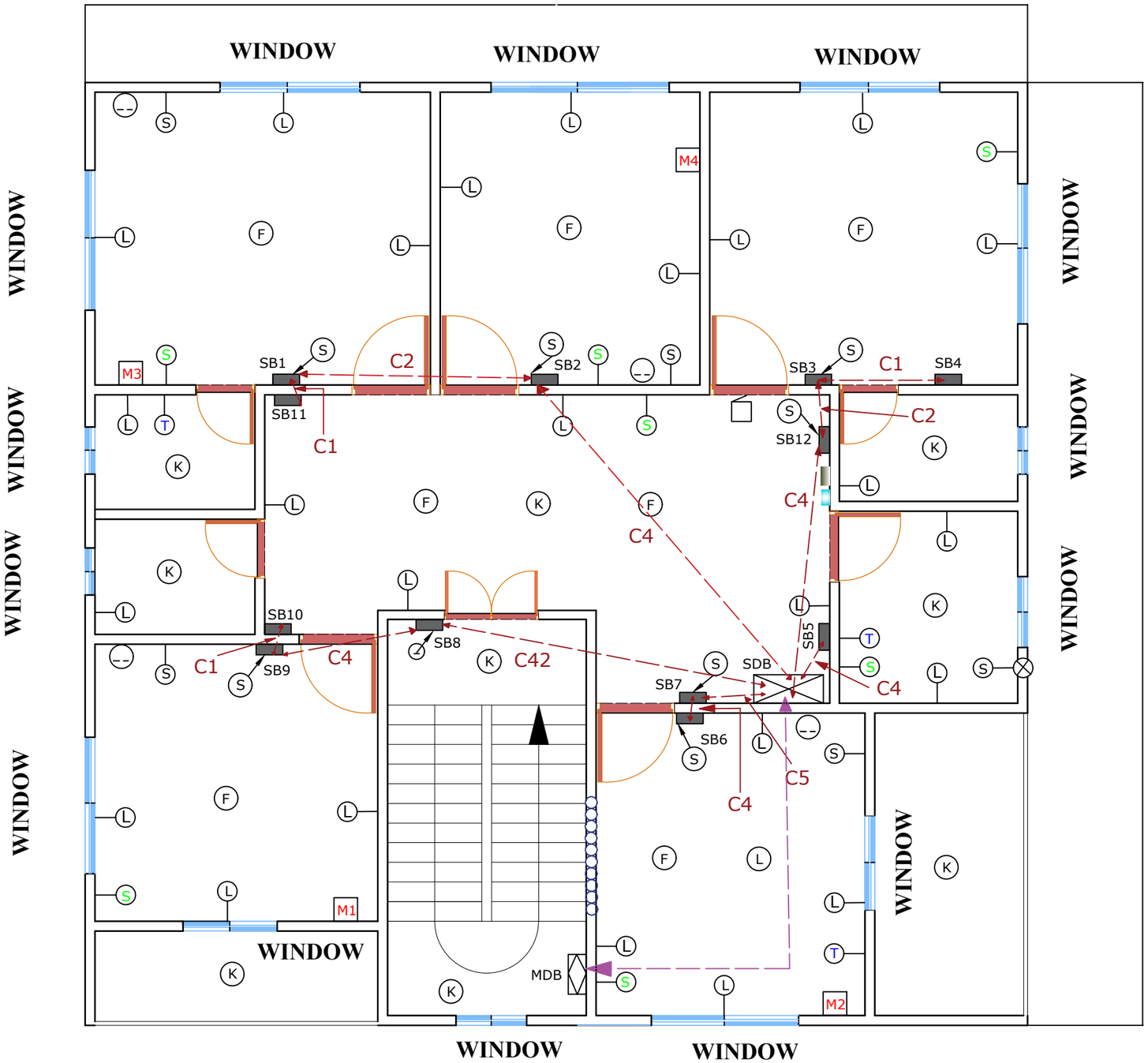
C52 - 4*4mm^2,ECC (15A)

C252 -(6*4mm^2,ECC)(15A)

C6 - 2*6mm^2, ECC (20A)

C26 - 4*6mm^2, ECC (20A)

Switch Board & SDB to MDB Connection



Wire Colour	Connection
– – – – – –	SB Connection
— — — — — —	SDB to MDB

C1 - 2*1.5mm^2 (5A)

C2 - 4*1.5mm^2 (5A)

C3 - 6*1.5mm^2 (5A)

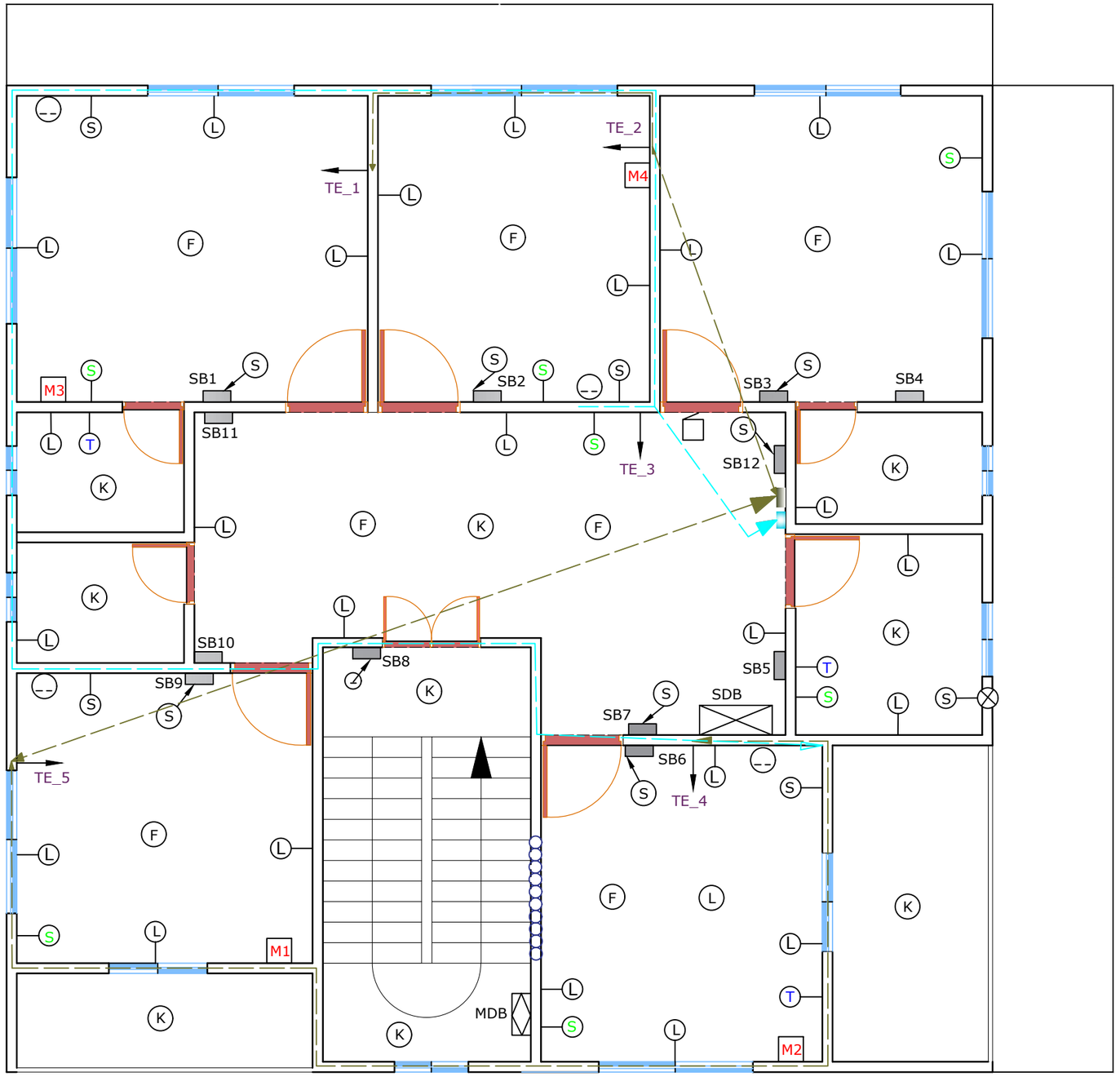
C4 - 2*2.5mm^2, ECC (10A)

C42 - 4*2.5mm^2, ECC (10A)

C5 - 2*4mm^2, ECC (15A)

C52 -4*4mm^2, ECC (15A)

Antenna, Telephone Connection



Symbol	Name
	Antena junction box
	Telephone junction box
	SDB
	MDB
	2 pin TV antena socket
	Telephone grammet

Wire colour	Connection
	Antena junction line
	Telephone line
	SDB to MDB line

Switch Board Calculation

Switch Board-1

TS = 500W
2L = 52 W
1F = 80W
1T = 40W
1SS = 500W

Total = 1172W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{1172W}{230V*0.85}$$

= 5.995A

Switch Board-2

1TS = 500W
2L = 52 W
1F = 80W
1T = 40W
1SS = 500W

Total = 1172W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{1172W}{230V*0.85}$$

= 5.995A

Switch Board-3

2L =52 W
1F =80W
1T =40W
1SS =500W

Total = 672W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{672W}{240V*0.85}$$

= 3.44A

Switch Board-4

1L =52 W
1K =60W

Total = 112W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{112W}{230*0.85V}$$

= 0.57A

Switch Board-5

1ST = 500W
2L =52 W
1K =60W
1SL =500W

Total = 1112W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{1112W}{230V*0.85}$$

= 5.69A

Switch Board-6

1TS = 500W
3L = 78 W
1F = 80W
1T = 40W
1SS = 500W
1CH = 80W
1ST = 500W
1K= 60W

Total = 1838W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{1838W}{230V*0.85}$$

= 9.4A

Switch Board-7

2L =52 W
1K=60W
2F =160W
1SS =500W

Total = 772W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{772W}{230V*0.85}$$

= 4A

Switch Board-8

2K =120 W
1PB = 20W

Total = 140W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{140W}{230V*0.85}$$

= 0.72A

Switch Board-9

TS = 500W
2L =52 W
1F =80W
1K = 60W
1T =40W
1SS =500W

Total = 1232W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{1232W}{230V*0.85}$$

= 6.30A

Switch Board-10

1L =26W
1K =60W

Total = 86W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{86W}{230V*0.85}$$

= 0.44A

Switch Board-11

1ST = 500W
1L = 26 W
1K =60W

Total = 586W

P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

$$I = \frac{586W}{230V*0.85}$$

= 3A

Switch Board-12

1L =26W
1T =40W
1SS =500W

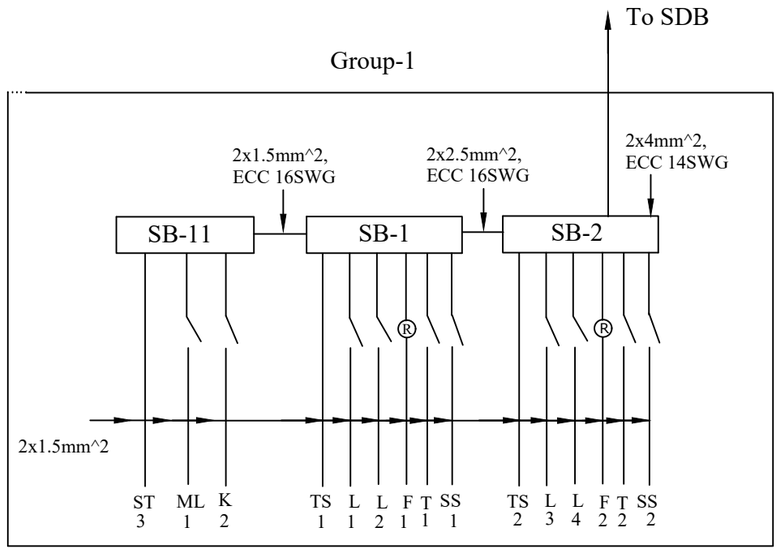
Total = 566W

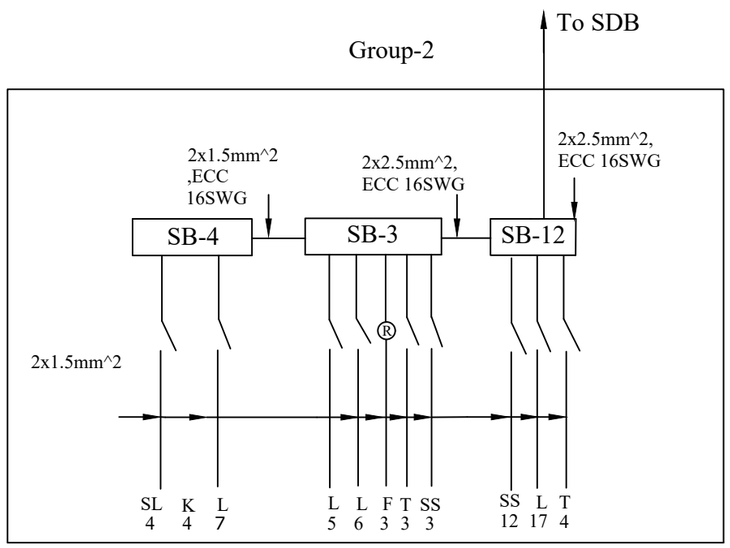
P = VICos(θ)
Here,V = 230V
Let, P.F = 0.85

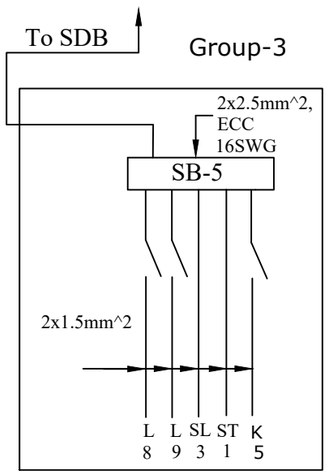
$$I = \frac{566W}{230V*0.85}$$

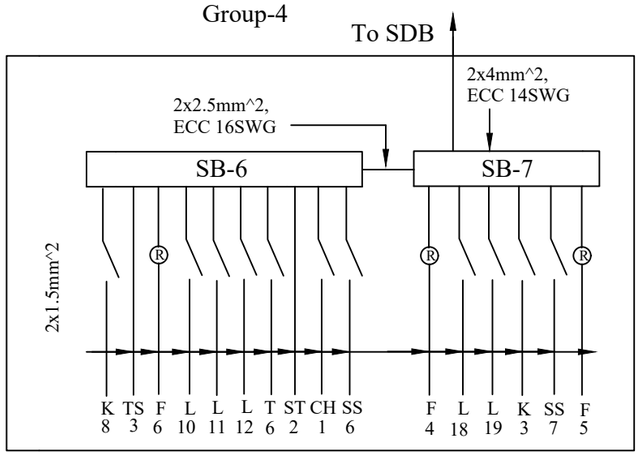
= 2.8951A

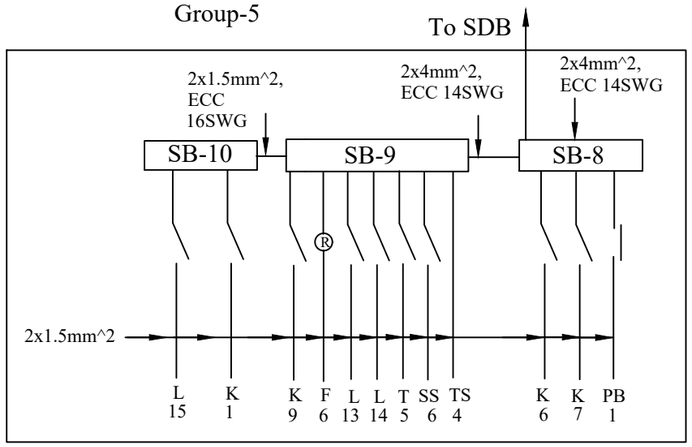
Switch Board Connection Diagram & Groups











Calculation for SDB

Light Loads

PLL

=(1172+1172+672+112+1112+1838+772+140+1232+86
+586+566) W
= 9374 W

Heavy Loads

PHL-15A

7*15_S =7*1000 W [Assuming 1000]
= 7000 W

PHL-20A

4 * M = 4*2.25 KW
= 9 KW
= 9000 W

P_total = PLL * 0.6 + PHL_15A * 0.7 + PHL_20 * 1
= 9374 * 0.6 + 7000 * 0.7 + 9000 * 1
=19524.4 W
=19.5244 KW

48 KW > 19.5244 KW > 9 KW , [So need 3 phase 415V line to line]

P3q = 1.7320 * VL * IL * Cos(θ) | Let, Cos(θ) = 0.85

$$\Rightarrow IL = \frac{P3q}{1.7320 \times VL \times 0.85}$$

$$= \frac{19524.4\ W}{1.7320 * 415 * 0.85}$$

= 31.9567 A

With Spare, I = 31.9567 A + 10A
= 41.9567 A

With safety factor, | Let, S.F = 1.25
ICB = I * S.F
= 50.61 A * 1.25
= 52.44 A

Now, I choose 60A TP Circuit Breaker

Calculation for MDB

Each Unit = 19.5244 KW

For, 10 Units = 10 * 19.5244 KW
= 195.244 KW

I choose 1 Water Pump.
So,
1 Water Pump = 3 * 746 W [1 HP = 746 W]
= 2238 W
= 2.238 KW

For Lift,
I choose 900KG Lift
Speed = 1.8m/s
Motor Capacity, P = 9.7 KW
MCCB Capacity = 30A

Ptotal = 195.244 KW + 2.238 KW + 9.7KW
= 207.182 KW

$$IL = \frac{207.182 * 1000}{1.7520 * 415 * 0.98}$$ | Let, Cos(θ) = 0.98

= 290.766 A

I choose 300 A TP MCCB

Breaker Selection for Groups

Group-1

SB- 1, SB- 2, SB- 11

= 5.995A+5.995A+3A

= 14.99A

So, I choose 15A breaker

Group-2

SB- 3, SB- 4, SB- 12

= 3.44A+0.57A+2.895A

= 6.9A

So, I choose 10A breaker

Group-3

SB- 5

= 5.67A

So, I choose 10A breaker

Group-4

SB- 6, SB- 7

= 9.4A+2.88A

= 13.4A

So, I choose 15A breaker

Group-5

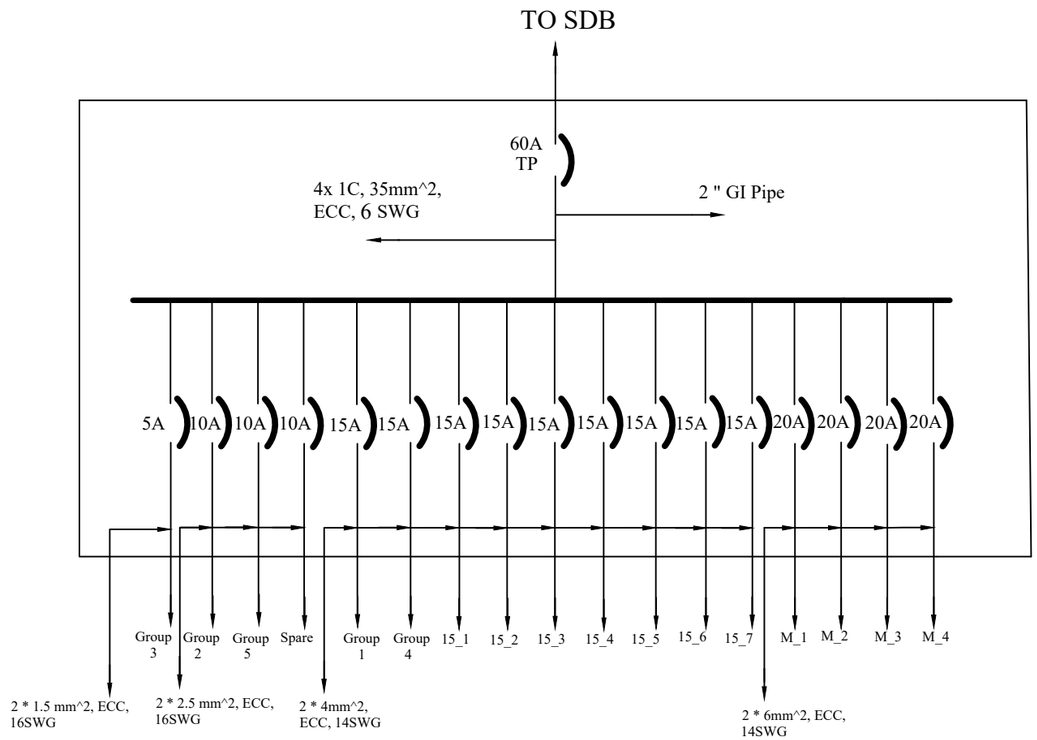
SB- 8, SB- 9, SB- 10

= 0.72A+6.30A+0.44A

= 7.46A

So, I choose 10A breaker

Distribution Board Connection Diagram



Load Division

Phase-A (82A)

M_1, Group-2, Group-5, Group-3, 15_1, 15_2, Spare,

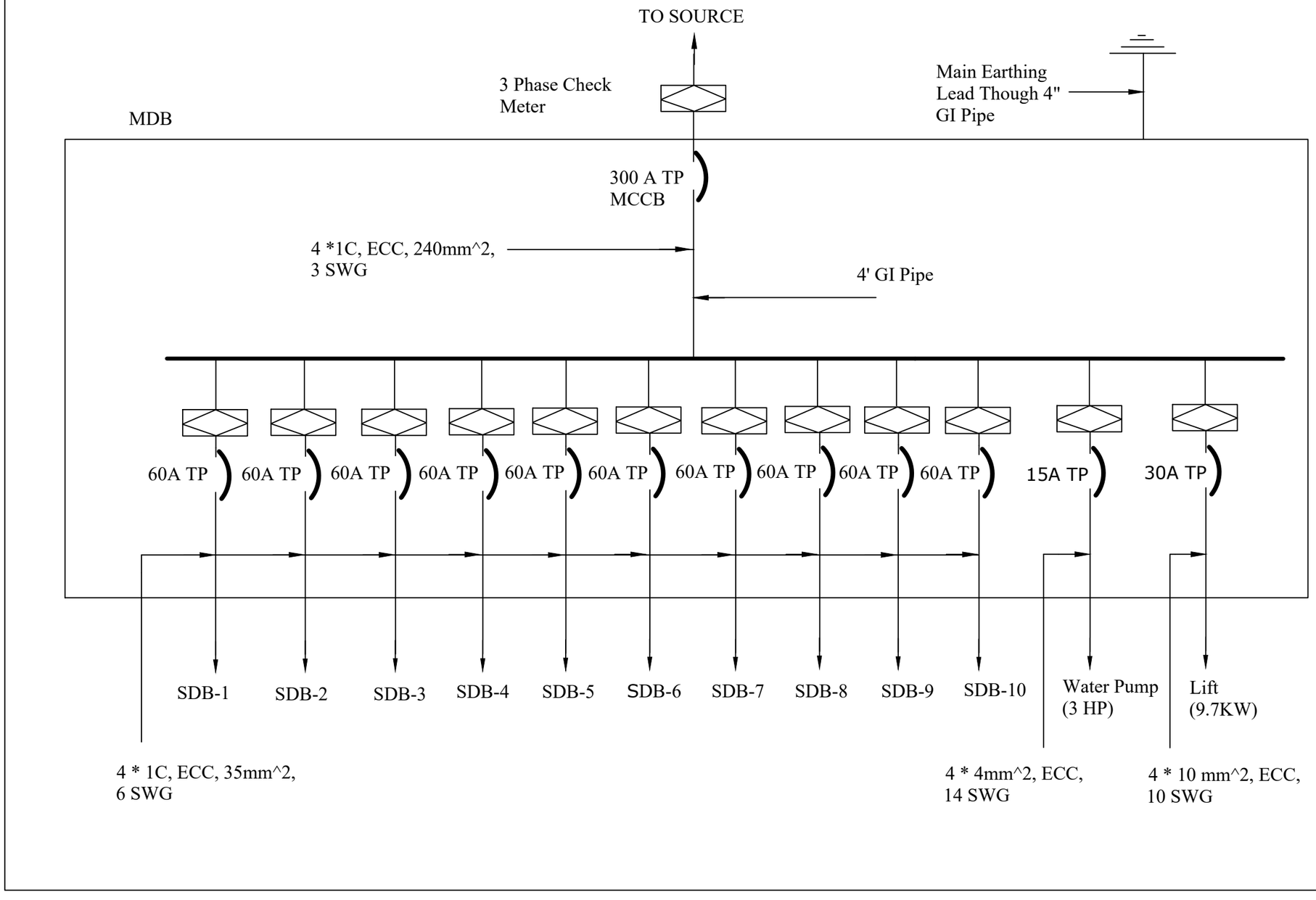
Phase-B (82A)

M_2, M_3, , Group-1, 15_3, 15_4

Phase-C (82A)

M_4, Group-4, 15_5, 15_6, 15_7

Main Distribution Board Connection Diagram



Calculation of SLD

MDB Total Power, Ptotal = 207.182 KW

Transformer,

$$= \frac{\text{Ptotal} * 80\% * \text{S.F.}}{\text{P.F}}$$

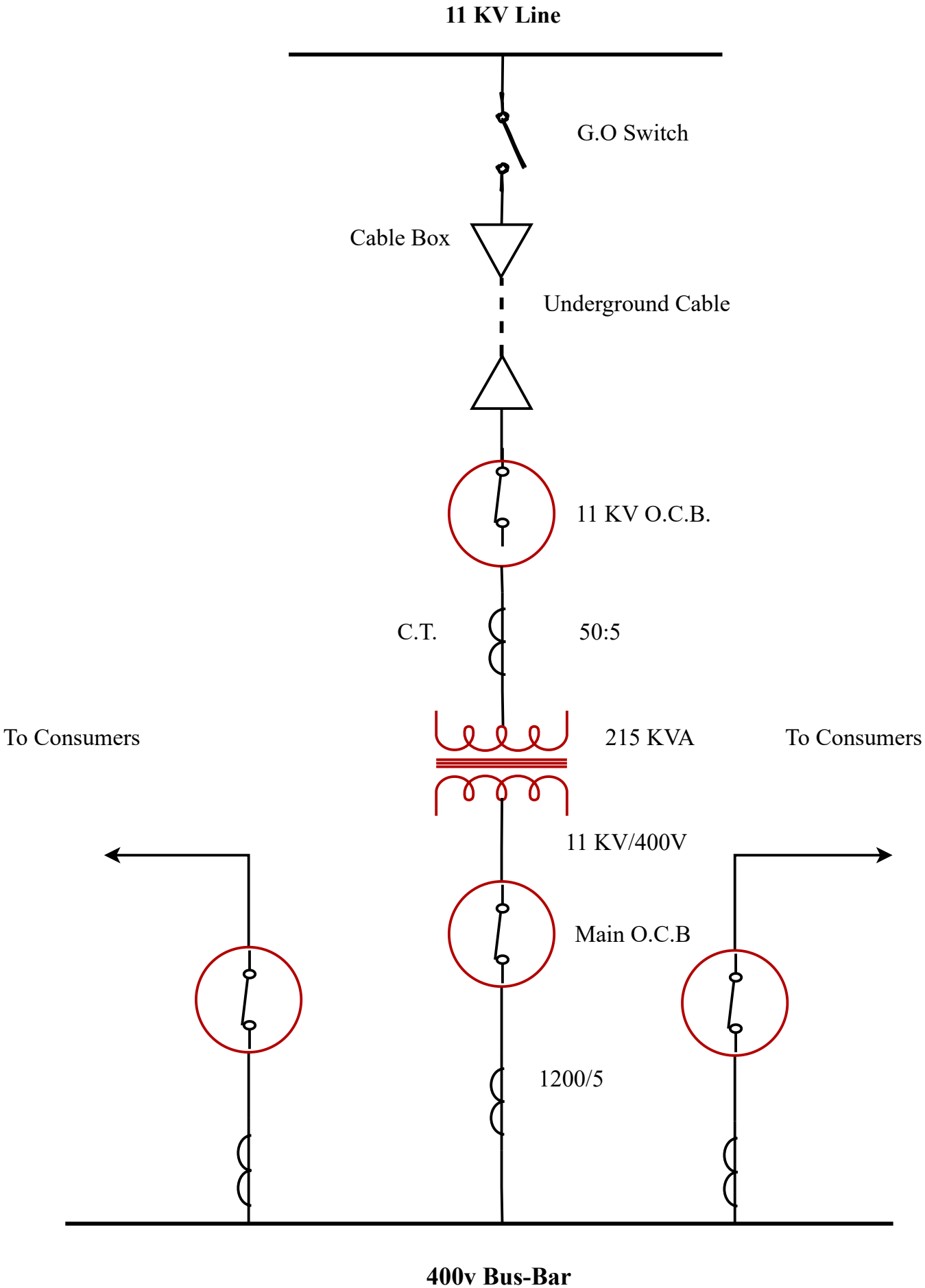
$$= \frac{207.182 * 0.8 * 1.25}{0.98}$$

$$= 211.41 \text{ KVA}$$

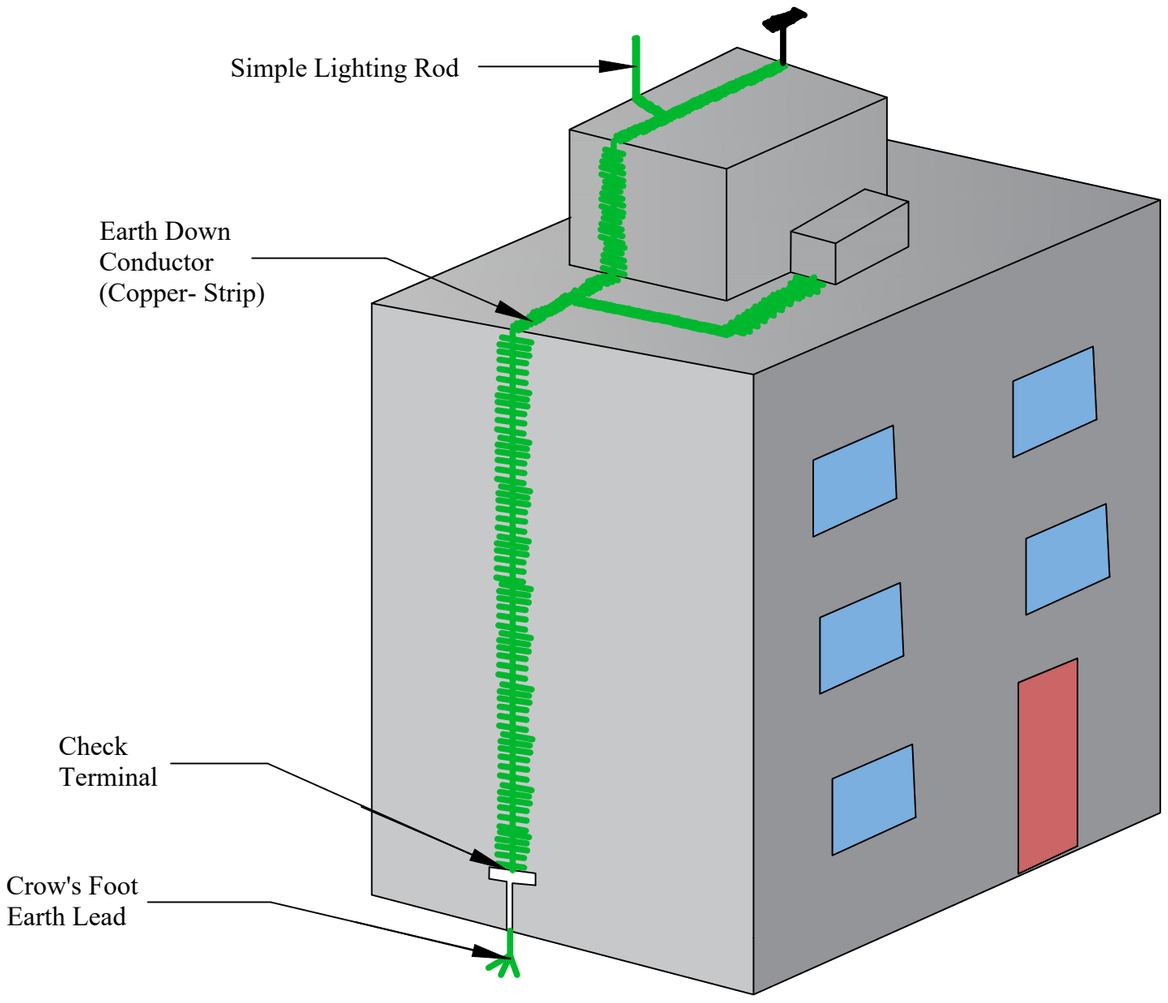
P.F. = 0.98

S.F. = 1.25

I am choosing 215 KVA transformer

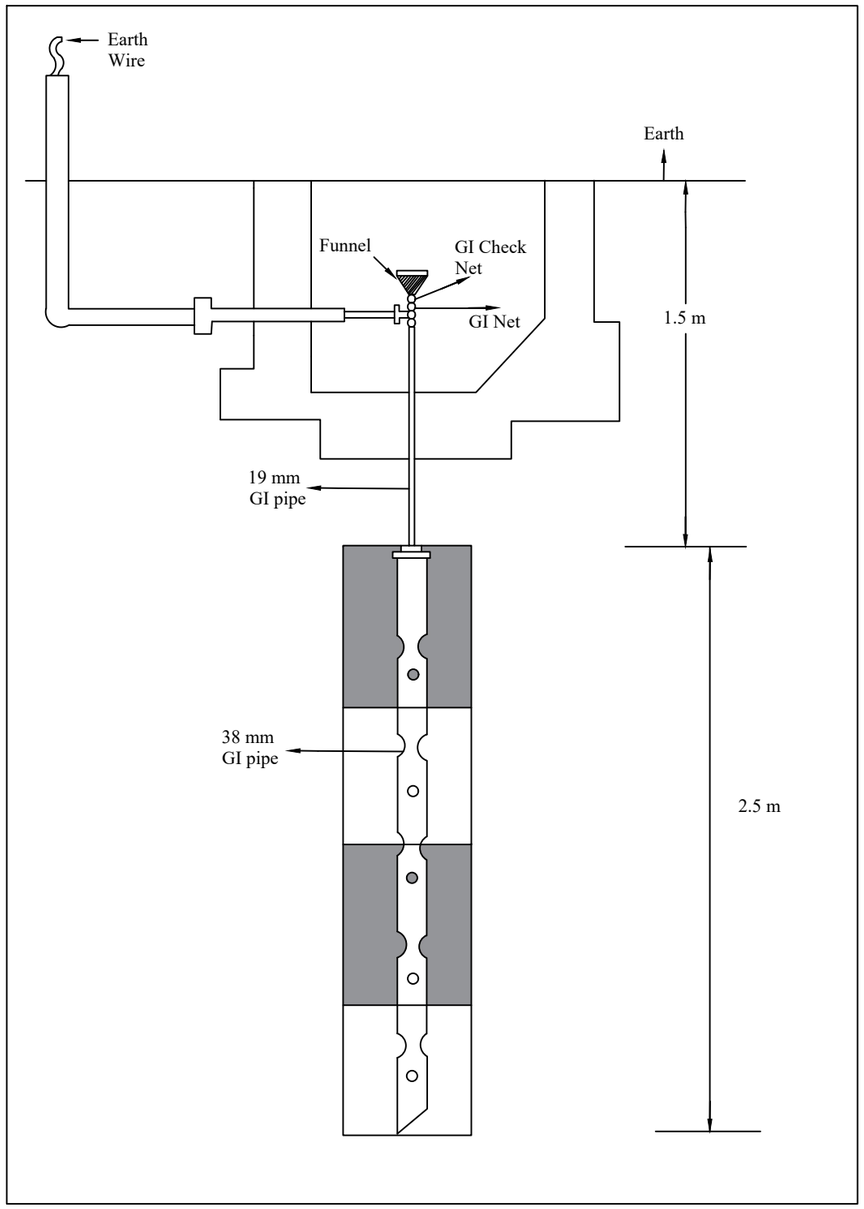

11 KV Line
G.O Switch
Cable Box
Underground Cable
11 KV O.C.B.
C.T.
50:5
To Consumers
215 KVA
To Consumers
11 KV/400V
Main O.C.B
1200/5
400v Bus-Bar

Lighting Protection Setup



Air Spike — Down Conductor — Check Terminal — Earth Lead

Earthing System



I choose Pipe Earthing System for this design.
For this type earthing,
- -Need GI pipe
- -Need permanent wet soil
- -Need coal and salt

Earth Continuity Conductor (ECC)

Connecting Point

Earthing Lead

Earth Electrode

Earth electroide and earthing lead are same material

The current rating for this building is 290.766 A

So, ECC size is 3 SWG &
Main Earthing lead size is 3 SWG

Main Earthing lead though 3.5" G.I pipe

By using 3 point method,
we find that the earth resistance is 1 ohm

Light Calculation for Living Room

L = 6.4 feet
= 6.4/3.281
= 1.96 m

W = 12.10 feet
= 12.10/3.281
= 3.7 m

Let,

For living room, E = 70 lux

I am choosing LED lamp
Lamp P = 11W
Lumen = 806 lm

Now,
Room Height = 3.30 m
Working height = 0.5 m
H = 3.30 - 0.5
= 2.80m

Room index,

$$RI = \frac{L * W}{H * (L + W)}$$

$$= \frac{1.96 * 3.7}{2.80 * (1.96 + 3.7)}$$

$$= 0.46$$

$$\approx 0.75$$

Room Reflectences,
70-50-20
So,
UF= 0.36
Let, LLF = 0.8

Number of lights,

$$N = \frac{E * A}{F * UF * LLF}$$

$$= \frac{70 * (1.96 * 3.7)}{806 * 0.36 * 0.8}$$

$$= 2.2$$

$$\approx 3$$

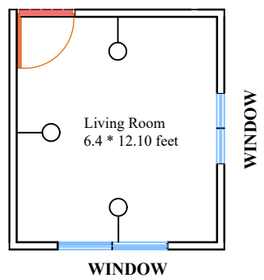
Distance,

$$D = \frac{L}{L_H + 1}$$

$$= \frac{1.96}{1+1}$$

$$= 0.98 \text{ m}$$

L_H = 1 light
L_V = 1 light



PV System Calculation For 10 Story Building

Room	CFL Lamp	K-Type	FL Lamp	Fan	Tv	ML
Dinning	3	1	1	2	0	0
Living	3	0	1	1	1	0
Toilet/Bath	2	3	0	0	0	1
Bed Room	8	0	4	4	3	0
Corridor	0	2	0	0	0	0
Kitchen	2	1	0	0	0	0
Balcony	0	2	0	0	0	0
Total	18	9	6	7	4	1

Name	Number	Watt	Hour	Energy
CFL Lamp	18	26	10	4680
K-Type	9	60	6	3240
FL lamp	6	40	9	2160
Fan	7	80	9	5040
TV	4	200	4	3200
ML	1	20	2	40
Total		18360 W		

For 10 units (5% load),

P = 18360 * 10 * 0.05

= 9180 W

Total power consumption per floor,

= 18*26 + 9*60 + 6*40 + 7*80 + 4*200 + 1*20

= 2628W

Total power consumption for entire building with 5% load,

= 2628 * 10 * 0.05

= 1314 W

=1.314 KW

Here, 1.314 < 1.5 KW,
So, System Nominal Voltage is 12V

PV System Calculation For 10 Story Building Battery Sizing

I am choosing,

Suncare 250W-12V Solar Panel

Pmax = 250 W
Nominal Voltage = 12 V
ISC = 8.95 A
Maximum Current = 8.957 A
Voc = 37.25 V
Maximum voltage = 29.94 V

Parralal Modules,

$$= \frac{\text{Total Energy in WH}}{\text{Tpeak Solar} * \text{nPV} * \text{nInv} * \text{nBattery} * \text{V of sys nominal} * \text{Imax-PV}}$$

$$= \frac{9180\ \text{W}}{7 * 0.90 * 0.85 * 0.8 * 12 * 8.957}$$

$$= 19.93 \text{ modules}$$

$$\simeq 20 \text{ modules}$$

Series modules,

$$= \frac{\text{System nominal voltage}}{\text{Nominal volatge of soler module}}$$

$$= \frac{12\ \text{V}}{12\ \text{V}}$$

$$= 1 \text{ modules}$$

Total modules = 20 * 1
= 20 modules

Battery Sizing

$$\text{Parallel Batteries} = \frac{\text{Total Energy in WH} * \text{Number of Days}}{\text{nInv} * \text{nBattery} * \text{V of sys of nominal} * \text{usage of battery}}$$

Battery capacity = 80%

$$= \frac{9180\ \text{W} * 1\ \text{day}}{0.85 * 0.80 * 12 * 0.80}$$

$$= 1406.10\ \text{Ah}$$

I choose U-power 100A-12V GEL Battery,

Nominal voltage = 12 V
Current I = 100 Ah

Parallel Battery = 1406.10 Ah / 100Ah
= 14.061 batteries
= 15 batteries

Series battery =Nominal voltage / Nominal V of battery
= 12V/12V
= 1 battery

Total batteries = 15 x 1
= 15 batteries

Sizing of Solar Charge Controller & PV Inverter

Sizing of Solar Charge Controller (A)

= 20 parallel modules * 8.95 * 1.25

= 223.75 A

[Isc = 8.95 A , S.F. = 1.25]

Sizing of PV Inverter

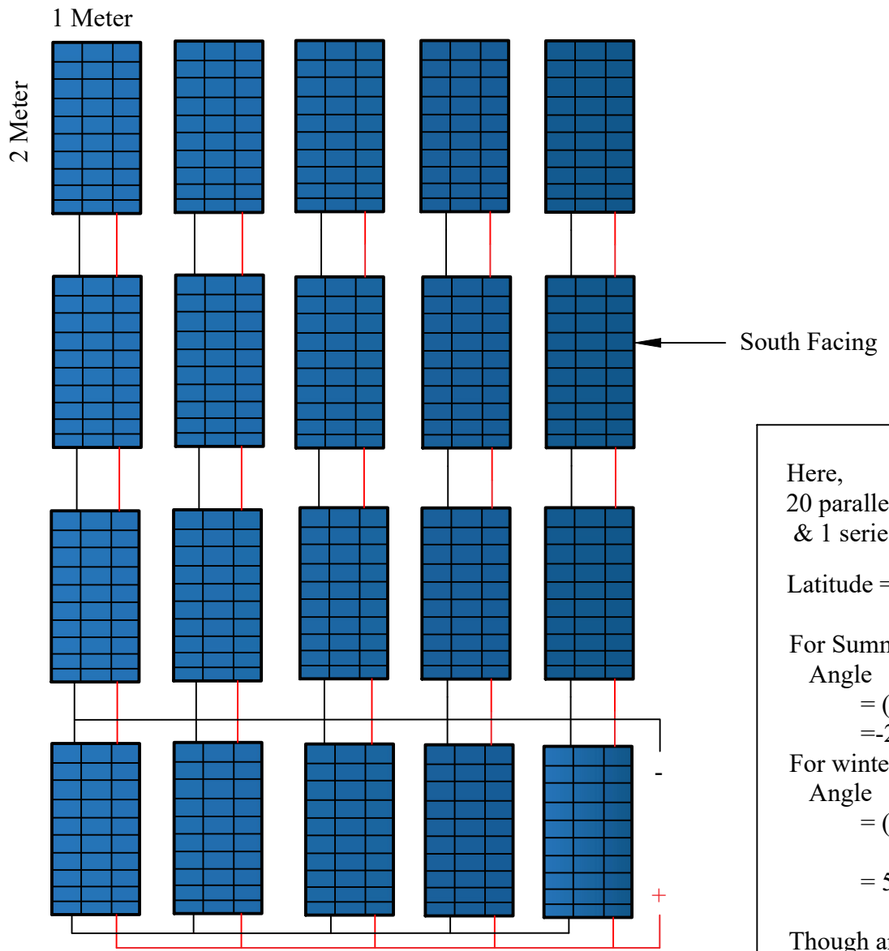
= Total 5% power of entire building * S.F.

= 1.314 KW * 1.25

= 1.6425 KW

S.F =1.25
Total 5% power of entire building = 1.314 KW]

Rooftop Solar PV Design & Setup



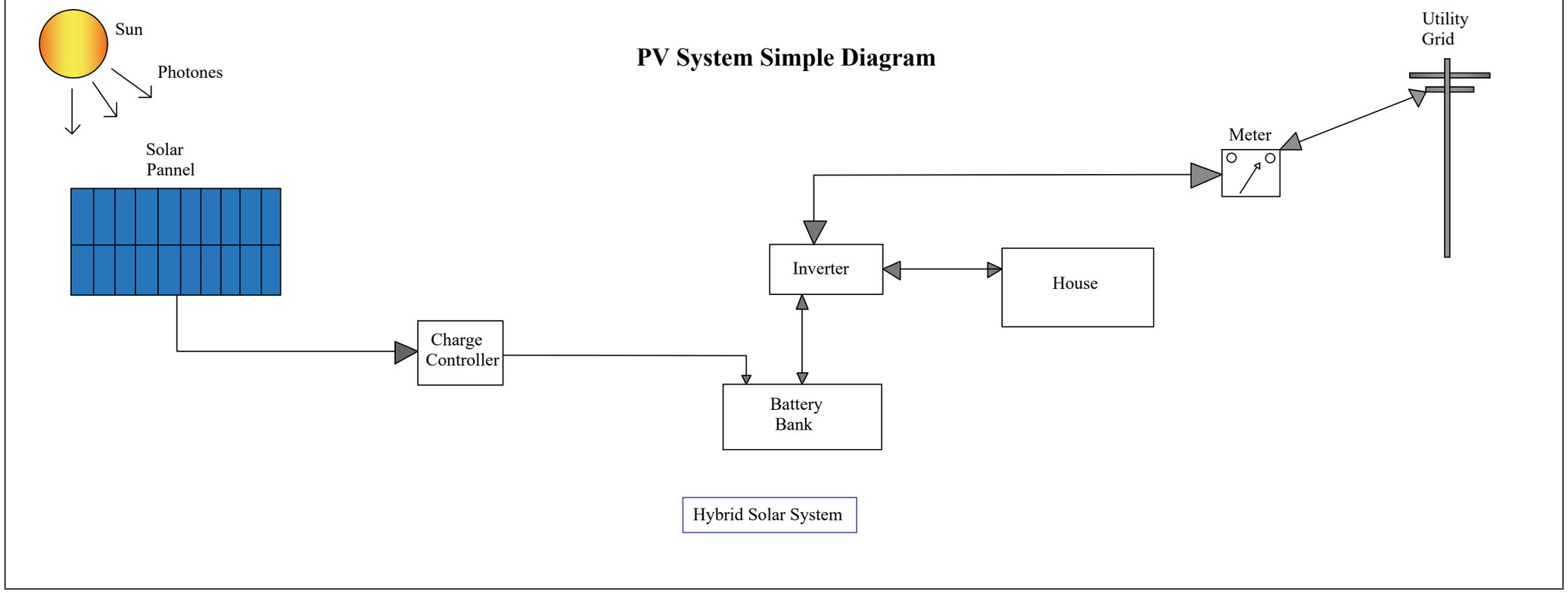
Here,
20 parallel modules
& 1 series modules

Latitude =23.8 degree

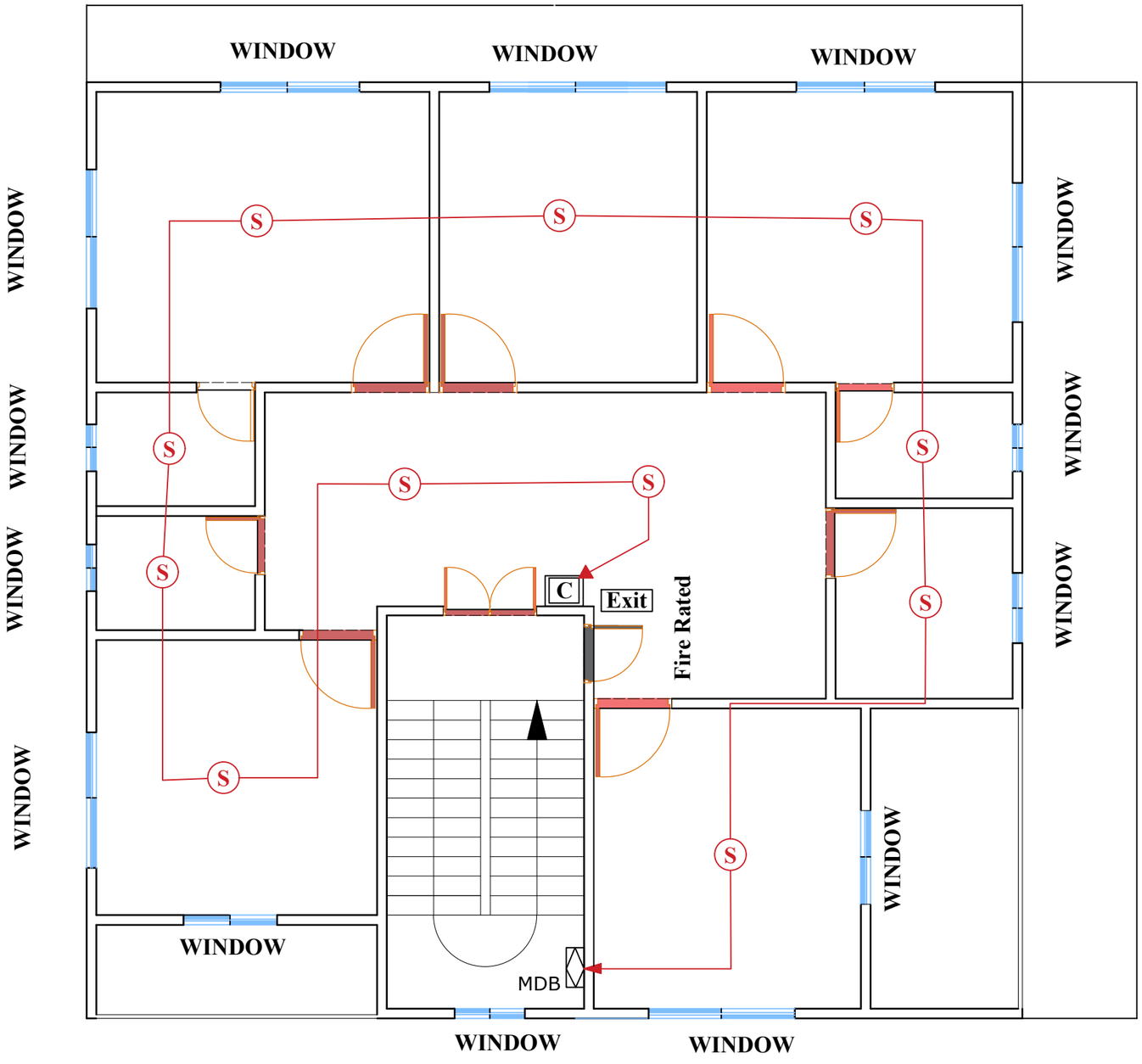
For Summer,
Angle
= (23.8 * 0.9) - 23.5
=-2.08 degree
For winter,
Angle
= (23.8 * 0.9) + 29

= 50.42 degree

Though angle is negative thus tilt angle is 0 degree


PV System Simple Diagram
Sun
Photones
Solar
Pannel
Charge
Controller
Battery
Bank
Inverter
House
Meter
Utility
Grid
Hybrid Solar System

Fire Safety System



Symbol	Name
	MDB
C	Control Panel
S	Sensor

Wire colour

The End

Thank You